ASX RELEASE
AMERICAN RARE EARTHS **ABN 83 003 453 503**

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# COWBOY STATE MINE PREFEASIBILITY STUDY DELIVERS NPV UPLIFT AND MAIDEN ORE RESERVE

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## HIGHLIGHTS

- **Prefeasibility Study outcome: after tax NPV of approximately US$1.3B at an 8% real discount rate and after-tax IRR of 24% for Cowboy State Mine, with pre-production capital of US$840M including contingency**
- **Value upside under way: recovery optimisation with Novex has commenced, and each one percentage point increase in NdPr recovery adds approximately US$50 million to NPV[8]**
- **Greater definition and confidence: capital and operating costs estimated to ±25% accuracy, with contingency of 15% of direct capital compared with the 2026 Scoping Study accuracy of ±30-50% with contingency of 30%**
- **Long life domestic supply: mining and processing of 4.5 million tonnes per annum over 26 years, with average annual NdPr oxide production of approximately 2,500 tonnes, scheduled entirely from Probable Ore Reserves**
- **Maiden Ore Reserve: Probable Ore Reserve of 116.4 million tonnes at 1,257 ppm payable rare earth oxide (PREO) declared at Cowboy State Mine**
- **Feasibility Study advancing: drilling to convert Mineral Resources to Ore Reserves for the Feasibility Study is complete, with yttrium being assessed as a future product opportunity**

American Rare Earths Limited (**ASX: ARR | OTCQX: ARRNF | ADR: AMRRY**) **("ARR" or "the Company")** is pleased to announce the results of the Prefeasibility Study ("**PFS**") for Cowboy State Mine ("**CSM**"), the first development phase of the Halleck Creek Project in Wyoming, together with the declaration of a maiden Probable Ore Reserve.

The PFS evaluates a 4.5 million tonne per annum open pit operation over 26 years, with estimated after tax NPV of approximately US$1.3B at an 8% real discount rate and pre-production capital of approximately US$840M, including contingency. It builds on the updated Scoping Study released on 30 September 2026,[1] which brought forward PFS level mine planning and engineering to support the U.S. SEC Regulation S-K, Subpart 1300 Initial Assessment prepared as part of the Company's Nasdaq listing process. The Cowboy State Mine PFS contains less than 5% of the total Halleck Creek resource.

[1] American Rare Earths, ASX announcement, 30 September 2026, "Cowboy State Mine Study Strengthens Foundation for Domestic U.S. Rare Earth Supply".

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## IMPORTANT DISCLOSURES

The PFS is a prefeasibility level technical and economic assessment, with capital and operating cost estimates prepared to a target accuracy of ±25%. The production target described in this announcement is based entirely on Probable Ore Reserves, which have been derived only from Indicated Mineral Resources. No Inferred Mineral Resources or Exploration Target material are scheduled as mill feed; Inferred material within the designed pits is treated as waste.

Recoveries downstream of the leach circuit are based on the Competent Person's rare earth processing experience rather than completed test work and remain subject to confirmation through the pilot and demonstration program. There is no certainty that the production target or forecast financial outcomes will be realised. Further work, including a Feasibility Study, permitting and financing, is required before a development decision can be made.

Forecast outcomes depend on product prices, recoveries, capital and operating costs, technical performance, approvals and funding. This announcement contains forward looking statements concerning development, test work, studies, partnerships and capital markets initiatives. Actual outcomes may differ materially because of technical, market, permitting, financing and operational risks.

*"Declaring a maiden Ore Reserve is a defining step for Halleck Creek. It moves Cowboy State Mine from a resource with development potential to a defined mining project, supported by a prefeasibility level mine plan and cost estimate.*

*The PFS confirms the scale we outlined in the Scoping Study: 4.5 million tonnes a year over 26 years, producing around 2,500 tonnes of NdPr oxide annually. The cost estimates now carry a tighter accuracy range and a lower contingency, which gives investors and funding partners a firmer basis for assessing the project.*

*We also see clear room to improve on this base case. Our work with Novex is focused on lifting NdPr recovery and producing NdPr metal from Halleck Creek ore, and every percentage point of NdPr recovery is worth about US$50 million in project value. At the same time, we are working to reduce mining costs and improve how we manage waste streams.*

*We are advancing the underlying upstream Halleck Creek project while also working hard on our domestic mine to magnet supply chain. The work that is underway with Novex aims to see Halleck Creek ore taken through to oxide and NdPr metal using non-Chinese metal production methodology. The work continues for the largest US domestic rare earths deposit on a total contained rare earth basis."*

**- Mark Wall, Chief Executive Officer, American Rare Earths**

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## FROM RESOURCE TO RESERVE AT HALLECK CREEK

CSM is the first development phase of the broader Halleck Creek Project, which hosts a reported JORC Mineral Resource of approximately 2.63 billion tonnes at 3,292 ppm total rare earth oxides ("TREO"). Within this, the Indicated Mineral Resource for the CSM area is 391.4 million tonnes at 3,295 ppm TREO, estimated by Odessa Resources with an effective date of November 2025.

The PFS has converted part of that Indicated Mineral Resource into a maiden Probable Ore Reserve. The Ore Reserve represents approximately 30% of the CSM Indicated tonnage and is the first Ore Reserve declared for Halleck Creek. It establishes the reserve basis for the first phase of development while leaving substantial resource for later phases and for the Whole of Property Assessment.

**Cowboy State Mine Ore Reserve, effective November 18, 2026**

| Category | Tonnes (Mt) | PREO (ppm) | NdPr oxide (ppm) | SEG oxide (ppm) | $Tb_4O_7$ (ppm) | $Dy_2O_3$ (ppm) | Contained PREO (t) |
|---|---|---|---|---|---|---|---|
| Proven | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Probable | 116.4 | 1,257 | 958 | 230 | 12 | 57 | 146,300 |
| **Total** | **116.4** | **1,257** | **958** | **230** | **12** | **57** | **146,300** |

Notes: The Ore Reserve is reported above a payable rare earth oxide (PREO) cut-off grade of approximately 875 ppm, calculated as the sum of mining cost, process cost and general and administrative cost, divided by the product of the PREO price less royalty and the recovery. The pit optimization inputs were a mining cost of US$5.38 per tonne, a process cost of US$28.28 per tonne, general and administrative costs of US$1.10 per tonne and a Wyoming State royalty of 2.50%. Material above the cut-off is sent to the process plant and material below it reports to the waste rock storage facility or is used as construction material. The Mineral Resource is separately reported above a 1,000 ppm TREO cut-off derived from Stantec net smelter return calculations.

The Cowboy State Mine deposit will be mined by open-pit methods using conventional truck-and-shovel extraction; the mine plan does not include underground mining. Pit optimization was carried out in Whittle and the life-of-mine schedule was developed in Deswik. The mine plan moves 135.0 Mt of total material, comprising 116.4 Mt of ore and 18.7 Mt of waste at a strip ratio of 0.16:1, feeding the plant at 4.5 Mtpa over 26 years of production following a three-year construction period. Mining recovery is taken as 100% and mining dilution as nil, because the geological interpretation treats nearly all material within the pit as mineralized and the waste adjacent to the reserve is itself above cut-off grade Inferred material. Minimum mining widths are 32.5 m per bench and 28 m at the pit bottom, set by shovel swing radius, truck turning circle and safety berm requirements. Overall slope angles range from 54 degrees at a 300 m slope height to 45 degrees at 700 m, with a 50 degree inter-ramp angle applied in optimization; groundwater data was not available and was not incorporated in the geotechnical analysis. All ore in the schedule is drawn from the Indicated Mineral Resource; no Inferred material is scheduled as ore.

Run-of-mine ore is crushed to 100% passing 300 micron through a jaw crusher, cone crusher and vertical roller mill at the mine site, then concentrated approximately ten times using gravity separation in a reflux classifier concentrator together with dry induced roll magnetic separation and wet high intensity magnetic separation on the minus 50 micron fines stream. Concentrate is trucked to a refinery proposed at Wheatland, Wyoming, for dilute sulfuric acid tank leaching, impurity removal through two neutralization stages and uranium ion exchange, bulk solvent extraction, and solvent extraction separation and finishing into separate oxide products. Recoveries by unit operation are 78% through gravity and magnetic separation, 85% through leaching, 98% through partial neutralization and 96% through separation and finishing for NdPr oxide and 98% for the other products. The recoveries applied in the economic model are 58.2% for NdPr oxide, 25.8% for SEG oxide, 28.7% for terbium oxide and 12.4% for dysprosium oxide, giving an overall recovery of 49.9% of contained payable rare earth oxide. The process uses conventional unit operations, but yield losses downstream of the leach are based on the Competent Person's rare earth processing experience rather than on completed test work, and the recoveries remain subject to confirmation by the pilot and demonstration plant program.

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No statistical or geostatistical quantification of the relative accuracy of the Ore Reserve has been carried out. The estimate is global rather than local and carries the plus or minus 25% target accuracy of the underlying pre-feasibility level cost estimates. Confidence is supported by the conversion of Indicated Mineral Resources only, 100% mining recovery with nil dilution, and a mine plan returning a positive after-tax net present value in every single-variable downside case tested. Factors that may affect the estimate are unexpected variations in the quantity of mineralized material, grade or recovery, geotechnical conditions differing from those assumed, failure of plant, equipment or processes to operate as anticipated, and variations in project costs or metal prices. Groundwater data was not incorporated in the geotechnical analysis, no sustaining capital has been estimated for the processing and refinery facilities or site infrastructure over the 26-year mine life (mining fleet sustaining capital is included in the mining operating cost), and the metallurgical recoveries remain subject to pilot-scale confirmation. There are no production records against which to compare the estimate. A quantitative risk assessment is recommended at the feasibility stage.

## PFS COMPARED WITH THE 2026 SCOPING STUDY

The 2026 Scoping Study already incorporated PFS level mine planning, which means the mine plan, throughput and modelled recoveries are largely unchanged. The PFS adds the Ore Reserve, a more definitive capital and operating cost estimate, and firmer infrastructure arrangements, including a signed water lease.

| Key measure | 2026 Scoping Study base case | 2026 PFS base case |
|---|---|---|
| Study accuracy | ±30% to ±50% | ±25% |
| Ore Reserve | None declared | 116.4 Mt Probable at 1,257 ppm PREO |
| Planned ROM throughput | 4.5 Mtpa | 4.5 Mtpa |
| Modelled mine life | 26 years | 26 years |
| Construction / production | Commissioning 2030 / commercial production 2031 | Construction 2028 to 2030 / production 2031 to 2056 |
| Material mined in the mine plan | 135.0 Mt | 135.0 Mt |
| Ore / waste mined | 116.4 Mt / 18.7 Mt | 116.4 Mt / 18.7 Mt |
| Average annual NdPr oxide production | Approximately 2,500 tonnes | Approximately 2,500 tonnes |
| NdPr oxide recovery | 58.2% | 58.2% |
| After tax NPV at 8% real | Approximately US$1.07 billion | US$1.3 billion |
| After tax NPV at 10% real | US$764 million | US$966 million |
| After tax IRR | 21% | 24% |
| After tax payback from first capital | 6.9 years | 6.4 years |
| Pre-production capital, including contingency | US$900 million | US$840 million |
| Contingency | US$208 million; 30% of direct capital | US$114M; 15% of direct capital |
| Closure | US$56 million | US$56 million |
| NdPr oxide price assumption | US $151/kg | US $163/kg |
| Average operating cost | US$39.68/t ROM processed | US$40.62/t ROM processed |

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**Basis of comparison:** Both studies use an 8% real discount rate and constant Q1 2026 U.S. dollars, and both schedules only Indicated material as mill feed. Changes in modelled value between the two studies reflect the revised capital estimate and contingency, updated operating costs and Adamas Intelligence forward looking pricing. They should not be read as a change in the underlying resource or mine plan. Assumed product prices are study inputs, not contracted sales prices.

The project remains most sensitive to NdPr price and NdPr recovery. Single variable sensitivities were evaluated over a range of minus 30% to plus 30%, and after tax NPV remains positive at the minus 30% case for both variables, with an IRR of 14%. Discount rate, processing operating cost and processing capital cost are the next most significant variables.

## MINING AND THE ORE RESERVE

CSM will be mined by conventional open pit truck and shovel methods. Stantec carried out pit optimisation in Whittle and developed the life of mine schedule in Deswik. The mine plan moves 135.0 million tonnes of total material, comprising 116.4 million tonnes of ore and 18.7 million tonnes of waste, a strip ratio of 0.16:1, and feeds the plant at 4.5 million tonnes per annum over 26 years following a three-year construction period.

Mining recovery is taken as 100% and dilution as nil, because the geological interpretation treats nearly all material within the pit as mineralised and the material adjacent to the reserve is itself above cut off grade. Minimum mining widths of 32.5 m per bench and 28 m at the pit bottom were adopted, with overall slope angles ranging from 54 degrees at a 300 m slope height to 45 degrees at 700 m. Groundwater data was not available for the geotechnical analysis and will be incorporated in the Feasibility Study.

The final pit designs contain approximately 14% more waste than the selected optimisation shell, reflecting design and operating constraints. The Ore Reserve is classified entirely as Probable because no Measured Mineral Resource has been reported.

The Probable classification follows from conversion of Indicated Mineral Resources after applying the PFS Modifying Factors, including pit optimisation, a 10 m by 10 m by 10 m selective mining unit, the assumed 100% mining recovery and nil dilution, metallurgical recoveries, and infrastructure, cost and market assumptions. Ore Reserve confidence has been assessed qualitatively on a global basis rather than quantified statistically. Cost estimates target ±25% accuracy, while groundwater has not been incorporated in the pit slope analysis, downstream recoveries require pilot confirmation, processing and refinery sustaining capital beyond the planned waste disposal expansion has not been estimated, and permitting remains outstanding.

The Ore Reserve cut-off of approximately 875 ppm payable rare earth oxide (PREO) was calculated by comparing the recoverable value of the payable oxide products, net of royalty, with pit optimisation inputs of US$5.38 per tonne for mining, US$28.28 per tonne for processing and US$1.10 per tonne for general and administrative costs. Material above this cut-off is processed; material below it is treated as waste or used for construction. This is distinct from the 1,000 ppm TREO cut-off used for reporting Mineral Resources.

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## PROCESSING FLOWSHEET AND RECOVERIES

Run of mine ore is crushed and ground to 100% passing 300 micron at the mine site using a jaw crusher, cone crusher and vertical roller mill. It is then concentrated approximately ten times through gravity separation in a reflux classifier, dry induced roll magnetic separation and wet high intensity magnetic separation of the fines. Concentrate is trucked to a refinery for dilute sulphuric acid tank leaching, two stage impurity removal, including disposal of deleterious elements (uranium and thorium), uranium ion exchange, bulk solvent extraction and separation into individual oxide products.

The recoveries applied in the PFS economic model are unchanged from the 2026 Scoping Study and give an overall recovery of 49.9% of contained payable rare earth oxide.

Iron and aluminium occur at levels requiring removal from the leach liquor, while uranium and thorium are present at low levels but require control for product quality and residue management. Zirconium, uranium, thorium and iron were estimated alongside rare earth grades in the Resource model. The PFS allows for staged neutralisation and filtration to remove iron, thorium and aluminium, followed by uranium ion exchange; associated reagents, processing and waste disposal costs, including refinery waste facility expansion and closure, are included in the economic assumptions. No separate value is assigned to these impurities and no third-party treatment or product specification penalties are modelled for the oxide products sold FOB. Impurity deportment and residue characteristics remain subject to further testing and permitting.

| Product | 2026 Scoping Study recovery | 2026 PFS recovery |
|---|---|---|
| NdPr oxide | 58.2% | 58.2% |
| Terbium oxide | 28.7% | 28.7% |
| Dysprosium oxide | 12.4% | 12.4% |
| Samarium, europium and gadolinium (SEG) oxide | 25.8% | 25.8% |

In August 2025 a test pit was excavated at CSM under a License to Explore by Dozer permit. Approximately 3,080 tonnes of fresh ore was excavated and crushed, and approximately 14.9 tonnes was shipped to FLSmidth, Loesche, DISA and COREM for comminution testing and downstream flowsheet work. No demonstration scale plant has yet been operated, and completion of the demonstration program, with rare earth oxide targeted for late Q2 2027, is a high priority metallurgical workstream.

## RECOVERY OPTIMISATION AND COST REDUCTION

Optimisation work is continuing, with particular focus on improving recoveries and reducing operating costs.

**Novex recovery program:** Small scale continuous pilot plant work with Novex has commenced on NdPr and includes additional work on producing NdPr metal from Halleck Creek ore. The second phase of the planned Novex program will focus on heavy rare earth recovery options. The PFS sensitivity analysis indicates that each one percentage point increase in NdPr recovery adds approximately US$50 million to after tax NPV at an 8% discount rate. This work is developmental and does not yet establish improved recoveries or commercial metal production.

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**Nagrom and Saskatchewan Research Council:**

**Operating cost reduction:** Work on operating costs is focused on reducing mining costs and improving the management of waste streams. Operating costs accounts are as follows;

*Run of Mine-Driven Operating Costs*

| Cost Category | Unit | Unit Cost | Life-of-Project Total (USD M) | % of OpEx |
|---|---|---|---|---|
| Grinding | USD/t ROM | 1.54 | 178.9 | 3.8% |
| Concentration | USD/t ROM | 2.62 | 304.8 | 6.4% |
| Extraction | USD/t ROM | 7.51 | 874.0 | 18.5% |
| Impurity Removal | USD/t ROM | 6.37 | 741.7 | 15.7% |
| Separation and Finishing | USD/t ROM | 6.90 | 802.8 | 17.0% |
| Infrastructure | USD/t ROM | 3.90 | 454.2 | 9.6% |
| Product Packaging | USD/t ROM | 0.04 | 4.4 | 0.1% |
| Other | USD/t ROM | 2.15 | 250.3 | 5.3% |
| **Total ROM-Driven Operating Costs** | **USD/t ROM** | **31.03** | **3,611.1** | **76.4%** |

Notes: Unit operating costs are expressed on a ROM tonne basis over 116.4 Mt processed. Costs exclude royalties and production levies, which are reported in the Economic Analysis section. Processing costs encompass both on-site (grinding, concentration, and leaching) and off-site refinery (solvent extraction, separation, and finishing) components. All costs in this table were estimated by Tetra Tech. Tetra Tech's estimate includes disposal of process residues within the Impurity Removal (US$1.16/t ROM) and Infrastructure (US$0.64/t ROM) areas.

*Operating Costs Not Driven by Run of Mine Tonnes*

| Cost Category | Cost Driver | Unit | Unit Cost | Total (USD M) |
|---|---|---|---|---|
| Mining | Ore + waste tonnes mined | USD/t mined | 5.47 | 738.6 |
| Material Movement – Sand By-Product | Processed by-product tonnes (94% of ROM) | USD/t by-product | 2.00 | 218.8 |
| Refinery Waste Disposal – Disposal | Refinery waste tonnes (890 t/day) | USD/t waste | 3.60 | 30.4 |
| Refinery Waste Disposal – Thorium Dilution | Mine tailings tonnes (123.13 t/day) | USD/t tailings | 21.60 | 25.3 |
| Water – Mine Site | Fixed annual, adjusted for utilization | USD/year | 1,340,000 | 34.6 |
| Water – Hydrometallurgical Facility | Fixed annual, adjusted for utilization | USD/year | 500,000 | 11.7 |
| Closure – Mine | Lump sum, final year of mine plan | USD | 30,891,191 | 30.9 |
| Closure – Refinery Waste Disposal | Lump sum, final year of mine plan | USD | 25,000,000 | 25.0 |
| **Total Non-ROM-Driven Operating Costs** | | | | **1,115.3** |

Notes: Mining cost is applied to total material mined of 135.0 Mt (116.4 Mt of ore and 18.7 Mt of waste at a strip ratio of 0.16:1) and was estimated by Stantec as an all-in owner-operated rate built up from first-principles labor and equipment costs, including mobile equipment rebuild and replacement costs. Sand by-product tonnage is modelled at 94% of ROM tonnes processed. Refinery waste tonnage is modelled at a fixed rate of 890 tonnes per day, comprising leach residue (707.07 t/day), iron precipitate (59.8 t/day) and mine tailings (sand) (123.13 t/day). The mine tailings are used for dilution of thorium in the refinery waste and carry an additional cost of US$21.60 per tonne. Fixed annual costs are shown at their full annual rate and scaled by annual utilization. The life-of-Project average utilization is 89.9% for the hydrometallurgical facility and 99.5% for the mine site. This gives average annual costs of US$0.45 million for Hydromet water and US$1.33 million for mine site water. Closure costs are incurred as a lump sum in 2056 and carry no contingency. USD/t ROM figures are expressed on a common basis of 116.4 Mt for comparison only.

Potential recovery improvements, cost reductions, additional product streams and downstream opportunities remain subject to test results and further assessment; they are not included in the PFS base case. The Company has entered into a signed agreement under which up to 1,620 acre-feet of water can be supplied per year to the Project for Project water needs, including site based non-chemical ore beneficiation and general site uses. A conceptual monthly water balance has been developed for the project. To manage the seasonal availability of the contracted water supply, a water-supply pond with an indicative capacity of approximately 550 acre-feet is currently included in the capital costs.

## CAPITAL AND OPERATING COSTS

Pre-production capital is estimated at US$840M, comprising direct capital of US$730M and a 15% contingency of US$110M. Of this, US$840M is spent over the three-year construction period, and a further US$33M of expansion capital is provided for staged development of the refinery waste disposal facility in 2034 and 2044, giving total life of Project capital of US$873M.

Closure costs of US$55.9 million, comprising US$30.9 million for mine closure and US$25.0 million for refinery waste disposal closure, are included in operating costs in the final year of the mine plan. Life of Project operating cost is estimated at US$4,726M undiscounted, equivalent to US$40.62 per tonne of ROM ore processed.

Sustaining capital for the replacement of the mining fleet is included in the mining unit rate. Sustaining capital was also included for the staged refinery waste disposal expansion and has been estimated. The Project is subject to a sliding scale Wyoming State royalty of 5% to 10%, a 2% Wyoming severance tax, a 7% Albany County ad valorem tax and a 0.875% industrial property tax. Total royalties, levies and federal income tax are estimated at US$1,785M over the life of the Project.

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| Capital Cost Category | USD (M) | % of Initial | Notes |
|---|---|---|---|
| Mining Capital | 55.0 | 6.3% | Owner mobile fleet and ancillary equipment |
| On-Site and Refinery Processing | 590.1 | 67.6% | Comminution, WHIMS, leach, SX, purification, finishing |
| Refinery Waste Disposal | 47.9 | 5.5% | Phased 40% Year −2, 30% Year 3, 30% Year 13; includes individual cells for Fe precipitate. |
| Sand By-Product Stockpile | 21.2 | 2.4% | |
| Electric Infrastructure | 25.0 | 2.9% | |
| Water Infrastructure | 20.0 | 2.3% | |
| **Sub-Total Direct Capital** | **759.2** | **87.0%** | **Contingency-bearing items** |
| Contingency (15%) | 113.9 | 13.0% | Applied to direct capital only |
| **Total Initial Capital** | **873.1** | **100.0%** | **Includes US$33.0 M expansion capital** |

Notes: Capital is drawn down at US$122.7 million in 2028 (14.6% of construction capital), US$308.3 million in 2029 (36.7%) and US$409.0 million in 2030 (48.7%), with first ore in 2031. Direct capital is phased 15% / 35% / 50% over the three construction years. The exception is the refinery waste disposal facility, which is phased 40% in 2029 (US$19.1 million before contingency), 30% in 2034 and 30% in 2044. Expansion capital of US$16.5 million, inclusive of contingency, is expended in each of 2034 and 2044. Closure costs of US$55.9 million, incurred in 2056, are included in operating costs. Percentages may not sum precisely due to rounding.

## PRICING AND MARKETS

Pricing in the PFS continues to use the long-term price forecasts produced by Adamas Intelligence, a leading independent rare earth market research firm, consistent with previous studies. Prices are held constant in real terms across the life of the Project.

| Product (US$/kg) | 2026 Scoping Study | 2026 PFS |
|---|---|---|
| NdPr oxide | 151.00 | 163.00 |
| Terbium oxide | 1,975.20 | 2,010.00 |
| Dysprosium oxide | 533.80 | 552.50 |
| SEG oxide | 27.37 | 34.58 |

NdPr oxide accounts for approximately 87% of life of Project revenue. Lanthanum carbonate is excluded from base case revenue given current market conditions. Adamas Intelligence forecasts global rare earth oxide demand for permanent magnets to grow at 8.4% a year from 2025 to 2040, compared with 7.8% a year growth in magnet rare earth production, implying a widening supply deficit. No offtake agreements are currently in place.

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## FUTURE OPPORTUNITY: YTTRIUM

Yttrium is present throughout the Halleck Creek Mineral Resource and is the largest single component of the heavy rare earth group, making up on average approximately 5.4% of TREO. It is not included in the PFS base case, Ore Reserve, production target or financial evaluation.

A mixed rare earth oxide produced from Halleck Creek ore in December 2025 confirmed yttrium is present in the product, although the flowsheet has not been optimised for yttrium. Early mineralogy indicates that a significant share of the yttrium may be hosted in minerals other than allanite, so the current test work is examining recovery routes both within and beyond the base case flowsheet. ARR is investigating yttrium recovery with U.S. Government research partners.

The program will confirm the minerals that host yttrium, test leach and separation conditions, develop a route to a commercial grade yttrium oxide product and define product specifications and market requirements. If this work demonstrates a viable recovery route and a supportable market, yttrium will be assessed for inclusion as a product in the Feasibility Study.

## ADVANCING TO THE FEASIBILITY STUDY

Drilling to support the conversion of Mineral Resources to Ore Reserves for the Feasibility Study has been completed. Results from this program were not incorporated in the PFS and will be included in an updated Mineral Resource estimate to support the Feasibility Study. The PFS sets out a work program toward the Feasibility Study with an order of magnitude budget of approximately US$10 million.

*"The PFS gives us a reserve-based development case to build on. The Feasibility Study will now focus on the areas with the greatest influence on project value: NdPr recovery, mining and processing costs, water and waste management, and confirming the flowsheet at pilot scale.*

*With the Feasibility Study drilling complete, we can move straight into resource updating and engineering, while the Novex and pilot programs work to improve the base case before major capital is committed."*

**- Andrew Conover, Chief Development Officer, American Rare Earths**

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| Workstream | Next milestone or objective |
|---|---|
| Pilot and demonstration program | Confirm and optimise NdPr and heavy rare earth recovery; separated rare earth oxide targeted for late Q2 2027. |
| Novex recovery program | Complete NdPr recovery optimisation and production of NdPr metal from Halleck Creek ore, followed by a second phase on heavy rare earth recovery options. |
| Resource update | Incorporate the completed Feasibility Study drilling into an updated Mineral Resource estimate and Ore Reserve. |
| Cost reduction | Advance mining cost reduction and waste stream management, including the manufactured sand byproduct and refinery waste disposal. |
| Engineering and study progression | Advance the Feasibility Study, equipment replacement, groundwater and geotechnical inputs. |
| Permitting and water | Progress the WDEQ Land Quality Division permit to mine application and hydrology and hydrogeology work with WWC Engineering. |
| Yttrium opportunity | Confirm yttrium deportment and recovery routes and assess product and market requirements for the Feasibility Study. |
| U.S. capital markets readiness | Progress PCAOB audits and SEC S-K 1300 technical disclosure in support of the Nasdaq listing pathway. |

These are planned workstreams and targets, not guarantees of timing or outcome. Completion of the Feasibility Study, permitting and financing will be required to support a future development decision.

## FUNDING AND U.S. CAPITAL MARKETS READINESS

Development would require approximately US$840M of initial capital, including contingency. This materially exceeds the Company's current cash resources and would require funding from a combination of sources.

ARR believes there is a reasonable basis to assume that funding will be available to develop the Project as envisaged in the PFS to develop a long life strategic rare earth project within the United States. Options may include strategic investors, project debt, equity funding, government supported programs and joint venture arrangements.

The Company has previously announced a non-binding Letter of Interest from the Export Import Bank of the United States (EXIM). The Letter of Interest is not committed financing and remains subject to further evaluation, due diligence and approvals. There can be no assurance that funding will be available when required or on acceptable terms. Equity financing may dilute existing shareholders, while joint ventures or other funding arrangements may reduce ARR's ownership interest or economic exposure to the Project.

The PFS shares its underlying technical basis with the SEC Regulation S-K, Subpart 1300 technical report prepared to support a potential Nasdaq listing. The reports use different reporting standards and are not interchangeable. Listing readiness does not constitute approval of a listing or assurance of project funding.

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## ORE RESERVE SUMMARY INFORMATION

The following summary is provided in accordance with ASX Listing Rule 5.9.1. Further detail is provided in the JORC Table 1 in Appendix A.

| Item | Summary |
|---|---|
| Economic assumptions | Constant Q1 2026 U.S. dollars, 8% real after tax discount rate, Adamas Intelligence long term prices, 21% federal income tax, 14% depletion allowance and MACRS depreciation. |
| Classification | Probable only, derived from Indicated Mineral Resources. No Measured Mineral Resource is reported, so no Proved Ore Reserve is declared. |
| Mining method | Conventional open pit truck and shovel; 100% mining recovery and nil dilution; 10 m by 10 m by 10 m selective mining unit. |
| Processing method | Mine site grinding and gravity and magnetic concentration; offsite refinery with dilute sulphuric acid leach, impurity removal and solvent extraction separation. |
| Cut-off grade | Approximately 875 ppm PREO, based on mining, processing and general and administrative costs, PREO price less royalty, and recovery. |
| Estimation methodology | Pit optimisation in Whittle on a regularised resource model, pit design and Deswik life of mine scheduling by Stantec. |
| Material modifying factors | State mineral leases and federal claims in good standing; permit to mine application not yet filed; signed water agreement; water rights not adjudicated; no offtake agreements; recoveries subject to pilot confirmation. |

## COMPETENT PERSON STATEMENT AND SUPPORTING DISCLOSURE

This work was reviewed and approved for release by Mr. Kelton Smith (Society of Mining, Metallurgy & Exploration #4227309RM) who is employed by Tetra Tech Inc. and has sufficient experience which is relevant to the processing, separation, metallurgical testing and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2012 JORC Code. Mr. Smith is an experienced technical manager with a degree in Chemical engineering, operations management, and engineering management. He has held several senior engineering management roles at rare earth companies (Molycorp and NioCorp) as well as ample rare earth experience as an industry consultant. Mr. Smith consents to the inclusion in this announcement of the matters based upon the information in the form and context in which it appears.

The information in this announcement that relates to Ore Reserves and the mine plan was reviewed and approved for release by Mr. Patrick A Sobecke (Society of Mining, Metallurgy and Exploration #04133849RM) who is employed by Stantec and has sufficient experience which is relevant to the mining plan, the estimation of Ore Reserves and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2012 JORC Code. Mr. Sobecke is a Professional Engineer (IL 062.064122) with over 21 years of experience in multiple commodities, mining methods and countries. Mr. Sobecke consents to the inclusion in this announcement of the matters based upon the information in the form and context in which it appears.

This work was reviewed and approved for release by Mr. Alfred J Gillman, a Fellow and Chartered Profession of the Australasian Institute of Mining and Metallurgy (AusIMM 107303). Mr. Gillman is an independent geological consultant to American Rare Earths Limited and has sufficient experience relevant to the style of mineralisation and type of deposit under consideration, and to the activity being undertaken, to qualify as a Competent Person as defined in the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code). Mr. Gillman consents to the inclusion in this announcement of the matters based on his information in the form and context in which they appear.

This work was reviewed and approved for release by Mark W. Travis, CPG, a Certified Professional Geologist and member of the American Institute of Professional Geologists (AIPG CPG-12090). Mr. Travis is an independent geological consultant to American Rare Earths Limited and has sufficient experience relevant to the style of mineralisation and type of deposit under consideration, and to the activity being undertaken, to qualify as a Competent Person as defined in the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code). Mr. Travis consents to the inclusion in this announcement of the matters based on his information in the form and context in which they appear.

The Company confirms that it is not aware of any new information or data that materially affects the information included in the previously announced Mineral Resource estimate and that all material assumptions and technical parameters underpinning that estimate continue to apply and have not materially changed.

This announcement has been authorized for release by the Board of American Rare Earths Limited.

## INVESTOR CONTACT

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**Stock Information**
ASX: ARR
OTCQX: ARRNF
ADR: AMRRY

## ABOUT AMERICAN RARE EARTHS LIMITED

American Rare Earths (ASX: ARR | OTCQX: ARRNF | ADR: AMRRY) is a critical minerals company at the forefront of reshaping the U.S. rare earths industry. Through its wholly owned subsidiary, Wyoming Rare (USA) Inc. (“WRI”), the company is advancing the Halleck Creek Project in Wyoming, a world class rare earth deposit with the potential to secure America’s critical mineral independence for generations. Located on Wyoming State land, the Cowboy State Mine within Halleck Creek offers cost efficient open pit mining methods and benefits from streamlined permitting processes in this mining friendly state.

With plans for onsite mineral processing and separation facilities, Halleck Creek is strategically positioned to reduce U.S. reliance on imports, predominantly from China, while meeting the growing demand for rare earth elements essential to defense, advanced technologies, and economic security. As exploration progresses, the project’s untapped potential on both State and Federal lands further reinforces its significance as a cornerstone of U.S. supply chain security. In addition to its resource potential, American Rare Earths is committed to environmentally responsible mining practices and continues to collaborate

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with U.S. Government supported R&D programs to develop innovative extraction and processing technologies for rare earth elements. Further information is available at www.americanree.com.

## FORWARD LOOKING STATEMENTS

This announcement contains forward-looking statements that involve subjective judgement and analysis and accordingly, are subject to significant uncertainties and risks, many of which are outside the control of, and are unknown to, American Rare Earths ("ARR"). In such circumstances, the forward-looking statements can be identified by the use of forward-looking words such as "may", "will", "expect", "intend", "seek", "estimate", "believe", "continue" or other similar words. No representation, warranty or assurance is given or made in relation to any forward-looking statement by ARR or its representatives, In addition, no representation, warranty or assurance is given in relation to any underlying assumption or that any forward-looking statements will be achieved. Actual future events may vary materially from the forward-looking statements and the assumptions on which the forward-looking statements are based. Accordingly, announcement readers are cautioned not to place undue reliance on such forward-looking statements as a result of the uncertainties. ARR wishes to caution readers that these forward-looking statements are based on economic predictions and assumptions on reserves, mining method, production rates, metal prices and costs (both capital and operating) developed by ARR management in conjunction with consultants. This presentation and the forward-looking statements made in this announcement, speak only as of the date of the announcement. Accordingly, subject to any continuing obligations under the Corporations Act and the Australian Securities Exchange Listing Rules, ARR disclaims any obligation or undertaking to publicly update or revise any of the forward-looking statements in this announcement, whether as a result of new information, or any change in events, conditions or circumstances on which any such statements is based.

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## Appendix A – Halleck Creek JORC Table 1

The conclusions in the Report titled Halleck Creek JORC Table  are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from Wyoming Rare - Cowboy State Mine (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

| **Section 1 Sampling Techniques and Data** | | |
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| (Criteria in this section apply to all succeeding sections.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Sampling techniques* | *Nature and quality of sampling (e.g. cut channels, random chips, or specific specialized industry standard measurement tools appropriate to the minerals under investigation, such as downhole gamma sondes, handheld XRF instruments, etc.). These examples should not be taken as limiting the broad meaning of sampling.* | Sample material from the CSM Project includes rock chip outcrop samples, channel samples, RC drill samples, and diamond drill core. Wyoming Rare maintains SOPs for sample collection, logging, security, and transport. |
| | *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* | Rock chip samples are split in the office. One part is ground to P100-P180 mesh (0.08 mm) and analyzed in triplicate on an Olympus Vanta handheld XRF analyzer. Odessa Resources' 2024 statistical evaluation confirmed that increasing the core sample interval from 1.5 m to 3.0 m has no significant influence on resource estimates. |
| | *Aspects of the determination of mineralization that are Material to the Public Report.* | Rare earth mineralization at Halleck Creek is disseminated, allanite-hosted and is not visually distinguishable in core or chips. Determination of mineralization therefore rests entirely on laboratory assay rather than on visual logging or estimation. |

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| | | The determinations that are Material to the Report are: total rare earth oxide (TREO) grade; the split of TREO into light, medium and heavy fractions (LREO, MREO, HREO); and the proportion of magnet rare earth oxides, principally neodymium-praseodymium (NdPr), which accounts for approximately 87% of life-of-Project revenue in the economic analysis. TREO, LREO, MREO and HREO are reported as sum calculations of the individually assayed rare earth element grades. Thorium, uranium, zirconium and iron were also estimated. (Sections 6, 8.4 and 11.2.2.) |
| | *In cases where 'industry standard' work has been done, this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverized to produce a 30 g charge for fire assay'). In other cases, more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralization types (e.g. submarine nodules) may warrant disclosure of detailed information.* | Rock chip, channel, RC, and diamond core sampling methods used at Halleck Creek are consistent with industry standards for this deposit type. |
| *Drilling techniques* | *Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or another type, whether the core is oriented and if so, by what method, etc.).* | Drilling used two methods across four campaigns from 2022 to 2024: HQ diamond core drilling (28 holes, 3,362 m, 63.5 mm core) and reverse circulation drilling (70 holes, 9,128 m). Core was sampled at 1.5 m intervals prior to 2024 except at lithological breaks; 2024 core holes were sampled at 3.0 m intervals. RC drilling produced three chip samples per 1.5 m interval using a rotary sample splitter. |
| *Drill sample recovery* | *Method of recording and assessing core and chip sample recoveries and results assessed.* | Core recovery at Halleck Creek is approximately 96% for diamond core holes. No quantitative recovery figure was calculated for RC drilling; no zones of loss or zero-sample recovery were recorded in any RC program. |
| | *Measures are taken to maximize sample recovery and ensure the representative nature of the samples.* | Recovery of core and RC chips to surface has been consistently high. The rotary sample splitter used in RC drilling provides representative samples. |
| | *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.* | No relationship between sample recovery and grade has been assessed or reported in the Pre-feasibility Study.<br>Diamond core recovery averages approximately 96%, and no zones of core loss or zero-sample recovery were recorded in any of the four drilling campaigns. The |

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| | | dataset therefore contains little recovery variation against which grade could be tested. On that basis sample bias arising from preferential loss or gain of fine or coarse material is not considered likely, but this has not been quantitatively demonstrated and remains an item for the next study stage. (Section 7.4.4.) |
| *Logging* | *Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.* | All core and RC chip cuttings were logged in detail by Wyoming Rare geologists, including RQD, lithology, and alteration. WSP-trained geologists have completed geotechnical logging since 2023. |
| | *Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc.) photography.* | Logging includes quantitative RQD measurement and qualitative description of lithology and alteration. All core is photographed. RC cuttings are logged under 10x binocular microscope and photographed for each hole. |
| | *The total length and percentage of the relevant intersections logged.* | All 98 drill holes completed to date have been geologically logged in full, comprising 28 HQ diamond core holes (3,362 m) and 70 reverse circulation holes (9,128 m) for a total of 12,490 m (40,979 ft). Logging coverage is therefore 100% of drilled meters, and all 98 holes are included in the resource models.<br>Geotechnical logging is not continuous across the full dataset. Geotechnical logging by WSP-trained geologists has been undertaken since 2023, and 48 geotechnical core samples from 11 drill holes were collected during the Fall 2024 program. (Sections 7.4 and 11.1.1.) |
| *Sub-sampling techniques and sample preparation* | *If core, whether cut or sawn and whether quarter, half or all core taken.* | Diamond core was cut longitudinally in half using a core saw. Core sample intervals were selected at lithological breaks, measured with a tape measure, marked on the core and core box with a paint pen, and tagged with ALS sample tags and barcodes. One half of the cut core was submitted for assay, with the remaining half retained in the core box for reference. |
| | *If non-core, whether riffled, tube sampled, rotary split, etc. and whether sampled wet or dry.* | RC drilling uses a rotary sample splitter, producing three samples (plus a fourth reserve split) per 1.5 m interval: one for chip trays, one for in-house XRF analysis, and one for external assay. |
| | *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* | Diamond core sample intervals are set by lithologic breaks and never cross lithology boundaries. Intervals are measured with a tape measure and marked on the core with a paint pen. ALS sample tags and barcodes are affixed to the core box, with entries recorded in the sample booklet. RC sampling uses a rotary splitter producing separate chip-tray, XRF, and assay splits for each interval. |

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| | *Quality control procedures adopted for all sub-sampling stages to maximize the representivity of samples.* | CRMs were inserted at a rate of approximately 1 per 19 samples for both RC and diamond core drilling. Total QA/QC insertion rates for the 2024 programs were 6.84% for diamond core (35 samples) and 4.51% for RC drilling (60 samples), including CRMs, blanks, and duplicates. |
| | *Measures are taken to ensure that the sampling is representative of the in situ material collected, including, for instance, results for field duplicate/second-half sampling.* | Company duplicate samples (riffle splits of coarse rejects) returned a regression $R^2$ greater than 0.99 for all elements against TREE content. |
| | *Whether sample sizes are appropriate to the grain size of the material being sampled.* | Sample support is 1.5 m (approximately 5 ft) for rock chip, channel, reverse circulation and pre-2024 diamond core sampling. For the 2024 core program, Odessa Resources carried out a statistical evaluation demonstrating that 3.0 m sample lengths have no statistically significant influence on resource estimates, provided lithological contacts are sampled discretely; 2024 core holes accordingly used 3.0 m intervals in homogeneous lithology with shorter intervals at contacts. Mineralogical characterization by SGS Lakefield established P80 and median grain sizes by mineral phase for the REE-bearing minerals. The Pre-feasibility Study does not contain an explicit assessment of sample mass against grain size. The mineralization is fine grained, disseminated and evenly distributed, and variography of TREO returned a near-zero nugget with long ranges, which is consistent with sample sizes being adequate for the material being sampled. (Sections 8.1, 10.3.5 and 11.2.4.) |
| *Quality of assay data and laboratory tests* | *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* | ALS analyzes samples by ICP-MS using the ME-MS81d package (including ME-ICP06 for whole rock analysis), providing quantitative results for all rare earth elements, major oxides, and selected trace elements. |
| | *For geophysical tools, spectrometers, handheld XRF instruments, etc., the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* | Surface rock chip samples are analyzed in triplicate using an Olympus Vanta handheld XRF analyzer as an initial screening tool ahead of external laboratory assay. |
| | *Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks)* | QA/QC included company and laboratory blanks, company and laboratory duplicates ($R^2$ > 0.99 for TREE), and CRMs (CDN-RE-1201 and CDN-RE-1202 internally; AMIS0304, OREAS 146, OREAS-101b, and SY-5 at ALS). Two CDN-RE- |

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| | *and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.* | 1201 results (Nd and Pr) and one ALS OREAS-101b result fell outside acceptable tolerance and require further investigation. |
| *Verification of sampling and assaying* | *The verification of significant intersections by either independent or alternative company personnel.* | The Competent Person routinely verified geological data collection and analysis throughout the drilling and analytical programs, reviewed geological descriptions against core and RC cutting photographs, monitored analytical progress through ALS's online laboratory information management system, and prepared and reviewed strip logs of assay and geological data for each drill hole. The Competent Person concluded that the data collected and maintained by ARR is comprehensive and adequate for geological modeling and resource estimation. No significant intersections are reported as Exploration Results, so no separate verification of individual intersections arises. (Section 9.) |
| | *The use of twinned holes.* | No twinned holes have been drilled at Halleck Creek, and none are reported in the Pre-feasibility Study. |
| | *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* | All drill hole collar information, surveys, lithology, alteration, assays, and geotechnical data are entered into the DHDB, which provides secure user access and audit tracking. Assay and QA/QC data are imported directly from certified laboratory data, which minimizes data entry error. Validation queries check for gaps and overlaps in lithology, alteration and assay data, cross-reference total depths of collar and lithologic data, and cross-reference entries to data dictionaries to restrict data entry to approved values. Original field logs, core and chip photographs and certified assay certificates are stored within the DHDB and cross-referenced to each drill hole. (Sections 8.9.2 and 8.9.4.) |
| | *Discuss any adjustment to assay data.* | No adjustment, factoring or recalculation of assay data is reported.<br>Grades were not capped and no outlier restrictions were applied at any estimation pass. TREO, LREO, MREO and HREO are reported as sums of the individually assayed rare earth element grades rather than as adjusted or derived values. Handheld XRF readings are used as a field screening tool only and do not substitute for, or adjust, the ALS laboratory assays used in the resource estimate. (Sections 8.4 and 11.2.2.) |
| *Location of data points* | *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* | Drill hole collars were surveyed by Laramie Land Surveying, registered professional land surveyors, using the NAD 1983 UTM Zone 13 North projection. Downhole |

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| | | deviation surveys were collected for all holes except the 2022 maiden program, which was drilled vertically. |
| | *Specification of the grid system used.* | Drill hole, trench, and surface sample locations are stored using the NAD 1983 UTM Zone 13 coordinate system. WGS 1984 latitude/longitude coordinates are retained as secondary coordinates. |
| | *Quality and adequacy of topographic control.* | Topographic control is provided by LiDAR data acquired from the United States Geological Survey, released publicly in August 2022 under the USGS Earth MRI project. Wyoming Rare personnel processed the LiDAR imagery into high-resolution topographic surfaces for use in ArcGIS and Leapfrog, and these surfaces were used to constrain the geological model and the block model. Topographic control is considered adequate for a resource estimate at this stage. (Sections 7.8 and 11.3.) |
| *Data spacing and distribution* | *Data spacing for reporting of Exploration Results.* | The drill pattern at Red Mountain is mostly irregular, with drill spacing of approximately 200 m. Fifty drill holes provide the data points for the Cowboy State Mine resource estimate, supported by 112 channel samples and a surface database of approximately 950 rock chip samples. No Exploration Results are reported, so no data spacing is quoted for that purpose. (Section 11.2.7.) |
| | *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* | Empirical observations and statistical analysis, supported by variography, confirm a high degree of geological and grade continuity within the Red Mountain rock masses. |
| | *Whether sample compositing has been applied.* | Grades were composited to 1.5 m (5 ft), the dominant sampling interval. |
| *Orientation of data in relation to geological structure* | *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* | Mineralization at Halleck Creek is controlled by batholith-scale fractionation, not by structural (fracture or vein) control. |
| | *If the relationship between the drilling orientation and the orientation of key mineralized structures is considered to have introduced a sampling bias, this should be assessed and reported if material.* | As mineralization is not structurally controlled, drilling orientation relative to any mineralized structure is not considered to have introduced a sampling bias. |
| *Sample security* | *The measures are taken to ensure sample security.* | Wyoming Rare geologists collect and log drilling samples daily, and surface geochemical and channel samples stay in the possession of Wyoming Rare |

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| | | geologists while in the field. Prior to shipping, drill core is held in a storage yard that is locked whenever no Wyoming Rare employees are on site, and RC chips are held in a locked shipping container. All samples are transported to Wyoming Rare's secure storage facilities in Laramie, Wyoming, and are cataloged with sample manifests prepared before shipment. Shipments are boxed or bagged, wrapped and sent by bonded carrier, with Wyoming Rare personnel preparing each shipment and supervising loading. ALS has carried out analytical services for Wyoming Rare since 2022 and maintains its own internal chains of custody. Split core not consumed in analysis and all sample pulps are returned to Wyoming Rare and stored in locked cabinets at the Laramie warehouse, and Wyoming Rare intends to retain them indefinitely. (Section 8.6.) |
| *Audits or reviews* | *The results of any audits or reviews of sampling techniques and data.* | Mr. Paul Dockwiler, CPG, CEM, audited the Halleck Creek core material in June 2025 and also reviewed Wyoming Rare's standard operating procedures and field procedures in the same month. No formal audit of the drill hole database has been carried out, and no bias analysis, check-and-balance review or dedicated sampling audit has been performed. Wyoming Rare personnel have not carried out in-person laboratory checks at ALS or SGS. Two CDN-RE-1201 certified reference material results (Nd and Pr) and one OREAS-101b external standard result fell outside acceptable tolerance and remain subject to further investigation. (Sections 8.5.3, 8.9.5 and 8.10.) |

| **Section 2 Reporting of Exploration Results** | | |
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| (Criteria listed in the preceding section also apply to this section.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Mineral tenement and land tenure status* | *Type, reference name/number, location and ownership, including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* | Wyoming Rare controls mineral rights through 365 unpatented federal lode mining claims administered by the BLM (approximately 7,831 acres, 3,169 ha) and four Wyoming State Mineral Leases administered by WOSLI (approximately 1,560 acres, 631 ha), together totaling approximately 9,391 acres (3,800 ha). The Wyoming State Mineral Leases, assigned to Wyoming Rare in June 2021, constitute the core of the CSM project area addressed in this Pre-feasibility Study. A sliding-scale royalty of 5% to 10% on revenue is payable to the State of Wyoming on production from the State Mineral Leases; no other royalties are known to apply. |

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| | *The security of the tenure held at the time of reporting and any known impediments to obtaining a license to operate in the area.* | Wyoming Rare has not received any violations or fines from the State of Wyoming or federal government in connection with Halleck Creek. Wyoming Rare holds a License to Explore by Dozer permit and an active exploration drilling permit (DN-0511) from WDEQ-LQD, and has not yet filed a mine permitting application. The point of valuation for the State of Wyoming royalty is currently under review with WOSLI. Water rights have not been adjudicated for the Project. |
| *Exploration done by other parties* | *Acknowledgment and appraisal of exploration by other parties.* | Anderson (1995) documented anomalous REE values at Red Mountain in a PhD thesis, providing the basis for later exploration interest. Blackfire Minerals acquired the Wyoming State Mineral Leases in 2010 and conducted preliminary research before dropping the leases in 2011 due to low REE prices; no drilling or resource estimation was completed. Zenith Mineral Ltd. reactivated the Project in 2018, staked five federal lode claims, and collected 87 surface samples in 2019 showing broad REE mineralization exceeding 2,000 ppm TREO; no Mineral Resources were compiled or reported by Zenith. |
| *Geology* | *Deposit type, geological setting and style of mineralization.* | The CSM Project is hosted within the Red Mountain Pluton (RMP), a magmatic allanite-hosted REE deposit composed primarily of monzonitic to syenitic rocks, classified as an A-type granite. REE mineralization is attributed to fractional crystallization during the final stages of magma evolution, concentrating allanite and other REE-bearing phases. Hydrothermal alteration in the RMP is minimal and does not appear to have significantly affected REE mineralization. |
| *Drill hole Information* | *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:* | Wyoming Rare completed four exploration drilling campaigns between March 2022 and October 2024, totaling 98 holes for 12,490 m (40,979 ft): 28 HQ diamond core holes for 3,362 m and 70 reverse circulation holes for 9,128 m. By area, Red Mountain accounts for 50 holes and 6,565 m and Overton Mountain for 48 holes and 5,925 m. All holes are included in the resource models. The 2022 maiden core program was drilled vertically and no downhole surveys were collected; downhole surveys were collected for all subsequent holes. Maiden core samples were assayed at American Assay Laboratories in Sparks, Nevada. Rock chip, RC and core samples from fall 2022 onward were prepared by ALS Global in Twin Falls, Idaho and assayed at ALS Global in Vancouver, British Columbia, with 2023 and 2024 core prepared at ALS Global in Reno, Nevada. In 2024 Wyoming Rare drilled 17 RC holes and 11 diamond core holes in the Cowboy State Mine area, and SGS in Lakefield, Ontario updated the mineralogical characterization using TIMA-X |

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| | | analysis. All collar information, surveys, lithology, alteration, assay and geotechnical data were entered into the DHDB. (Sections 7.4, 8.4.1 and 11.1.2.) |
| | *easting and northing of the drill hole collar* | Drill hole data from the 2022-2024 exploration campaigns is published in the "Technical Report of Exploration and Maiden Resource Estimates, Halleck Creek Rare Earths Project" (March 2023), the "Technical Report of Exploration and Updated Resource Estimates, Halleck Creek Rare Earths Project" (January 2024), the "Halleck Creek Updated Scoping Study Technical Report (Revision 3)" (28 February 2025), and the "Halleck Creek REE Project, Red Mountain Update Report" (Odessa Resources, 1 November 2025). |
| | *elevation or RL (Reduced Level – elevation above sea level in meters) of the drill hole collar* | Collar elevations were captured in the same registered survey and are held in the DHDB. Elevations are consistent with the LiDAR topographic surface used for the geological and block models. Individual collar RLs are not tabulated in the Pre-feasibility Study. (Sections 7.4.5 and 11.3.) |
| | *dip and azimuth of the hole* | Downhole deviation surveys were collected for all drill holes other than those of the 2022 maiden program, which were drilled vertically. Survey data are stored in the DHDB and were used in the resource models. Individual hole dips and azimuths are not tabulated in the Pre-feasibility Study. (Section 7.4.6.) |
| | *downhole length and interception depth* | No intercepts are reported as Exploration Results, so interception depths are not tabulated. Mineralization has been observed to a depth of 298 m at Red Mountain and 302 m at Overton Mountain, and both areas remain open at depth. Downhole lengths for every hole are held in the DHDB. (Sections 6 and 7.4.) |
| | *Hole length.* | Individual hole lengths are not tabulated. Aggregate lengths are reported by area and hole type: Red Mountain 6,565 m from 50 holes, Overton Mountain 5,925 m from 48 holes, for a Project total of 12,490 m from 98 holes. (Section 7.4.) |
| | *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.* | The Pre-feasibility Study reports Mineral Resource and Ore Reserve estimates; it does not report Exploration Results, and no individual intercepts are quoted. Hole-by-hole collar, survey and intercept tabulations are therefore not considered Material to an understanding of the Report, and their omission does not detract from it.<br>The underlying data for all 98 holes is held in the DHDB, was validated for gaps and overlaps, for consistency between collar and lithologic depths and against data dictionaries, and was reviewed by the Competent Person, who concluded it is |

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| | | adequate for geological modeling and resource estimation. Should Exploration Results be reported in a future public report, a full drill hole tabulation should be appended. (Sections 8.9 and 9.) |
| *Data aggregation methods* | *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually Material and should be stated.* | No Exploration Result intercepts are aggregated or reported in the Pre-feasibility Study.<br>For resource estimation, assay grades were composited to 1.5 m (5 ft), the dominant sampling interval. No weighting, maximum or minimum grade truncation, top-cutting or capping was applied, and no outlier restrictions were used at either estimation pass. The Mineral Resource is reported above a cut-off grade of 1,000 ppm TREO. (Sections 11.1.2, 11.2.3 and 11.5.) |
| | *Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low-grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.* | Not applicable. No aggregated intercepts are reported, and therefore no aggregation of short high-grade lengths with longer low-grade lengths arises. Mineralization at Halleck Creek is bulk-hosted and disseminated rather than occurring as discrete high-grade intervals. |
| | *The assumptions used for any reporting of metal equivalent values should be clearly stated.* | No metal equivalent values are reported. Grades are reported as TREO and as its LREO, MREO and HREO components, and as individual rare earth oxides, each derived as a sum of individually assayed element grades.<br>The economic analysis models revenue from four separately priced products, namely NdPr oxide, SEG (samarium, europium and gadolinium) oxide, terbium oxide and dysprosium oxide, rather than from a metal-equivalent grade. (Section 19.) |
| *Relationship between mineralization widths and intercept lengths* | *These relationships are particularly important in the reporting of Exploration Results. If the geometry of the mineralization with respect to the drill hole angle is known, its nature should be reported. If it is unknown and only the downhole lengths are reported, there should be a clear statement to this effect (e.g. 'down hole length, true width not known').* | Mineralization is a large, near-surface, disseminated body controlled by batholith-scale fractionation rather than by discrete mineralized structures. The Pre-feasibility Study states that, because mineralization is not structurally controlled, drilling orientation relative to any mineralized structure is not considered to have introduced a sampling bias.<br>No intercepts are reported as Exploration Results and no true-width corrections have been applied or required. Any downhole lengths held in the database are downhole lengths; true widths are not separately reported. (Sections 6 and 8.2.3.) |

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| *Diagrams* | *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported. These should include, but not be limited to, a plan view of drill hole collar locations and appropriate sectional views.* | Maps and cross sections are included in this Report, including a mineral tenure map, a surface control map, and a simplified geologic map of the Laramie Anorthosite Complex showing the location of the Red Mountain Pluton. |
| *Balanced reporting* | *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.* | The Pre-feasibility Study reports a Mineral Resource estimate for the whole modeled deposit above a 1,000 ppm TREO cut-off rather than selected intercepts, so reporting is inherently balanced. Grades were not capped or truncated and no outlier restrictions were applied, so high and low grades are represented as assayed.<br>Resource statements are presented both by classification category and by mineral owner, covering the Cowboy State Mine, Red Mountain Federal and Trail Creek areas, with the respective areas and the cut-off grade stated. The Pre-feasibility Study also discloses unfavorable information, including two certified reference material exceedances (Nd and Pr) and one external standard anomaly that remain subject to further investigation, and the comparatively lower confidence of the Overton Mountain portion of the deposit, which is not included in the current Mineral Resource estimate. (Sections 8.5.3, 11.6 and 22.) |
| *Other substantive exploration data* | *Other exploration data, if meaningful and material, should be reported, including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.* | Ground geophysical surveys have not been employed at Halleck Creek. The homogeneous nature of the host lithology and the low levels of radionuclides, metallic oxide minerals, and sulfide minerals do not lend themselves to conventional geophysical exploration methods. Wyoming Rare geologists were evaluating the use of handheld gamma spectrometers during the 2025 field season. |
| *Further work* | *The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out drilling).* | ARR/Wyoming Rare plans continued geological mapping, surface sampling, and targeted drilling to improve geological confidence and evaluate prospective areas within the broader Red Mountain Pluton, including the Bluegrass and County Line areas. Additional infill drilling in selected portions of the existing Mineral Resource is also planned to support future refinement of Mineral Resource classifications. |

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| | *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.* | The Pre-feasibility Study sets out a sequenced work program toward a Feasibility Study, with an order-of-magnitude budget of approximately US$8.1 million, comprising: geology and exploration US$2.0 million; metallurgy and process recovery US$1.5 million; mining and geotechnical engineering US$1.5 million; permitting US$1.0 million; engineering and infrastructure US$750,000; feasibility study integration and study preparation US$750,000; environmental and social programs US$500,000; process flowsheet reconciliation US$350,000; and Mineral Resource update and refinement US$250,000.<br>Exploration specific work comprises continued geological mapping and surface sampling; targeted drilling to improve geological confidence and to expand the Mineral Resource footprint where warranted, including evaluation of the Bluegrass and County Line areas within the broader Red Mountain Pluton; and additional infill drilling in selected portions of the existing Mineral Resource to support refinement of resource classification. A 2026 drilling program was in progress at the effective date, and its results are to be incorporated in any future Mineral Resource update supporting the Feasibility Study. (Section 23.) |

| **Section 3 Estimation and Reporting of Mineral Resources** | | |
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| (Criteria listed in the preceding section also apply to this section.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Database integrity* | *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.*<br>*Data validation procedures used.* | All drill hole and surface sample data were imported into the DHDB drill hole database, maintained by Wyoming Rare since 2004 and tailored for rare earth element data. Assay and QA/QC data are imported directly from certified laboratory data, minimizing data entry errors, and detailed validation queries are applied to the drill hole data. |
| *Site visits* | *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.*<br>*If no site visits have been undertaken indicate why this is the case.* | Alfred Gillman (Odessa Resources) visited the site on 7 March 2024, including Red Mountain and the core storage facility at Western Research Institute (Wyoming Rare) in Laramie, Wyoming. Patrick Sobecke (Stantec) visited the site on 10 February 2025, accompanied by Erick Kennedy (Stantec) and Sara Stotter (ARR). Mark Travis (Arkenstone Exploration) visited the site on 12-13 May 2026. Kelton |

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| | | Smith (Tetra Tech) has visited the site on numerous occasions in 2024, 2025, and 2026. |
| *Geological interpretation* | *Confidence in (or conversely, the uncertainty of ) the geological interpretation of the mineral deposit.*<br>*Nature of the data used and of any assumptions made.*<br>*The effect, if any, of alternative interpretations on Mineral Resource estimation.*<br>*The use of geology in guiding and controlling Mineral Resource estimation.*<br>*The factors affecting continuity both of grade and geology.* | The geological resource model was created by Odessa Resources using Leapfrog Edge modeling tools. A revised three-dimensional geological model isolates the higher-grade Red Mountain Pluton (RMP) domain from surrounding lithologies. Modeling domains comprise Quaternary alluvium (QAL), RMP (clinopyroxene quartz monzonite), RMP1 (biotite-hornblende quartz syenite and fayalite monzonite), the unmineralized Elmers Rock Greenstone Belt (ERGB), low-grade Sybille intrusions (SYB), and the Laramie Anorthosite Complex country rock (LAC). |
| *Dimensions* | *The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.* | The Red Mountain project area is approximately 2,075 m x 1,013 m; the Overton Mountain project area is approximately 1,210 m x 1,648 m. Both deposits remain open at depth: mineralization has been observed to a depth of 302 m at Overton Mountain and 298 m at Red Mountain. |
| *Estimation and modelling techniques* | *The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.*<br>*The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.*<br>*The assumptions made regarding recovery of by-products.*<br>*Estimation of deleterious elements or other non-grade variables of economic significance (eg sulfur for acid mine drainage characterization).* | Grade estimation was carried out by Odessa Resources in Leapfrog Edge using ordinary kriging. A standard variogram was modeled on undomained TREO composites and the interpolant profile developed for TREO was applied to the individual rare earth elements and minerals. Estimations were carried out on each rare earth element together with $UO_2$, $ThO_2$, $ZrO_2$ and Fe, so deleterious and non-grade variables of economic significance were estimated alongside the pay elements. Final TREO, HREO, LREO and MREO grades are reported as sum calculations of the respective element grades.<br>An orthogonal block model was used with a parent block size of 20 m by 20 m by 10 m and a minimum block size of 5 m by 5 m by 2.5 m. Several block sizes were trialed; differences in the resulting estimates were almost imperceptible, and the 20 by 20 by 10 m parent block was selected for faster processing and reporting. Parent block size is small relative to the approximately 200 m drill spacing. No selective mining unit was applied within the Mineral Resource block model; a selective mining unit was applied separately when the model was regularized for Ore Reserve pit optimization.<br>Two estimation passes were used at Red Mountain: Pass 1 with a 150 by 150 by 120 m search ellipsoid, minimum 4 and maximum 15 samples; Pass 2 with a 500 by |

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| | *In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.*<br>*Any assumptions behind modelling of selective mining units.*<br>*Any assumptions about correlation between variables.*<br>*Description of how the geological interpretation was used to control the resource estimates.*<br>*Discussion of basis for using or not using grade cutting or capping.* | 500 by 200 m ellipsoid, minimum 2 and maximum 15 samples. The TREO variogram is spherical with a normalized nugget of 0.1, a normalized sill of 0.8 and ranges of 445 m, 240 m and 170 m. Resource boundary limits were set at 90% of the sill range from variography. Grades were not cut or capped and no outlier restrictions were applied, on the basis of the homogeneous, low-nugget nature of the mineralization.<br>Check estimates were run using inverse distance squared and nearest neighbor methods (see 'validation' below). The estimate supersedes the February 2025 Scoping Study estimate and the differences are reconciled in the Resource Estimate Differences section. There are no mine production records, as the Project has no production history. No by-products are currently associated with the Cowboy State Mine; recovery assumptions are applied only in the downstream economic analysis. (Sections 11.2 and 11.7.) |
| | *The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.* | Validation runs (inverse distance squared, isotropic ID2, ID2 with variogram, and nearest neighbor) were compared against the kriged estimator and against raw composite data in east-west and north-south swath plots across Red Mountain. The kriged estimator was found to estimate a global resource grade with no systematic bias towards overestimating grades. |
| *Moisture* | *Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.* | Tonnages are estimated on a dry in-situ basis, using a specific gravity / dry bulk density of 2.70 derived from hydrostatic testing. Natural moisture content was not separately determined and no moisture allowance is applied to the reported tonnages. (Sections 7.3 and 10.3.) |
| *Cut-off parameters* | *The basis of the adopted cut-off grade(s) or quality parameters applied.* | The Mineral Resource is reported at a cut-off grade of 1,000 ppm TREO. Stantec developed net smelter return (NSR) calculations based on recovering oxides of NdPr, La, Dy, Tb, and SEG (mixed samarium, europium, and gadolinium), which demonstrated that 1,000 ppm TREO is the economic cut-off grade for in situ resource estimates within the proposed resource limits. |
| *Mining factors or assumptions* | *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and* | Resource material is at surface and can be mined with conventional open-pit mining equipment. Uncontrolled minerals (not controlled by ARR) were excluded from the resource estimate. Pit shell optimization using Whittle software confirms the Mineral Resource at CSM is amenable to open-pit mining at grades above the cut-off, with the resource located at or near surface at a low strip ratio. |

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| | *parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.* | |
| *Metallurgical factors or assumptions* | *The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.* | Metallurgical and mineralogical studies indicate that REE recoveries are broadly homogeneous across the Red Mountain and Overton Mountain resource areas. Representative core material from both areas was used to establish the concentration flowsheet, and geologist's logs and REE assays are consistent with the observed homogeneity of the deposit. |
| *Environmental factors or assumptions* | *Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.* | The Mineral Resource is assumed to be amenable to conventional open-pit mining. The material is at or near surface and can be mined with conventional open-pit equipment, and minerals not controlled by ARR were excluded from the resource estimates.<br>Pit shell optimization using Whittle software, carried out for the Pre-feasibility Study, confirms that the Mineral Resource at the Cowboy State Mine is amenable to open-pit mining at grades above the cut-off and that the resource sits at or near surface with a low strip ratio. The Pre-feasibility Study mine plan assumes a base-case processing rate of 4.5 Mtpa over 26 years of production, mining 116.4 Mt of ore and 18.7 Mt of waste at a life-of-Project strip ratio of 0.16:1. Indicated Mineral Resources only are scheduled as mill feed; Inferred material falling within the designed pits is scheduled as waste.<br>No selective mining unit was assumed within the Mineral Resource block model. For the Ore Reserve, the resource block model was regularized to 10 m by 10 m by 10 m blocks representing the selective mining unit for the anticipated equipment, minimum mining widths of 32.5 m per bench and 28 m at the pit bottom were adopted, and both internal and external mining dilution were assessed as negligible. (Sections 11.4 and 12.2.) |

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| *Bulk density* | *Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.* | Dry bulk density is based on hydrostatic testing of 10 core samples from Cowboy State Mine core, including both untreated and wax impregnated samples. A fixed specific gravity of 2.70 was adopted and applied as a constant value across all domains to derive tonnage; no domain-specific SG values were applied. |
| | *The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.*<br>*Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.* | Hydrostatic testing of untreated and wax-impregnated samples confirmed a narrow range of specific gravity values across the deposit, supporting the use of a single fixed SG of 2.70. The full Halleck Creek composite weighted average SG (untreated) was 2.70, based on the 10 core samples tested. |
| *Classification* | *The basis for the classification of the Mineral Resources into varying confidence categories.*<br>*Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).*<br>*Whether the result appropriately reflects the Competent Person's view of the deposit.* | The Mineral Resource is classified as either Indicated or Inferred; no Measured Mineral Resource is reported. Classification is based on geological continuity, as mineralization is controlled by batholith-scale fractionation rather than by structure, with a high degree of continuity confirmed by empirical observation, statistical analysis and variography, and on drill spacing, which is mostly irregular at approximately 200 m. Relative to the previous estimate, the Indicated limit was extended to the west to approximately 200 m below surface on the basis of the 2025 surface channel samples, the lateral limit of Inferred was extended west to take in all of the Red Mountain Pluton, and the vertical limit of Inferred was extended to 510 RL on the basis of additional drilling results. The Competent Person considers the classification strategy and methodology appropriate and reasonable for this style of mineralization. (Section 11.2.7.) |
| *Audits or reviews* | *The results of any audits or reviews of Mineral Resource estimates.* | No external audit or review of the Mineral Resource estimate is reported. The estimate was prepared by Odessa Resources and validated internally against inverse distance squared and nearest neighbor check estimates and against raw composite data in swath plots. The current estimate is reconciled against the February 2025 Scoping Study estimate, which shows the Cowboy State Mine tonnage increasing by approximately 4.5 Mt (1%) and the TREO grade decreasing by approximately 94 ppm (3%), with approximately 68.4 Mt reclassified from Inferred to Indicated following the 2025 channel sampling program. (Sections 11.2.5 and 11.7.) |
| *Discussion of relative* | *Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an* | Uncertainty associated with sampling, drilling, geological interpretation, data processing, density assignment, and resource estimation has been incorporated |

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| *accuracy/ confidence* | *approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.*<br>*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*<br>*These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.* | into the Mineral Resource classification. The Competent Person concluded that the quantity and quality of available geological, drilling, sampling, density, analytical, and estimation data are sufficient to support the reported Mineral Resource in accordance with the JORC Code (2012 Edition), and that the deposit retains potential for further expansion through additional drilling beyond the limits of the current resource model. (Sections 9.2 and 11.8.) |

| **Section 4 Estimation and Reporting of Ore Reserves** | | |
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| (Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Mineral Resource estimate for conversion to Ore Reserves* | *Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.*<br>*Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.* | The Ore Reserve is converted from the Indicated Mineral Resource within the Cowboy State Mine area, estimated by Odessa Resources and reported at a 1,000 ppm TREO cut-off with an effective date of November 2025. The Indicated Mineral Resource for the Cowboy State Mine area is 391.4 Mt at 3,295 ppm TREO. Ore Reserves are reported as a subset of, and are therefore included in, the Mineral Resource; they are not additional to it. Only Indicated Mineral Resources were converted to Ore Reserves. Inferred material falling inside the designed pit, 2.8 Mt above the cut-off grade, is treated as waste and contributes no Ore Reserve. (Sections 14.6 and 22.) |
| *Site visits* | *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* | Alfred Gillman (Odessa Resources) visited the site on 7 March 2024, including Red Mountain and the core storage facility at Western Research Institute (Wyoming Rare) in Laramie, Wyoming. Patrick Sobecke (Stantec) visited the site on 10 February 2025, accompanied by Erick Kennedy (Stantec) and Sara Stotter (ARR). |

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| | *If no site visits have been undertaken indicate why this is the case.* | Mark Travis (Arkenstone Exploration) visited the site on 12-13 May 2026. Kelton Smith (Tetra Tech) has visited the site on numerous occasions in 2024, 2025, and 2026. |
| *Study status* | *The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.*<br>*The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.* | The Project has been evaluated to Pre-feasibility Study level. This Report is a Pre-feasibility Study prepared by Stantec, which has determined a mine plan that is technically achievable and economically viable and has considered the material Modifying Factors. The capital and operating cost estimates carry a target accuracy of plus or minus 25%, consistent with a pre-feasibility level of study. A Probable Ore Reserve is reported on this basis, and the Report recommends further work to advance the Project to the feasibility stage. (Sections 2.1.1, 22 and 20.6.) |
| *Cut-off parameters* | *The basis of the cut-off grade(s) or quality parameters applied.* | The Ore Reserve is reported above a payable rare earth oxide (PREO) cut-off grade of approximately 875 ppm, calculated as the sum of mining cost, process cost and general and administrative cost, divided by the product of the PREO price less royalty and the recovery. The pit optimization inputs were a mining cost of US$5.38 per tonne, a process cost of US$28.28 per tonne, general and administrative costs of US$1.10 per tonne and a Wyoming State royalty of 2.50%. Material above the cut-off is sent to the process plant and material below it reports to the waste rock storage facility or is used as construction material. The Mineral Resource is separately reported above a 1,000 ppm TREO cut-off derived from Stantec net smelter return calculations. (Sections 14.5 and 22.2.6.) |
| *Mining factors or assumptions* | *The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design).*<br>*The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.*<br>*The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.* | The Cowboy State Mine deposit will be mined by open-pit methods using conventional truck-and-shovel extraction; the mine plan does not include underground mining. Pit optimization was carried out in Whittle and the life-of-mine schedule was developed in Deswik. The mine plan moves 135.0 Mt of total material, comprising 116.4 Mt of ore and 18.7 Mt of waste at a strip ratio of 0.16:1, feeding the plant at 4.5 Mtpa over 26 years of production following a three-year construction period. Mining recovery is taken as 100% and mining dilution as nil, because the geological interpretation treats nearly all material within the pit as mineralized and the waste adjacent to the reserve is itself above cut-off grade Inferred material. Minimum mining widths are 32.5 m per bench and 28 m at the pit bottom, set by shovel swing radius, truck turning circle and safety berm requirements. Overall slope angles range from 54 degrees at a 300 m slope height |

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| | *The major assumptions made and Mineral Resource model used for pit and stope optimization (if appropriate).*<br>*The mining dilution factors used.*<br>*The mining recovery factors used.*<br>*Any minimum mining widths used.*<br>*The manner in which Inferred Mineral Resources are utilized in mining studies and the sensitivity of the outcome to their inclusion.*<br>*The infrastructure requirements of the selected mining methods.* | to 45 degrees at 700 m, with a 50 degree inter-ramp angle applied in optimization; groundwater data was not available and was not incorporated in the geotechnical analysis. All ore in the schedule is drawn from the Indicated Mineral Resource; no Inferred material is scheduled as ore. (Sections 22.2 to 22.5 and 15.) |
| *Metallurgical factors or assumptions* | *The metallurgical process proposed and the appropriateness of that process to the style of mineralization.*<br>*Whether the metallurgical process is well-tested technology or novel in nature.*<br>*The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.*<br>*Any assumptions or allowances made for deleterious elements.* | Run-of-mine ore is crushed to 100% passing 300 micron through a jaw crusher, cone crusher and vertical roller mill at the mine site, then concentrated approximately ten times using gravity separation in a reflux classifier concentrator together with dry induced roll magnetic separation and wet high intensity magnetic separation on the minus 50 micron fines stream. Concentrate is trucked to a refinery proposed at Wheatland, Wyoming, for dilute sulfuric acid tank leaching, impurity removal through two neutralization stages and uranium ion exchange, bulk solvent extraction, and solvent extraction separation and finishing into separate oxide products. Recoveries by unit operation are 78% through gravity and magnetic separation, 85% through leaching, 98% through partial neutralization and 96% through separation and finishing for NdPr oxide and 98% for the other products. The recoveries applied in the economic model are 58.2% for NdPr oxide, 25.8% for SEG oxide, 28.7% for terbium oxide and 12.4% for dysprosium oxide, giving an overall recovery of 49.9% of contained payable rare earth oxide. The process uses conventional unit operations, but yield losses downstream of the leach are based on the Competent Person's rare earth processing experience rather than on completed test work, and the recoveries remain subject to confirmation by the pilot and demonstration plant program. (Sections 13.8 and 16.) |
| | *The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.* | A test pit of approximately 629 $m^2$ was excavated at the Cowboy State Mine in August 2025 under a License to Explore by Dozer permit from WDEQ-LQD, in two benches each approximately 4 m deep. Approximately 5,430 tonnes of weathered ore was excavated and stockpiled and approximately 3,080 tonnes of fresh ore was |

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| | *For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?* | excavated and crushed to minus 55 mm. Approximately 14.9 tonnes of fresh ore was bagged and shipped to FLSmidth, Loesche, DISA and COREM for comminution testing and downstream flowsheet work, approximately 72 tonnes was hauled to the Wyoming Rare warehouse in Laramie, and approximately 2,357 tonnes remained stockpiled on site. Seven stockpile samples averaged 4,590 ppm TREO and are considered representative of the Cowboy State Mine resource area at Red Mountain. No pilot plant has yet been operated; completion of the pilot and demonstration plant program, targeted for the end of 2026, is identified as the highest-priority metallurgical workstream. (Sections 11.8 and 26.8.) |
| *Environmental* | *The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterization and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.* | Baseline environmental studies have been underway across the proposed permit area since 2024 to support the permit-to-mine application, covering cultural resources, climatology, geology and waste characterization, groundwater and surface water hydrology, soils, vegetation, wildlife, wetlands and aquatic resources, and air quality, each carried out by named specialist contractors. A Class III Cultural Resource Inventory has been completed and the Wyoming State Historic Preservation Office issued a concurrence letter dated 31 July 2025. Wyoming Rare has not yet filed a mine permitting application and is working with WWC Engineering to compile it for WDEQ-LQD; an Industrial Siting Permit will be sought once the refinery site is selected. Three closure scenarios were evaluated, a best case assuming continued mining onto adjacent federal ground, an intermediate pit lake case and a worst case involving full pit regrading, and closure costs of US$55.9 million are carried in operating costs in the final year of the mine plan. Waste rock characterization and water management remain open items identified in the risk register. (Sections 15.6 and 19.) |
| *Infrastructure* | *The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labor, accommodation; or the ease with which the infrastructure can be provided, or accessed.* | Regional infrastructure is based out of the town of Wheatland (population 3,560), approximately 39 km from the Cowboy State Mine by Wyoming State Highway 34 and served by the BNSF Railroad mainline and Interstate 25. A 46 kV substation lies approximately 3.7 km from the western side of the state mineral leases. Power will be taken from the Wheatland Rural Electric Association grid, with a new mine site substation fed by a transmission line following Wyoming Highway 34 and Halleck Creek Road from an existing substation approximately 6 miles away, which requires upgrading; the association has confirmed the arrangement will be suitable by the time power is required. Planned infrastructure also covers access and |

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| | | haulage roads, natural gas supply, a pipeline, concentrate and tailings trucking, dewatering, water supply and the manufactured sand byproduct storage facility. American Rare Earths Limited has entered into a signed lease agreement under which up to 1,620 acre-feet of water per year to the Project. Under the current water-supply basis, water may be pumped from the period of 1 June to 15 September, subject to the terms and conditions of the agreement and applicable regulatory requirements. A conceptual monthly water balance has been developed for the project. It indicates an average annual make-up raw-water requirement of approximately 820 acre-feet per year. To manage the seasonal availability of the contracted water supply, a water-supply pond with an indicative capacity of approximately 550 acre-feet is currently proposed. Further engineering, hydrological and operational studies are required to confirm the required storage capacity and the timing and reliability of water availability. Hydrological and hydrogeological studies being undertaken by WWC Engineering are ongoing and will support further refinement of the Project water balance and water-supply design. The signed agreement provides a contractual basis for the Project's proposed water supply of up to 1,620 acre-feet per year; however, any additional permits, approvals, infrastructure, or water-related authorizations required to abstract, convey, store and use the water for the Project remain subject to confirmation as the project design and permitting program advance. No mining-related infrastructure has yet been constructed at the site. (Sections 4.5, 5.4 and 17.) |
| *Costs* | *The derivation of, or assumptions made, regarding projected capital costs in the study.*<br>*The methodology used to estimate operating costs.*<br>*Allowances made for the content of deleterious elements.*<br>*The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co-products.*<br>*The source of exchange rates used in the study.*<br>*Derivation of transportation charges.* | Initial capital expenditure is estimated at US$873.1 million, comprising direct capital of US$759.2 million and a 15% contingency of US$113.9 million. Of this, US$840.0 million is spent over the three-year construction period and US$33.0 million is expansion capital for staged development of the refinery waste disposal facility in 2034 and 2044, so total life-of-Project capital cost is US$873.1 million. Refinery processing capital of US$590.1 million is based on Tetra Tech's Class 4 estimate (Revision 3), comprising direct costs of US$536.5 million and indirect costs of 10% for detailed engineering, construction management and third-party QA/QC; Tetra Tech's own contingency allowance is not carried, and the Project contingency of 15% is applied instead. Closure costs of US$55.9 million, |

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| | | comprising US$30.9 million of mine closure and US$25.0 million of refinery waste disposal closure, carry no contingency and are included in operating costs in the final year of the mine plan rather than in capital. Life-of-Project operating cost is estimated at US$4,726.4 million undiscounted, equivalent to US$40.62 per tonne of ROM ore processed, of which downstream hydrometallurgical processing accounts for 51.2% and mining for 15.6%; reagents represent 45.6% of life-of-Project operating cost across all functional areas. Processing and refining operating costs were estimated by Tetra Tech on a unit cost per ROM tonne basis, totaling US$31.03 per tonne and 76.4% of life-of-Project operating cost; mining, material movement, refinery waste disposal and closure costs were estimated by Stantec (22.6%), and water supply costs were provided by ARR (1.0%). Canadian-based cost data in the Stantec mining estimate is converted at 1 USD to 1.38 CAD; this conversion applies only to that input data, and all revenues, capital costs, operating costs, royalties and taxes are denominated in US dollars, so no exchange rate risk is carried in the economic analysis. The estimate carries a target accuracy of plus or minus 25%. Sustaining capital for the mining fleet, including mobile equipment rebuilds and replacements, is included in the mining operating cost of US$5.47 per tonne of total material mined. No sustaining capital has been estimated for the processing and refinery facilities or site infrastructure beyond the staged refinery waste disposal expansion; this will be developed at the feasibility stage. (Section 20.) |
| | *The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. The allowances made for royalties payable, both Government and private.* | The Project is subject to a Wyoming State royalty applied on a sliding scale by product against factored revenue per short ton processed, at 5% below US$50 per ton, 7% from US$50 to US$100 per ton, 9% from US$100 to US$150 per ton and 10% above US$150 per ton, or US$0.50 per saleable short ton processed, whichever is greater. Under base case assumptions NdPr is levied at 7% and SEG, terbium and dysprosium at 5% in all production years. The Project also pays a 2% Wyoming severance tax and a 7% Albany County ad valorem tax, both on a netback basis, and a 0.875% industrial property tax on the net book value of infrastructure capital. Royalties and levies total US$927.9 million over the life of the Project, of which US$816.7 million is the Wyoming State royalty, and total royalties, levies and federal income tax are estimated at US$1,785.1 million. No treatment or refining charges or specification penalties are modeled, as the products are sold FOB. (Section 21.1.3.) |

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| *Revenue factors* | *The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.*<br>*The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.* | Four rare earth oxide products are modeled for revenue: NdPr oxide, terbium oxide, dysprosium oxide and SEG mixed oxide. Lanthanum carbonate is excluded from base case revenue given current market pricing conditions. Base case pricing is US$163.00 per kg for NdPr oxide, US$2,010.00 per kg for terbium oxide, US$552.50 per kg for dysprosium oxide and US$34.58 per kg for SEG oxide, applied on an FOB basis and held constant in real terms across the life of the Project. Pricing was derived from ARR's assessment of market expectations, drawing on forecasts from investment bank analysts and specialist rare earth market consultants, and is not based on spot prices at the date of the Report. Total life-of-Project revenue is US$12,103.0 million, of which NdPr oxide contributes 87.4%, terbium oxide 6.9%, dysprosium oxide 3.8% and SEG oxide 2.0%. Floor, downside and upside pricing scenarios are also defined, with NdPr oxide priced at US$110.00, US$131.80 and US$193.50 per kg respectively. No offtake agreements are currently in place, and no off-take discounts have been modeled. (Sections 18.5 and 21.3.1.) |
| *Market assessment* | *The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.*<br>*A customer and competitor analysis along with the identification of likely market windows for the product.*<br>*Price and volume forecasts and the basis for these forecasts.*<br>*For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.* | As of 2025, China was responsible for 67% of global mine production of magnet rare earths and over 89% of each subsequent step, making it the world's dominant producer of refined rare earth oxides, metals and alloys, magnetic alloys, and NdFeB permanent magnets. Demand for Nd, Pr, Tb, and Dy (the "magnet" rare earths) is driven principally by permanent magnets used in defense, electric vehicles, and consumer electronics. Adamas forecasts that global TREO demand will increase at a CAGR of 6.0% going forward, from 252,000 tonnes in 2025 to 607,000 tonnes in 2040, driven primarily by the permanent magnet sector. Over the same period, global demand for permanent magnets is forecast to grow at an 8.4% CAGR, while magnet rare earth production grows more slowly at 7.8% CAGR, implying a widening supply deficit. In all scenarios examined, Adamas projects that magnet rare earths will collectively drive over 77% of the Halleck Creek project basket value (i.e., value of rare earth oxides contained in one kilogram of separated TREO) each year from 2031 to 2040. In its base case scenario, Adamas forecasts the Halleck Creek TREO basket value will reach $66.37 per kilogram in 2031, before gradually declining to $54.58 per kilogram in 2036, then plateauing through 2040. No offtake agreements are currently in place. (Section 18.) |
| *Economic* | *The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these* | The economic evaluation is presented in constant Q1 2026 USD with no escalation, assuming an owner-operated open-pit mine and two-stage processing comprising |

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| | *economic inputs including estimated inflation, discount rate, etc.*<br>*NPV ranges and sensitivity to variations in the significant assumptions and inputs.* | mine site concentration and an off-site refinery, a 4.5 Mtpa base case processing rate, a three-year construction period from 2028 to 2030 and 26 production years from 2031 to 2056. A real after-tax discount rate of 8.0% is adopted for the base case, with 10.0% shown for comparison. The analysis applies the 21% U.S. federal corporate income tax rate, with no Wyoming state income tax, a 14% depletion allowance limited to 50% of taxable income, and MACRS depreciation. The base case returns an after-tax NPV of US$1,309.8 million at 8%, an after-tax NPV of US$965.6 million at 10%, an after-tax IRR of 23.94% and an after-tax payback period of 6.38 years from first capital expenditure. On a pre-tax basis the Project returns an NPV of US$1,579.5 million at 8%, an IRR of 25.93% and a payback period of 6.19 years. Peak funding requirement is US$840.0 million. Under the upside and downside price scenarios, the after-tax NPV at 8% is US$2,081.1 million (IRR 31.27%) and US$713.3 million (IRR 17.45%) respectively. Single-variable sensitivity analysis over minus 30% to plus 30% shows the Project is most sensitive to NdPr price and NdPr recovery, each giving an NPV spread of US$1,669.7 million and remaining positive at the minus 30% case with an IRR of 14.33%, followed by discount rate, processing operating cost and processing capital cost. (Section 21.) |
| *Social* | *The status of agreements with key stakeholders and matters leading to social license to operate.* | Stantec and Wyoming Rare completed an initial impact-based materiality assessment, guided by the Sustainability Accounting Standards Board standards for the Metals and Mining industry and the Global Reporting Initiative framework, engaging internal stakeholders responsible for project and corporate level risks. Key external stakeholders were identified, covering permitting engagement with state and federal agencies, indigenous relations, community engagement, adjacent landowners, and funding agency and investor engagement. Both parties concluded that full external stakeholder engagement was premature for the Project's current stage, and external outreach plans associated with permitting and community engagement are in development and expected to mature as the Project advances. ARR intends to engage and employ local contractors and operators throughout permitting, construction and operations wherever practical, supported by an established regional workforce. Wyoming Rare has developed working relationships with local surface owners and has secured long-term exploration access across the project area. No agreements with key stakeholders are reported as concluded. (Sections 4.8 and 19.5.) |

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| *Other* | *To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:*<br>*Any identified material naturally occurring risks.*<br>*The status of material legal agreements and marketing arrangements.*<br>*The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.* | A workshop level risk and opportunity register was prepared as part of the Pre-feasibility Study, covering geology, mining, processing, marketing, ESG and cost domains. The principal risks identified are grade variability or dilution exceeding modeled assumptions, adverse geotechnical outcomes requiring flatter slopes or additional dewatering, lower than modeled recoveries, sustained low rare earth prices or changes to Chinese export policy, tailings characterization or water management issues arising during permitting, inflationary pressure on reagent, energy and labor costs, and the absence of a sustaining capital estimate for the processing and refinery facilities and site infrastructure over the 26-year mine life (mining fleet sustaining capital is included in the mining operating cost). Commodity price risk is the dominant economic risk, as NdPr oxide accounts for 87.4% of life-of-Project revenue. The Project holds its mineral rights through four Wyoming State Mineral Leases and 365 unpatented federal lode claims in good standing, has received no violations or fines, and has not yet filed a mine permitting application; water rights have not been adjudicated and no offtake agreements are in place. The risks have not been probability-weighted, and a quantitative risk assessment is recommended at the feasibility stage. (Sections 4, 22.6 and 21.5.) |
| *Classification* | *The basis for the classification of the Ore Reserves into varying confidence categories.*<br>*Whether the result appropriately reflects the Competent Person's view of the deposit.*<br>*The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).* | The Ore Reserve is classified entirely as Probable; no Proved Ore Reserve is reported. The Probable Ore Reserve is 116.4 Mt at 1,257 ppm PREO, containing 146.3 Mkg of PREO, with contained grades of 958 ppm NdPr, 230 ppm SEG, 12 ppm Tb4O7 and 57 ppm Dy2O3. The classification follows directly from the Mineral Resource, in which no Measured Mineral Resource is reported, so no part of the Ore Reserve can be classified as Proved. The Competent Person for the Ore Reserve estimate is Patrick Sobecke of Stantec. (Section 22.5.) |
| *Audits or reviews* | *The results of any audits or reviews of Ore Reserve estimates.* | No external audit or review of the Ore Reserve estimate is reported. The estimate was prepared by Stantec and reviewed internally by the Competent Person, who has reviewed the risks, opportunities, conclusions and recommendations and is not aware of any unique conditions that would place the Ore Reserve at a higher level of risk than any other developing project. The Reserve pit designs were compared against the selected Whittle optimization shell as a check, which showed a 14% increase in waste material relative to the shell, reflecting the design and operational constraints that the optimization cannot model. (Sections 22.1 and 22.5.1.) |

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| *Discussion of relative accuracy/ confidence* | *Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.*<br>*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*<br>*Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage.*<br>*It is recognized that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available* | No statistical or geostatistical quantification of the relative accuracy of the Ore Reserve has been carried out. The estimate is global rather than local and carries the plus or minus 25% target accuracy of the underlying pre-feasibility level cost estimates. Confidence is supported by the conversion of Indicated Mineral Resources only, 100% mining recovery with nil dilution, and a mine plan returning a positive after-tax net present value in every single-variable downside case tested. Factors that may affect the estimate are unexpected variations in the quantity of mineralized material, grade or recovery, geotechnical conditions differing from those assumed, failure of plant, equipment or processes to operate as anticipated, and variations in project costs or metal prices. Groundwater data was not incorporated in the geotechnical analysis, no sustaining capital has been estimated for the processing and refinery facilities or site infrastructure over the 26-year mine life (mining fleet sustaining capital is included in the mining operating cost), and the metallurgical recoveries remain subject to pilot-scale confirmation. There are no production records against which to compare the estimate. A quantitative risk assessment is recommended at the feasibility stage. (Sections 22.6, 20.6, 21.4 and 21.5.) |

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# Halleck Creek Rare Earth Project- Cowboy State Mine- Pre-Feasibility Study

Stantec

Prepared for:
Wyoming Rare Inc - Cowboy State Mine

Date:
November 18, 2026

Prepared by:
Stantec Consulting Services Inc. and Others.

Project/File:
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Stantec Consulting Services Inc.

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# Acronyms / Abbreviations

| Acronym / Abbreviation | Full Name |
|---|---|
| AACE | AACE International (Association for the Advancement of Cost Engineering) cost-estimate classification system |
| AAL | American Assay Laboratories |
| ALS | ALS Global |
| AMSL | Above Mean Sea Level |
| ANFO | Ammonium Nitrate Fuel Oil |
| AQD | Air Quality Division |
| ARR | American Rare Earths Limited |
| ASX | Australian Securities Exchange |
| BEV | Battery Electric Vehicle |
| BHS | Biotite-Hornblende Quartz Syenite |
| BLM | Bureau of Land Management |
| BNSF | Burlington Northern Santa Fe Railroad |
| BS | Bachelor of Science |
| CAGR | Compound Annual Growth Rate |
| CALA | Canadian Association for Laboratory Accreditation |
| CIF | Cost, Insurance, Freight |
| CP | Competent Person as defined by JORC |
| CPG | Certified Professional Geologist |
| CQM | Clinopyroxene Quartz Monzonite |
| CRM | Certified Reference Material |
| CSM | Cowboy State Mine |
| CSTRs | Stirred Tank Reactor |
| DHDB | Drill hole database |
| EBITDA | Earnings Before Interest, Taxes, Depreciation, and Amortization |
| EDS | Energy Dispersive Spectroscopy |
| EG | Europium-Gadolinium |
| EMPA | Electron Probe Micro-Analysis |
| ERGB | Elmer's Rock Greenstone Belt |
| ERP | Emergency Response Plan |
| FAusIMM | Fellow of the Australasian Institute of Mining and Metallurgy |
| FM | Fayalite Monzonite |
| GPS | Global Positioning System |
| HPGR | High-Pressure Grinding Roll |
| HPSA | High-Pressure Slurry Ablation |
| HREE | Heavy Rare Earth Element(s) |
| HREO | Heavy Rare Earth Oxides |
| HV | Hybrid Vehicle |
| IA | Initial Assessment |
| ICP-MS | Inductively Coupled Plasma Mass Spectrometry |
| ICP-OES | Inductively Coupled Plasma Optical Emission Spectrometry |
| IEA | International Energy Agency |
| IRMS | Induced Roll Magnetic Separation/Separator |

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| Acronym / Abbreviation | Full Name |
|---|---|
| IRR | Internal Rate of Return |
| ISO | International Organization for Standardization |
| JORC | Joint Ore Reserves Committee (JORC Code, 2012 Edition) |
| LAC | Laramie Anorthosite Complex |
| LIMS | Laboratory Information Management System |
| LLC | Limited Liability Company |
| LLD | Liquid Line of Descent |
| LNG | Liquefied Natural Gas |
| LOM | Life of Mine |
| LREO | Light Rare Earth Oxides |
| MOU | Memorandum of Understanding |
| MRE | Mineral Resource Estimate |
| MREO | Magnet Rare Earth Oxides |
| NAD | North American Datum |
| NdPr | Neodymium-Praseodymium |
| NEPA | National Environmental Policy Act |
| NPV | Net Present Value |
| NRC | Nuclear Regulatory Commission (Agreement State Program) |
| NSR | Net Smelter Return |
| OEM | Original Equipment Manufacturer |
| OK | Ordinary kriging |
| ORP | Oxidation Reduction Potential |
| OTCQX | OTCQX Best Market (stock exchange tier) |
| PLC | Public Limited Company |
| PLS | Pregnant Leach Solution |
| PREO | Payable Rare Earth Oxide |
| PREO26 | Payable Rare Earth Oxide annual averaged over the Project's 26 prod. years |
| PFS | Pre-Feasibility Study |
| QA | Quality Assurance |
| QC | Quality Control |
| QP | Qualified Person as defined by SEC code |
| RC | Reverse Circulation drilling |
| REE | Rare Earth Elements |
| REM | Rare Earth Mineral |
| REO | Rare Earth Oxide(s) |
| RL | Reduced Level |
| RMG | Red Mountain Granite |
| RMP | Red Mountain Pluton |
| ROM | Run of Mine |
| RPEEE | Reasonable Prospects for Eventual Economic Extraction |
| RQD | Rock Quality Designation |
| SAG | Semi-Autogenous Grinding |
| SBS | Manufactured Sand Byproduct Storage |
| SEC | United States Securities and Exchange Commission |
| SEG | Samarium-Europium-Gadolinium mixed oxide |
| SEO | State Engineers Office |

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| Acronym / Abbreviation | Full Name |
|---|---|
| SFM | State Fire Marshall |
| SG | Specific Gravity |
| SGS | SGS Lakefield |
| SHPO | State Historic Preservation Office |
| SHWD | Solid and Hazardous Waste Division |
| SME-RM | Society for Mining, Metallurgy and Exploration – Registered Member |
| SMDF | Source Material Disposal Facility |
| SMU | Selective Mining Unit |
| SOP | Standard Operating Procedures |
| SX | Solvent Extraction |
| TIMA-X | TESCAN Integrated Mineralogical Analyzer |
| TREE | Total Rare Earth Elements |
| TREO | Total Rare Earth Oxide(s) |
| TRS | Technical Report Summary |
| USA | United States of America |
| USACE | US Army Corps of Engineers |
| USD | United States Dollars |
| USFWS | US Fish and Wildlife Service |
| USGS | United States Geological Survey |
| VRM | Vertical Roller Mill |
| WDEQ | Wyoming Department of Environmental Quality |
| WDEQ-LQD | Department of Environmental Quality – Land Quality Division |
| WGFD | Wyoming Game and Fish Department |
| WGS | World Geodetic System |
| WHIMS | Wet High-Intensity Magnetic Separation |
| WIM | World Industrial Minerals |
| WOSLI | Wyoming Office of State Lands and Investments |
| WOTUS | Waters of the United States |
| WQD | Water Quality Division |
| WRI | Wyoming Rare (USA) Inc |
| WRSF | Waste Rock Storage Facility |
| WSGS | Wyoming State Geological Survey |
| XRD | X-ray Diffraction |
| XRF | X-ray Fluorescence |

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# Cautionary Statement

The information in this report relating to exploration results is based on data compiled by a Competent Person who is a Member of The Australasian Institute of Mining and Metallurgy. The exploration results are preliminary in nature and are subject to further verification, sampling, and analysis. There is no certainty that further exploration will result in the determination of Mineral Resources or that any Mineral Resources, if identified, will be economically viable. Investors are cautioned not to place undue reliance on these results, as they may not be representative of the deposit as a whole.

# Forward Looking Disclaimer

This announcement contains forward-looking statements within the meaning of applicable securities laws and in accordance with the 2012 Edition of the JORC Code. Such statements include, but are not limited to, estimates of mineral resources and reserves, anticipated production schedules, projected exploration results, and potential economic outcomes. Forward-looking statements are based on current expectations, assumptions, and interpretations of available data, which are subject to known and unknown risks, uncertainties, and other factors that may cause actual results to differ materially from those expressed or implied.

Factors that could cause actual results to differ include changes in commodity prices, variations in geological conditions, operational challenges, regulatory changes, and other risks inherent to the mining industry. The Company undertakes no obligation to update or revise any forward-looking statements to reflect events or circumstances after the date of this announcement, except as required by law.

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# 1 Executive Summary

## 1.1 Project Overview and Ownership

The Halleck Creek Rare Earth Project (the Project) is an allanite-hosted rare earth element (REE) exploration and early-development project located in the central Laramie Range of Albany and Platte Counties, Wyoming, USA, approximately 43 miles (70 km) northeast of Laramie and near the town of Wheatland. The Project is held by Wyoming Rare (USA) Inc., the U.S. operating subsidiary of American Rare Earths Limited (ARR) (ASX: ARR; OTCQX: ARRNF). This Pre-Feasibility Study Technical Report Summary has been prepared in accordance with Regulation S-K 1300 and addresses the full Halleck Creek Project, comprising the Cowboy State Mine/Red Mountain area, adjacent Red Mountain Federal unpatented lode claims, and the Overton Mountain resource area located approximately 1.6 miles (2.5 km) to the north.

The Project comprises Wyoming State mineral leases and unpatented federal lode mining claims held by WRI, a wholly owned subsidiary of American Rare Earths Limited. American Rare Earths Limited acquired the state leases and initial federal claims from Zenith Mineral Limited in 2021 and has since staked additional federal lode claims across the Halleck Creek district. Land tenure status, claim maintenance, royalty terms, and encumbrances are described in Section4.

## 1.2 Geology and Mineralization

Halleck Creek is a magmatic, allanite-hosted REE deposit associated with the Red Mountain Pluton (RMP), a residual granitic body interpreted as a late-stage differentiate of the ca. 1.4 giga-annum (Ga) Laramie Anorthosite Complex (LAC). REE mineralization is hosted principally in allanite, with zircon as a secondary REE-bearing mineral, and is found primarily within three of the four intrusive rock units (fayalite monzonite, clinopyroxene quartz monzonite, biotite-hornblende quartz syenite, and Red Mountain granite). REE grades correlate with modal allanite and zircon abundance. The deposit is at or near surface across large areas of both the Red Mountain and Overton Mountain project areas and remains open at depth.

## 1.3 Exploration History

The Project area has a limited historical mining record; REE-enriched pegmatites in the broader Laramie Range were noted during 1950s Uranium prospecting but not developed. Modern exploration began with Blackfire Minerals (2010 to 2011) and Zenith Mineral Limited (2018 to 2021), followed by American Rare Earths Limited/Wyoming Rare (USA) Inc. from 2021 to date. Wyoming Rare (USA) Inc. has completed regional geological mapping, approximately 950 surface rock chip samples, a 2025 channel sampling program, and four drilling campaigns between 2022 and 2024, with an active 2026 drilling program underway as of the effective date of this Report.

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## 1.4 Mineral Resource Estimate

The full Halleck Creek Project Mineral Resource for this Report encompasses the Red Mountain area, including the Cowboy State Mine area, and Overton Mountain, and is reported at a 1,000-ppm Total Rare Earth Oxides (TREO) cut-off: approximately 2,627 million tonnes at an average grade of 3,292 ppm TREO, comprising Measured, Indicated, and Inferred.

## 1.5 Capital and Operating Cost Estimates

Total life-of-Project capital cost is estimated at US$873.1 million, comprising initial capital of US$840.0 million expended over the three-year construction period from 2028 to 2030 and expansion capital of US$33.0 million for the staged development of the refinery waste disposal facility in 2034 and 2044. Total capital consists of direct capital of US$759.2 million and a 15% contingency of US$113.9 million. Sustaining capital for the mining fleet, including mobile equipment rebuilds and replacements, is included in the mining operating cost. No sustaining capital has been estimated for the processing and refinery facilities or site infrastructure beyond the staged refinery waste disposal development at this stage of study.

Life-of-Project operating cost is estimated at US$4,726.4 million, equivalent to US$40.62 per tonne of ROM ore processed. Processing and refining costs prepared by Tetra Tech account for US$3,611.1 million, or 76.4% of total operating cost, and are driven by ROM tonnes processed at a rate of US$31.03 per tonne. Mining, material movement, refinery waste disposal and closure costs prepared by Stantec Consulting Services Inc (Stantec) account for US$1,069.0 million, or 22.6%, including closure costs of US$55.9 million incurred in the final year of the mine plan; mining is estimated as an all-in owner-operated cost of US$5.47 per tonne of total material mined, including mobile equipment rebuild and replacement costs. Water supply costs provided by ARR account for US$46.3 million, or 1.0%. Reagents are the single largest cost element at 45.6% of life-of-Project operating cost. Both estimates carry a target accuracy of ±25%, consistent with a pre-feasibility level of study and are expressed in constant Q1 2026 US dollars with no escalation applied.

## 1.6 Economic Results

The economic analysis is based on an owner-operated open pit mining operation processing 4.5 Mtpa of ROM ore over a 26-year mine life, with construction from 2028 to 2030, first ore production in 2031 and full-rate production from 2032. The mine plan schedules 116.4 Mt of ore at an average grade of 1,257 ppm PREO26 and 18.7 Mt of waste, at a life-of-Project strip ratio of 0.16:1. All material scheduled for processing is classified as Probable Mineral Reserve; no Inferred Mineral Resources are included in the production schedule. Key project parameters and economic results are summarized in Table 1-1.

Four rare earth oxide products are modelled for revenue: NdPr oxide, SEG oxide, Tb oxide and Dy oxide, with metallurgical recoveries of 58.2%, 25.8%, 28.7% and 12.4% respectively, giving an overall recovery of 49.9% of contained payable rare earth oxide. Life-of-Project production totals 73,024 tonnes of payable oxide. Base case prices of US$163.00/kg NdPr oxide, US$34.58/kg SEG oxide, US$2,010.00/kg terbium oxide and US$552.50/kg dysprosium oxide, based on Adamas Intelligence's 2031 to 2040 average Base Case price forecasts, are held constant in real terms over the life of the Project, generating total revenue of

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US$12,103.0 million. NdPr oxide contributes 87.4% of life-of-Project revenue and is the dominant value driver.

Royalties and production levies total US$927.9 million and federal corporate income tax totals US$857.3 million, giving total royalties, levies and taxes of US$1,785.1 million. At an 8% real after-tax discount rate, the Project generates an after-tax net present value of US$1,309.8 million, an after-tax internal rate of return of 23.94%, and an after-tax payback period of 6.38 years from first capital expenditure. On a pre-tax basis, net present value is US$1,579.5 million, internal rate of return is 25.93% and payback is 6.19 years.

Sensitivity analysis indicates that Project value is driven principally by NdPr price and NdPr recovery, each producing an after-tax NPV range of US$1,669.7 million across a ±30% variation, followed by the discount rate and the operating and capital intensity of the downstream processing plant. The Project returns a positive after-tax net present value in every single-variable downside case tested.

The base case excludes working capital, corporate overhead, contingency on closure costs and sustaining capital for the processing and refinery facilities and site infrastructure, and applies product prices without deduction for freight, insurance or offtake discounts (Section 21.3.7).

*Table 1-1: Summary of Key Project Parameters and Economic Results*

| **Parameter** | **Unit** | **Value** |
|---|---|---|
| Mine Life | Years | 26 |
| Processing Rate | Mtpa ROM | 4.5 |
| Ore mined | Mt | 116.4 |
| Waste mined | Mt | 18.7 |
| Strip Ratio | t:t | 0.16 |
| Average Feed Grade | ppm PREO26 | 1,257 |
| Payable Oxide Production | t | 73,024 |
| Initial Capital Cost (2028-2030) | USD M | 840.0 |
| Expansion Capital (2034, 2044) | USD M | 33.0 |
| Total Capital Cost | USD M | 873.1 |
| Total Operating Cost | USD M | 4,726.4 |
| Unit Operating Cost | USD / t ROM | 40.62 |
| Total Revenue | USD M | 12,103.0 |
| EBITDA | USD M | 6,448.7 |
| Royalties and Levies | USD M | 927.9 |
| Federal Income Tax | USD M | 857.3 |
| After-Tax Free Cash Flow | USD M | 4,718.4 |
| After-Tax NPV @ 8% | USD M | 1,309.8 |

| Parameter | Unit | Value |
|---|---|---|
| After-Tax IRR | % | 23.9 |
| After-Tax payback | Years | 6.4 |

## 1.7 Qualified Person's Conclusions and Recommendations

The Halleck Creek Cowboy State Mine Project has advanced to the Pre-Feasibility Study stage through continued geological evaluation, Mineral Resource estimation, metallurgical testwork, and engineering studies. The Project is characterized by extensive, near-surface, allanite-hosted rare earth element mineralization within the Red Mountain pluton of the Laramie Anorthosite Complex. The geological continuity, scale of mineralization, and supporting exploration databases provide the foundation for the Mineral Resource estimates and subsequent mine planning evaluations presented in this report.

The PFS incorporates an updated Mineral Resource model, preliminary mine designs, metallurgical recovery assumptions, process engineering, infrastructure requirements, and capital and operating cost estimates. The study evaluates a conventional open-pit mining operation with a nominal processing capacity of 4.5 million tonnes per annum over a 26-year operating period. The resulting technical and economic evaluations provide a basis for assessing the Project's advancement toward feasibility-level development.

Metallurgical investigations have demonstrated the potential for beneficiation and hydrometallurgical recovery of rare earth elements from the allanite-bearing mineralization. Additional metallurgical testing, including confirmation of the proposed process flowsheet, recovery performance, and variability across the planned mining inventory, remains an important component of subsequent engineering work.

The Qualified Persons recommend continued advancement of geological, metallurgical, geotechnical, environmental, and engineering investigations to progressively reduce remaining uncertainties. Principal priorities include further validation of geological and resource assumptions, metallurgical and process optimization, refinement of mine designs and operating parameters, confirmation of infrastructure and water requirements, and continued permitting and environmental baseline activities.

Collectively, the technical investigations and engineering evaluations completed to date provide a foundation for continued Project development. Further feasibility-level studies will be required to refine the technical and economic assumptions, confirm applicable modifying factors, and support subsequent development and investment decisions.

# 2 Introduction

American Rare Earths Limited (ARR), through its wholly owned US subsidiary, Wyoming Rare (USA) Inc. (WRI) is a mineral exploration company specializing in exploring and developing rare earth elements. WRI, a mineral exploration company specializing in exploring and developing rare earth elements, has engaged Stantec Consulting Services Inc. (Stantec), a global consulting firm with extensive experience in the mining

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industry, to conduct a pre-feasibility study for the Cowboy State Mine Project on a portion of the Halleck Creek Rare Earth Deposit located in Wyoming. The study was carried out according to the standards set by the United States Securities and Exchange Commission (SEC) Regulation SK-1300 and the Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code or JORC) with technical and estimating accuracy within the SEC standard of +/-20%. Cowboy State Mine Project is in the Central Laramie Mountains in Albany County and Platte County, Wyoming. It is approximately 70 km northeast of Laramie and 39 km southwest of Wheatland, Wyoming.

## 2.1 Terms of Reference

### 2.1.1 Report Purpose

This technical report aims to provide WRI, its investors, and potential investors with a clear understanding of the Project based on existing data and development of the Project at a Pre-Feasibility level with recommendations for further work to advance the Project into the feasibility stage.

### 2.1.2 Terms of Reference

All measurements herein will be given in Metric system units (meters, metric tons, degrees centigrade, etc.) except where they are designated as Imperial units. All currency values are in United States Dollars except where specified otherwise.

## 2.2 Qualified Persons

This Report has been prepared under the supervision of, or reviewed and accepted by, the Qualified Persons (QPs) listed in Table 2-1 as defined under SEC Code.

*Table 2-1: Competent Persons*

| Qualified Persons | Credentials | Organization | Report Responsibility |
|---|---|---|---|
| Alfred J. Gillman | BSc (Geol)<br>FAusIMM (CP Geol) | Odessa Resources Pty. Ltd. (Independent) | Mineral Resource Estimates (Section 14). |
| Mark W. Travis | BS (Geology)<br>CPG CPG-12090, d/b/a | Arkenstone Exploration. (Independent) | Sections 4 through 12 of the Report, covering Property Description; Accessibility, Climate, Local Resources, Infrastructure and Physiography; History; Geological Setting and Mineralization; Deposit Type; Exploration; Drilling; and Sample Preparation, Analyses, and Security, including QA/QC & Data Verification, together with those portions of Section 1 (Executive Summary), |

| Qualified Persons | Credentials | Organization | Report Responsibility |
|---|---|---|---|
| | | | Section 25 (Interpretation and Conclusions), and Section 26 (Recommendations) that relate to Sections 4 through 12 |
| Patrick A. Sobecke | PE, RM-SME | Stantec Consulting Services Inc. (Independent) | Section 1-3; Mining Methods (15); Environmental (19); Capital and Operating Costs for mining, benign refinery waste disposal and closure (20); Economic Analysis (21); Mineral (Ore) Reserves (22); Adjacent Properties (23); relevant portions of Sections 25-27. |
| Kelton Smith | RM-SME | Tetra Tech, Inc. (Independent) | Mineral Processing (13); Process and Recovery (16); Infrastructure (17); processing and infrastructure capital costs and processing and refining operating costs (20); relevant portions of Sections 1, 25 and 26. |
| Darren L. Smith | M.Sc., P.Geo | Mentor & Senior Technical Advisor, Rare Earths and Niobium Dahrouge Geological Consulting Ltd. | Market Studies (18) |

## 2.3 Site Visits and Scope of Personal Inspection

The following site visits have been conducted by the QP responsible for sections of this Report:

- Alfred J. Gillman (Odessa Resources): Site visit 07 March 2024 with ARR personnel. Included Inspection of Red Mountain and core storage facility at Western Research Institute (Wyoming Rare) in Laramie, Wyoming.
- Patrick A. Sobecke (Stantec): Site visit 10 February 2025, accompanied by Erick Kennedy (Senior Mining Engineer, Stantec) and Sara Stotter (geologist, ARR). Included Red Mountain and core storage at Wyoming Rare.
- Mark W. Travis, CPG-12090, d/b/a Arkenstone Exploration: Site visit May 12 and 13, 2026, with WRI personnel. Included Red Mountain and related site facilities.
- Kelton Smith (Tetra Tech): Has visited the site on numerous occasions in 2024, 2025, and 2026.

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## 2.4 Report Date

November 18, 2026

## 2.5 Information Sources and References

In preparing this Report, the QP relied on the following categories of information.

- Technical information, reports, and databases prepared by WRI and ARR geologic staff, including drill hole databases, sampling logs, geological mapping, and standard operating procedures.
- ASX releases and technical reports previously published for the Halleck Creek and Cowboy State Mine (CSM) project areas.
- Publicly available information from the Wyoming State Geological Survey (WSGS) and United States Geological Survey (USGS).
- Academic and technical papers including Anderson et al. (2003) and associated Laramie Anorthosite Complex (LAC) literature.
- Reports from specialist consultants including Stantec (mining engineering and economics), Tetra Tech (metallurgy and processing), Odessa Resources (resource estimation), Geosyntec (environmental and channel sampling), WWC Engineering (hydrology and permitting), and Burgex Inc. (claim management).

## 2.6 Previous Technical Report Summaries

- JORC Technical Report Summary – Scoping Study, Halleck Creek Rare Earth Project, American Rare Earths Project, September 2026.
- SK 1300 Technical Report Summary – Initial Assessment, Halleck Creek Rate Earth Project, American Rare Earths Project, September 2026.
- Halleck Creek Updated Scoping Study Technical Report, Halleck Creek Rare Earths, American Rare Earths, February 2025.
- The following technical reports have been publicly released by ARR under ASX disclosure obligations (JORC Code 2012) and constitute the body of existing technical work upon which the previous Scoping Study drew upon.
- Technical Report of Exploration and Maiden Resource Estimates, Halleck Creek Rare Earths Project, American Rare Earths, March 2023.
- Technical Report of Exploration and Updated Resource Estimates, Halleck Creek Rare Earths Project, American Rare Earths, January 2024.
- Halleck Creek Updated Scoping Study Technical Report (Revision 3), Stantec Consulting Services Inc., 28 February 2025.
- Halleck Creek REE Project, Red Mountain Update Report — Methodology and Resource Estimation, Odessa Resources Pty. Ltd. (Alfred Gillman), 1 November 2025.

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# 3 Reliance on Other Specialists

In preparing this Report, the QPs have relied on certain information provided by the ARR or by specialist experts who are not QPs under SEC/JORC.

## 3.1 Reliance on Legal Experts

The QPs have relied on information and representations provided by ARR and WRI, together with legal information prepared or reviewed by the Company's legal counsel and other authorized representatives, regarding matters outside the QPs' areas of expertise. Such matters include but are not limited to the following.

- Ownership of mineral rights, Wyoming State Mineral Leases, federal unpatented lode mining claims, and related property interests.
- Validity of title, claim maintenance, lease status, royalties, encumbrances, agreements, and other legal interests affecting the Project.
- Corporate ownership, contractual arrangements, and other legal matters relevant to the Project.
- Applicable federal, state, and local legal and regulatory requirements not requiring independent technical evaluation by the QPs.

The QPs have not independently verified the legal opinions, title status, contractual rights, or other legal matters described above and have relied upon the information and representations provided by the Company and its legal advisors for purposes of this Pre-Feasibility Study.

## 3.2 Reliance on Environmental Experts

Environmental studies, baseline data collection, and permitting activities are being conducted by specialist environmental consultants under ARR/WRI direction. The QPs have relied on information provided by ARR and its environmental and permitting consultants regarding environmental baseline studies, permitting status, regulatory requirements, and environmental compliance.

- Environmental baseline data (hydrology, hydrogeology, water quality, air quality, wildlife) has been collected by WWC Engineering (Sheridan, Wyoming) and other contractors. The QPs have not independently verified this data.
- The mine permitting application under WDEQ-LQD jurisdiction has not been filed as of the effective date. ARR has represented that baseline studies commenced in 2024 and remain in progress.
- An Industrial Siting Permit application through WDEQ-ISD will be required for the refinery site once selected. No application has been filed.
- Project mineralization contains naturally occurring Uranium and Thorium at concentrations that may require evaluation under applicable source-material regulations as project design advances. The applicability and timing of any source-material licensing requirements will depend on the concentrations, quantities, processing methods, and disposition of Uranium- and Thorium-bearing materials generated by the proposed operation.

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Based on the current Project configuration, the principal mine permitting pathway is anticipated to be through Wyoming state agencies. The extent to which review under NEPA may be required will depend on whether Project development requires federal permits, approvals, authorizations, funding, or other federal actions.

## 3.3 Reliance on Land Tenure and Claim Management Experts

ARR has contracted with Burgex, Inc. (Salt Lake City, Utah) to monitor and manage WRI's federal lode claims and Wyoming State Mineral Leases. The QPs have relied on representations from ARR management and Burgex regarding the current standing and annual maintenance status of the 364 unpatented lode claims and four State Mineral Leases. The QPs have not independently reviewed BLM or Wyoming Office of State Lands and Investments (WOSLI) records to confirm claim status.

The mineral rights within the CSM area (Wyoming State Mineral Leases) are administered through WOSLI. The surface rights within the CSM area also belong to the State of Wyoming and are administered through WOSLI. The QPs have relied on ARR's representations regarding the terms and conditions of these leases.

## 3.4 Reliance on Economic and Market Information

The economic analysis presented in this PFS is based on the technical and economic assumptions described in this Report. The following information was provided by Adamas Intelligence's independent report and relied upon by the QPs.

- Commodity pricing projections for NdPr oxide, Dy oxide, and Tb oxide were prepared through Adamas Intelligences' assessment of market expectations, price forecasts from investment bank analysts, and specialist rare earth market consultants. Pricing for SEG oxide was determined by ARR drawing on Adamas Intelligence’s forecasts. SEG oxide is assumed to be sold at 73% of the separated-oxide basket value. This reflects the product’s advanced stage of processing relative to mixed concentrates and the short separation circuit remaining for the buyer.
- No binding off-take agreements are in place as of the effective date.

## 3.5 Reliance on Geotechnical and Hydrogeological Data

Geotechnical testing was conducted by WSP (Burnaby, British Columbia) on 49 core samples from the Fall 2024 drilling program. QPs relied on WSP test results for geotechnical characterization used in pit slope design. Stantec evaluated the data for pit design in the PFS.

Geotechnical testing was conducted by Tetra Tech on 5 borings around the proposed mine site manufactured sand byproduct storage facility at the mine site, 6 borings at the mine site corresponding to proposed process and admin buildings, and 6 borings at the proposed refinery site in Wheatland. Drilling was conducted in March 2026.

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Hydrological and hydrogeological studies are being conducted by WWC Engineering (Sheridan, Wyoming). This work is ongoing as of the effective date. Water supply has been secured. The QPs relied on ARR's representations regarding the status of these studies.

## 3.6 Competent Person Responsibility Notwithstanding Reliance

Notwithstanding the reliance disclosed in Sections 3.1 through 3.5, the QPs retain responsibility for the sections of this Report that fall within their respective areas of expertise and for the overall technical conclusions of the Report. Reliance on information provided by the Company or by specialist experts who are not QPs is limited to the specific matters identified above and does not extend to matters within the QPs' own areas of expertise. Each QP has exercised professional judgment in evaluating the reasonableness of the information relied upon before incorporating it into this Report.

## 3.7 Reliance on Information Provided by the Company

In preparing this PFS, the QPs have relied upon information provided by American Rare Earths Limited and its U.S. operating subsidiary, Wyoming Rare (collectively, the Company), where such information is outside the QPs' areas of technical expertise or is not reasonably capable of independent verification, consistent with SEC/JORC code. This information was provided through technical submissions, corporate records, supporting documentation, and communications with Company personnel. The QPs have no reason to believe that the information relied upon is inaccurate or misleading.

The QPs have relied upon the Company with respect to certain non-technical matters, including land tenure and mineral title; surface rights and property access; water rights and related permitting activities; royalties, encumbrances, and other property interests; permitting and regulatory status; legal matters affecting the Project; applicable taxation regimes and tax incentives incorporated into the economic analysis; corporate ownership and organizational structure; commercial arrangements, including the existence or absence of off-take agreements and hedging arrangements; and commodity price assumptions.

The QPs have not independently verified the legal, corporate, commercial, taxation, permitting, or other non-technical information described above and express no opinion on matters of law, corporate governance, taxation, or the Company’s commercial affairs. Responsibility for such information remains with the Company. Where reliance on Company-supplied information materially affects the conclusions presented in this PFS, that reliance is identified in the relevant Section.

# 4 Property Description

## 4.1 Property Location

The Project site is situated in the Central Laramie Mountains, approximately 70 km northeast of Laramie and approximately 39 km southwest of Wheatland, Wyoming.  The Project falls within Albany County and Platte County in Southeastern Wyoming, USA, as Figure 4-1**.**

indicates. The region is sparsely populated, and the landscape is characterized by short grass and sparse sagebrush. The Project area's elevations range from 1,900 meters above sea level (masl) on the plains to over 2,135 m on Red Mountain and Overton Mountain, providing diverse topography.

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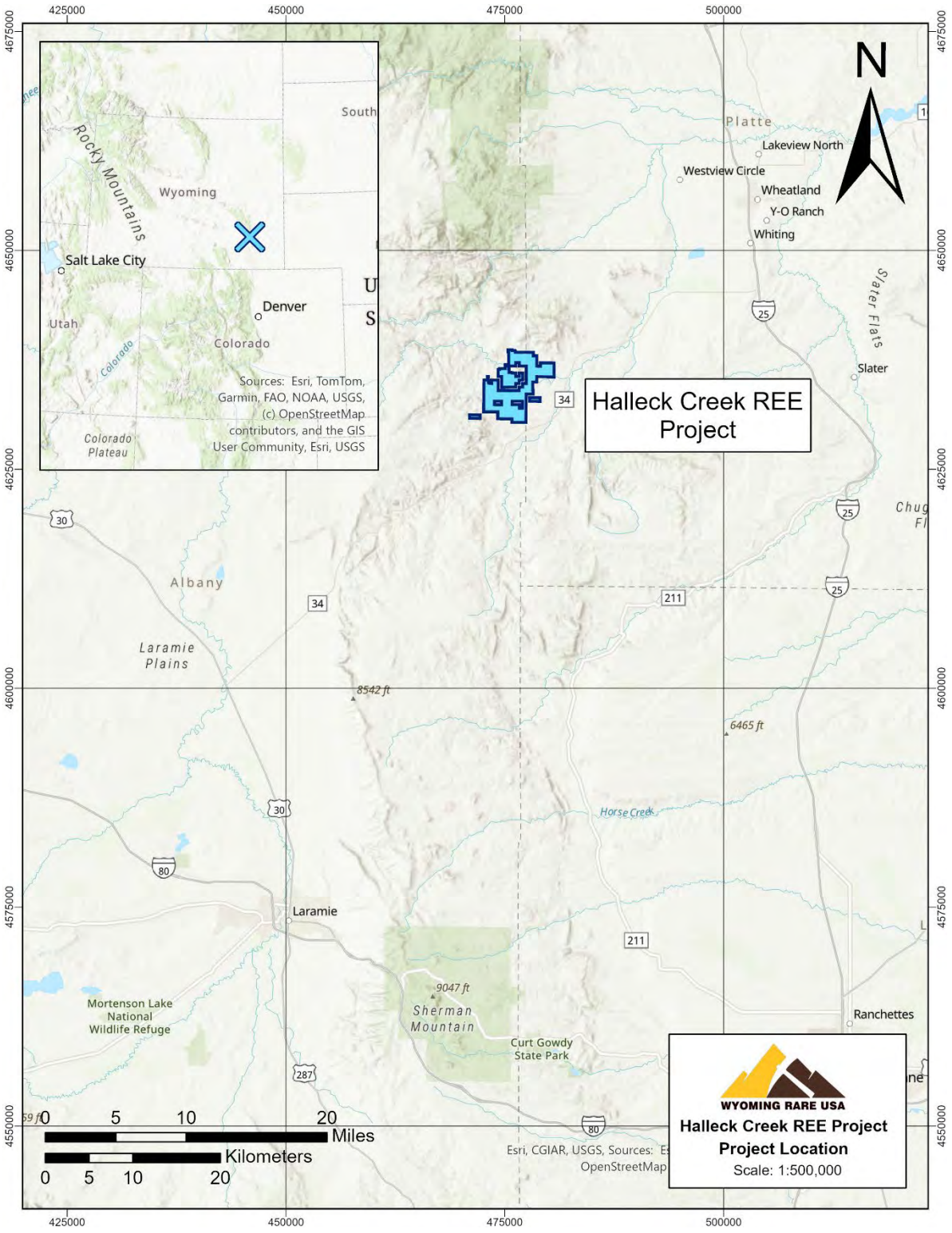


*Figure 4-1: Location Map of Cowboy State Mine REE*

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## 4.2 Ownership

The Project is indirectly 100% held by ARR through Wyoming Rare (USA) Inc., a wholly owned subsidiary of ARR. WRI holds all mineral tenements, surface easements, and contractual arrangements described in this Section.

## 4.3 Mineral Title

The Wyoming Office of State Lands and Investments assigned WRI four Wyoming state mining leases in June 2021. WRI controls 365 unpatented federal lode claims at Cowboy State Mine. Since the acquisition in 2021, WRI has expanded the land package to 7,831 acres (3,169 ha) across the Cowboy State Mine Project area.

### 4.3.1 Unpatented Lode Claims

Cowboy State Mine is comprised of 365 unpatented lode mining claims totaling 6,271 acres (2,538 ha) shown in Figure 4-2.

- Township 22 North, Range 71 West (Albany County): Sections 12, 13, 23, 24, 25, 26, 35
- Township 22 North, Range 70 West (Albany County): Sections 07, 08, 17, 18, 19, 20, 29, 30, 31
- Township 21 North, Range 70 West (Albany County): Section 06
- Township 22 North, Range 70 West (Platte County): Sections 08, 17, 20, 29
- Annual maintenance fees must be paid prior to renewal dates to maintain claims in good standing. Claim monitoring and management is performed by Burgex, Inc. (Salt Lake City, Utah) under contract to Wyoming Rare (USA) Inc.

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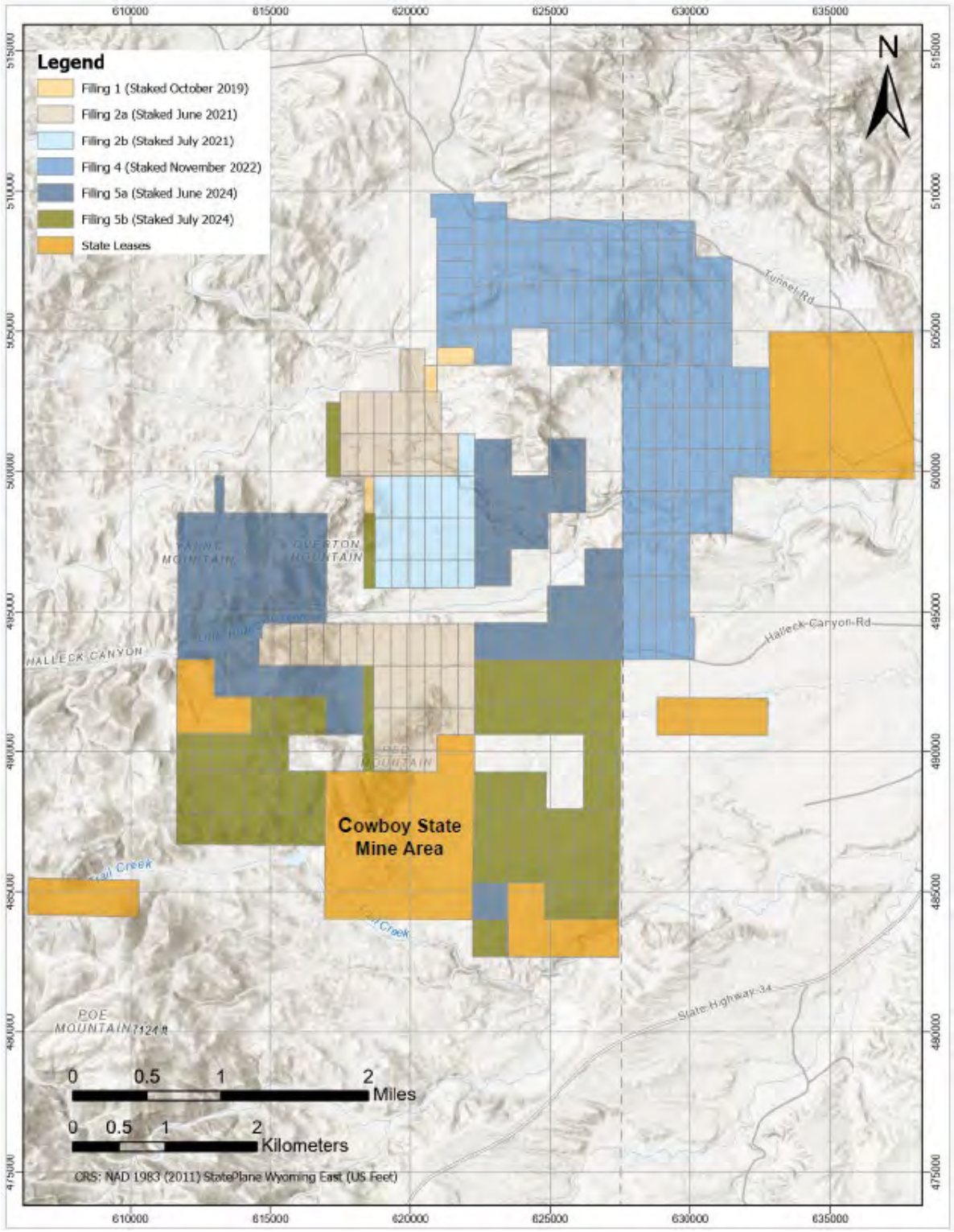


*Figure 4-2: State Mineral Leases and Unpatented Federal Lode Claims*

### 4.3.2 Wyoming State Mineral Leases

WRI controls four Wyoming State Mineral Leases totaling 1,560 acres (631 ha) which are in Township 22 North, Range 70 West Sections 16, 29, 31, Township 21 North, Range 70 West Section 06, Township 22 North, Range 71 West Sections 25, 26, 34, 36 (Figure 4-3). These leases were assigned to WRI in June 2021.

The mineral rights within the CSM area belong to the state of Wyoming and are administered through the Wyoming Office of State Lands and Investments.

The State Mineral Leases constitute the core of the CSM project area, which is the principal mineralized area addressed in this Report. Annual lease fees must be paid prior to renewal dates to maintain leases in good standing.

## 4.4 Surface Rights

### 4.4.1 Wyoming State Leases

The surface lands within the Halleck Creek Mineral Control vary between state, privately owned, and federal land administered by the Bureau of Land Management (BLM) (Figure 4-3). The surface rights within the CSM Project area belong only to the state of Wyoming and are administered through the Wyoming Office of State Lands and Investments.

### 4.4.2 CSM Private Surface

WRI obtained a memorandum of understanding (MOU) from the surface landowner of four (4) 40-acre tracts of private land adjacent to the Wyoming mineral leases. The MOU provides WRI the exclusive opportunity to acquire the tracts for future development of mine facilities and mineral processing facilities.

WRI also holds a site access easement from the same property owner to access the CSM project area via Halleck Canyon Road (County Road 720). The distribution of State, BLM, and private surface parcels within the Project area is shown in Figure 4-3.

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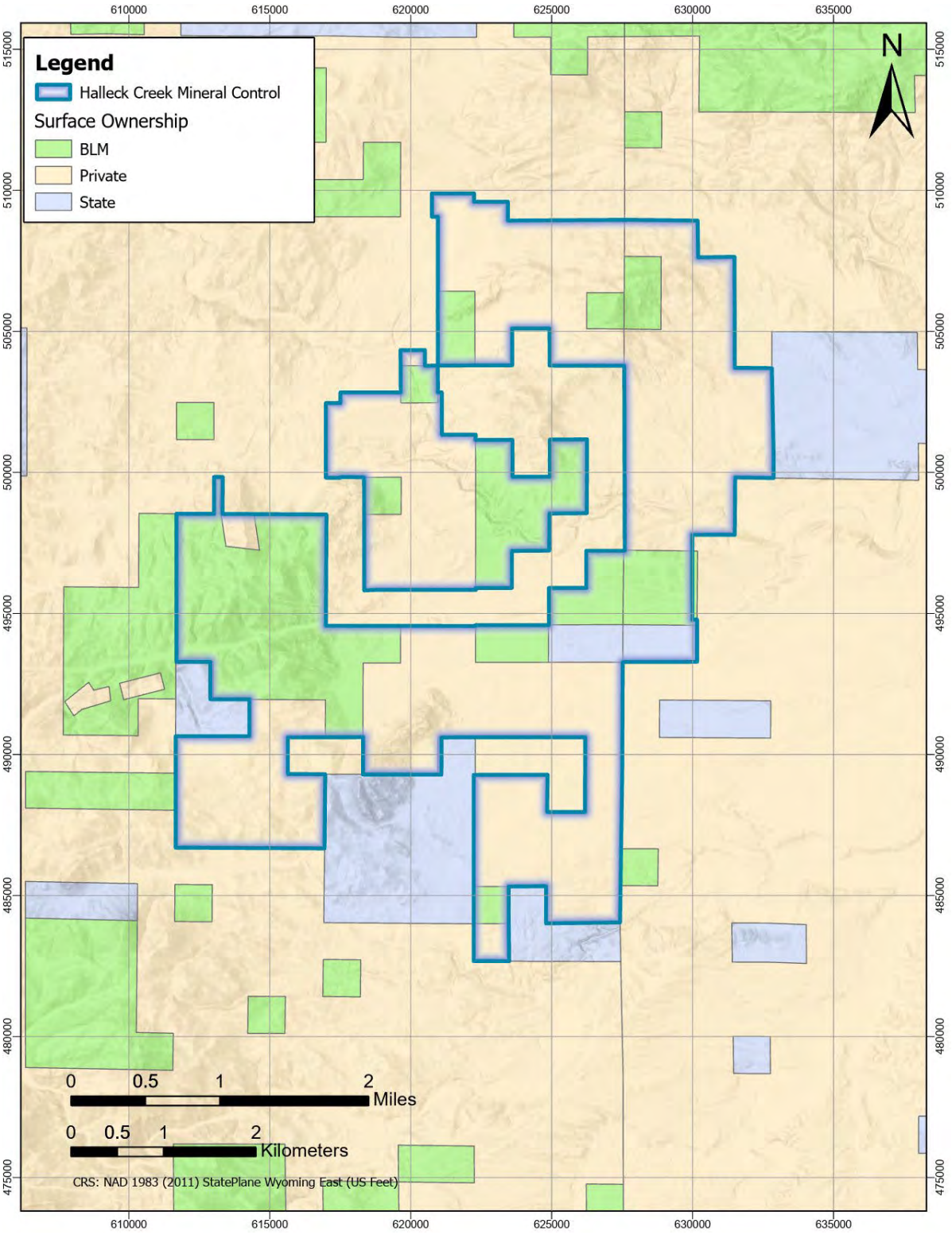


*Figure 4-3: Surface Control*

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### 4.4.3 Refinery Site Surface

WRI is evaluating multiple locations for the location of a rare earths refining plant for the Project.

The first location resides north of the town of Wheatland, Wyoming adjacent to the Laramie River Power Station. WRI obtained a memorandum of understanding (MOU) with Basin Electric to evaluate the economic, environmental, and technical merits of a 257-acre tract.

WRI obtained a memorandum of understanding (MOU) from Pete Lien and Sons to evaluate the economic environmental and technical merits of a 253-acre tract. This tract resides north of the city of Laramie, Wyoming about 2 miles west of a limestone processing plant owned by Pete Lien and Sons.

## 4.5 Water Supply

The mine and associated processing facilities need water obtained from regional surface and/or groundwater resources, each of which require adjudication through the Wyoming State Engineer's Office and agreements from existing water rights holders or landowners.

Section 17 states that approximately 820 acre-ft of water will be needed annually to supply the mine and mineral processing facilities. The rare earth refinery is estimated to need approximately 29 acre-ft of water annually.

WRI obtained an agreement from a local water supplier to supply water to the CSM mine site for an initial period of 10 years.

## 4.6 Royalties

The PFS identified the following royalties applicable to the Project.

- Unless specifically rate is prescribed by a state official, a sliding scale royalty between 5% and 10% on revenue payable to the State of Wyoming is used on production of other/unspecified minerals from the Wyoming State Mineral Leases. The point of valuation is currently under review with the WOSLI. An explanation of the royalty rate calculation used in this project's valuation is given in Section 21.1.1.
- Wyoming State severance tax on mineral production.
- Albany County ad valorem property tax.
- Industrial property tax (as applicable).

Stantec is unaware of any royalty interests on the Project properties exceeding 5% of gross revenue, payable to the State of Wyoming.

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## 4.7 Encumbrances

### 4.7.1 Permitting Requirements

WRI has not filed a mine permitting application with the Department of Environmental Quality – Land Quality Division (WDEQ-LQD) for the State of Wyoming. Since 2024, WRI has been collecting baseline environmental data to prepare a permit to mine application. WRI enlisted the services of WWC Engineering, in Sheridan, Wyoming, to compile the permit to mine application for the CSM. Details pertaining to the mine permit application are described in Section 18.

Once a rare earth refinery site has been selected, WRI will commence the process of obtaining an Industrial Siting Permit through the Department of Environmental Quality – Industrial Siting Division.

WRI obtained a License to Explore by Dozer permit to collect bulk samples at the CSM from WDEQ-LQD. WRI collected approximately 3,080 tonnes of unweathered ore in August 2025.

WRI also has an active exploration drilling permit (drilling notice) DN-0511 from WDEQ-LQD to exploration drilling at the CSM.

### 4.7.2 Violations and Fines

Stantec is unaware of any violations or fines which WRI has received from the State of Wyoming or the Federal government.

## 4.8 Significant Factors and Risks that may Affect Access, Title, or Work Programs

WRI closely monitors lease and claim control across the entire Cowboy State Mine Project area. WRI contracted with Burgex, Inc. in Salt Lake City, UT, to monitor and manage WRI's federal lode claims and state mineral leases. If annual maintenance fees and lease fees are paid prior to annual renewal dates, then the claims and leases remain in good standing.

WRI has developed good working relationships with local surface owners and have secured long-term exploration access across the project area. WRI is working with these people to secure additional access agreements for the duration of the Project.

WRI is partnering with well-established consulting firms to compile a permit to mine document for the project.

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# 5 Accessibility, Climate, Local Resources, Infrastructure and Physiography

## 5.1 Physiography

The Project is located at the edge of the high plains of Wyoming characterized by short grass, sparse sagebrush, and pine trees. Elevations range from approximately 6,230 ft (1,900 m) AMSL on the rolling plains to over 7,000 ft (2,135 m) AMSL at the summits of Overton Mountain and Red Mountain. The region is sparsely populated.

## 5.2 Accessibility

The Cowboy State Mine Project is approximately 70 km northeast of Laramie, and 39 km southwest of Wheatland, Wyoming. Road access from Wheatland is via Wyoming State Highway 34, traveling southwest for approximately 18 miles (29 km), followed by an additional 6 miles (10 km) west on County-maintained gravel road number 720 (Halleck Canyon Road). WRI holds a site access easement with the private landowner to access the CSM project area from Halleck Canyon Road.

Wheatland is serviced by Interstate Highway 25, linking the city to the broader United States transportation network. The Burlington Northern Santa Fe (BNSF) railroad mainline runs through Wheatland, providing rail connectivity for future concentrate and product transport. Laramie is accessible via Interstate Highway 80. The Union Pacific railroad runs through Laramie, providing rail connectivity for that area.

## 5.3 Climate

The climate is semi-arid and continental. The region experiences the following four seasons and is drier and windier in comparison to most of the United States, with greater temperature extremes.

- Summer: Warm and dry; July highs averaging 84 °F (29 °C) to 95 °F (35 °C).
- Winter: Cold and moderately snowy; temperatures ranging from approximately 5 °F (-15 °C) to 36 °F (+2 °C); annual precipitation averaging about 15 inches (381 mm), mostly as snow.
- Spring: Variably mild to very snowy; conditions can be unpredictable.
- Autumn: The mildest season, with little moisture and generally warm days.

The semi-arid climate is relevant to the water supply assessment (Section17.12 17.11). Exploration and drilling activities have been conducted year-round, with seasonal access constraints during severe winter conditions. Mining operations are expected to be conducted year-round with appropriate equipment and infrastructure.

## 5.4 Infrastructure

Local infrastructure is based out of the town of Wheatland (population 3,560), located 39 km east of the property by Wyoming State Highway 34. The Burlington Northern Santa Fe railroad mainline runs through

Wheatland as does Interstate Highway 25, linking the city to the entire United States. Residential power runs along County Road 720. A 46 kV substation is located along Highway 34 and is approximately 3.7 km from the western side of the Cowboy State Mine state mineral leases.

Because the Project is in the early stages of development, no mining related infrastructure has been constructed at site.

### 5.4.1 Power Supply

Residential power currently runs along County Road 720. A 46 kV electrical substation is located along Wyoming State Highway 34, approximately 2.3 miles (3.7 km) from the western side of the CSM State Mineral Leases. Future power supply for mining and processing will likely be supplied by the Wheatland Rural Electric Association.

The proposed refinery site is currently being evaluated and is likely to be located near Wheatland or Laramie and would benefit from natural gas, power, rail, and water infrastructure available in the area. Locating the refinery in either of these locations takes advantage of rail access, natural gas, power, and water infrastructure.

### 5.4.2 Water Supply

Water supply has been secured through a signed agreement providing up to 1,620 acre-feet of water per year. This volume is sufficient to meet the current PFS water balance, which indicates an average annual make-up water requirement of approximately 820 acre-ft/yr. Water availability is seasonal, and additional engineering, hydrological, hydrogeological, permitting, conveyance, and storage studies are ongoing to confirm the final water-supply infrastructure and operating requirements. Refer to Section 4 for the discussion of water supply and associated agreements and Section 17 for the Project water balance and water-supply design basis.

### 5.4.3 Personnel

The cities of Wheatland and Laramie can supply work personnel for the CSM Project. Laramie is home to the University of Wyoming, providing a source of professional and technical positions. Wyoming has a good base of skilled labor from oil, gas, and mining industries at both technical and operational levels.

### 5.4.4 Suppliers

Numerous suppliers exist in the region. Access to Interstate Highway 25 provides the Project with the ability to source goods from Cheyenne (~62 miles [100 km] south), Casper (~162 miles [260 km] north), or Denver, Colorado as needed. The BNSF railroad through Wheatland provides additional supply chain options for bulk materials.

### 5.4.5 Communications

Cellular telephone service is available across much of the Project area through regional wireless networks, although signal strength may be intermittent in localized areas due to terrain and line-of- sight limitations

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within the Laramie Range. In general, the most reliable cellular coverage is obtained where direct line of sight exists toward Wheatland to the northeast.

Conventional two-way radio communications are widely used throughout the local ranching community and provide a practical means of communication for field operations. Additional communications infrastructure, including dedicated radio repeaters, satellite communications, or temporary network enhancements, could be implemented during advanced exploration or future mine development, if required

## 5.5 Adjacent Properties

The CSM area is part of the Halleck Creek Rare Earth Project. The CSM is being developed independently from the other resource areas at Halleck Creek. The other resource area at Halleck Creek is the Overton Mountain resource area.

There are no other active mineral prospects or mining operations within 5 km of the CSM area.

# 6 History

In the 1960s or 1970s, a small mine that extracted fuchsite (ornamental stone), operated to the northwest of the Cowboy State Mine claim area. Otherwise, no large-scale mining has occurred in this portion of the Laramie range. During the 1950s rush for uranium prospecting, several occurrences of thorium and uranium containing Rare Earths Elements (REEs) were discovered in pegmatite bodies nearby and throughout the Laramie range. None of these were seriously explored (drilling, trenching, etc.), and none were mined. The region has received little attention since.

In 2010, Blackfire Minerals filed for and acquired the current set of state leases WRI now controls for REE exploration activities. Based on research completed by World Industrial Minerals (WIM), areas of anomalous REE values were discovered in Red Mountain as part of a Ph.D. thesis (Anderson, 1995). Much of Red Mountain was covered by a State Mineral Lease that was subsequently acquired. Blackfire dropped the leases in 2011 due to low REE prices.

In 2018, the Project was re-activated by Zenith Mineral Ltd. (Zenith) who applied for the same state leases that Blackfire held and staked five federal unpatented lode claims. Additional sampling was completed on both the Wyoming State Leases and unpatented lode claims. Results from 87 samples collected in 2019 showed broad areas of REE mineralization exceeding 2,000 parts per million (ppm) Total Rare Earths Oxides (TREO). Previous exploration performed by Zenith was limited and never amounted to compiling or reporting mineral resources.

In 2021, ARR acquired the state mineral leases, and 5 unpatented federal lode claims from Zenith. The Wyoming Office of State Lands and Investments assigned WRI four Wyoming state mining leases in June 2021. From June 2021 through August 2024, ARR acquired an additional 359 unpatented federal lode claims across the Halleck Creek Project area.

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# 7 Geological Setting and Mineralization

## 7.1 Regional Geology

The Cowboy State Mine Project is located within the Red Mountain pluton (RMP), which is a residual granitic melt associated with the Laramie anorthosite complex (LAC). The LAC represents the northernmost component of widespread 1.4 Ga magmatism in the western United States. The LAC was emplaced ca.1437 ± 2.4 Ma and forms the core of the central Laramie Range, a Laramide-aged uplift in southeastern Wyoming. (Anderson et al., 2003). The RMP is the youngest and smallest monzonitic intrusion associated with the Laramie anorthosite complex. (Anderson et al., 2003).

A regional geology map is provided in Figure 7-1.

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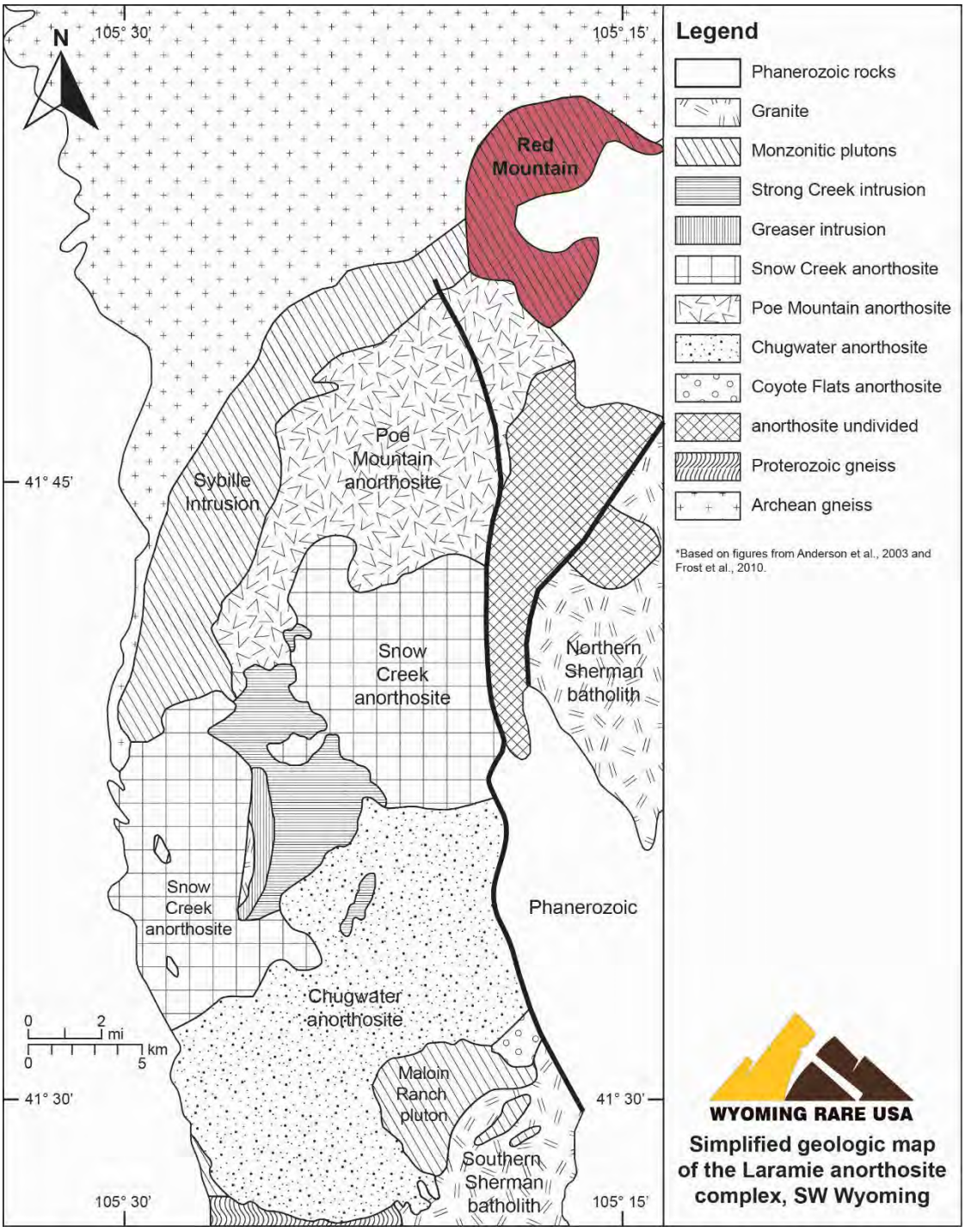


*Figure 7-1: Simplified Geologic Map of the Laramie Anorthosite Complex*

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## 7.2 Local Geology

### 7.2.1 Lithologies

The RMP is composed of four primary rock units: fayalite monzonite (FM) (zircon dated at 1431.3 ± 1.4 Ma), clinopyroxene quartz monzonite (CQM), biotite-hornblende quartz syenite (BHS), and the Red Mountain granite (RMG). The FM, CQM, and BHS are nearly indistinguishable from one another in the field, all being equigranular, medium-grained, and red-weathering. The RMG is the only readily distinguishable unit and forms a steeply dipping ring around the northern margin of the pluton. The RMG contains allanite in lower modal abundance than the other units of the RMP and is not considered a principal REE-bearing lithology (Anderson et al., 2003). Additionally, three types of dikes also occur within the pluton: fine quartz monzonite, medium quartz monzonite, and biotite-hornblende monzonite (Anderson et al., 2003).

The CQM and BHS units are the primary REE bearing lithotypes at the CSM project. The fayalite monzonite forms a discontinuous rim around the margin of the Red Mountain pluton and is predominantly composed of olivine, clinopyroxene, hornblende, and perthitic microcline. Olivine and clinopyroxene occur as individual grains but also as glomerocrysts (commonly called mafic clots), typically rimmed by hornblende. Trace amounts of biotite are secondary to hornblende. Zircon is abundant, while quartz and allanite occur in trace amounts. Ilmenite has been identified as the only Fe-Ti oxide within the unit (Anderson et al., 2003).

The BHS is more quartz-rich than both the CQM and the FM. The only ferromagnesian minerals present in this unit are hornblende and biotite. As with the other units, perthitic microcline is the dominant alkali feldspar, and ilmenite is the only Fe-Ti oxide present (Anderson et al., 2003).

The fourth rock type, the RMG, is located at the outer margin of the RMP, where it forms dikes and bodies concordant with the pluton margins (Anderson et al., 2003). The RMG is easily distinguishable from the other three units due to its abundance of quartz. It also has lower amounts of hornblende, biotite, plagioclase, and allanite compared to the FM, CQM, and BHS.

As mentioned above, the CQM and BHS are the primary REE-bearing units within the RMP. The FM unit contains variable levels of REE, while the RMG has comparatively low REE contents relative to the principal mineralized units. In the RMP, REE abundances correlate with modal abundances of allanite and zircon. The CQM generally contains the highest abundances of allanite and zircon, while the BHS and FM contain lesser, but still significant amounts.

The RMP intrudes rocks of the Archean (ca. 2.6 Ga) Elmer's Rock Greenstone Belt (ERGB) to the west and north. The ERGB consists of amphibolite facies supracrustal rocks, including marble, calc-silicate, amphibolite, pelitic gneiss, granite gneiss, quartzites, banded iron formation, and minor amounts of ultramafic rock. (Anderson, 1995). Marble, calc-silicate, and pelitic gneisses are most common near the RMP contact. (Spicuzza, M.J., 1990).

To the south and southwest, the RMP is in direct contact with the Sybille intrusion (ca. 1.434 Ga) (Scoates et al., 1996). Historically, the contact between the two plutons has been noted as sharp. However, recent work has shown that this contact may be gradational in nature. Regardless, the lack of evidence of brittle

deformation at the contact indicates that the Sybille Formation was still hot at the time of the RMP intrusion. (Anderson, 1995).

Results from the 2024 drilling program have further refined the local geology, particularly in the eastern portion of the CSM, where the Red Mountain pluton is in contact with unmineralized Sybille intrusion and Archean granites.

To the east, the RMP is covered by thin tertiary sediments consisting of unconsolidated gravels and fine-grained sediments derived from LAC sources. (Anderson, 1995). A geologic map of the Project Area can be observed in *Figure 7-2*, and a detailed stratigraphic column is provided in *Figure 7-3*. Geological cross sections can be observed in *Figure 7-4* through *Figure 7-6*.

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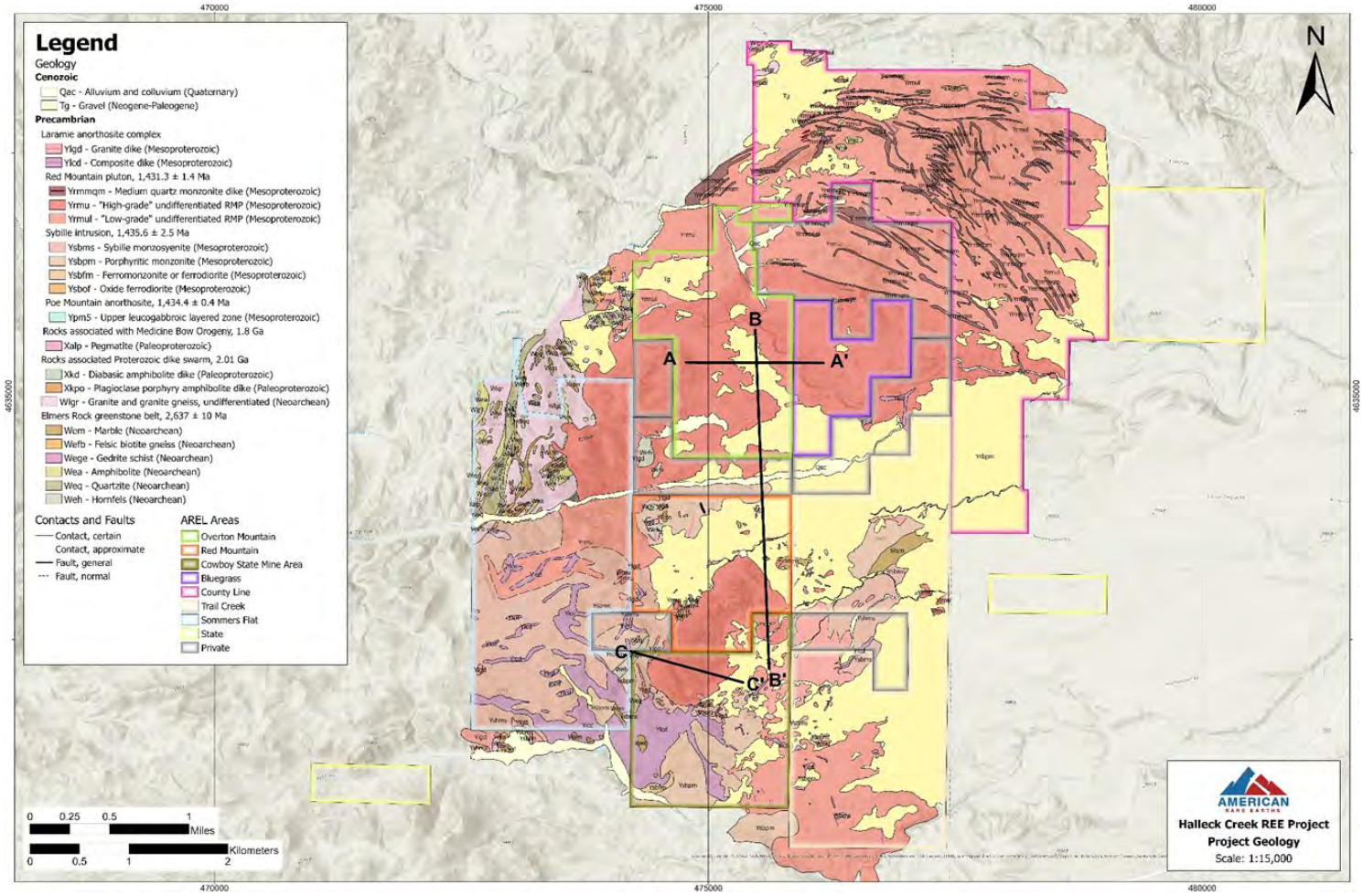


*Figure 7-2 Cowboy State Mine Project Geology*



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| Eon | Period | Formation | | | Code | Lithology |
|---|---|---|---|---|---|---|
| Cenozoic | Quaternary | Alluvium and colluvium | | | Qac | Consists of silt, sand, and gravel; may contain well-rounded clasts dominated by resistant Precambrian lithologies. |
| | Neogene-Paleogene | Gravel | | | Tg | Poorly exposed, unconsolidated to weakly consolidated, poorly sorted gravels and boulders in a silty and sandy matrix; locally tuffaceous. |
| **Major unconformity** | | | | | | |
| Proterozoic | Mesoproterozoic | Laramie Anorthosite Complex ca. 1.43 Ga | Granite dike | | Ylgd | Includes pink leucogranite dikes and irregular small intrusions as well as several large inclusions of coarse-grained biotite-hornblende granite in the Sybille monzosyenite. |
| | | | Composite dike | | Ylcd | Pink granite dike similar to Ylgd but contains pillows and irregular blobs of fine-grained, mafic monzonitic magma. Various degrees of mixing between the two melts common. Inlcudes isolated K-feldspar megacrysts in the mafic magma and dispersed grains of biotite and hornblende extending from the mafic magma into the granitic magma. |
| | | | Red Mountain Pluton 1,431.3 ± 1.4 Ma (Scoates and Chamberlain, 2003) | Biotite-hornblende monzonite dike | Yrmhd | Typically red-brown in color, markedly darker than the main pluton constituents. Very fine-grained, with an average grain size of 0.25 mm. Contains high modal abundances of hornblende and biotite. Petrographically similar to the BHS, but is much more fine-grained and contains lower modal quartz. |
| | | | | Fine quartz monzonite dike | Yrmfqm | Mineralogically similar to the CQM, with slightly increased abundances of hornblende and biotite. Typical grain size of 0.5-0.75 mm. |
| | | | | Medium quartz monzonite dike | Yrmmqm | Nearly mineralogically identical to the FQM dikes, but with slightly lower modal plagioclase. Mean grain size of >1.0 mm. |
| | | | | Fayalite monzonite | Yrmfm | Red weathering, equigranular, and medium grained. Olivine and clinopyroxene occur as individual grains or glomerocrysts associated with hornblende. Minor biotite is secondary after hornblende. Quartz and allanite may be present in small quantities, whereas zircon is abundant. Orthoclase and microline often appear perthitic. |
| | | | | Clinopyroxene quartz monzonite | Yrmcqm | Red weathering, equigranular, and medium grained. Petrographically similar to the fayalite monzonite, but allanite is more abundant and olivine is absent. Glomerocrysts of clinopyroxene, hornblende, and allanite are observed. Zircon and ilmenite are rare, but increased biotite, quartz and microcline in comparison to fayalite monzonite. |
| | | | | Biotite hornblende quartz syenite | Yrmbhs | Dominant rock type within the RMP. The BHS lacks fayalite and clinopyroxene: the only ferromagnesian phases present are hornblende and bioltite. As with the other units, perthitic microcline is the major alkali feldspar. |
| | | | | Red Mountain granite | Yrmg | Occurs as concordant ring-like dikes interleaved with supracryustal rocks on the north and northwest margins of the pluton. Red weathering, equigranular, and medium-grained similar to other RMP rocks, but has high abundance of quiartz. The unit also exhibits more abundant microcline and increased perthite. Clinopyroxene tends to be rare, occuring only as relict cores in hornblende. |
| | | | Sybille Intrusion 1,435.6 ± 2.5 Ma (Scoates and Chamberlain, 2003) | Sybille monzosyenite | Ysbms | Orange-weathering rock that is black on fresh surfaces, consisting of interlocking alkali-feldspar megacrysts. Ferromagnesian minerals include fayalite, hedenbergite, and rarely hornblende which occur in the interstices between the megacrysts. Contains about 5% quartz, but is seldom seen in hand specimen. |
| | | | | Sybille porphyritic monzonite | Ysbpm | Brown-weathering rock that is black on fresh surfaces consisting of alkali feldspar megacrysts in a finer-grained matrix of plagioclase, alkali feldspar, olivine, and hedenbergite. Rarely contains quartz. |
| | | | | Ferromonzonite or ferrodiorite | Ysbfm | Fine-grained, dark-brown-weathering rock that is black on fresh surfaces consisting of interlocking feldspars. Proportions of feldspars range from mainly plagioclase to an equal proportion of plagioclase and highly exsolved alkali feldspar. In a few occurences, the alkali feldspars from small phenocrysts identifiable in hand sample. Ferromagnesian minerals present may be ferroaugite, olivine, and in some rocks pigeonite. |
| | | | | Oxide ferrodiorite | Ysbof | Fine-grained, black rock on both weathered and fresh surfaces, rich in Fe-Ti oxides. Plagioclase, olivine, ferroaugite, and rarely pigeonite are identifiable in thin section. |
| Archean | Neoarchean | Granite and granite gneiss | | | Wlgr | Medium- to coarse-grained, massive to highly foliated granitic gneisses that are pink on both weathered and fresh surfaces. Biotite is prominent and muscovite might be present locally. Includes large, partially melted inclusions within the Sybille intrusion. |
| | | Elmers Rock Greenstone Belt 2,637 ± 10 Ma (Snyder et al., 1998) | Marble | | Wem | White, coarse-grained marble. Locally may contain cm-scale blades of tremolite. |
| | | | Pelitic schist | | Weps | Quartz, biotite, and muscovite schist, generally black to dark brown on fresh and weathered surfaces. Outside the contact aureole of the Sybille intrusion the schist commonly has the assemblage kyanite, sillimanite, and garnet, but within the aureole, it contains andalusite and cordierite. Adjacent to the intrusion it has melted and may contain streaks of granitic melt. |
| | | | Felsic biotite gneiss | | Wefb | Speckled gray feldspar, quartz, and biotite gneiss and schist, possibly derived from clay bearing silts, sands, or gravels. |
| | | | Amphibolite | | Wea | Medium-grained, green to black, layered amphibolite. In low-strain areas, pillow structures may be observed. Commonly interlayrered with calc-silicate rocks. In the contact aureole of the Sybille pluton, the amphibolite has been converted to a fine-grained brown hornfels with the assemblage orthopyroxene, clinopyroxene, hornblende, and plagioclase. |
| | | | Quartzite | | Weq | Massive white, greenish-white, or brown quartzite. |
| | | | Hornfels | | Weh | Undifferentiated fragments of the Elmers Rock greenstone belt that occur as inclusions in the Sybille monzosyenite and Red Mountain pluton. Protolith for these rocks may include pelitic, semi-leitic, calc-pelitic, or mafic lithologies. |
| | | | Calc-silicate hornfels | | Wecs | White to pale-green weathering hornfels consisting of calcite, dolomite, and pale-green serentine. The serpentine was produced by hydration of olivine. |

*Figure 7-3 Stratigraphic Column for Cowboy State Mine Project Area*

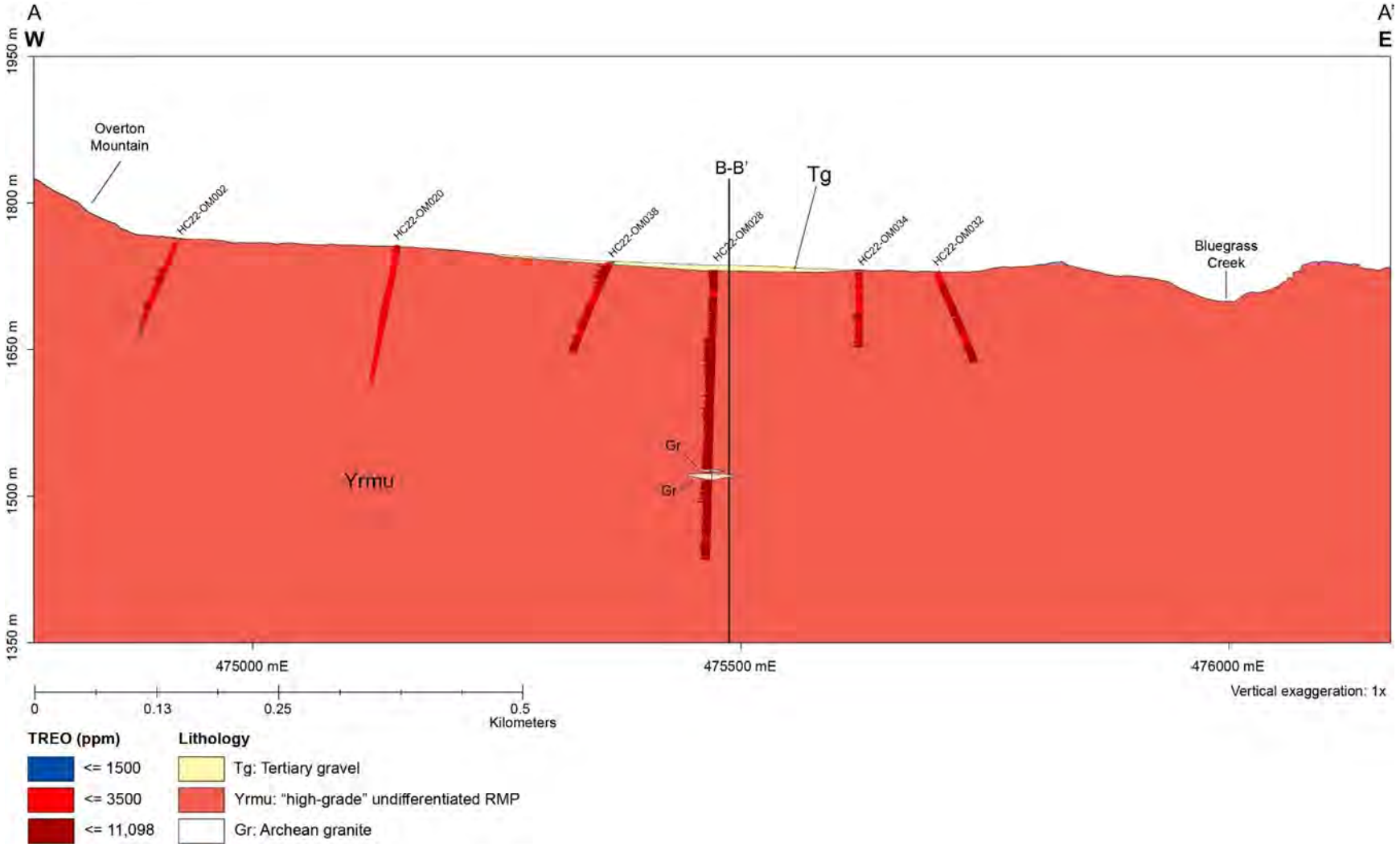


*Figure 7-4 Cross-Section of the Cowboy State Mine Project Area: A to A*



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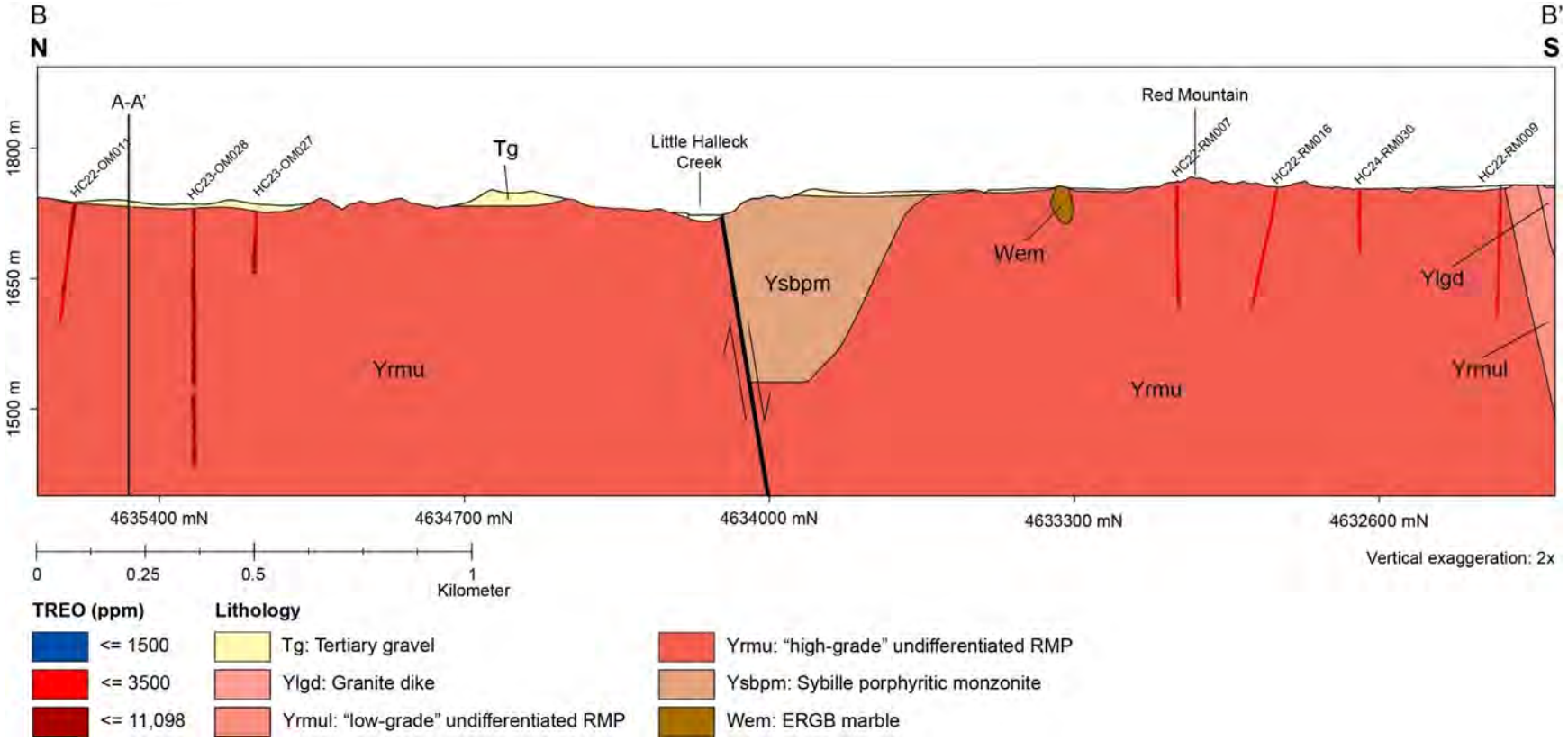


*Figure 7-5 Cross-Section of the Cowboy State Mine Project Area: B to B*

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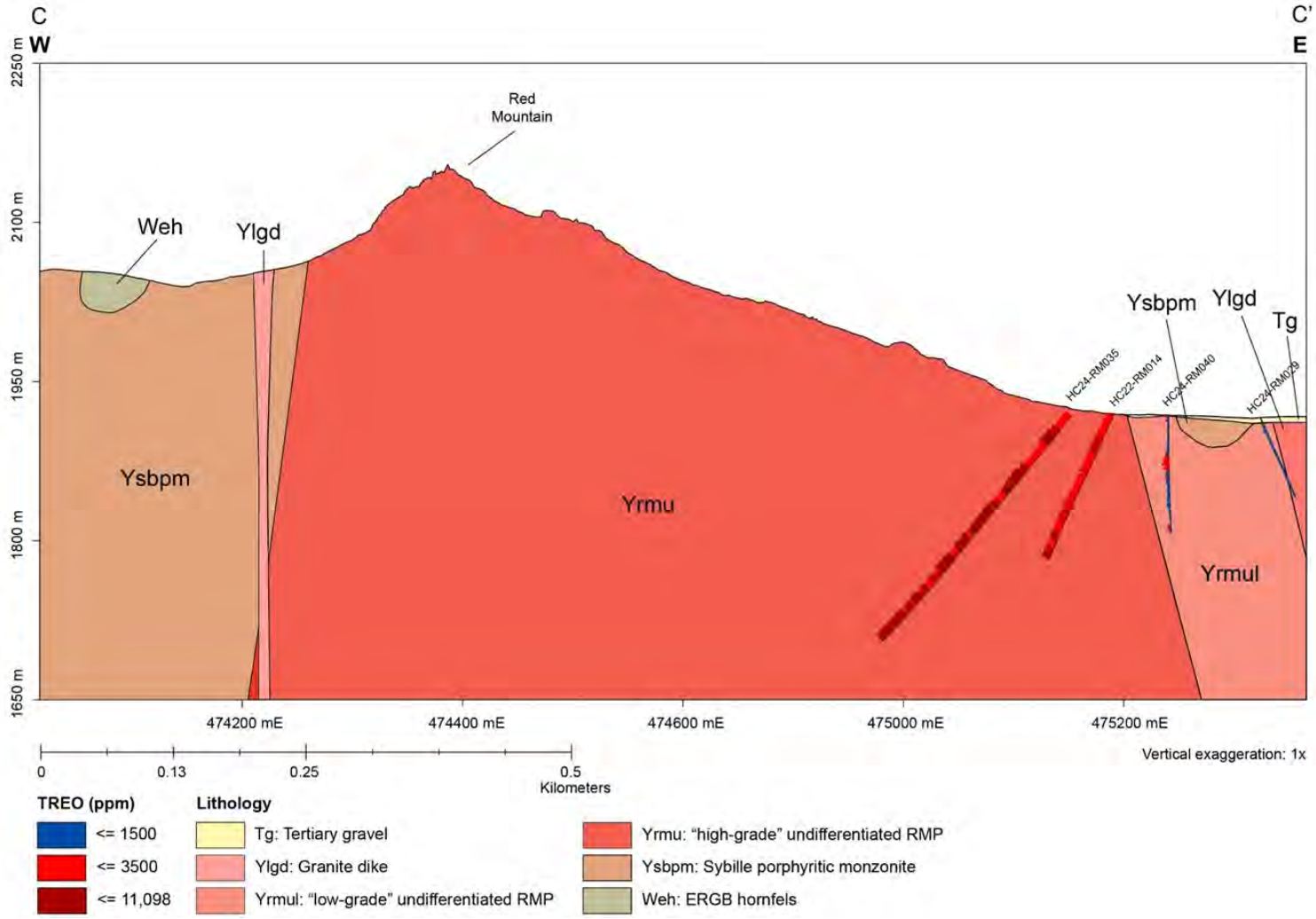


*Figure 7-6 Cross-Section of the Cowboy State Mine Project Area: C to C*



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### 7.2.2 Structure

Contacts between units of the RMP are intrusive. There are few country rock inclusions within the RMP, and the foliations in the surrounding Archean schists of the ERGB concordantly wrap the pluton. This suggests that the RMP was most likely emplaced by forcibly shouldering aside the country rock as part of late-stage development of the pluton.

The only prominent structure in the region is the Halleck Canyon fault which generally parallels County Road 720, bisecting the Halleck Creek project area with Red Mountain, and the Cowboy State Mine area to the south and Overton Mountain to the north.

Extensive joint sets are present across Red Mountain and Overton Mountain. The joints are thought to be closely related to uplift of the LAC.

## 7.3 Property Geology

### 7.3.1 Data Density, Distribution, and Reliability

Since ARR acquired the project in June 2021, WRI geologists have performed multiple campaigns of geological mapping, geochemical sampling, channel sampling, reverse circulation (RC) drilling and core drilling across the entire Halleck Creek project area. Since 2024 geological exploration has focused on the CSM area.

Surface geochemical samples and channel samples are evenly distributed across the CSM area, with a focus on Red Mountain. Exploration drilling is distributed around the perimeter of Red Mountain and the areas immediately to the east.

The geological data for the CSM area is considered to be very reliable. The location of each sample was obtained using hand-held GPS units. All drill hole locations were surveyed by a professional land surveyor. Each geological sample has been geologically logged by an experienced geologist, and each sample has been assayed by an accredited third-party laboratory.

### 7.3.2 Lithologies

The three major mineralized phases within the RMP are the CQM, the BHS, and the FM. The lesser mineralized phases include medium quartz monzonite dikes and sills and biotite-hornblende monzonite dikes and sills (Figure 7-3).

### 7.3.3 Structure

Mineralization in the RMP is not structurally controlled. However, the deposit does exhibit significant jointing and minor faulting associated with Laramide-aged uplift, which influenced the development of joint sets in the monzonitic body.

Mapping revealed no major fault structures or structural controls within the mapped areas except for prominent joint sets within the RMP rocks. Strike and dip measurements of these joint sets were recorded during mapping (Figure 7-7). Joint measurements falling outside the primary conjugate set are presumed to result from stress relief related to the uplift and emplacement of the intrusive body.

A minor fault was observed within the Sybille Intrusion, north of Red Mountain. Stereonets reveal a prominent conjugate joint set, with additional jointing interpreted as a response to the Laramide uplift of the Red Mountain body (Figure 7-8). Mapped features are assumed to represent igneous contacts.

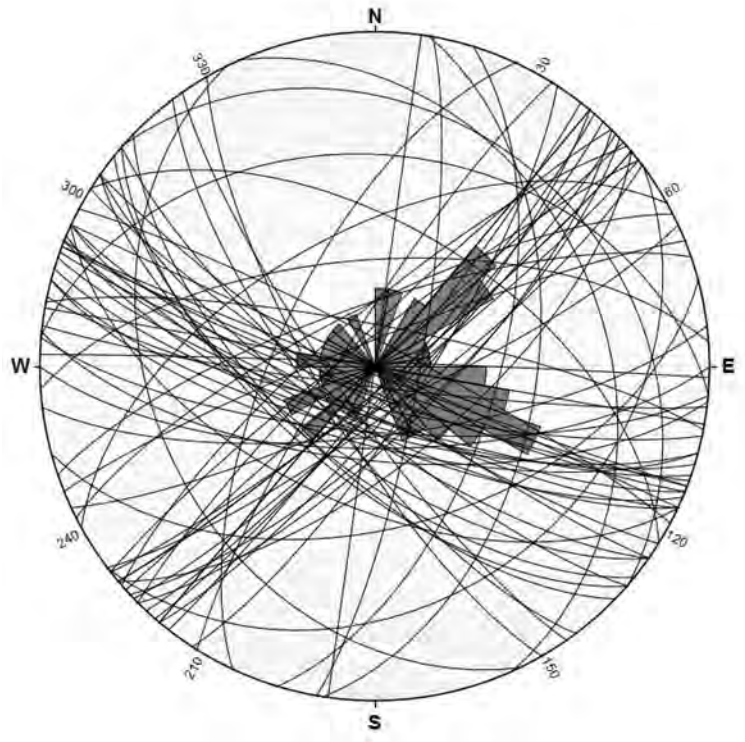


*Figure 7-7: Stereonet Exhibiting All Joint Measurements and Associated Rose Diagram*

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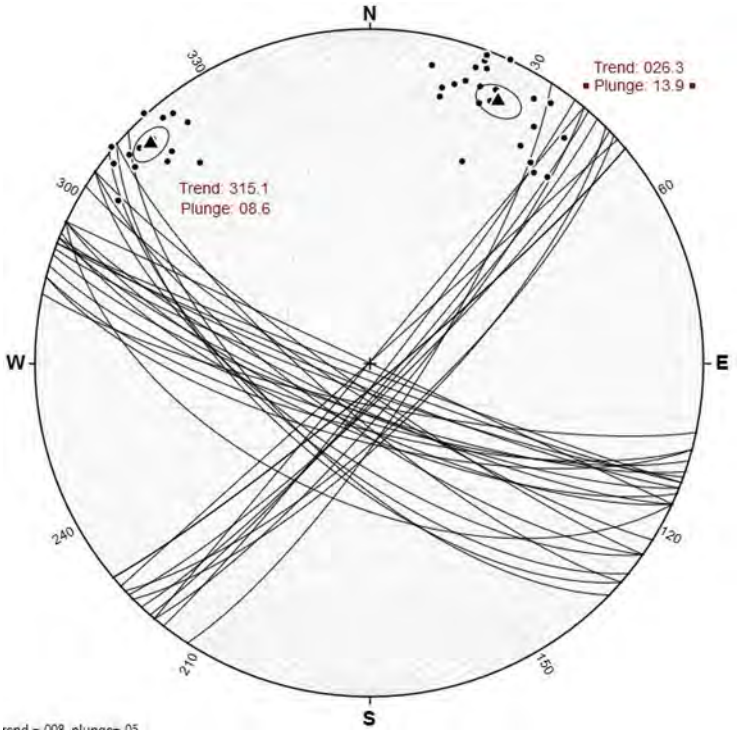


*Figure 7-8: Stereonet Exhibiting Joint Set, Poles to Planes, and Mean Vectors*

### 7.3.4 Alteration

The RMP exhibits differing types of alteration of varying intensity. Most observed alteration is low to moderate. Alteration has not been shown to affect REE grades. More work is required to determine an exact relationship between alteration and grade, but preliminary results show there is no effect.

Regardless, the prominent style of alteration observed throughout the pluton is weak potassic alteration and oxidation. Lesser amounts of epidote alteration have been observed. Alteration is most prevalent along joints and minor fault surfaces.

Metamict structures observed in micrographs of allanite, display the decomposition of allanite crystal structure to amorphous solids and radial fractures emanating from allanite crystal cores. The metamict structure is common throughout the allanite at Cowboy State Mine. Metamict structures have been observed to a lesser extent within zircon crystals.

Metamict structures are geologic structures (specifically, minerals) that were originally crystalline but have become amorphous (non-crystalline or "glassy") due to internal radiation damage over geologic time. The mineral maintains its original outward crystal shape (a pseudomorph) but loses its internal ordered atomic arrangement. (https://www.ebsco.com/research-starters/physics/metamictization)

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The primary cause is the alpha decay of radioactive elements (primarily uranium and thorium) substituting within the mineral's crystal structure. The high-energy alpha particles and the recoiling nuclei create "damage tracks" and intense atomic displacements, disrupting the crystal lattice. The accumulation of this damage outpaces the mineral's ability to self-repair its structure, resulting in amorphization.

## 7.3.5 Mineralization

Rare earth element mineralization within the pluton is hosted within allanite [Ce,Ca,Y,La)2(Al,Fe3)3(SiO4)3(OH)], a sorosilicate of the epidote group, and zircon. Mineralization occurred due to fractional crystallization of the RMP bodies over time. Minor occurrences of Chevkinite, Tornebohmite, Monazite and Synchysite/Bastnasite were observed in detailed mineralogical characterization, but none of these minerals are significant contributors of rare earth elements or resources.

### 7.3.5.1 Petrography

Most allanite grains occur as inclusions in and around aggregates of fractured amphibole. Allanite measurements range from 400 µm up to 2.5 mm in diameter. Allanite occasionally exhibits thin rinds of epidote with metamict and isotropic cores. Metamict allanite often exhibits radial fracturing in the surrounding minerals due to the hydration of the crystal structure during metamictization.

Feldspars are the dominant silicate phase in all units within the RMP. Late-stage grid twinned microcline is most commonly observed, followed by plagioclase, often weakly sericitized. Microcline ranges in composition from Or65 to Or95, and plagioclase ranges in composition from An7 to An24 (Anderson et al., 2003). Microcline is typically anhedral and ranges in diameter from 500 µm to 4 mm, whereas plagioclase occurs as anhedral to subhedral grains which vary in size from 500 µm to 5.5 mm (DCM, 2019).

Green amphibole is the second most abundant silicate and typically comprises no more than 25% of the samples by volume. Mineralogical characterization shows this amphibole to be hastingsite ($NaCa_2(Fe^{2+}4Fe^{3+})(Si_6Al_2)O^{22}(OH)_2$). Hastingsite typically occurs as aggregates and prisms up to 5 mm in size and exhibits mild to moderate decay to iron-oxide along cleavage planes.

Quartz content comprises no more than 10–15% in thin sections observed. Typically, anhedral / rounded grains occur interstitially between feldspar and amphibole. Myrmekitic quartz is present yet confined to the margins of smaller plagioclase grains.

Zircon is common throughout the RMP as fractured euhedral prisms and is commonly hosted within amphibole and is less commonly included in feldspars (DCM, 2019). Zircons range in diameter from 50–600 µm. Trace, rounded apatite occurs as inclusions within feldspar and quartz. Trace biotite occurs as aggregates associated with amphibole. Trace pyrite or pyrrhotite was observed in one sample and was identified using EDS spectrometry. Sulfides, when present, typically occur around the edges of allanite grains (DCM, 2019).

All examined petrographic samples exhibited varying amounts of Fe-oxide which occur as fracture fill or as replacement of amphibole. Ilmenite is the most common variety observed, albeit in trace amounts.

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#### 7.3.5.2 Mineralogical Characterization

In 2024, SGS in Lakefield, Ontario updated the detailed mineralogical characterization of HQ core samples to determine liberation parameters, particle distribution and mineral associations of REE bearing rocks at Cowboy State Mine. Work completed included TESCAN integrated mineralogical analyzer (TIMA-X), electron probe micro-analysis (EMPA), X-ray diffraction (XRD) analysis, an electron-microscope, and chemical assays.

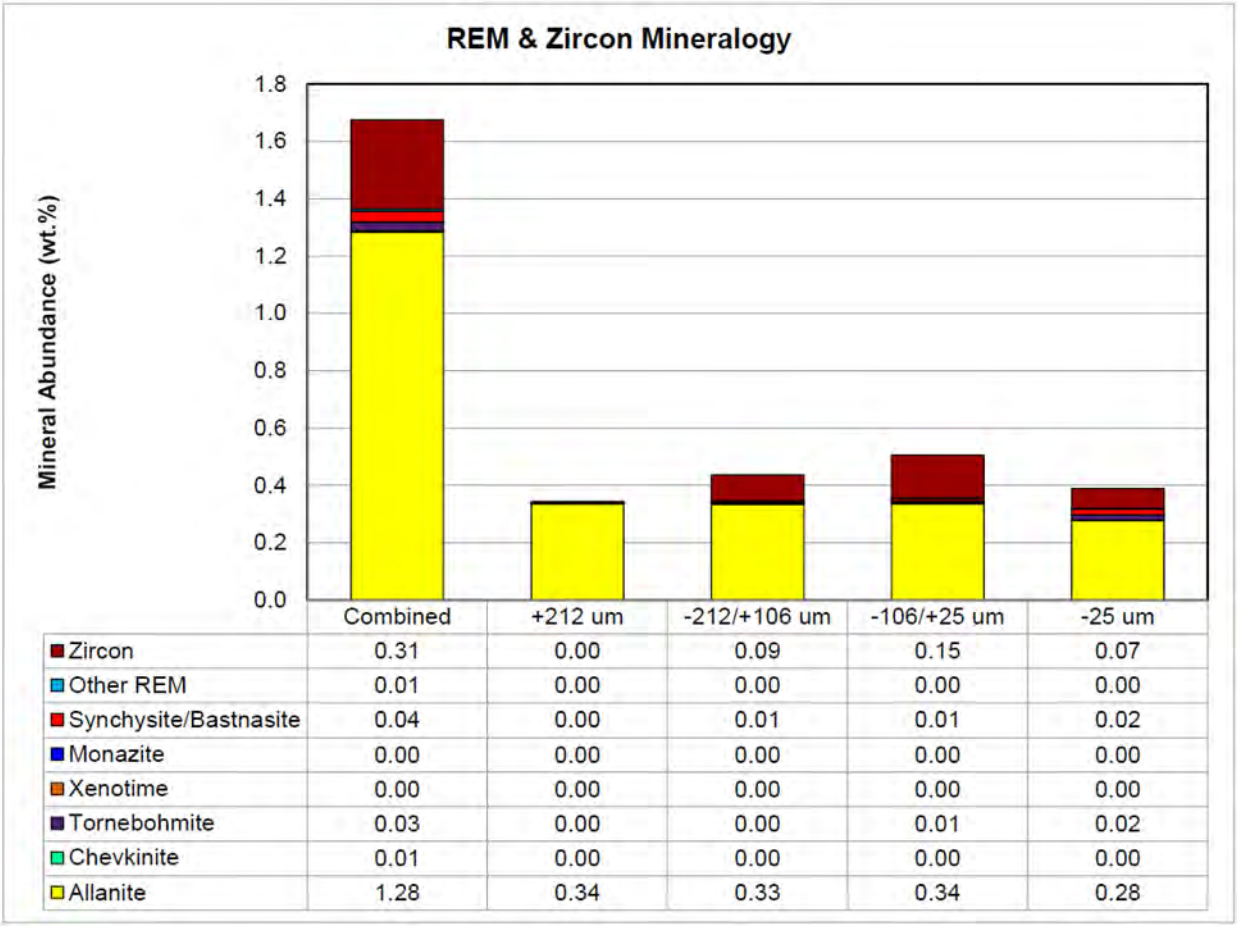
The sample was analyzed with XRD to determine its bulk mineralogy. The sample consists mainly of albite (37.5%), microcline (30.5%), actinolite (15.1%), diopside (3.4%), quartz (5.8%), and minor (<2-3%) other minerals (Table 7-1). TIMA-X analysis shows the mineral abundance for the calculated head includes orthoclase (42.0%), plagioclase (30.9%), amphibole (17.0%) (which includes minor pyroxene because it yields a chemical composition similar to that of the amphibole), quartz (5.9%), and trace amounts (<1%) of biotite, garnets, carbonates, epidote, other silicates, apatite, sulphides, Fe-Oxides, ilmenite, and other minerals. It should be noted that the effects that metamict structures have on allanite significantly reduce the ability of XRD to identify allanite.

*Table 7-1: XRD Results*

| **Mineral / Compound** | **Head Mineralogy (%)** |
|---|---|
| Quartz | 5.8 |
| Albite | 37.5 |
| Muscovite | 1.9 |
| Biotite | 0.8 |
| Chlorite | 0.6 |
| Stilpnomelane | 1.7 |
| Actinolite | 15.1 |
| Microcline | 30.5 |
| Calcite | 2.2 |
| Magnetite | 0.5 |
| Diopside | 3.4 |
| **Total** | **100** |

SGS determined that the main rare earth mineral (REM) is allanite (1.28%), while chevkinite (0.01%), tornebohmite (0.03%), synchysite/ bastnasite (0.04%) are present in trace amounts. Note the presence of zircon (0.31%). Rare xenotime, monazite, niobates, and other REM are tentatively identified (Figure 7-9).

Liberated (pure, free, and liberated) allanite accounted for 87.5% of the samples, and the remainder occurred as complex particles (2.4%), middlings with quartz / feldspars (5.4%), amphibole (1.1%) and other minerals in trace amounts (<1%). Liberated chevkinite / tornebohmite accounted for 50.2% in the samples, and synchysite / bastnasite for 23% (Figure 7-9).




| | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| Zircon | 0.31 | 0.00 | 0.09 | 0.15 | 0.07 |
| Other REM | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Synchysite/Bastnasite | 0.04 | 0.00 | 0.01 | 0.01 | 0.02 |
| Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Xenotime | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Tornebohmite | 0.03 | 0.00 | 0.00 | 0.01 | 0.02 |
| Chevkinite | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Allanite | 1.28 | 0.34 | 0.33 | 0.34 | 0.28 |

*Figure 7-9: REE Mineral and Zircon Mineral Mass by Size Fraction and Calculated Head*

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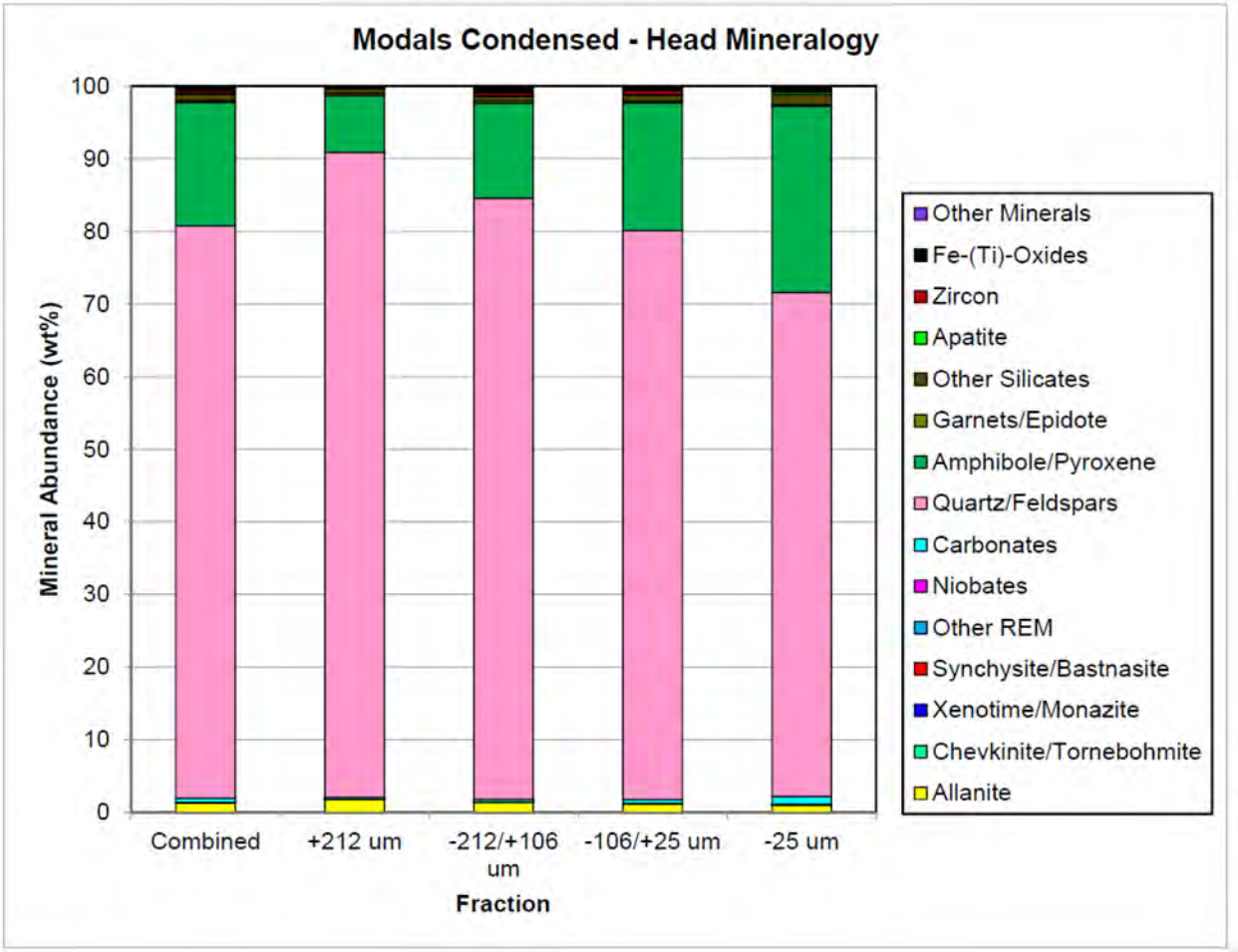


*Figure 7-10: Modal Mineralogy by Size and Calculated Head*

The grain size report serves to study the distribution of the grain size of a specific phase; within the TIMA software, it is defined as equivalent circle diameter (d). It is the diameter of a circle that has the same area (A) as the particle (or grain). The diameter is defined in pixels and then multiplied by pixel spacing (Ps) to obtain size in micrometres. The precise definition is described in the following formula: $d = 2 \cdot \sqrt{A/\pi} \cdot Ps$.

Table 7-2 shows the median grain size and P80 for selected minerals. The term particle refers to both liberated and middling particles, monomineralic, and polymineralic. The P80 for particle is 196 µm, allanite 218 µm, chevkinite/ tornebohmite is 17 µm, xenotime/monazite 20 µm, synchysite/ bastnasite 35 µm, other REM 36 µm, and niobates 19 µm, zircon 125 µm, quartz/ feldspars 206 µm, amphibole/ pyroxene 112 µm, garnets/epidote 50 µm, and Fe-(Ti)-Oxides 151 µm.

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*Table 7-2: P80 and Median Size (µm) by Size Fraction and Calculated for the Head*

| Sample | Head Mineralogy | |
|---|---|---|
| **Grain Size (µm)** | **Median** | **P80** |
| Allanite | 90 | 218 |
| Chevkinite/Tornebohmite | 8 | 17 |
| Xenotime/Monazite | 13 | 20 |
| Synchysite/Bastnasite | 15 | 35 |
| Other REM | 11 | 36 |
| Niobates | 7 | 19 |
| Carbonates | 14 | 40 |
| Quartz/Feldspars | 81 | 206 |
| Amphibole/Pyroxene | 29 | 112 |
| Garnets/Epidote | 14 | 50 |
| Other Silicates | 11 | 25 |
| Apatite | 19 | 36 |
| Zircon | 67 | 125 |
| Fe-(Ti)-Oxides | 59 | 151 |
| Other Minerals | 15 | 75 |
| Particle | 72 | 196 |

# 8 Deposit Type

## 8.1.1 Deposit Type

The Red Mountain pluton (RMP) of the Cowboy State Mine Rare Earths Project represents a magmatic allanite-hosted REE deposit composed primarily of monzonitic to syenitic rocks. The RMP is associated with evolved, A-type granitoid magmatism and is interpreted to have developed through differentiation of a ferrodioritic parental magma associated with the Laramie Anorthosite Complex. Mantle-derived magma ascends through the crust, undergoing chemical differentiation driven by factors such as temperature, pressure, and interaction with surrounding wall rock.

The term “alkaline” refers to magmas enriched in sodium (Na2O) and potassium (K2O), leading to the formation of abundant Na- and K- bearing minerals, including feldspathoids, alkali pyroxenes, and alkali amphiboles. These magmas are characteristically enriched in REEs and often contain elevated concentrations of zirconium, niobium, strontium, barium, and lithium (Balaram, 2019). Despite exhibiting high levels of Na20 and K20, the RMP is defined as metaluminous (higher Al/alkalis) rather than peralkaline as typically seen in alkaline igneous hosted REE deposits. As such, the RMP notably lacks the presence of feldspathoids and Na-rich amphiboles and pyroxenes and is geochemically distinct from this deposit type. Furthermore, while many primary alkaline deposits are associated with elevated levels of uranium and thorium, the RMP deposit is distinctive for its unusually low concentration of radioactive elements.

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Primary magmatic mineralization is frequently overprinted by late-stage magmatism and/or hydrothermal processes. (Balaram, 2019). However, hydrothermal alteration in the RMP is minimal and does not appear to have significantly affected REE mineralization. At Cowboy State Mine, REE mineralization is primarily attributed to fractional crystallization during the final stages of magma evolution, resulting in the concentration of allanite and other REE-bearing phases.

## 8.1.2 Deposit Evolution

Monzonitic plutons, such as the RMP, are believed to form through open-system fractionation of a ferrodioritic parent magma, which typically remains after the crystallization of the primary anorthosite bodies (Anderson et al., 2003). Scoates et al. (1996) conducted crystallization experiments on one of the LAC ferrodiorites and demonstrated that extensive crystallization of a ferrodioritic parent magma can produce potassium-rich monzonitic liquids. Based on isotopic similarities between the RMP and the least contaminated rocks of the LAC, it is believed that a similar ferrodioritic parental magma is appropriate for the RMP (Anderson et al., 2003).

Continued fractional crystallization played a critical role in forming the RMP and its various units. The liquid line of descent (LLD) from monzodiorite to fayalite monzonite was driven by the crystallization of olivine, clinopyroxene, plagioclase, apatite, magnetite, and ilmenite. The crystallization sequence for the REE-bearing units of the RMP is zircon, apatite, olivine, clinopyroxene, allanite, plagioclase, K-feldspar, hornblende, biotite, and quartz (Anderson et al., 2003). Petrographic work suggests that olivine, clinopyroxene, plagioclase, apatite, zircon, and allanite are cumulate phases, while alkali feldspar, hornblende, biotite, and quartz crystallized from intercumulus liquid (Anderson et al., 2003).

Allanite is the primary REE host mineral at the Cowboy State Mine Project. As a sorosilicate within the epidote group, allanite contains significant amounts of REEs in its primary mineral structure. The presence of allanite is the primary reason that the RMP exhibits higher REE content than any of the coeval monzonitic bodies in southeastern Wyoming. In other regional plutons, REEs are typically hosted in phosphates, primarily apatite (Anderson et al., 2003).

It is speculated that the incorporation of REEs into allanite, rather than apatite, resulted from increased water content and lower $P_2O_5$ levels relative to other monzonitic plutons in the region. The major chemical constraint influencing allanite formation within the RMP is the abundance of $Fe_2O_3$ in the parent magma. Ilmenite is typically the primary competing phase for $Fe_2O_3$: however, the RMP contains low amounts of $TiO_2$, allowing more iron to be available for allanite formation.

### 8.1.2.1 Deposit Dimensions

The deposit can be subdivided into two Project Areas: Red Mountain and Overton Mountain. The deposit at the Red Mountain Project Area is approximately 2,075 m x 1,013 m, and the deposit at the Overton Mountain Project Area is approximately 1,210 m x 1,648 m. Both deposits remain open at depth: in drilling data, mineralization has been observed to a depth of 302 m at Overton Mountain, and 298 m at Red Mountain.

# 9 Exploration

## 9.1 Data Acquisition

Since the project was acquired in 2021, WRI geologists have performed multiple campaigns of geological mapping, geochemical sampling, channel sampling, reverse circulation (RC) drilling and core drilling across the entire Halleck Creek project area. Since 2024, geological exploration has focused on the Cowboy State Mine area.

## 9.2 Grids and Surveys

Drill hole, trench, and surface sample locations are stored in the Project database using the NAD 1983, UTM Zone 13 coordinate system.

The WGS 1984 latitude and longitude coordinates are stored as secondary coordinates in the Project database.

## 9.3 Geological Mapping

During the spring of 2024, WRI Geologists continued mapping and sampling of the Cowboy State Mine resource area. These activities focused on further characterizing and locating the rare earth element-enriched RMP.

Since 2021, WRI geologists mapped and sampled WRI claim areas where previous geologic mapping was sparse and speculative. Specifically, mapping and sampling occurred in the Sommers Flat, Overton Mountain, Bluegrass and County Line areas. WRI Geologists updated contacts between geologic units in these areas.

## 9.4 Geochemistry

Since 2021, WRI geologists have collected approximately 950 surface geochemical samples across the broader Halleck Creek Project area, including the Cowboy State Mine area. Figure 8-1 illustrates the distribution of surface samples within the Cowboy State Mine Project area. American Assay Laboratories (AAL) and ALS Global have assayed these samples. The RMP outcrops throughout the Project Area allow for thorough surface sampling of the Project Area. WRI Geologists found that surface geochemistry (TREO) corresponds very well with TREO grades observed in reverse circulation and core drilling samples.

Because of this, WRI relied upon surface geochemistry to define drill hole locations and to assist in resource modeling to define resource extents.

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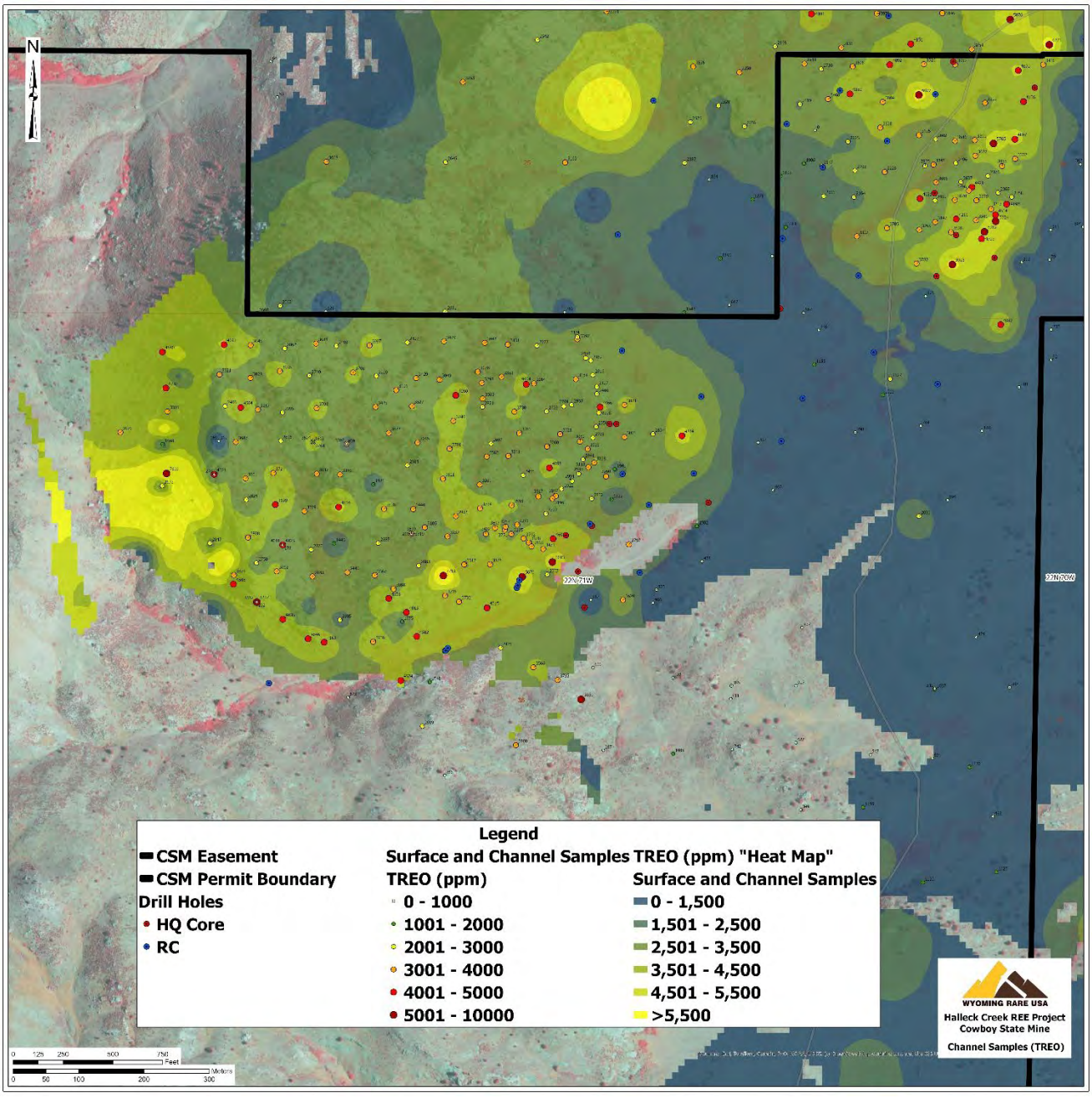


*Figure 9-1: Location of All Surface Samples at Cowboy State Mine Project Area*

## 9.5 Geophysics

Ground geophysical programs have not been employed at Cowboy State Mine. The homogenous nature of lithology and low levels of radionuclides, metallic oxide minerals, and sulphide minerals do not lend themselves to conventional geophysical exploration. Surface geochemical sampling has provided valuable

exploration data, including gamma radiation measurements that may serve as a correlative indicator of REE abundance within the mineralized lithologies.

## 9.6 LiDAR and NAIP Imagery

The Wyoming State Geological Survey and the University of Wyoming School of Energy Resources made LiDAR data in Albany County Wyoming available to the public. WRI downloaded LiDAR data covering the entire Halleck Creek project area and built a high-resolution digital terrain model across the project area.

WRI also uses USA NAIP natural color and color infrared imagery as basemap imagery for geological maps and cross-sections.

## 9.7 Competent Person's Interpretation of the Exploration Information

Exploration activities conducted across the Halleck Creek Project have established a substantial geological and geochemical dataset supporting the interpretation of REE mineralization within the Red Mountain Pluton. Geological mapping, surface geochemical sampling, and channel sampling provide information on the distribution and continuity of mineralized lithologies, particularly within the Cowboy State Mine area.

Surface geochemical results generally correspond with REE grades encountered in RC and diamond core drilling, supporting their use in identifying prospective areas and guiding exploration. The distribution and density of exploration data vary across the broader Halleck Creek Project, with more detailed investigation concentrated within the Cowboy State Mine area.

In the Competent Person's opinion, the exploration information provides an appropriate geological basis for the interpretation of mineralization and the planning of subsequent exploration activities. The adequacy of drilling, sampling, and analytical data for Mineral Resource estimation is addressed separately in the relevant technical sections of this Report.

# 10 Drilling

## 10.1 Overview of Drilling Programs

Between March 2022 and October 2024, WRI completed four exploration drilling campaigns across the Halleck Creek project area. These drilling programs are a mix of 28 HQ core drilling and 70 RC holes. To date, 98 drill holes have been drilled for a total meterage of 12,490 m (40,979 ft) (Table 10-1).

These drilling totals represent the four exploration campaigns completed through October 2024 and distinguish the broader Halleck Creek drilling database from the 50 drill holes completed within the Red Mountain/Cowboy State Mine area. Any subsequent drilling is addressed separately, where applicable.

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*Table 10-1: Cowboy State Mine Drilling Summary*

| Area | Hole Type | Number | Length (m) | Length (ft) |
|---|---|---|---|---|
| **Red Mountain** | | | | |
| | HQ Core | 15 | 1,967 | 6,455 |
| | Reverse Circulation | 35 | 4,598 | 15,085 |
| | **Total** | **50** | **6,565** | **21,540** |
| **Overton Mountain** | | | | |
| | HQ Core | 13 | 1,395 | 4,576 |
| | Reverse Circulation | 35 | 4,530 | 14,862 |
| | **Total** | **48** | **5,925** | **19,438** |
| **Grand Total** | | **98** | **12,490** | **40,979** |

WRI Geologists logged all core and RC chip cuttings in detail. All core was photographed with rock quality designation (RQD) measured and calculated. 2023 and 2024 core holes were geotechnically logged by WRI Geologists. RC samples were collected using a rotary sampler that provided three samples for each 1.5-m interval. Core and RC samples were sampled and assayed at 1.5-meter intervals. Core samples for 2024 were defined in 3-m intervals except at lithological contacts. All core and RC samples are stored in secure storage facilities and chains of command have been followed through laboratory analysis.

All drill hole collar information, surveys, lithology, alteration, assays, and geotechnical data were entered into the drill hole database (DHDB). WRI geologists have exclusive access to DHDB. Photographs of surface samples, core, and RC cuttings are cross-referenced to drill holes in DHDB. Likewise, certified assay results are also cross-referenced to drill holes in DHDB.

WRI developed and implemented daily safety protocols for drilling, drillers and WRI staff. Daily work plans and safety meetings were held and recorded for each drilling campaign.

## 10.2 Drilling Supporting Mineral Resource Estimates

All drill holes with completed geological logging and assay results available to Odessa Resources at the time of Mineral Resource model construction were included in the resource models.

## 10.3 Drill Methods

Table 10-1 summarizes the drilling at Cowboy State Mine, showing 6,565 m (21,540 ft) of total drilling. To date, WRI drilled 15 HQ core holes for a total of 1,967 m (6,455 ft). WRI drilled 35 RC holes for a total of 4,598 m (15,085 ft).

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## 10.4 Logging

WRI Geologists logged all HQ core. HQ core logging consists of measuring RQD, logging lithology and alteration, photographing all core, and defining samples. Commencing in 2023 WRI enlisted Geotechnical Engineers from WSP to train WRI Geologists to geotechnically log core. WRI Geologists geotechnically logged the 2023 and 2024 core as part of standard logging protocols.

RC cuttings were collected into three splits using a rotary splitter attached to the drill rig. One portion of the RC chips were placed in cutting trays for logging by WRI Geologists. The other sample portions were placed in bags for XRF analysis and for assay. WRI Geologists logged the RC cuttings under 10x binocular microscopes. WRI Geologists logged lithology, alteration, and took photographs of cuttings trayed for each RC hole.

## 10.5 Recovery

The core recovery at Cowboy State Mine is approximately 96%, please refer to Table 10-2. Quantitative RC sample recovery was not calculated. However, drilling records do not identify intervals of complete sample loss. Accordingly, RC recovery cannot be independently quantified from the available records.

*Table 10-2: Cowboy State Mine Core Recovery for 2024 Drilling*

| DHID | TD (m) | Length Cored (m) | Length Recovered (m) | % Recovery |
|---|---|---|---|---|
| HC24-RM023 | 120 | 120 | 116.39 | 96.99 |
| HC24-RM024 | 302 | 302 | 296.69 | 98.24 |
| HC24-RM025 | 101 | 101 | 91.08 | 90.19 |
| HC24-RM027 | 100 | 100 | 89.61 | 89.61 |
| HC24-RM029 | 80 | 80 | 74.45 | 93.06 |
| HC24-RM034 | 150 | 150 | 144.95 | 96.63 |
| HC24-RM035 | 301 | 301 | 297.84 | 99.00 |
| HC24-RM042 | 50 | 50 | 43.6 | 87.20 |
| HC24-RM043 | 150 | 150 | 141.41 | 94.27 |
| HC24-RM044 | 175 | 175 | 173.8 | 99.29 |
| HC24-RM045 | 57 | 57 | 54.2 | 95.00 |
| **Total** | **1,586** | **1,586** | **1,524.02** | **~96%** |

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## 10.6 Collar Surveys

All drill hole collars were surveyed by Laramie Land Surveying out of Laramie, Wyoming who are professional land surveyors. Surveys were collected and reported using the NAD 1983 UTM 13 North projection system.

## 10.7 Down Hole Surveys

Down hole surveys were collected for all drill holes except the 2022 maiden drilling program, which were vertical. The down hole survey data is stored in DHDB and is used in resource models.

## 10.8 Comment on Material Result and Interpretation

Drilling at Cowboy State Mine has been conducted using established exploration methods, with geological logging and photographic records maintained for the drill holes. Diamond core recovery has generally been high, averaging approximately 96% for the 2024 core holes reported in Table 9-2. Quantitative RC recovery measurements were not calculated, although no intervals of complete sample loss were recorded.

In the Competent Person's opinion, the drilling methods, geological logging, survey information, and available recovery records provide an appropriate basis for geological interpretation and support the use of the drilling data in Mineral Resource modeling, subject to the sampling, QA/QC, and data verification assessments presented elsewhere in this Report.

## 10.9 Channel Sampling

From March through August 2025, WRI geologists and geologists from Geosyntec collected 129 channel samples across Red Mountain within the CSM project area.

For each channel sample the location was marked with a metal ID tag and anchored to the outcrop. The location of each sample was collected using a field GPS unit using NAD1983 UTM Zone13 projection. The orientation of the channel sample was marked, geologically logged and photographed. Channel samples, one meter in length, were collected using diamond bladed angle grinders and chisels. The samples were bagged, tagged and stored in WRI’s core storage facility.

The channel samples were submitted to ALS Global labs for assay using ALS method ME-MS81 and ME-ICP06.

## 10.10 Distinction Between The Property And Surrounding Properties

As mentioned above, the Red Mountain Pluton represents the final pulse of magmatic intrusive events associated with the Laramide Anorthosite Complex. The RMP is the only one of these intrusive events bodies to host rare elements in economic abundance. While not completely understood, the prevailing

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hypothesis of rare earth mineral accumulation within the RMP is related to very low free silica, phosphorus, and moisture within the pluton. Therefore, in these conditions, abundant allanite crystals were formed. The similar plutons in the LAC do not share the same geochemistry and therefore, do not host economic grades of rare earth minerals.

## 10.11 Data Sets with All Relevant Metadata

All geological data is stored in the DHDB database with geological descriptions of the sample. Detailed header information is compiled in DHDB for each drill hole.

GIS data is contained on ARR servers with map projections.

## 10.12 Representative Models and Sample Locations

Descriptions of the geological resource model for the CSM area resides in Section 14 below. Model surface geochemical analyses (TREO heat maps), GIS maps and models, and databases are stored on secure data servers within the WRI network.

## 10.13 Exploration Potential

Additional development/exploration drilling is planned to collect drilling data from the top of Red Mountain down into proposed pit locations.

# 11 Sample Preparation, Analyses, and Security

## 11.1 Sample Types

### 11.1.1 Rock Chip

WRI Geologists collect surface rock chip samples from outcrops using rock hammers as part of geological mapping programs. In the field, each sample is assigned a unique sample ID. Locations of samples are recorded using a handheld Garmin GPSMap 66i device. Samples are geologically described and placed in sample bags.

In the office, rock chip samples are photographed and broken into two parts. One part is ground using a pneumatic hammer P100 -180-mesh sieve (0.08 mm) and analyzed using an Olympus Vanta handheld XRF analyzer in triplicate. The other part is prepared for shipment to an external lab (usually ALS) for assay.

Sample collection densities range from 50 m x 50 m up to 200 m x 200 m spacing, depending on the location and rock types being mapped.

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### 11.1.2 Channel Samples

WRI collected 129 channel samples across the CSM area. Each channel sample location was marked with a metal ID tag and anchored to the outcrop. The location of each sample was collected using a field GPS unit using NAD1983 UTM Zone13 projection. The orientation of the channel sample was marked, geologically logged and photographed. Channel samples, approximately one meter in length, were collected using diamond bladed angle grinders and chisels. The samples were bagged, tagged and stored in WRI's core storage facility.

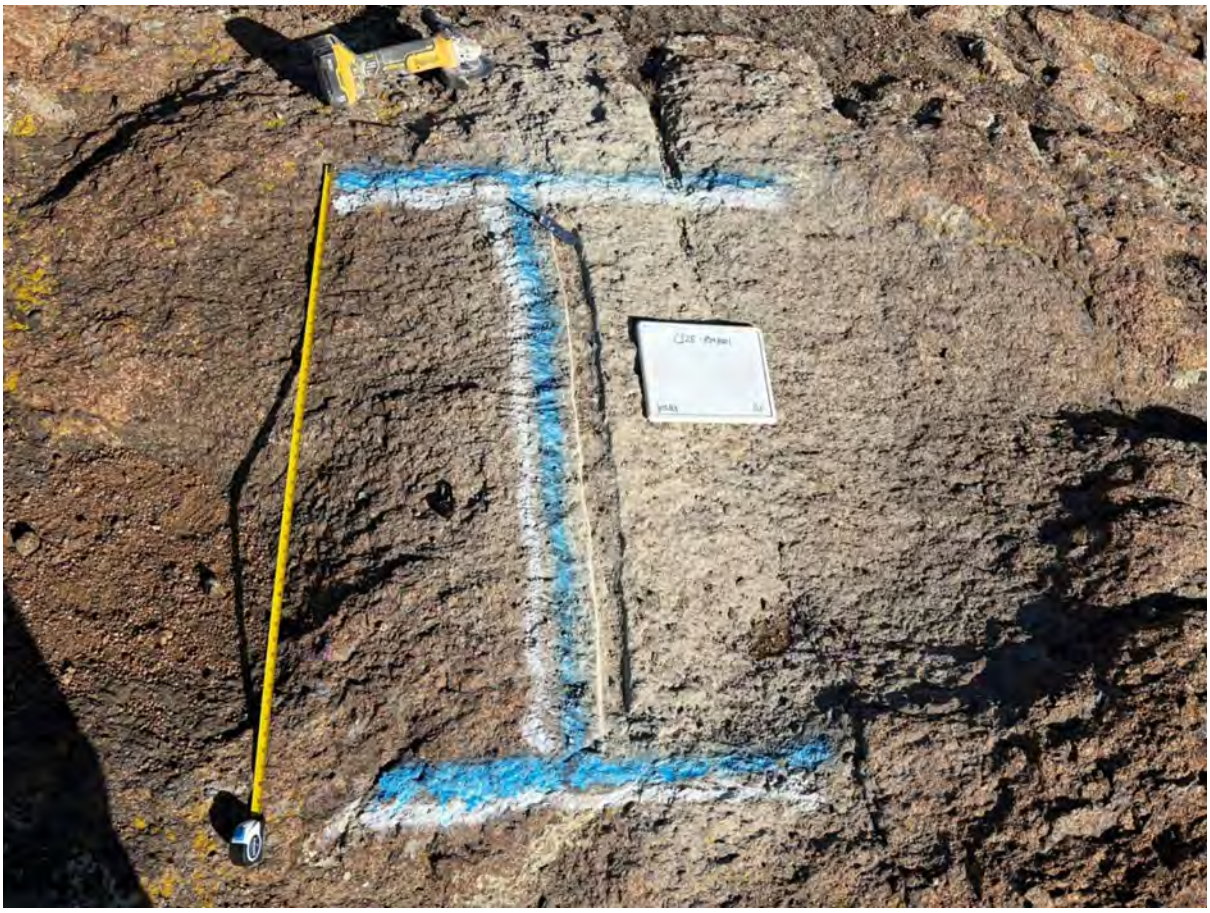

*Figure 11-1: Channel Sample CS25-RM001 (TREO 4,703 ppm)*

The channel samples were submitted to ALS Global labs for assay using ALS method ME-MS81 and ME-ICP06. The assay results were imported into the DHDB database for storage and analysis, ArcGIS for mapping and Leapfrog for resource modeling.

### 11.1.3 Reverse Circulation

Rock chips are collected in 1.5 m (~5 ft) intervals.  RC drilling samples were collected at 1.5 m intervals using a rotary sample splitter. The resulting material was allocated for geological logging, in-house XRF

analysis, and external laboratory assay, with reserve material retained where collected. Each sample interval was given a unique, pre-labeled sample ID that is shared between the identical chip tray, XRF, and lab assay samples. Chip trays and XRF samples have been retained and stored for WRI records and future usage. Rock chip trays and assay samples were retrieved from the drill sites daily to be logged and prepared for shipment, respectively. Samples were stored within locked storage units, or in WRI offices at all times until shipped by bonded carrier to ALS Global labs.

### 11.1.4 Core

Prior to 2024, rock core was divided into 1.5 m (~5 ft) sample intervals, except for when lithologic breaks occurred down hole. As a result, sample intervals never crossed lithology boundaries to ensure assays accurately reflected potential differences in REE mineralization associated with different rock types within the RMP. Each sample was given a unique sample ID and tag, labeled with the drill hole ID number, sample number, and sample interval depths.

Odessa Resources performed a statistical evaluation of core sample lengths of 1.5 m and 3.0 m. The analyses indicated that as long as lithological contacts were sampled discretely, samples lengths of 3.0 m make no statistical influence on resource estimates. Therefore, for the 2024 exploration program homogenous lithology samples were collected using 3.0-m lengths.

## 11.2 Sampling Methods

Sample material from the Cowboy State Mine Project includes rock chip outcrop samples collected by WRI Geologists, RC drilling, and Diamond Drill coring. All sampling methods are appropriate for exploratory work and are considered industry standards. WRI maintains SOP documents for all aspects of sample collection, logging, security and transport. Text in the following sections were extracted from WRI SOP documents.

### 11.2.1 Sample Stages

Throughout the life of the project various types of mapping, logging and sampling have occurred across the CSM area. As described above, WRI has performed extensive mapping and surface geochemical sampling across entire project area. Channel sampling was performed across the Red Mountain within the CSM project boundary. RC and HQ core drilling and sampling has occurred around the perimeter of Red Mountain.

### 11.2.2 Method of Recording and Assessing Sample Recoveries

WRI geologists calculate core sample recovery by measuring lengths of core in core boxes against lengths of core cut for each core run. This data is tabulated and stored with drill hole logs.

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### 11.2.3 Geometry of Mineralization with Respect to Drill Hole Angle

Given the nature of mineralization throughout the Red Mountain Pluton and that REE mineralization occurs from fractional crystallization, mineralization grade and recovery is not biased due to drill hole angle or azimuth.

## 11.3 Sample Preparation Methods

### 11.3.1 Core Sampling Methods

Core sampling will be conducted at 3 m intervals. Core sampling is determined by lithologic breaks. Core samples will never cross lithologic boundaries. Therefore, samples may be shorter than 3 m, and multiple samples may occur within a 3 m interval if multiple lithologies are observed in a short depth. In cases of consistent lithology over a long interval, sample intervals will remain at 3 m. Sample intervals will be measured using a standard tape measure and marked directly onto the core using a paint pen. These intervals will also be marked on each side of the interior of the core box.

Sample tags, provided by ALS laboratories, will be filled out for each interval. The barcodes from the sample booklet will be affixed to the core box within the sample interval using a stapler. Subsequently, the corresponding information for each sample will be written in the sample booklet. For added security, the sample number will be written onto the core at the start of the sample interval with the paint pen.

### 11.3.2 Non-core Sampling Methods

Drilling contractors collect RC samples using a rotary sample splitter to collect four samples from each 1.5m interval. The samples include one sample in chip trays, one small sample for XRF analysis, one larger sample for assay, and a fourth sample for reserve.

WRI geologists retrieve the previous day's RC chips and sample bags from the site. At the warehouse in Laramie, tasks include chip logging and XRF analysis of five samples from various depths of each RC hole. Geologists examine chips with binocular microscope and/or hand lens. The chips may be covered in dust and mud. Rinse them as appropriate to the best of your ability. Log the chips using the chip logging template located in the designated folder. Chips can be logged in the chip tray. When necessary, a few chips from an interval can be placed on a separate plastic boat for more detailed observations before being returned to the chip tray. The logging sheet is designed to capture weathering, oxidation, lithology, alteration, secondary mineralization, any other observed features, and a thorough geologic description of the sample, including grain size, texture, color, and mineralogy.

For each hole, perform XRF analysis at five different depths to obtain preliminary results. Use the smaller XRF bags collected at the site, not the assay sample bags being shipped to ALS, for these analyses. Ensure that the depths are evenly spaced along the hole and divided into five sections. Adjust the depth of analysis according to the specific characteristics of each hole. Please see ARR XRF SOP for detailed instructions.

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### 11.3.3 Sample Preparation, Sub-Sampling

WRI geologists prepare RC and core samples as outlined above. Sub-sampling of core occurs where distinct lithological changes are observed. RC samples are not sub-sampled.

## 11.4 Sample Analysis

### 11.4.1 Analytical and Test Laboratories

For the maiden core drilling program, core samples were sent for assay at AAL in Sparks, Nevada which has ISO 17025 Accreditation and is approved by the Nevada Division of Environmental Protection.

Subsequent rock chip, RC and core samples from fall 2022 through present were sent to ALS Global in Twin Falls, Idaho for processing and sample prep, but were subsequently assayed at ALS Global in Vancouver, British Columbia. ALS Vancouver has an ISO 17025 Accreditation and is also accredited by the Canadian Association for Laboratory Accreditation, Inc. Core samples from the 2023 and 2024 programs were sent to ALS Global in Reno, Nevada for splitting and sample preparation. Like the RC samples, the core samples were then assayed by ALS Global in Vancouver, British Columbia.

### 11.4.2 Analytical Methods

Samples submitted to ALS are analyzed on ICP-MS for ME-MS81d package (includes ME-ICP06 for whole rock analysis).

### 11.4.3 Sample Preparation to Analytical Stages Flow Process

The following items are the RC chip and core sample preparation methods provided by ALS:

- Samples undergo fine crushing to 70%, passing 2 mm.
- Excessively wet samples undergo drying in drying ovens.
- Samples are pulverized up to 250 g to 85%, passing 75 µm.
- Samples marked for duplicates are split using a riffle splitter.
- Samples undergo lithium borate fusion prior to acid dissolution.
- Samples are analyzed on ICP-MS for ME-MS81d package (includes ME-ICP06 for whole rock analysis).

## 11.5 Quality Assurance and Quality Control

Quality assurance / quality control (QA/QC) protocols were similar for RC and diamond core drilling. Certified reference materials (CRM) were inserted at a rate of 1 per 19 samples for both drilling types. Variability in the overall insertion rates occurred due to factors such as shortened holes and other sampling constraints. Details are provided in Table 11-1 and Table 11-2.

*Table 11-1: CRM Insertion Rates for 2024 Diamond Core Drilling*

| QA/QC Type | Number of Each | Insertion Rate |
|---|---|---|
| CDN-RE-1201 | 6 | 1.17% |
| Blank | 11 | 2.15% |
| Duplicate | 12 | 2.34% |
| CDN-RE-1202 | 6 | 1.17% |
| **TOTAL** | **35** | **6.84%** |

*Table 11-2: CRM Insertion Rates for 2024 RC Drilling*

| QA/QC Type | Number of Each | Insertion Rate |
|---|---|---|
| CDN-RE-1201 | 13 | 0.98% |
| Blank | 20 | 1.50% |
| Duplicate | 17 | 1.28% |
| CDN-RE-1202 | 10 | 0.75% |
| **TOTAL** | **60** | **4.51%** |

## 11.5.1 Blanks

### 11.5.1.1 WRI BLANKS

WRI sourced blank material for the Fall 2024 Drilling Campaign from CDN Resource Laboratories in Langley B.C., Canada. The blank material, CDN-BL-10 was prepared using a blank granitic material. Reject ore material was dried, crushed, pulverized, and then passed through a 200-mesh screen. The -200 material was mixed for 5 days in a double-cone blender. Splits were taken and sent to 15 commercial laboratories for round robin assaying.

All blanks analyzed behaved appropriately and did not exhibit potential for contamination, as seen in Figure 11-2 and 11-3.

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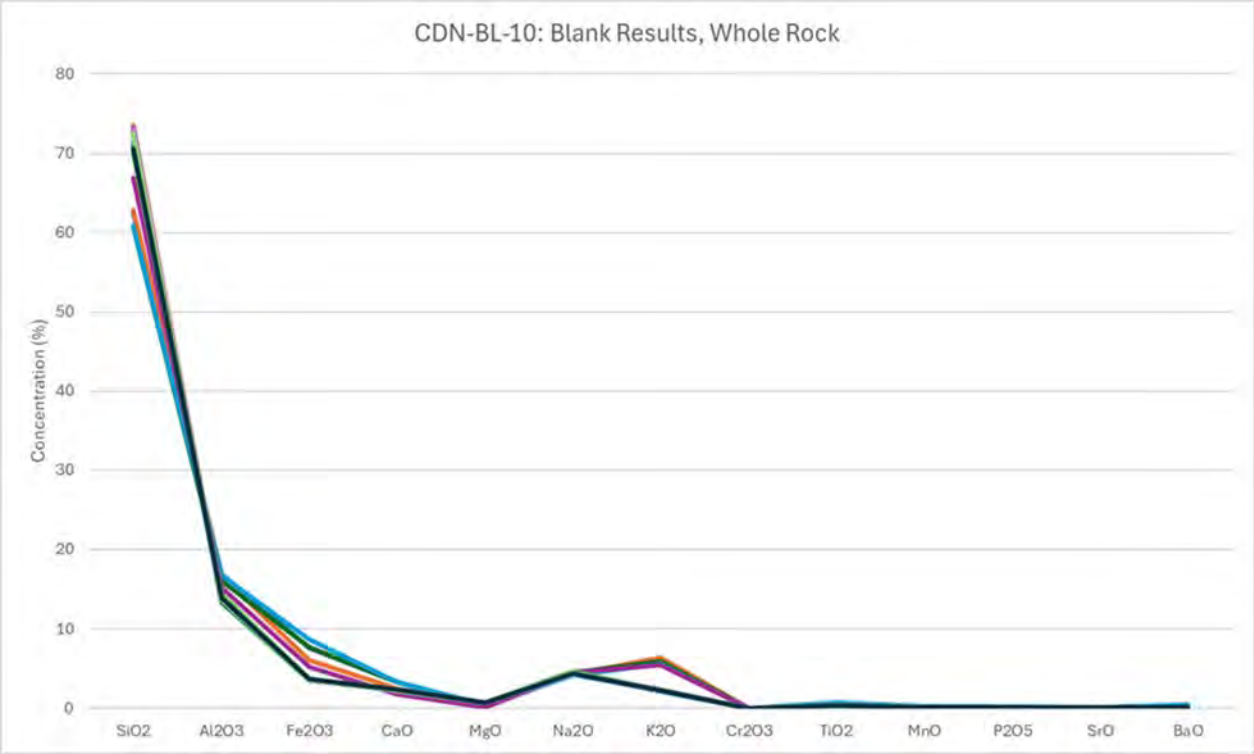


*Figure 11-2: CDN-BL-10: All REE Values for Internal QA/QC, whole rock*

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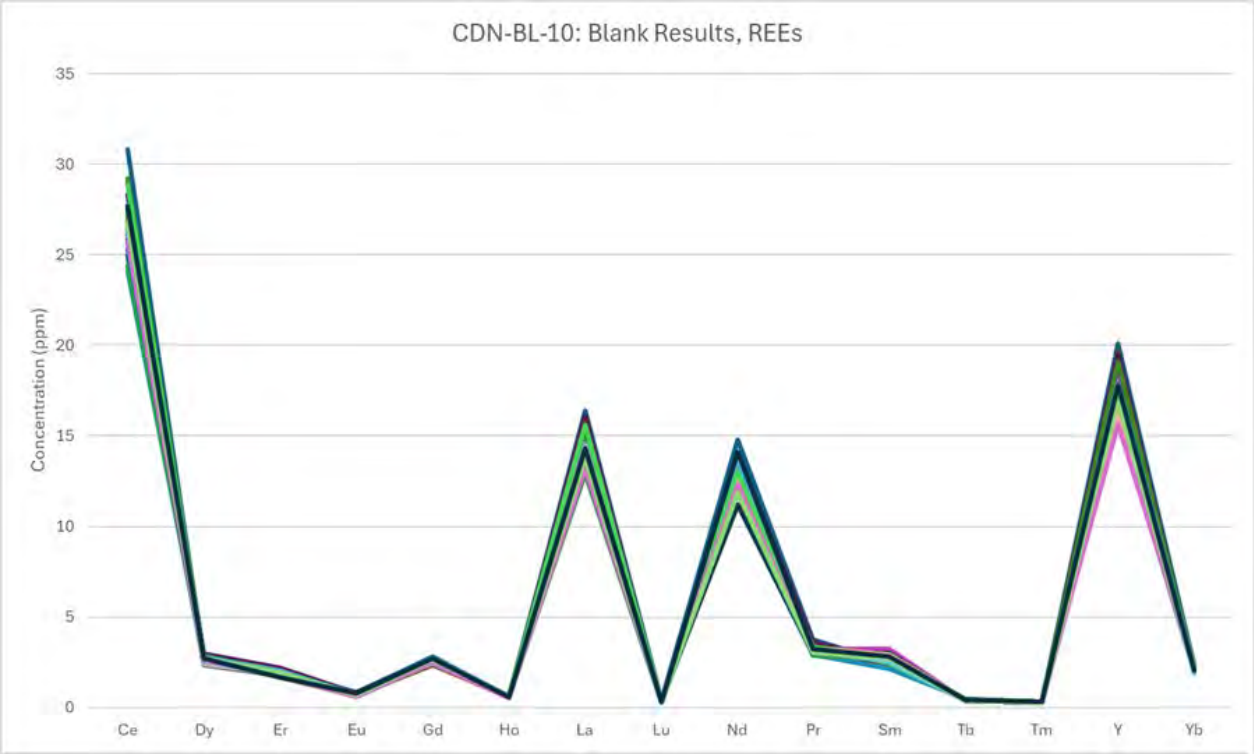


*Figure 11-3: CDN-BL-10: All REE Values for Internal QA/QC, REE analysis*

#### 11.5.1.2 LABORATORY BLANKS

ALS Laboratories in Vancouver, British Columbia, Canada, implemented their own internal QA/QC procedures, including the insertion of blanks into the sample stream. The blanks used by ALS contai*ned low concentrations of REEs (*Figure 11-4) *as well as whole rock compositions (Figure 11-5). Most blanks fell within acceptable tolerances, as indicated by the red dashed lines in the graphs below. Although a few exceeded these tolerances, the results are still considered acceptable.*

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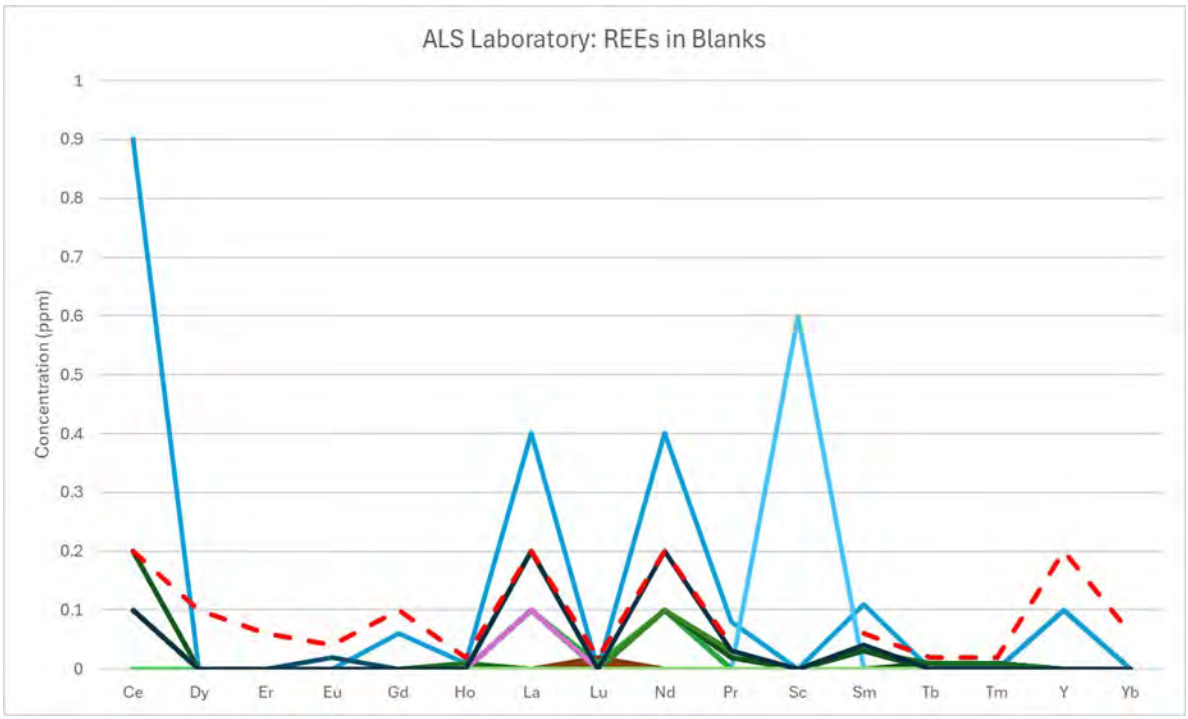


*Figure 11-4: ALS Blanks: REE Values*

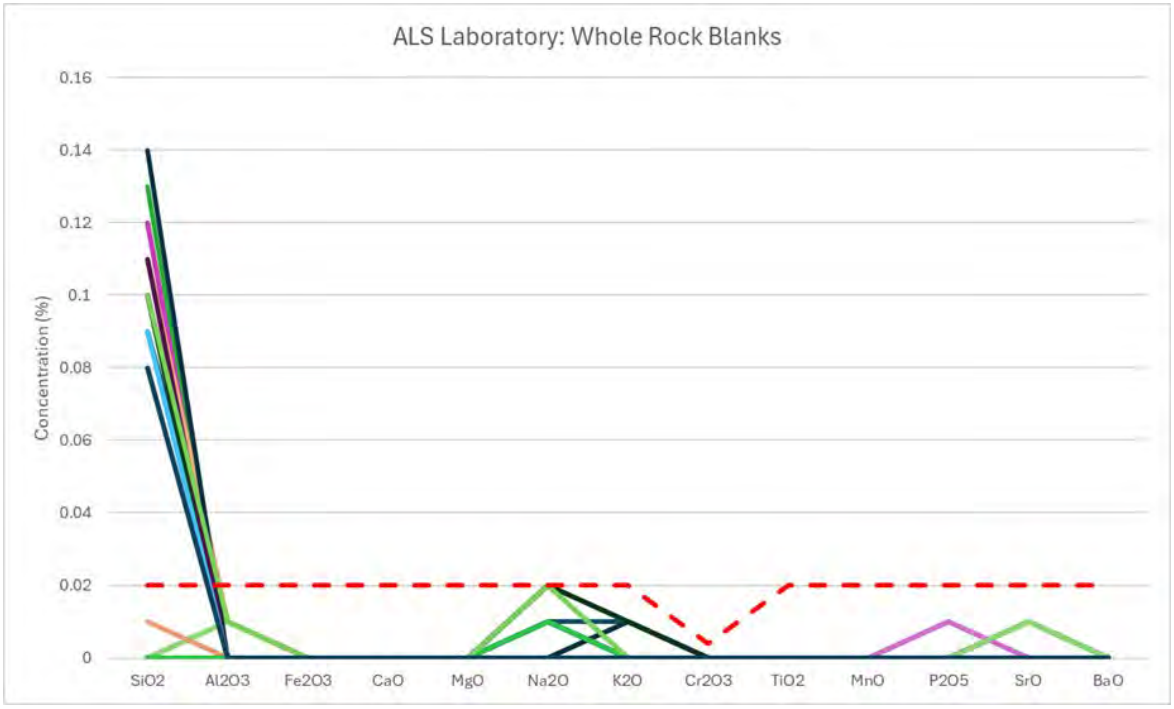


*Figure 11-5: ALS Blanks: Whole Rock Blanks*

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## 11.5.2 Duplicates

### 11.5.2.1 WRI DUPLICATES

Riffle splits of coarse rejects were taken as duplicate samples, as identified by company geologists. The results demonstrate that the duplicates exhibit acceptable precision and replication, with minor variance observed at both the higher- and lower-grade ends. A regression curve and $R^2$ factor were calculated for TREE, Ce, La, Nd, and Pr, as shown in Figure 11-6 through Figure 11-8, respectively. The R2 value exceeded 0.99 for all factors and elements, indicating a very high level of correlation in the duplicate samples.

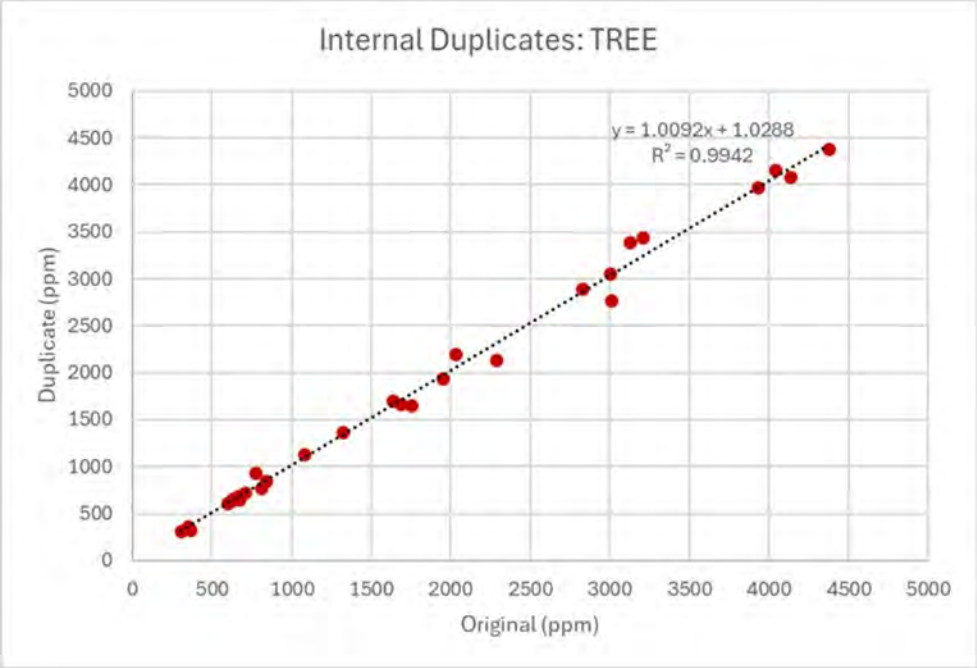


*Figure 11-6: Chart of Internal Duplicates for TREE*

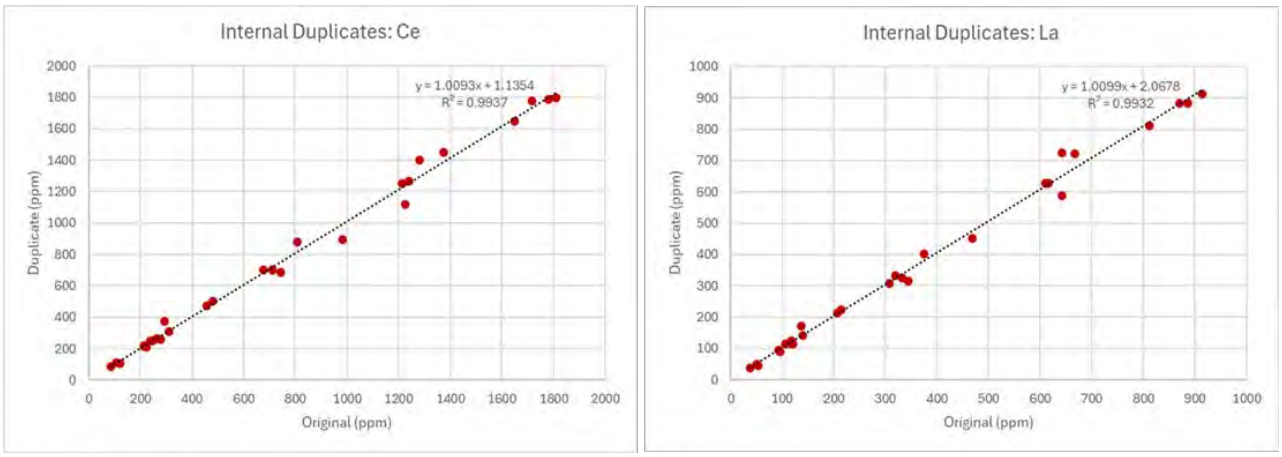


*Figure 11-7: Chart of Internal Duplicates for Ce and La*

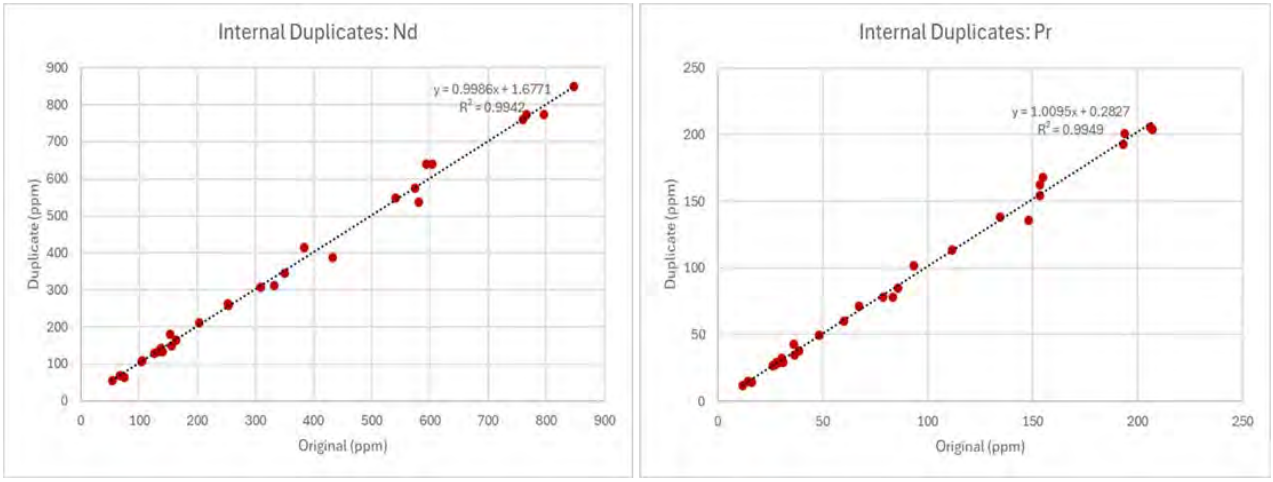


*Figure 11-8: Chart of Internal Duplicates for Nd and Pr*

### 11.5.2.2 LABORATORY DUPLICATES

ALS created internal duplicates from randomized samples for each work order submitted. These duplicates, like those requested by WRI, were prepared from coarse sample rejects using a riffle splitter. WRI plotted a regression curve and R2 factor for TREE shown in Figure 11-9. The $R^2$ value exceeded 0.99 for all factors and elements, further indicating a very high level of correlation in the duplicate samples.

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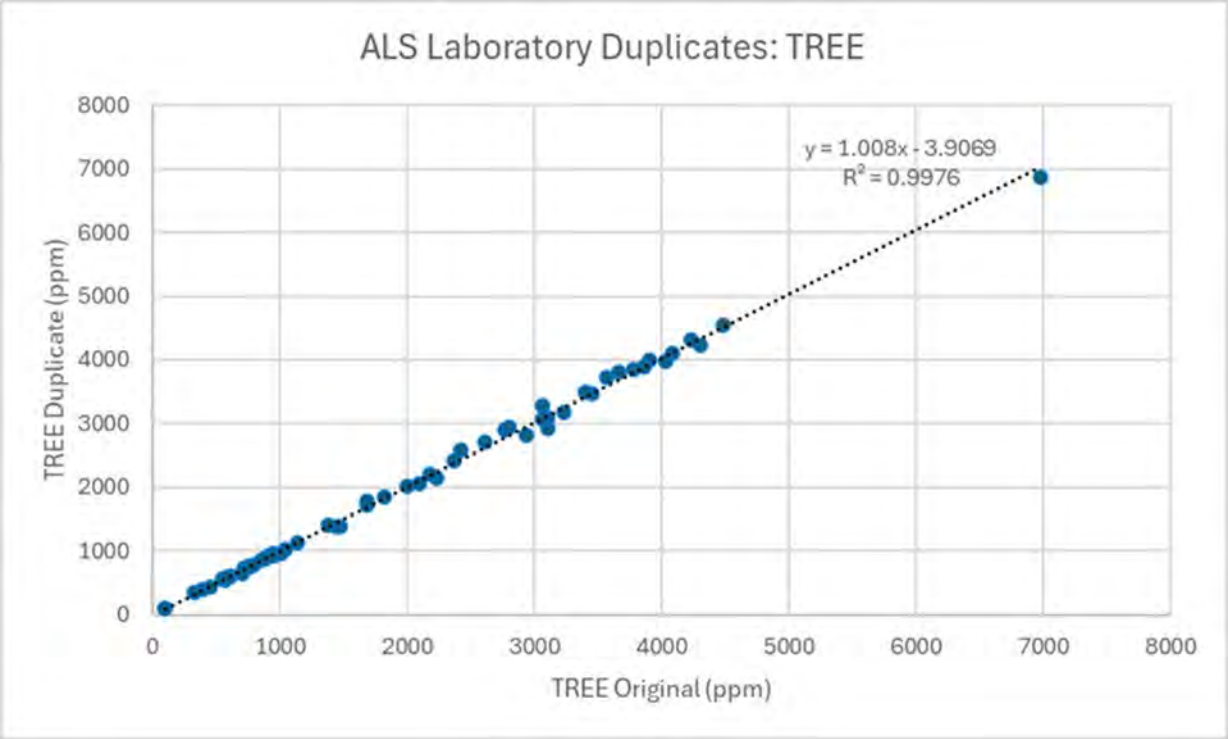


*Figure 11-9: Chart of ALS Duplicates for TREE*

## 11.5.3 Standards

### 11.5.3.1 WRI STANDARDS

Company geologists obtained REE standards from CDN Resource Laboratories in Langley, B.C., Canada. The two standards used were CDN-RE-1201 and CDN-RE-1202. CDN-RE-1201 is most representative of the grades observed in the Red Mountain Pluton, while CDN-RE-1202 represents a slightly higher grade. Most CRM standards from the WRI's internal QA/QC program fell within an acceptable range, except for two minor variations observed in CDN-RE-1201. Results can be observed in Figure 11-10 through Figure 11-13.

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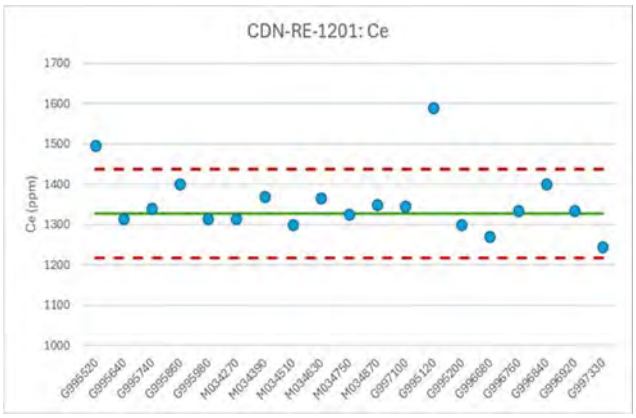


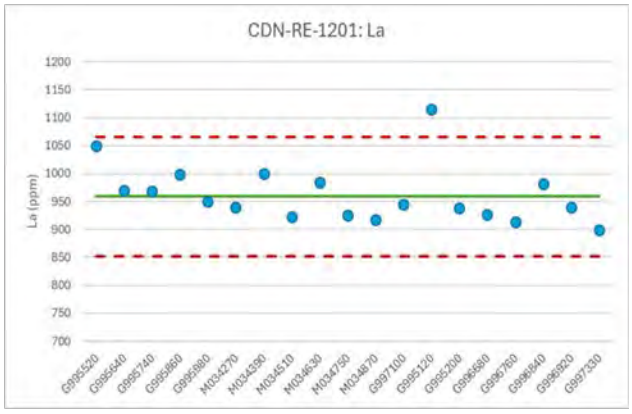
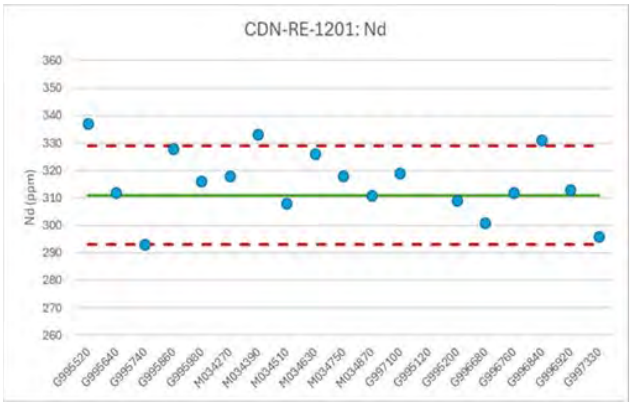




*Figure 11-10: Graphs of Internal CRM Tolerances for Ce and La: CDN-RE-1201*



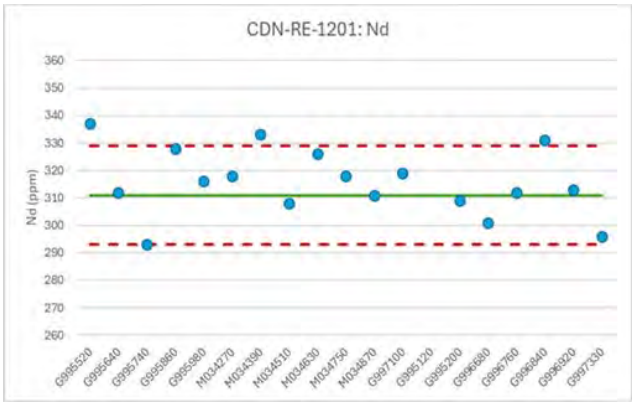
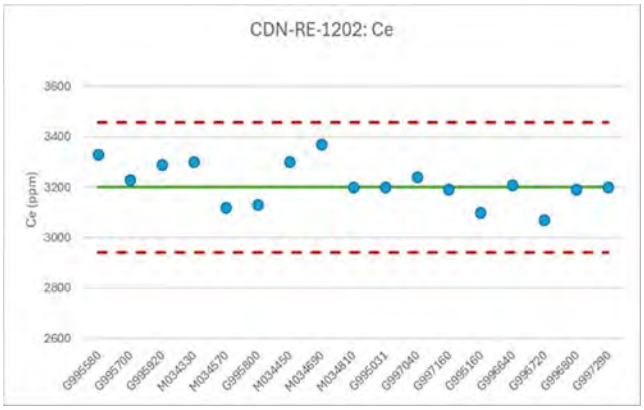




*Figure 11-11: Graphs of Internal CRM Tolerances for Nd and Pr: CDN-RE-1201*



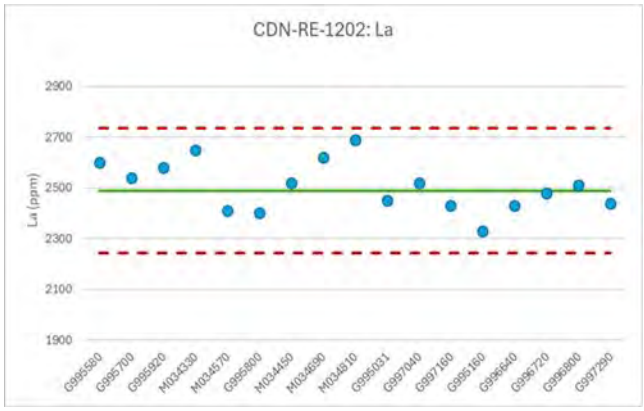




*Figure 11-12: Graphs of Internal CRM Tolerances for Ce and La: CDN-RE-1202*

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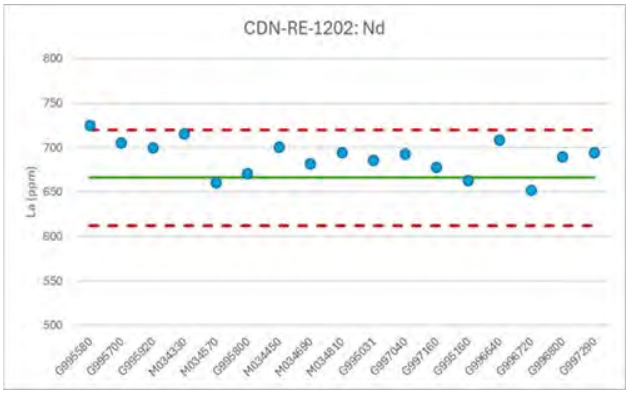


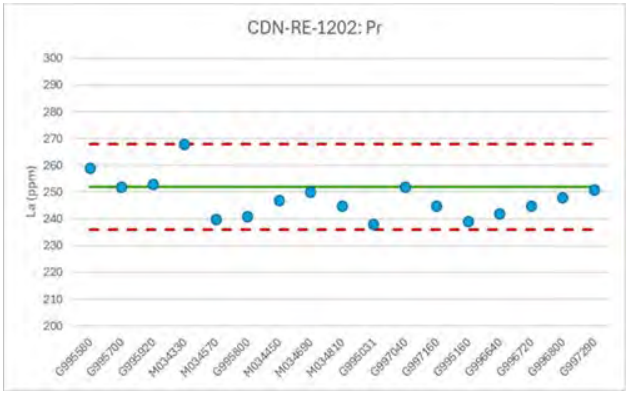
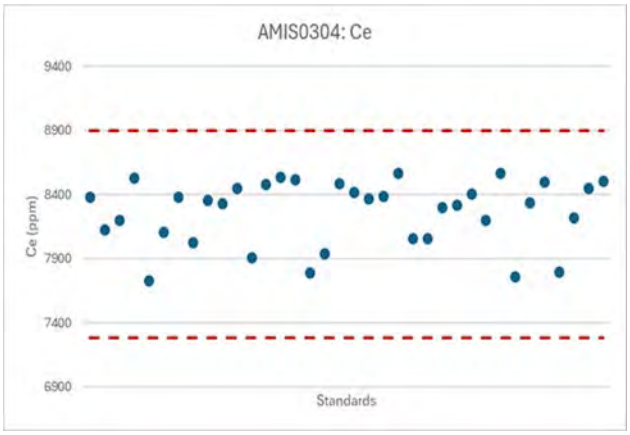




*Figure 11-13: Graphs of Internal CRM Tolerances for Nd and Pr: CDN-RE-1202*

### 11.5.3.2 LABORATORY STANDARDS

ALS also utilized their own rare earth element standards, which were inserted into the sample stream. These included AMIS0304, OREAS 146, OREAS-101b, and SY-5. The majority of REE standards from the laboratory QA/QC fell within acceptable ranges. One laboratory CRM result fell outside the specified acceptance limits; however, the overall laboratory QA/QC results demonstrated generally acceptable analytical performance. Results can be observed in Figure 11-14 through Figure 11-17. The dashed red lines in the following figures represent upper and lower tolerances as provided by ALS.



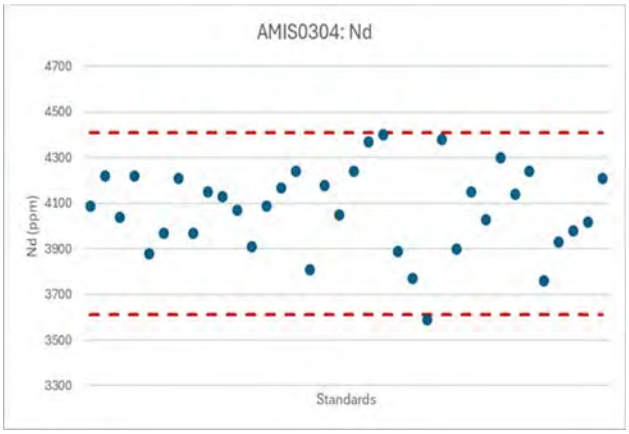




*Figure 11-14: Graphs of External CRM Tolerances for Ce and Nd: AMIS0304*

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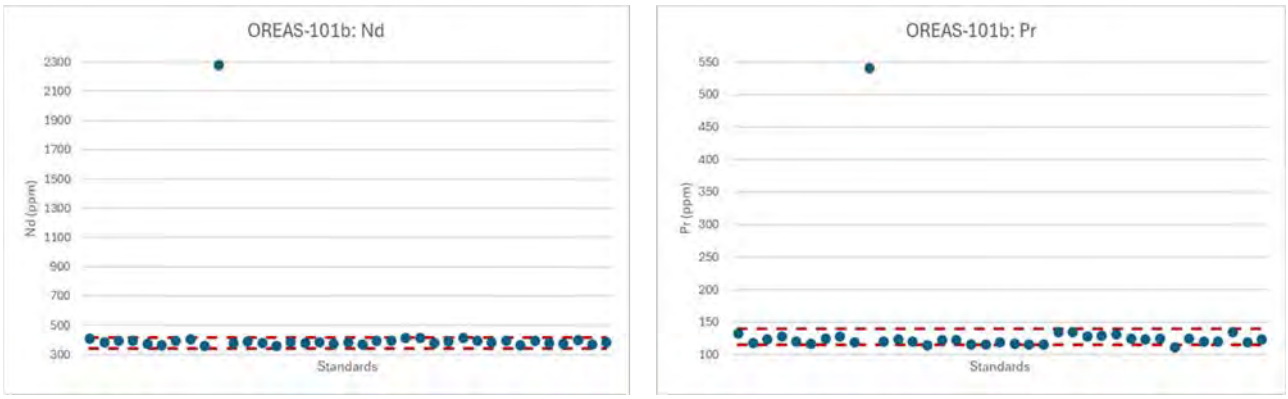


*Figure 11-15: Graphs of External CRM Tolerances for Nd and Pr: OREAS-101b*

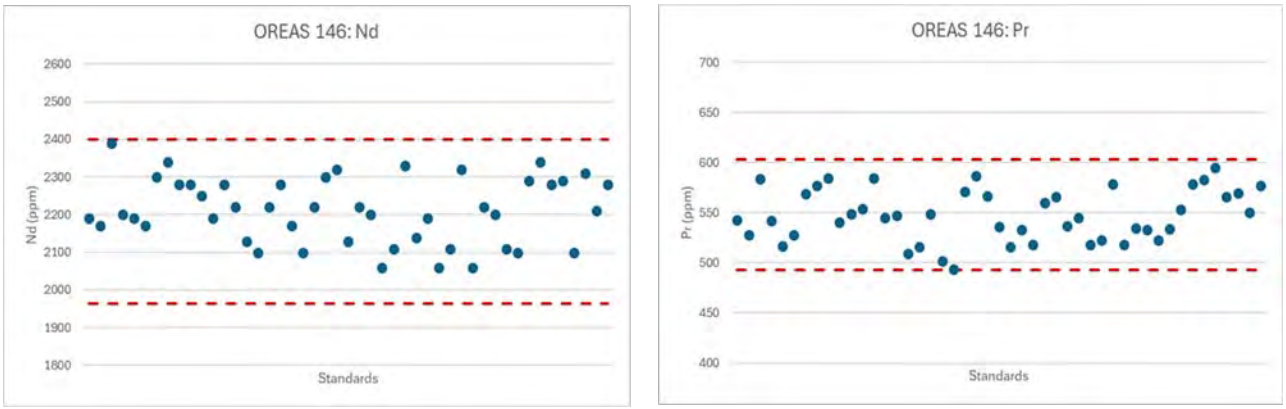


*Figure 11-16: Graphs of External CRM Tolerances for Nd and Pr: OREAS-146*

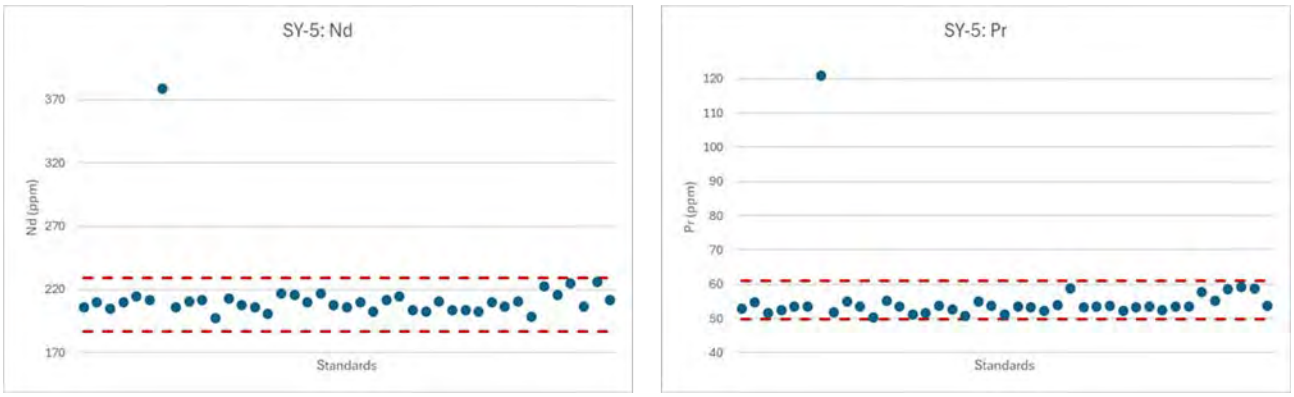


*Figure 11-17: Graphs of External CRM Tolerances for Nd and Pr: SY-5*

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## 11.6 Sample Security Methods

Prior to sample shipping, all drill cores resided in the storage yard which was securely locked when there were no WRI employees on site.

RC chips were stored in a locked shipping container prior shipment.

Core and RC were shipped to the labs via bonded carrier. WRI personnel prepared each shipment and supervised the loading of each shipment.

### 11.6.1 Governance of sampling campaign and process

WRI geologists and management reviewed and updated sampling protocols and procedures prior to each exploration program or season. WRI maintains written safety, logging, and sampling protocols for all aspects of geological exploration and sampling performed at the Cowboy State Mine area.

### 11.6.2 Chain of Custody Security

WRI geologists collect and log drilling samples on a daily basis when they are not logged and at site. Surface geochemical samples and channel samples remain in the possession of WRI geologists while in the field. All samples are transported to WRI's secure storage facilities in Laramie, Wyoming. All samples are cataloged and sample manifests prepared prior to shipping for analysis. All samples are securely boxed or bagged, wrapped and shipped using a bonded shipper. ALS has performed analytical services for WRI since 2022. ALS maintains strict internal chains of custody.

### 11.6.3 Retention Policy and Storage of physical samples

ALS has split core for WRI since 2022. All split core not used for analysis is returned to WRI and stored in WRI's secure storage facilities in Laramie, Wyoming. ALS returns sample pulps for all analytical samples WRI. These are stored in locked cabinets at the WRI warehouse.

WRI plans on keeping split core and pulp samples indefinitely.

## 11.7 Density Determination

Nagrom Labs in Perth, Australia, performed hydrostatic testing on 10 core samples to determine the specific gravity of the Cowboy State Mine core. Specific gravity was determined for untreated and wax-impregnated samples. Table 11-3 summarizes the results of the hydrostatic testing.

*Table 11-3: Specific Gravity Determination*

| Sample ID | Bag No. | Mass (kg) | SG | SG RPT | SG (Wax) | SG (Wax) RPT |
|---|---|---|---|---|---|---|
| HC22-RM002 | 1 | 0.5 | 2.68 | | 2.69 | |
| HC22-RM002 | 3 | 0.49 | 2.67 | | 2.64 | |
| HC22-RM003 | 5 | 0.31 | 2.66 | 2.68 | 2.65 | 2.64 |
| HC22-RM003 | 7 | 0.38 | 2.71 | | 2.75 | |
| HC22-RM003 | 9 | 0.31 | 2.68 | | 2.65 | |
| HC22-OM003 | 11 | 0.59 | 2.79 | 2.79 | 2.78 | 2.77 |
| HC22-OM003 | 13 | 0.4 | 2.69 | | 2.67 | |
| HC22-OM003 | 15 | 0.37 | 2.7 | | 2.7 | |
| HC22-OM004 | 17 | 0.37 | 2.72 | 2.71 | 2.69 | 2.7 |
| HC22-OM004 | 19 | 0.35 | 2.68 | | 2.66 | |
| Wt. Avg. | | 4.05 | 2.7 | 2.74 | 2.69 | 2.72 |

### 11.7.1 Basis of assumptions made

Overall, the range of specific gravity values was very low. This is because the rock types at Cowboy State Mine are very homogeneous. Based on the available hydrostatic measurements, a specific gravity of 2.70 was adopted for Mineral Resource tonnage estimation. The applicability of this value across the modeled lithologies is addressed in the Mineral Resource estimation methodology.

### 11.7.2 Wet Sampling

Wet density values are shown in Table 11-3.

### 11.7.3 Dry Sampling

Dry density values are shown in Table 11-3.

### 11.7.4 Material Zone Density Estimates

The rock types at Cowboy State Mine are very homogeneous primarily composed of QCM and BHS lithotypes have similar densities. Density of rock materials do not vary by zone.

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## 11.8 Bulk Sampling or Trial-Mining

### 11.8.1 Location of Samples

WRI obtained a license to explore by dozer in the CWM project area from the WDEQ-LQD. WRI contracted with Buckley Explosives to drill and blast the test pit and Superior Contracting to excavate, crush and haul material from the test pit. The CSM test pit is in T22N, R71W in the SESE quarter-quarter of Section 25, in Albany County, Wyoming, Figure 11-18.

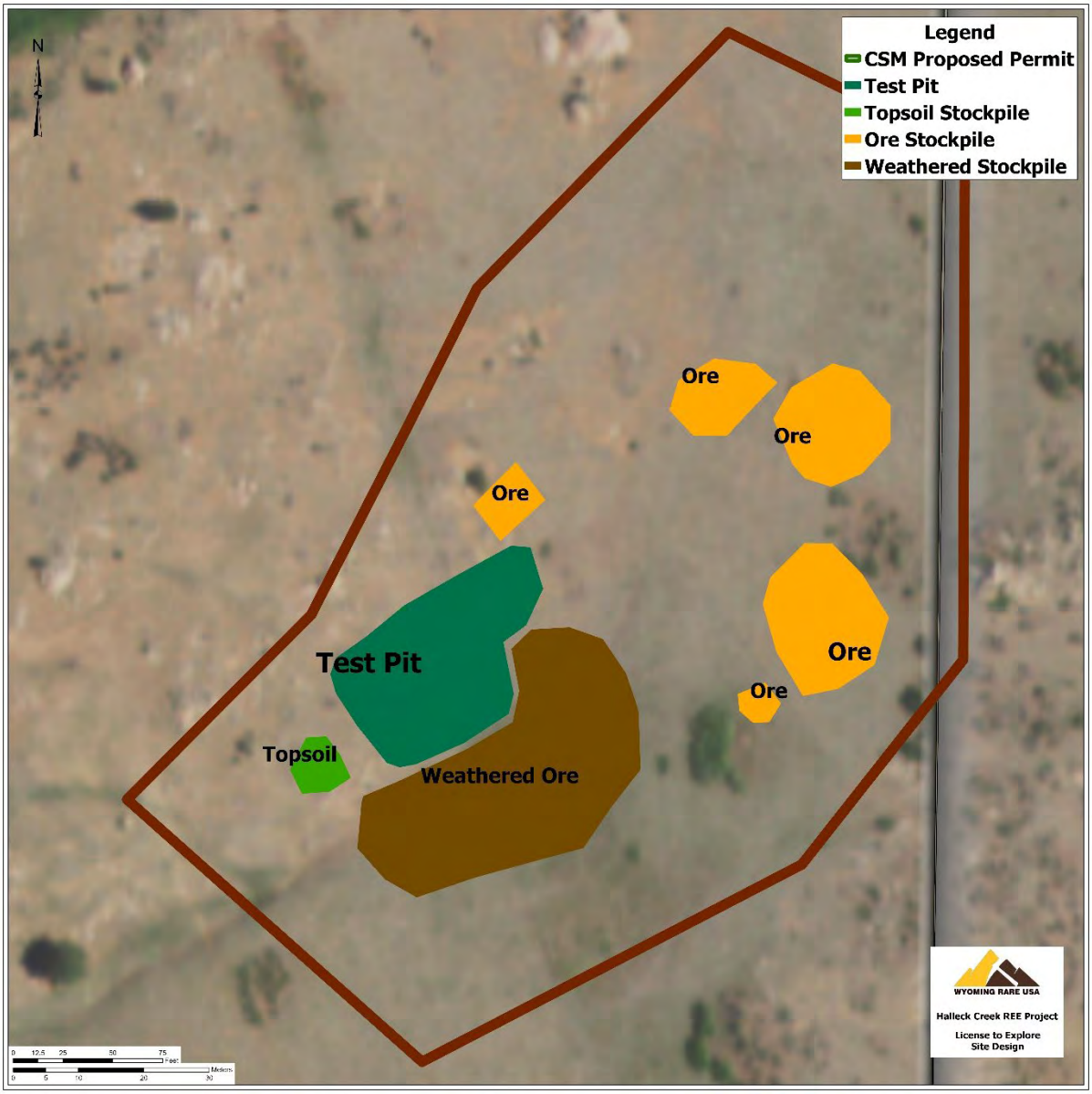


*Figure 11-18: CSM Test Pit Layout*

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### 11.8.2 Size of Samples, Spacing, Distribution

The CSM Test Pit covers approximately 629 m2 (0.16 acres). 2 benches approximately 4 meters in depth were excavated from the pit. The upper bench consisted of weathered ore material and the lower bench consisted of fresh ore material. Approximately 5,430 tonnes of weathered ore were excavated and stockpiled, while approximately 3,080 tonnes of fresh ore were excavated and crushed.

Approximately 14.9 tonnes of fresh ore were bagged and shipped to various vendors for comminution testing and downstream processing through the CSM flowsheet, Table 11-4.

*Table 11-4: Shipped Ore from CSM Test Pit*

| **Shipped Mass** | | |
|---|---|---|
| **Vendor** | **Actual (kg)** | **Actual (t)** |
| FLS | 7,891 | 7.9 |
| Loesche | 4,746 | 4.7 |
| DISA | 1,125 | 1.1 |
| Corem | 1,130 | 1.1 |
| **Total** | **14,891** | **14.9** |

### 11.8.3 Mining Method and Treatment

Superior contracting used two John Deere backhoes to excavate the ore. The ore was crushed to -55mm x 0mm. Superior hauled approximately 72 tonnes of crushed ore from the CSM Test Pit to the WRI warehouse in Laramie. Approximately 2,357 tonnes of crushed ore remained at CSM as stockpiled material.

### 11.8.4 Degree of Representative Sampletoo the Deposit as a Whole

WRI geologists collected seven stockpile samples from the CSM Test Pit. The average grade of the samples was 4,590ppm TREO. These samples characterize material excavated from the CSM test pit but do not, by themselves, establish representativeness across the entire Red Mountain Mineral Resource area.

## 11.9 Database Management

All drill hole and surface sample data for the Halleck Creek project was imported into the DHDB drill hole database system. The DHDB was written and maintained by Dwight Kinnes, formerly of Highland GeoComputing, LLC, and has been used by various mining companies since 2004. Highland GeoComputing, LLC tailored the DHDB to store and process rare earth element data. Table 10-5 summarizes the records contained in the database extract used for this report. These counts may differ

from cumulative exploration totals where additional sampling or data entry occurred after the database extract was prepared.

*Table 11-5: Data Type and Counts in DHDB*

| Data Type | Number |
|---|---|
| Core Holes | 28 |
| Reverse Circulation Holes | 70 |
| Channel Samples | 44 |
| Surface Samples | 791 |
| HQ Core Assays | 1301 |
| RC Chip Assays | 6636 |
| Blanks (WRI/Lab) | 280 |
| Duplicates (WRI/Lab) | 271 |
| CRM Standards (WRI/Lab) | 345 |

### 11.9.1 Primary Data Elements

A comprehensive suite of data is stored in DHDD for each drill hole. Relational tables in DHDB include header, downhole survey, lithology, alteration, sample descriptions, elemental assays, whole rock assay, and geotechnical logs. External images of dry and wet core, field logs, and assay datasheets are cross-referenced to each drill hole in DHDB.

### 11.9.2 General Database Components

Drill hole, channel samples, trenched and surface sample locations are stored in DHDB using the NAD 1983, UTM Zone 13 coordinate system. WGS 1984 latitude and longitude coordinates are stored as secondary coordinates in DHDB. Lithologic and Assay sample depths are stored in feet and meters.

Assay data is stored in DHDB as elemental data in units of parts per million (ppm).

### 11.9.3 Datasets Recorded

Table 11-5 summarizes the various types of data stored in DHDB.

### 11.9.4 Validation Procedures

DHDB provides secure user access and audit tracking within the database. Assay and QA/QC data are imported directly from certified data supplied by laboratories. Therefore, data entry errors are minimal. Detailed validation queries are applied to the drill hole data to minimize data entry errors.

Validation includes the following.

- Checking for gaps and overlaps in lithology, alteration, and assay data.

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- Cross-referencing total depths of collar and lithologic data.
- Cross-referencing to data dictionaries to restrict data entry to approved values.

Original field logs, core and chip sample photos, certified assay certificates, and other drill hole specific data are stored with DHDB and cross-referenced with each drill hole. This data is directly accessible from DHDB.

### 11.9.5 Audit Process and Frequency

A formal audit of the DHDB database has not been performed.

## 11.10 Quality Management System

### 11.10.1 Standard Operating Procedures

WRI geologists maintain a comprehensive set of Standard Operating Procedures (SOP) for safety, data collection, data logging and information management. These SOP are reviewed and updated as needed prior to exploration projects.

WRI maintains a detailed emergency response plan (ERP) for the CSM project area. WRI personnel review the ERP with all employees and contractors. WRI provides contractors with the ERP, and they are required to keep copies of the ERP while working at site.

### 11.10.2 Audits by Competent Persons

The core material from Halleck Creek was audited by Mr. Paul Dockwiler, CPG, CEM in June 2025.

### 11.10.3 Audits Demonstrating Good Practices

Mr. Paul Dockwiler also reviewed WRI SOP and field procedures in June 2025.

### 11.10.4 Checks and Balances Review Process

A check and balances review has not been performed for the CSM data or database

### 11.10.5 Review of Quality Control Data

WRI performed a comprehensive review of Qa/Qc of assay data as part of each exploration program. The latest Qa/Qc analysis results are shown above.

### 11.10.6 Bias Analysis

A bias analysis has not been performed for the CSM data or database.

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### 11.10.7 Precision Determination

Mr. Alf Gillman performed a statistical analysis of core sample intervals for WRI. Mr. Gillman determined that no statistical differences occurred between core samples of 1.5m in length versus core samples 3.0m in length, within the same lithotype. Upon this review, WRI increased core sample intervals from 1.5m to 3.0m when the lithotype remains constant.

### 11.10.8 External Laboratory Checks

WRI personnel have not performed in person laboratory check for ALS or SGS.

### 11.10.9 Sampling Audit Process

WRI has not performed a specific sample audit for the CSM project.

## 11.11 Competent Person's Opinion on Sample Preparation, Security and Analytical Procedures

ARR Geologists developed and implemented detailed protocols for sample preparation, security, and for analytical QA/QC. Professional laboratories used by ARR also maintain rigorous QA/QC procedures.

The DHDB contains comprehensive storage of drilling and assay data with links to original logs, core and sample images, and certified copies of analytical results. User specific access and audit tracking of changes allows ARR to monitor database manipulation.

In the Competent Person's opinion, the documented sampling, analytical, security, and database management procedures provide an appropriate technical basis for this Pre-Feasibility Study, subject to the QA/QC exceptions and data limitations identified above and the verification assessments presented in Section 11.

# 12 Data Verification

## 12.1 Data Verification by Competent Person

The Competent Person participated in the verification of geological and analytical data collected during the Halleck Creek exploration programs. Verification activities included reviewing geological descriptions against core and RC cutting photographs, monitoring analytical results through the ALS laboratory information management system (LIMS), and reviewing drill-hole strip logs integrating geological descriptions and assay results. These activities provided checks on the consistency of geological logging, sample information, and analytical data used in subsequent geological interpretation and Mineral Resource estimation.

## 12.2 Competent Person's Opinion on Data Adequacy

In the Competent Person's opinion, the geological, sampling, analytical, and associated verification data collected and maintained by ARR are sufficiently comprehensive and reliable to support geological interpretation and Mineral Resource estimation at the level of confidence assigned to the reported Mineral Resources, subject to the limitations and qualifications described in the relevant technical sections of this Report.

# 13 Mineral Processing and Metallurgical Testing

## 13.1 Overview

This report provides an update on comminution, concentration, leaching, impurity removal and separation/finishing test work for Cowboy State Mine ore.

Cowboy State Mine Ore was obtained from a test pit created at Red Mountain. The ore was drilled and blasted then processed using a jaw crusher and grizzly to reduce the size to 100% passing 2". Grinding to 100% passing 300 microns was accomplished using a Vertical Roller Mill (VRM) with air classification. The VRM equipment generated less ultra fines, <50 micron, than other tested technology such as rod mill, or HPGR which tested previously.

The ultra-fines, <50 micron, were separated before gravity and magnetic separation steps, as the ultra-fines were not suitable for dry magnetic separation. For the ultra-fines a Wet High Intensity Magnetic Separation (WHIMS) was found suitable but the mass yield and TREO recovery were less than the dry magnetic separation used for the main processing step. This testing provided less overgrinding which translated to a better mass yield, TREO recovery and Upgrade Factor since a larger percentage of the crushed ore was >50 micron and could be processed through the gravity and magnetic separation.

The Concentration testing focused on the specific gravity and magnetic differences between the rare earth bearing mineral, allanite, and the host rock and other minerals. The specific gravity for the minerals of interest is shown in Table 13-1.

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*Table 13-1: Specific Gravity of Selected Minerals*

| Specific Gravity of Selected Minerals | | | | | |
|---|---|---|---|---|---|
| **Mineral Name** | **Formula** | **Specific Gravity** | **Mineral %** | **Float %** | **Sink %** |
| Orthoclase | KAlSi O | 2.56 | 39.3 | 39 | 61 |
| Plagioclase | $Na_{0.5}Ca_{0.5}Si_3AlO_8$ | 2.65 | 29.6 | 69 | 31 |
| Quartz | SiO | 2.65 | 6.56 | 75 | 25 |
| Calcite | $CaCO_3$ | 2.71 | 0.51 | 76 | 24 |
| Blotite | $K(Mg,Fe^{2+})_3(AlSi_3O_{10}(OH,F)_2)$ | 3.09 | 1.22 | 77 | 23 |
| Hastingsite | $NaCa_2(Fe^{2+}{}_4Fe^{3+})Si_6Al_2O_{22}(OH)_2$ | 3.2 - 3.6 | 16.3 | 93 | 7 |
| Epidote | $Ca_2Fe^{3+}{}_{2.25}Al_{0.75}(SiO_4)_3(OH)$ | 3.3 - 3.6 | 0.24 | 94 | 6 |
| Y-Allanite | $(Ce,Ca,Y)_2(Al,Fe^{3+})_3(SiO_4)_3(OH)$ | 3.5 - 4.2 | 1.34 | 95 | 5 |
| Zircon | $ZrSiO_4$ | 4.65 | 0.42 | 95 | 5 |
| Ilmenite | $FeTiO_3$ | 4.72 | 0.65 | 96 | 4 |
| Hematite | $Fe_2O_3$ | 5.25 | 0.88 | 97 | 3 |
| Total | | | 97.02 | | |

SGS performed a number of gravity and magnetic separation tests along with Mineral Technologies performing gravity spiral and Induced Roll Magnetic Separator (IRMS) testing. Nagrom in Perth Australia conducted Reflux Classifying Concentrator (RCC) testing with a goal of providing superior concentration results at a smaller equipment footprint.

The Extraction testing at SGS tested a sulfuric acid tank leach, sulfuric acid bake and water leach, and counter-current sulfuric acid leach. The sulfuric acid tank leach was found to be superior for simplicity of equipment and dosage of sulfuric acid. The allanite contained in the Cowboy State Mine ore, has experienced metamictisation by being bombarded by gamma radiation from the U and Th present in the ore which has altered the crystalline structure. The Metamict nature of the allanite allows for a low sulfuric acid dosage as compared to other allanite deposits and other rare earth deposits in general. The optimal dosage for the sulfuric acid leach was found to be 400 kg sulfuric/metric ton of concentrate. Other comparable projects are on the order of 1000 kg sulfuric/metric ton of concentrate which is a huge cost benefit for the Cowboy State Mine project.

Impurity Removal testing at SGS went very smoothly with minimal pause or re-work. The test consisted of a hydrogen peroxide addition to oxidize any ferrous iron to ferric ions which resulted in precipitation of the iron at a lower pH than without oxidation. A primary neutralization was tested with the following neutralization reagents: soda ash, sodium hydroxide, limestone, lime, magnesium carbonate and magnesium oxide. The results are as follows:

- Sodium reagents
    - Double salt formation of the rare earths
    - Near complete precipitation
    - Loss of all rare earths to the iron precipitation solids

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- Calcium reagents
    - Significant gypsum formation and precipitation
    - Rare earths notably co-precipitated
    - Loss to the iron precipitation solids.
- Magnesium reagents
    - Magnesium carbonate required higher consumption rate offsetting the reagent's lower unit price.
    - Magnesium oxide favored due to lower consumption rate
        - Requires two step pH adjustment
            - First adjustment pH to 3.15: Iron and Thorium precipitate and solution is filtered to remove solids
            - Second adjustment pH to 5 using magnesium oxide: Aluminum and Uranium precipitate along with rare earths requiring recycling these solids back to the leaching circuit.

### 13.1.1 Background

The ore from the Cowboy State Mine is considered 'low-grade' compared to other projects having a bastnasite, monazite or ionic clay mineral, so a well performing concentration step was paramount to project success. Knowing that the Extraction section would utilize a leaching, acid bake or cracking operation with the dosage based on a "kg of lixiviant per ton of concentrate", the lixiviant cost will be the largest single cost for the operation of the plant. The goal for the Concentration section of the plant was set at a 10X upgrade factor. The other way to measure the success of the Concentration section is the mass yield and TREO Recovery. The mass yield is 6.4% and the TREO Recovery 64.8%, which means that over 90% of the mass can be rejected with a loss of 35% of the TREO.

## 13.2 Test Laboratories

Zenith, previous owner of Cowboy State Mine claims, used Nagrom, a metallurgical facility located in Kelmscott, Western Australia to conduct minor testwork regarding the ore (microscopy, XRD and magnetic separation.

WRI has used the following laboratories.

- SGS, Lakefield, Ontario: mineralogical characterization testing (2022)
- Nagrom: hydrostatic testing for SG, grinding and comminution, magnetic separation, and leach testing. (2022 / 2023)
- Auralia, a metallurgical facility located in Perth WA conducted the following tests / analyses: sighter flotation, bulk flotation testing, wet high intensity magnetic separation (WHIMS) (Falcon C centrifugal magnetic separator), electrostatic separation, WHIMS mags mineralogy, gravity separation and sighter leaching (2023).

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- Auralia subcontracted certain tests to the following laboratories: ALS, Bureau Veritas (BV), Mineral Technologies, Watts and Fisher (2023)
- ALS Global in Perth Australia performed preliminary leach testing. (2023 / 2024)
- University of Kentucky, Dr. Rick Honaker, Principal Investigator (2023 / 2024)
- All the laboratories are independent of WRI. There is no international standard of accreditation provided for metallurgical testing laboratories or metallurgical testing techniques.

## 13.3 Previous Testwork (2022–2023)

### 13.3.1 Overview

Mining claims and mineral leases at Cowboy State Mine have been owned by two entities, Zenith and WRI. Zenith completed minor testwork which included microscopy, semi quantitative XRD, and magnetic separation. WRI conducted more exhaustive testwork which was supervised and directed by Wood in Perth, Australia and is detailed in the following sections...

The following list summarizes laboratories and tests performed as part of Wood's testwork.

- SGS Canada – Feed mineralogy using automated TIMA analyzer on separate samples to the master composite but geochemically similar.
- Nagrom – head grade analysis, comminution, and WHIMS.
- Auralia Metallurgy – direct and reverse flotation testing on ore and WHIMS magnetics, sighter gravity separation, settling testwork.
- Watts and Fisher – pyrophosphoric acid leaching of sighter gravity concentrate and flotation concentrate.
- ALS – assessment of acid and alkali routes for processing WHIMS magnetics and flotation concentrate, mineralogy on WHIMS magnetics.
- Mineral Technologies – HLS and electrostatic separation on WHIMS magnetics
- Bureau Veritas – Falcon C series proxy testing of WHIMS magnetics

The testwork and design conducted by Wood was summarized in two documents, Document No. 206139-0000-DC00-RPT-0001 – Cowboy State Mine Rare Earths Project, Preliminary Testwork Interpretation, December 2023; and Document No. 206076-0000-BA00-RPT-0002 – Cowboy State Mine Rare Earths Project, Desktop Study, Acid Tank Leach Option, December 2023.

The preliminary testwork resulted in a flowsheet consisting of the following.

- Semi-autogenous grinding (SAG) Mill for comminution
- WHIMS for pre-concentration
- Sulfuric acid tank leaching
- Partial neutralization for impurity removal
- Carbonate precipitation to produce a mixed rare earth concentrate for sale

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Different separation strategies were tested on the primary WHIMS concentrate including the following.

- Flotation
- Electrostatic separation
- Gravity separation
- Additional magnetic separation

Preliminary leaching strategies were employed including the following.

- Acid Bake – Water Leach
- High Pressure Acid Leach
- Alkali Bake – Water Leach
- Proprietary phosphoric acid leach

### 13.3.2 Zenith Testwork

Zenith completed the following testwork.

- Townsend Mineral Laboratory: Optical / scanning electron microscopy of four allanite-bearing products
- Townsend Australia: Semi-quantitative XRD analysis
- Nagrom: sizing and WHIMS.

Nagrom performed preliminary processing and metallurgical tests on sample pulps from 87 surface samples and channel samples collected in 2019.

The only available information from this work was reported in a news release dated 11 February 2020.

“Mineral separation by magnetic methods recovered 87% of the REE minerals into 27% of the mass whilst rejecting 73% of the waste material at a crush size of -0.5 mm. The magnetic separation results were from rougher magnetic separation and two scavenger passes. Mineral separation using gravity methods recovered 76% of the REE minerals into 22% of the mass whilst rejecting 78% of the waste material at a crush size of -2 mm.”

### 13.3.3 WRI Testwork

In 2022 and 2023 WRI completed a metallurgical testwork program. There were 648 kg of core samples from four core holes (HC22-RM002, HC22-RM003, HC22-OM003, and HC22-OM004) that were shipped to Nagrom. This testwork was designed and supervised by Wood personnel (Figure 13-1).

- Hydrostatic testing of core to determine SG.
- Mineralogical Characterization (performed by SGS Lakefield).
- Grinding, Comminution and Dewatering.
- Flotation.
- Leaching.
- Magnetic Separation (WHIMS).

- Gravity Separation.

Further explanation of key program modules is provided in the following items:

- Feed mineralogy – undertaken at SGS Montreal using their automated TIMA analyzer on a separate, but geochemically similar, sample to the master composite.
- Nagrom – head grade analysis, comminution, and WHIMS.
- Auralia Metallurgy – direct and reverse flotation testing on ore and WHIMS magnetics, sighter gravity separation, settling testwork.
- Watts and Fisher – pyrophosphoric acid leaching of sighter gravity concentrate and flotation concentrate.
- ALS – assessment of acid and alkali routes for processing WHIMS magnetics and flotation concentrate, mineralogy on WHIMS magnetics.
- Mineral Technologies – HLS and electrostatic separation on WHIMS magnetics.
- Bureau Veritas – Falcon C series proxy testing of WHIMS magnetics.

In late 2023, WRI contracted with the University of Kentucky (UK) to perform additional magnetic and gravity separation experiments. The work focused on Heavy Liquid Separation (HLS) to simulate Dense Medium Separation (DMS) to concentrate the REEs before the leaching step.

WRI is pursuing modifications and improvements to the initial process flowsheet to produce separated rare earth products. These modifications require more robust impurity removal and facilitate WRI's desire to produce a more effective pre-concentration step after grinding.

In addition to the preliminary testwork, WRI commissioned Dr. Rick Honaker of the UK to investigate the impacts of DMS prior to WHIMS.

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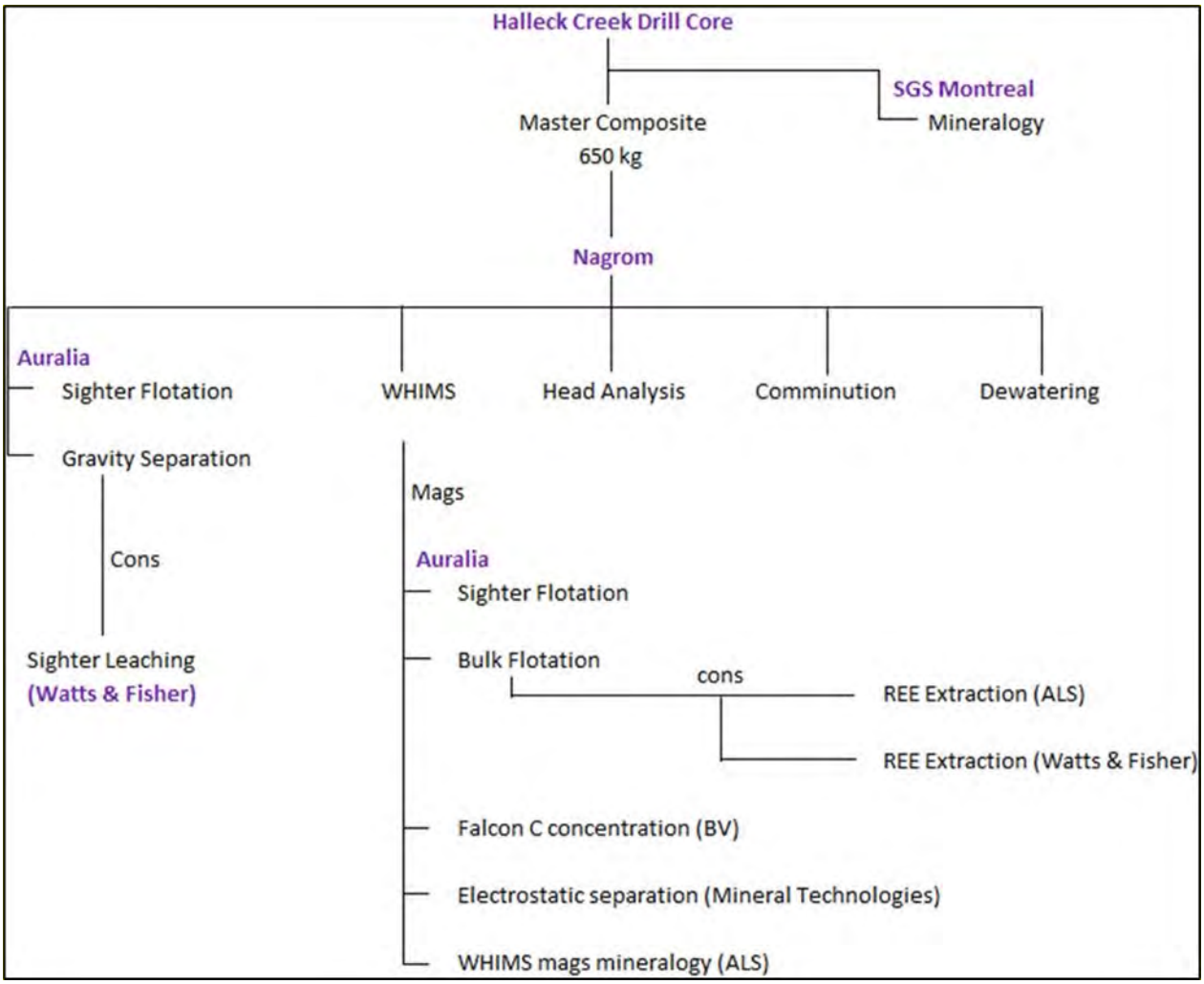


*Figure 13-1: Preliminary Test Work Workflow*

## 13.3.4 Specific Gravity

Nagrom performed SG testing on 10 core samples (Table 13-2). SG was determined for untreated and wax impregnated samples. Overall, the range of SG values are very low.

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*Table 13-2: Specific Gravity of Cowboy State Mine Core*

| Sample ID | Mass (kg) | Specific Gravity | Specific Gravity Repeat | Specific Gravity (Wax) | Specific Gravity (Wax) Repeat |
|---|---|---|---|---|---|
| HC22-RM002 | 0.5 | 2.68 | | 2.69 | |
| HC22-RM002 | 0.49 | 2.67 | | 2.64 | |
| HC22-RM003 | 0.31 | 2.66 | 2.68 | 2.65 | 2.64 |
| HC22-RM003 | 0.38 | 2.71 | | 2.75 | |
| HC22-RM003 | 0.31 | 2.68 | | 2.65 | |
| HC22-OM003 | 0.59 | 2.79 | 2.79 | 2.78 | 2.77 |
| HC22-OM003 | 0.4 | 2.69 | | 2.67 | |
| HC22-OM003 | 0.37 | 2.7 | | 2.7 | |
| HC22-OM004 | 0.37 | 2.72 | 2.71 | 2.69 | 2.7 |
| HC22-OM004 | 0.35 | 2.68 | | 2.66 | |
| Wt. Avg. | 4.05 | 2.7 | 2.74 | 2.69 | 2.72 |

## 13.3.5 Feed Mineralogy

A composite of Cowboy State Mine core was provided by WRI to SGS Montreal for mineralogical investigations to provide guidance for metallurgical testwork. For the mineralogical characterization study, SGS performed:

- Sample preparation, stage crushing to a P80 of 200 to 250 µm and riffling.
- Chemical analysis of the head sample including XRF.
- TIMA-X analysis of the sample to provide mineral identifications; REE deportment.
- Chemical analysis including XRF, ICP-MS to determine the REE, Y, Th, U, Zr, Nb, Ta, and Sc.
- Semi-Quantitative XRD analysis by Rietveld refinement to determine the bulk crystalline composition.
- Electron microscopy to evaluate the REE minerals.
- Mineral chemistry by electron microprobe to determine the major and trace elements of the minerals of interest.
- Davis Tube testwork to assess the presence of ferromagnetic minerals such as magnetite which will need to be removed ahead of WHIMS beneficiation.

### 13.3.5.1 HEAD ANALYSIS

SGS did not undertake an elemental head analysis of the test sample, instead focusing on mineral abundance, deportment and locking characteristics. A full head analysis of the composite is included in summary reports by Nagrom. An abridged summary with significant components is presented in Table 13-3.

*Table 13-3: Head Sample Assays*

| Rare Earth Oxide | Value, ppm | Gangue | Value, % |
|---|---|---|---|
| Y2O3 | 221 | SiO2 | 61.8 |
| La2O3 | 751 | Fetot | 5.11 |
| CeO2 | 1583 | FeO | 5.2 |
| Pr6O11 | 189 | Al2O3 | 15.9 |
| Nd2O3 | 644 | P2O5 | 0.072 |
| SEGs2 | 187 | CaO | 2.87 |
| HREOs3 | 105 | K2O | 6.03 |
| CREOs4 | 887 | Na2O | 4.24 |
| TREO+Y | 3668 | TiO2 | 0.5 |

### 13.3.5.2 DAVIS TUBE RECOVERY

Sub-samples of feed were subjected to Davis Tube Recovery (DTR) assessment to determine if significant magnetite or other ferromagnetic minerals were present to an extent that would require insertion of LIMS ahead of WHIMS. Table 13-4 presents the results of this analysis which indicates very minor presence of ferromagnetic minerals are present at coarse grind sizes, decreasing as the iron minerals are liberated from coarser gangue minerals. Based on these results, a LIMS stage is not warranted.

*Table 13-4: Particle Size and Mag Yield*

| Particle P80 Size (µm) | Magnetics Yield (%) |
|---|---|
| 604 | 0.8 |
| 116 | 0.3 |
| 58 | 0.2 |
| 41 | 0.1 |
| <20 | 0.1 |

### 13.3.5.3 MINERAL ABUNDANCE

Detailed mineralogy and geology are described in Section 5.5.5. Relative mineral abundance for the test sample is presented as Figure 13-2.

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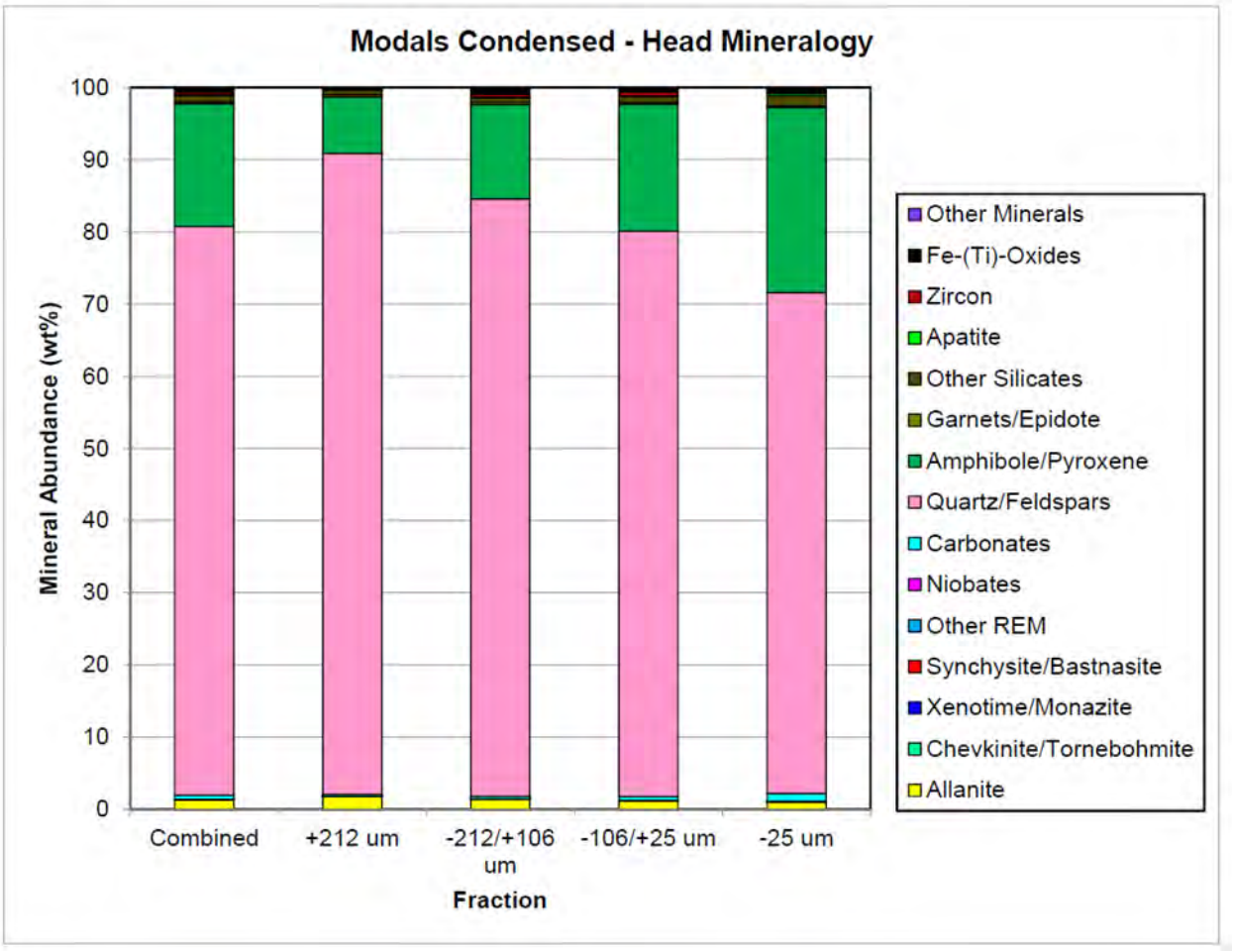


*Figure 13-2: Mineral Abundance by TIMA-X Analysis*

The primary minerals at Cowboy State Mine consist of feldspars (orthoclase and plagioclase predominantly), quartz, amphibole, garnets, and biotite. Quartz and feldspars make up around 75% of total mass, with amphiboles contributing another 16% mass.

SGS determined that allanite is the primary rare earth bearing mineral at Cowboy State Mine. Allanite makes up 1.28% of the total feed mass, with significant bias to the +212-micron fraction, indicating coarse crystal structure. The p80 grain size of allanite was 218 µm while the median grain size was 90 µm. Minor amounts of rare earth bearing minerals, zircon, chevkinite and tornebohmite, were also observed via TIMA-X electron microscopy and electron microprobe analyses. By contrast to allanite, chevkinite / tornebohmite averaged less than 30 µm in size. Trace amounts of fluorocarbonate minerals bastnaesite and synchysite were also detected.

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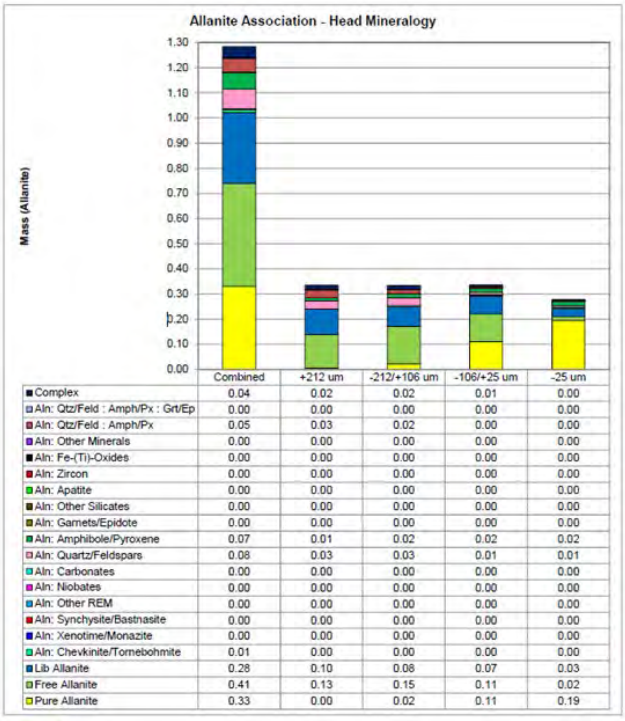
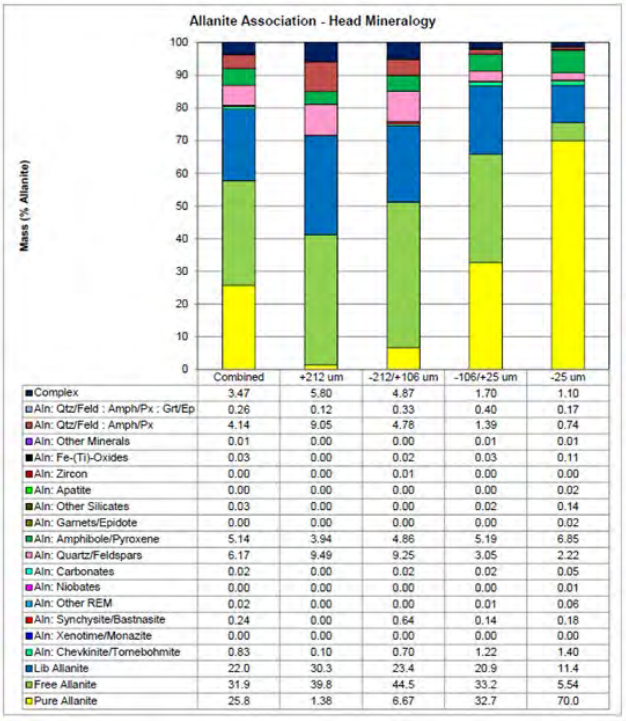
### 13.3.5.4 ALLANITE ASSOCIATION

SGS determined allanite association with matrix minerals in the supplied sample, reporting that approximately 79.6% of all allanite exists as free, pure, or liberated forms (due to grinding), as depicted in Figure 13-3. The remaining 21.4% of allanite is associated with matrix minerals (intergrowths with silicate gangue). The percentage of free, pure, and liberated allanite increases to 86.8% for material exceeding -106/+25 µm in size.




| | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| Complex | 0.04 | 0.02 | 0.02 | 0.01 | 0.00 |
| Aln: Qtz/Feld : Amph/Px : Grt/Ep | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Qtz/Feld : Amph/Px | 0.05 | 0.03 | 0.02 | 0.00 | 0.00 |
| Aln: Other Minerals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Fe-(Ti)-Oxides | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Zircon | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Apatite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Other Silicates | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Garnets/Epidote | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Amphibole/Pyroxene | 0.07 | 0.01 | 0.02 | 0.02 | 0.02 |
| Aln: Quartz/Feldspars | 0.08 | 0.03 | 0.03 | 0.01 | 0.01 |
| Aln: Carbonates | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Niobates | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Other REM | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Synchysite/Bastnasite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Xenotime/Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Chevkinite/Tornebohmite | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lib Allanite | 0.28 | 0.10 | 0.08 | 0.07 | 0.03 |
| Free Allanite | 0.41 | 0.13 | 0.15 | 0.11 | 0.02 |
| Pure Allanite | 0.33 | 0.00 | 0.02 | 0.11 | 0.19 |




| | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| Complex | 3.47 | 5.80 | 4.87 | 1.70 | 1.10 |
| Aln: Qtz/Feld : Amph/Px : Grt/Ep | 0.26 | 0.12 | 0.33 | 0.40 | 0.17 |
| Aln: Qtz/Feld : Amph/Px | 4.14 | 9.05 | 4.78 | 1.39 | 0.74 |
| Aln: Other Minerals | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| Aln: Fe-(Ti)-Oxides | 0.03 | 0.00 | 0.02 | 0.03 | 0.11 |
| Aln: Zircon | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| Aln: Apatite | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Aln: Other Silicates | 0.03 | 0.00 | 0.00 | 0.02 | 0.14 |
| Aln: Garnets/Epidote | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Aln: Amphibole/Pyroxene | 5.14 | 3.94 | 4.86 | 5.19 | 6.85 |
| Aln: Quartz/Feldspars | 6.17 | 9.49 | 9.25 | 3.05 | 2.22 |
| Aln: Carbonates | 0.02 | 0.00 | 0.02 | 0.02 | 0.05 |
| Aln: Niobates | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Aln: Other REM | 0.02 | 0.00 | 0.00 | 0.01 | 0.06 |
| Aln: Synchysite/Bastnasite | 0.24 | 0.00 | 0.64 | 0.14 | 0.18 |
| Aln: Xenotime/Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Chevkinite/Tornebohmite | 0.83 | 0.10 | 0.70 | 1.22 | 1.40 |
| Lib Allanite | 22.0 | 30.3 | 23.4 | 20.9 | 11.4 |
| Free Allanite | 31.9 | 39.8 | 44.5 | 33.2 | 5.54 |
| Pure Allanite | 25.8 | 1.38 | 6.67 | 32.7 | 70.0 |

*Figure 13-3: Liberation of Rare Earth Minerals by Size Fraction*

### 13.3.5.5 ALLANITE LIBERATION AND ASSOCIATION BY TIMA-X

Images of sorted particles provide a visual record of allanite liberation and association with other minerals, presented in Figure 13-4. Allanite grains are colored yellow, and it is evident that a large amount of the mineral is pure or free, with few inclusions of gangue minerals at coarse sizes. There are allanite inclusions within quartz and feldspars (pink color) and occlusions (particle attachment) with amphiboles with a high level of exposure (>50%), which would allow it to be recovered by flotation.

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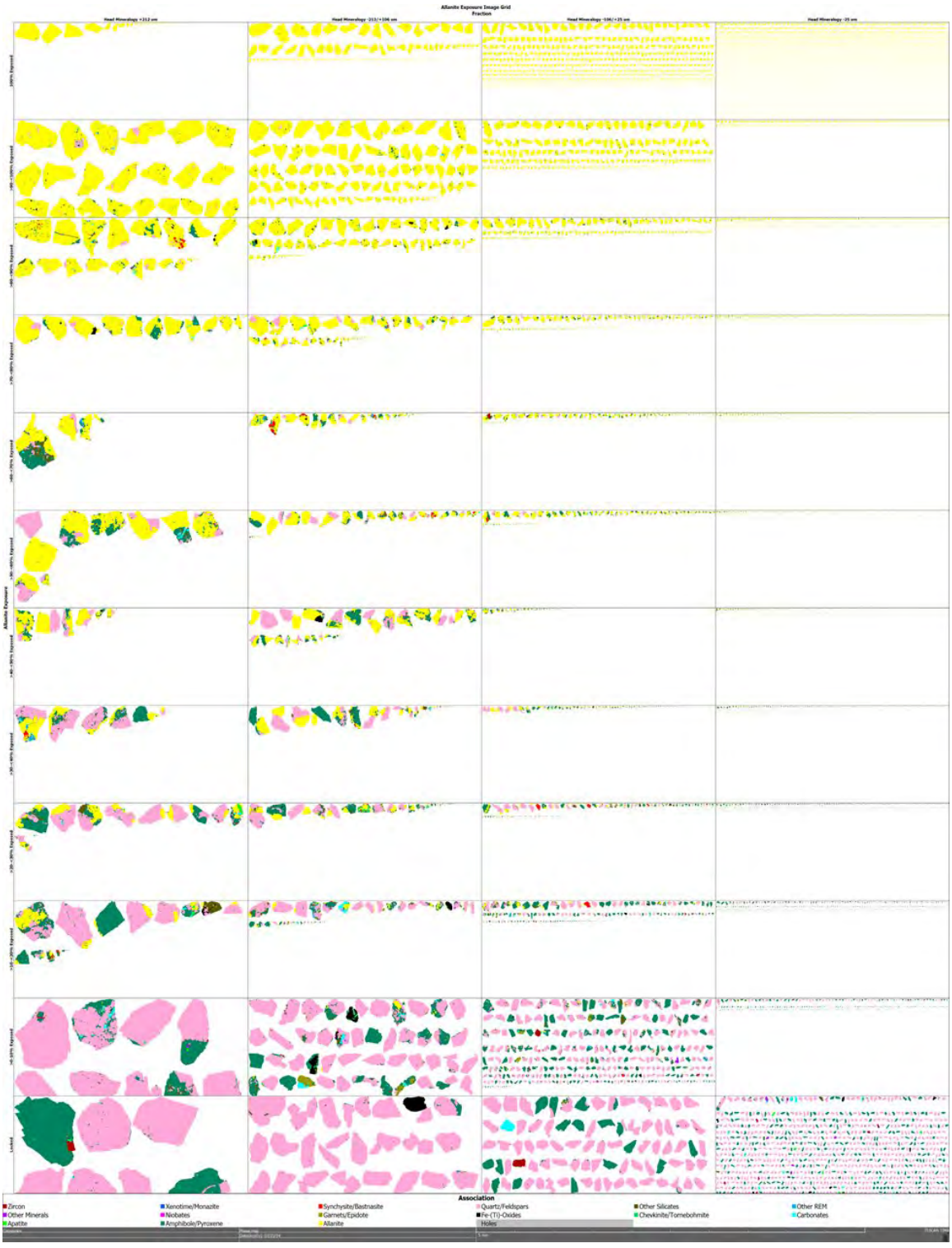


*Figure 13-4: Allanite Liberation and Association*

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#### 13.3.5.6 ALLANITE CHEMISTRY

There were 52 allanite grains that were analyzed with electron probe micro analysis (EPMA). Average REE oxide contents were as follows.

- Ce2O3 at 11.21%
- La2O3 at 5.54%
- Nd2O3 at 4.39%
- Pr2O3 at 1.22%
- Gd2O3 at 0.28%, Sm2O3 at 0.49%, and Y2O3 at 0.27%.
- ThO2 at 0.47% and UO2 at 0.02%

#### 13.3.5.7 SIMILARITY OF ALLANITE TO HASTINGSITE

As beneficiation work progressed, additional mineralogical work was undertaken by Perth mineralogical consultancy Diamantina Mineralogy, who identified the amphibole mineral mentioned by SG as hastingsite, a member of the hornblende family. It was found that hastingsite enriched along with allanite with WHIMS, gravity separation, and flotation. Chemical formulae and physical properties for each mineral are presented as follows.

- Allanite(Y): (Y,Ce,Ca)2(Al,Fe3+)3(SiO4)3(OH)
- Hastingsite: NaCa2(Fe2+4Fe3+)Si6Al2O22(OH)2

Fe2O3 makes up the second highest elemental abundance in allanite at 19.69%, after silica. This is unusually high as web database mindat.org indicates a typical content of 10.5%.

Hastingsite typically contains 8.1% Fe2O3 but 29.0% FeO, the latter being a reduced form of Fe. The mixed Fe(II) / Fe(III) oxidation state of hastingsite is expected to have ferromagnetic properties, akin to magnetite. The high Fe content is important to note when evaluating separation efficiency from other Fe gangue minerals such as hastingsite since total Fe is reported, not by mineral type.

Similarly, both allanite and hastingsite contain high levels of silica (41.11% and 36.38% respectively) so measuring success of gangue rejection based on silica content is also made more complicated.

The two minerals are expected to behave similarly, with both containing Ca and Al. Discussion on challenges encountered with separating these two minerals is presented later.

### 13.3.6 Comminution Test work

SAG Mill comminution (SMC) testing was performed by JKTech, a research laboratory and consultant arm of the University of Queensland, to produce data for the potential sizing of a SAG mill.

The SMC test work results indicate low mineralization competency, which would translate to low specific energy consumption in a SAG mill. Compared to SMC Testing Pty Ltd's (SMCT's) global database of over 2,000 deposits, Cowboy State Mine material was rated in the 14th percentile for competency.

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The Bond abrasion index test returned a value of 0.24, which is below the average of Wood Australia's database. The Bond ball mill work index test result of 15.6 kWh/t is close to the average hardness of the data in Wood's database.

The SMC test results indicate there could be significant energy savings due to the low competency mineralized material, and likely coarse primary grind as indicated by mineralogy. Apart from energy savings, the less abrasive mineralization will lead to reduced wear and tear on equipment and lower maintenance costs.

Sub-samples of ore were subjected to basis comminution testing at Nagrom to allow a preliminary characterization of ore competency, hardness and abrasiveness. The results were used to guide comminution circuit selection and equipment sizes. Results of testing are summarized in Table 13-5.

*Table 13-5: Summary of Comminution Characteristics*

| Parameter | Unit | Value | JKTech Database Percentile (%) | Comments |
|---|---|---|---|---|
| SMC parameters | | | | |
| Axb | | 78.7 | 17.6 | Below average competency |
| Dwi | kWh/m3 | 3.45 | 14 | Below average competency |
| ta | | 0.75 | 21.5 | Above average auto-attritioning |
| Apparent SG | | 2.71 | | |
| Mih | kWh/t | 7.4 | | Low competency |
| Mia | kWh/t | 11.4 | | Average grindability |
| Mic | kWh/t | 3.8 | | Low crushing resistance |
| SCSE | kWh/t | 7.46 | | |
| Bond indices | | | | |
| Ball mill work index | kWh/t | 15.6 | | Average grindability |
| Abrasion index | | 0.24 | | Below average abrasivity |

The SMC test produces data that is used for the sizing of SAG mills, using small samples of quarter core or screened crushed rock. It was originally designed to support Mine-to-Mill studies but has largely replaced the JKMRC Drop Weight test which requires up to 100 kg of core. SMCT has tested ores from over 2,000 different orebodies worldwide.

The following is some commentary on the various SMC test suite parameters.

- Drop Weight Index (Dwi) – the Dwi value of 3.45 kWh/m3 is below average relative to SMCC's database. It indicates below-average ore competency in a SAG mill (low impact resistance, easy to process).
- A x b – the product of the A and b values (impact and rebound energy in the drop weight machine) is a dimensionless value that allows predicting specific energy in a SAG mill. It is derived from the Dwi value and the tested ore-apparent SG. Values of 40 to 60 are considered "SAG friendly," while lower values may indicate the need for in-circuit pebble crushing or feed manipulation to reduce

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competency. Higher values, 70 or more, indicate low competency, and a moderate ball charge will be needed to provide adequate grinding media. In the case of Cowboy State Mine, with a value of 78.7, below-average specific energy demand is expected.

- ta – this is a dimensionless value that describes the degree of auto abrasion of ore particles. Initially, the value was determined from autogenous abrasion of an ore sample in a special mill, but it is now derived only from the SMC test data. Values of 0.4 to 0.6 are considered likely to indicate good power efficiency in grinding, with lower values indicating increasing impairment to grinding efficiency. High values of 70 or more corelate with high A x b products and indicate ease of pebble "skin loss" with abrasion by grinding media.
- The Mi functions are used for the estimation of various grinding operations:
- Mia represents coarse particle grinding down to 750 µm, in conjunction with the Mib (Bond Bwi) for fine grinding to the target product size. SMCC uses these parameters to calculate the specific energy of an ore in a SAG mill.
    - o - Mih is used by SMCC to estimate the specific energy in an HPGR operation. However, HPGR vendors typically do not use this parameter in their calculations, preferring to undertake pilot runs on representative ore.
    - o - Mic describes specific energy for conventional crushing used in SMCC's power equations.
    - o -The three values indicate low ore competency, translating to low specific energy consumption in a SAG mill.
- SAG Circuit Specific Energy (SCSE) index calculated using equations developed by SMCC, reflecting the use of a pebble crusher. The calculated 7.46 kWh/t value indicates below average power demand in a SAG mill.

The combination of values suggest that Cowboy State Mine ore should be suitable for processing in a SAG-Ball mill configuration without the need for pebble crushing and could also be processed in a single stage SAG mill provided the target product size is not too fine, which is determined in primary WHIMS testwork.

It is more challenging to estimate the size of grinding equipment such as HPGRs and vertical roller mills (VRMs) due to a poor correlation with SMC and Bond grindability data, requiring piloting of bulk sample to obtain design parameters. However, the coarse grain structure of ore coupled with low ore competency should translate to high unit capacities.

### 13.3.7 Dense Medium Separation

The University of Kentucky (UK), under the direction of Rick Honaker, Ph.D., performed a series of Heavy Liquid Separation (HLS) tests to evaluate the use of Dense Medium Seperation (DMS) as a unit operation to concentrate the rare earth content in the ore as well as rejecting a large portion of the ore mass (Figure 13-5). UK received a split core from the Cowboy State Mine core drilling campaign and made a rough size reduction using a laboratory scale jaw crusher with a setting of 9 mm gap followed by a roll crusher with a setting of 1 mm gap. The material was then screened on the following size splits: 500, 250, and 150 microns, resulting in the profile below (Table 13-6). Each size fraction was then tested via HLS using liquids of the following specific gravities: 2.7, 2.9, 3.1, 3.4, and 3.5 (Table 13-7).

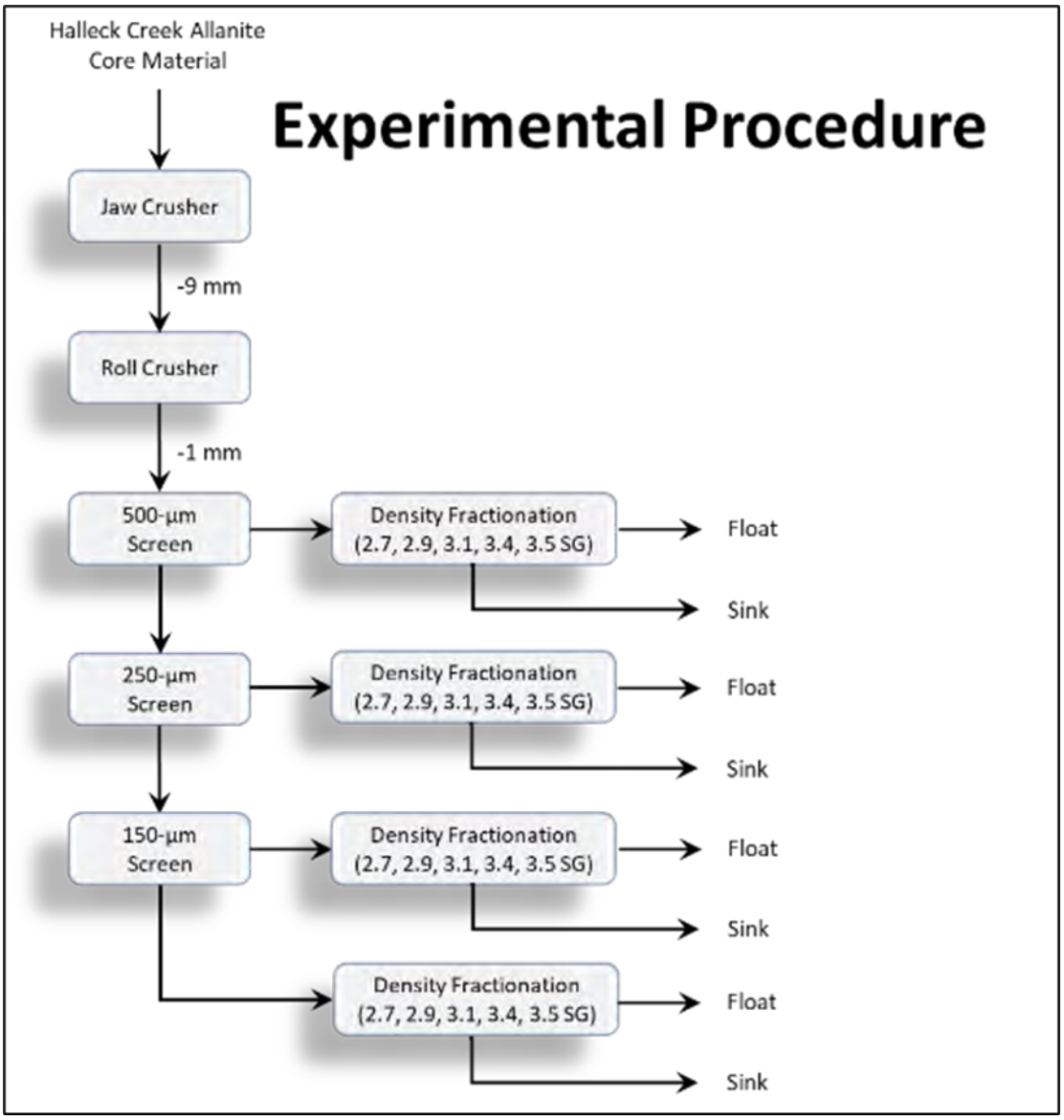


*Figure 13-5: HLS / DMS Test Procedure*

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*Table 13-6: Roll Crusher Product (-1 mm) – Particle Size Distribution*

| **Particle Size, microns** | **Percentage, %** |
|---|---|
| -1000+500 | 42.4 |
| -500+250 | 25.6 |
| -250+150 | 15.9 |
| -150 | 16.1 |
| **Total** | **100** |

*Table 13-7: Particle Size by Density Distribution*

| **Specific Gravity** | | **Incremental Weight (%)** | | | | |
|---|---|---|---|---|---|---|
| **Sink** | **Float** | **-1000 + 500** | **-500 + 250** | **-250 +150** | **-150** | **-1000 + 150 Composite** |
| - | 2.70 | 77.9 | 78.2 | 73.4 | 72.3 | 77.14 |
| 2.70 | 2.90 | 6.4 | 2.4 | 3.3 | 4.2 | 4.59 |
| 2.90 | 3.10 | 6.7 | 4.5 | 2.2 | 0 | 5.18 |
| 3.10 | 3.40 | 4.1 | 5.5 | 7.0 | 10.1 | 50.08 |
| 3.40 | 3.50 | 2.2 | 6.7 | 9.9 | 13.4 | 5.03 |
| 3.50 | - | 2.7 | 2.7 | 4.2 | | 2.98 |
| **Total** | | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |

Two densities were chosen based on the above information for HLS testing, 2.7 and 3.5 SG (Figure 13-6). The float off the 2.7 would result in rejection of approximately 77% of the total mass with close to zero rare earth yield loss. The size fraction chosen to feed the HLS and therefore DMS was -1000 +150 micron material. The fines (<150 microns) represent 16.1% of the total roll crusher output but pose a processing issue in the HLS/DMS systems fines would be screened prior to DMS and processed using WHIMS.

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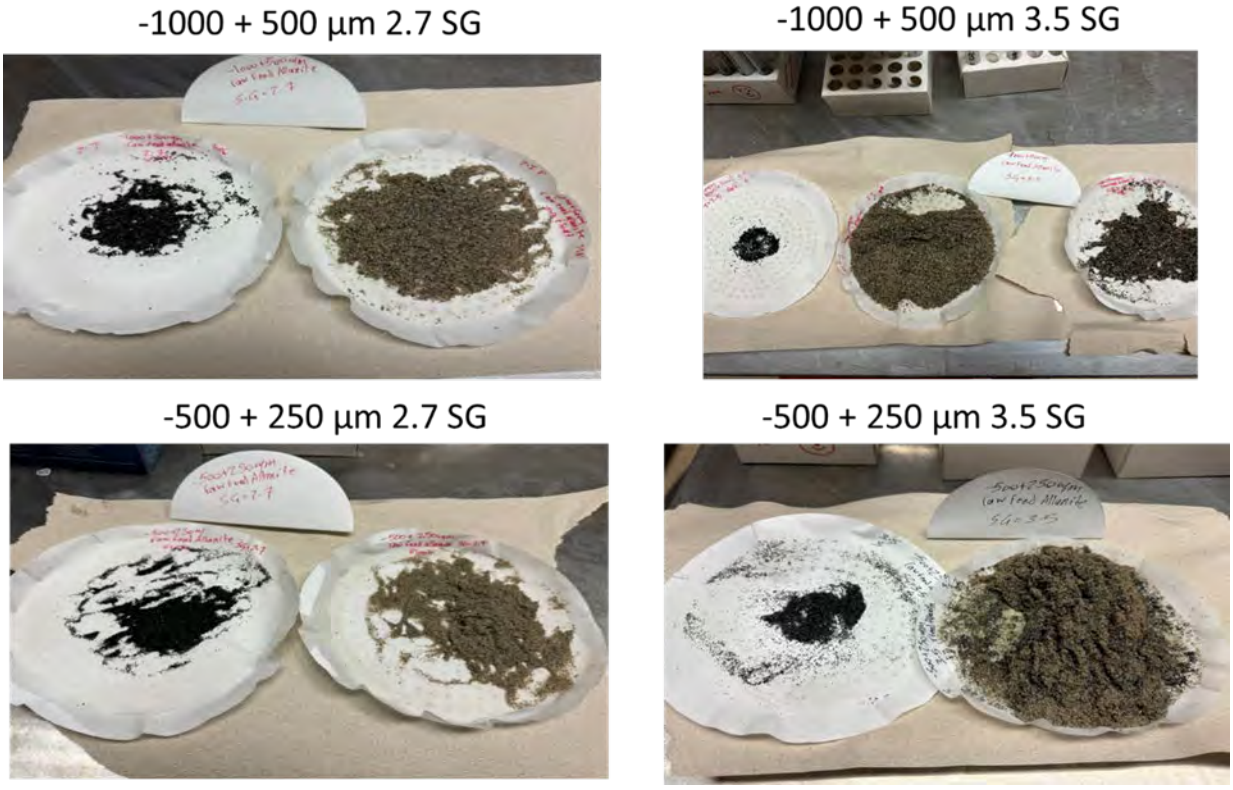


Note: Sink is the black material
University of Kentucky 2024

*Figure 13-6: Sink and Float from HLS Testing*

Figure 13-7 shows TREO increases relative to SG fraction. The results clearly show mineral and TREO separation between lower and higher SG. Table 13-8and

Table 13-9 summarize the results of the HLS testwork. The tables show that more the 76% of gangue material can be rejected using a 2.7 SG. Furthermore,

Table 13-9 shows TREO grade is increased by a factor of 3.8 with a TREO recovery of 87%.

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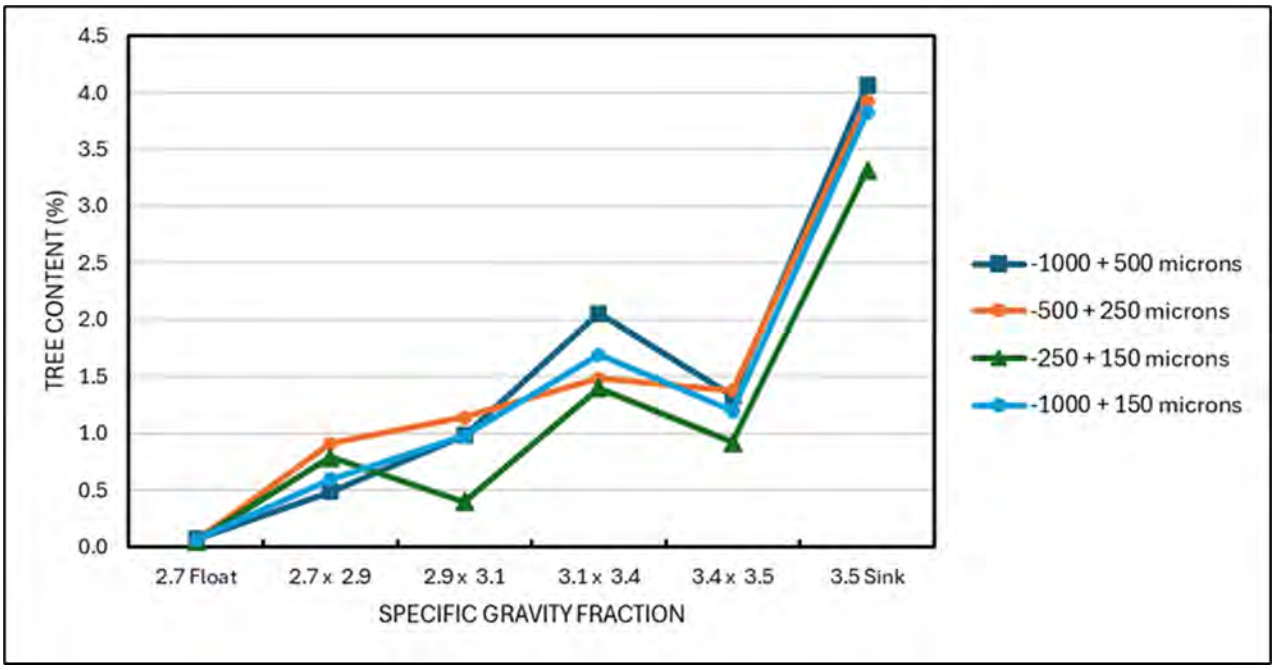


*Figure 13-7: TREO Content vs SG Fraction and Size Fraction*

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*Table 13-8: HLS Testing Results – 1000 x 150 microns*

| -1000 + 150 microns | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specific Gravity | | Incremental | | | Cumulative Float | | | | | Cumulative Sink | | | | | Specific Gravity Fraction | TREE Wt Dist. (%) | Fe Wt Dist. (%) |
| Sink | Float | Wt (%) | Total REE (%) | Iron (%) | Wt (%) | Total REE (%) | Iron (%) | REE Recovery (%) | Iron Recovery (%) | Wt (%) | Total REE (%) | Iron (%) | REE Recovery (%) | Iron Recovery (%) | | | |
| 2.65 | 2.7 | 77.16 | 0.0617 | 0.9435 | 77.16 | 0.0617 | 0.9435 | 12.32 | 13.57 | 100.00 | 0.386 | 5.367 | 100.00 | 100.00 | 2.7 Float | 12.32 | 13.57 |
| 2.7 | 2.9 | 4.58 | 0.5987 | 13.3129 | 81.74 | 0.0917 | 1.6363 | 19.42 | 24.92 | 22.84 | 1.482 | 20.310 | 87.68 | 86.43 | 2.7 x 2.9 | 7.10 | 11.36 |
| 2.9 | 3.1 | 5.17 | 0.9774 | 15.9045 | 86.91 | 0.1444 | 2.4847 | 32.51 | 40.24 | 18.26 | 1.703 | 22.064 | 80.58 | 75.08 | 2.9 x 3.1 | 13.08 | 15.31 |
| 3.1 | 3.4 | 5.05 | 1.6944 | 24.1476 | 91.96 | 0.2296 | 3.6752 | 54.69 | 62.98 | 13.09 | 1.990 | 24.495 | 67.49 | 59.76 | 3.1 x 3.4 | 22.18 | 22.74 |
| 3.4 | 3.5 | 5.05 | 1.1963 | 26.1800 | 97.01 | 0.2799 | 4.8460 | 70.33 | 87.60 | 8.04 | 2.176 | 24.714 | 45.31 | 37.02 | 3.4 x 3.5 | 15.64 | 24.62 |
| 3.5 | | 2.99 | 3.8270 | 22.2416 | 100.00 | 0.3860 | 5.3666 | 100.00 | 100.00 | 2.99 | 3.827 | 22.242 | 29.67 | 12.40 | 3.5 Sink | 29.67 | 12.40 |
| Total | | 100.00 | 0.3860 | 5.367 | | | | | | | | | | | | 100.00 | 100.00 |

*Table 13-9: HLS Testing Results - All Sizes*

| -1000 microns | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specific Gravity | | Incremental | | | Cumulative Float | | | | | Cumulative Sink | | | | | Specific Gravity Fraction | TREE Wt Dist. (%) | Fe Wt Dist. (%) |
| Sink | Float | Wt (%) | Total REE (%) | Iron (%) | Wt (%) | Total REE (%) | Iron (%) | REE Recovery (%) | Iron Recovery (%) | Wt (%) | Total REE (%) | Iron (%) | REE Recovery (%) | Iron Recovery (%) | | | |
| 2.65 | 2.7 | 76.39 | 0.0749 | 1.131 | 76.39 | 0.0749 | 1.1306 | 14.72 | 15.17 | 100.00 | 0.389 | 5.692 | 100.00 | 100.00 | 2.7 Float | 14.72 | 15.17 |
| 2.7 | 2.9 | 4.50 | 0.5705 | 12.764 | 80.89 | 0.1025 | 1.7784 | 21.33 | 25.27 | 23.61 | 1.403 | 20.449 | 85.28 | 84.83 | 2.7 x 2.9 | 6.61 | 10.10 |
| 2.9 | 3.1 | 4.34 | 0.9774 | 15.904 | 85.23 | 0.1470 | 2.4970 | 32.24 | 37.38 | 19.11 | 1.600 | 22.260 | 78.67 | 74.73 | 2.9 x 3.1 | 10.91 | 12.11 |
| 3.1 | 3.4 | 5.84 | 1.4447 | 24.386 | 91.07 | 0.2302 | 3.9012 | 53.96 | 62.41 | 14.77 | 1.782 | 24.125 | 67.76 | 62.62 | 3.1 x 3.4 | 21.72 | 25.03 |
| 3.4 | 3.5 | 5.12 | 1.1880 | 25.823 | 96.19 | 0.2812 | 5.0687 | 69.62 | 85.65 | 8.93 | 2.003 | 23.954 | 46.04 | 37.59 | 3.4 x 3.5 | 15.66 | 23.24 |
| 3.5 | | 3.81 | 3.0983 | 21.440 | 100.00 | 0.3886 | 5.6925 | 100.00 | 100.00 | 3.81 | 3.098 | 21.440 | 30.38 | 14.35 | 3.5 Sink | 30.38 | 14.35 |
| Total | | 100.00 | 0.3886 | 5.692 | | | | | | | | | | | | 100.00 | 100.00 |

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## 13.3.8 Magnetic Separation

WHIMS have been shown to be effective in the separation of rare earth minerals. Certain rare earth minerals have paramagnetic properties that allow separation from non-magnetic minerals (diamagnetic) using WHIMS. These minerals include bastnaesite, monazite, xenotime, synchysite, and allanite, typically being carriers of the four “magnet metals” – neodymium, praseodymium, terbium, and dysprosium in varying ratios.

WHIMS has been tested using Cowboy State Mine material by Zenith and by WRI.

Historical testing undertaken at Nagrom when the Project was known as the Laramie Project under Zenith Minerals indicated that it was possible to achieve high mass rejection of non-magnetics with high allanite recovery to magnetics in batch testing. With four stages of sequential treatment (rougher plus three scavenger stages), a concentrate of 29.5% mass with 88% TREO+Y recovery was achieved at a very coarse grind size of 80%, passing 500 µm. Iron recovery was higher at 93.8% while silica recovery was very low at 23.9%, indicating strong amenability of WHIMS as a primary separation stage for Cowboy State Mine ore.

On behalf of WRI, Wood supervised a thorough WHIMS testing program using Cowboy State Mine core at Nagrom during the 2023 testing program. Primary WHIMS batch testing was conducted to determine the basic responses of ore using WHIMS. A secondary WHIMS program was tested using a continuous WHIMS unit to simulate plant conditions.

### 13.3.8.1 Primary WHIMS

Sub-samples of crushed Cowboy State Mine drill core were subjected to wet rod mill grinding to three P80 grind sizes: 500, 250, and 106 µm. Mineralogy results, reported previously, indicated a high degree of liberation at these grind sizes. Progressive magnetic field strengths of 3,000, 6,000, 10,000, and 17,000 Gauss were applied to establish optimal bulk primary grinding and WHIMS processing conditions.

A plot of cumulative TREO + yttrium grade against recovery is shown in

Table 13-9.

Recovery at 3,000 Gauss is high (50 to 61%) given that this is typically the realm of magnetite and pyrrhotite.

Table 13-9 shows that recovery drops substantially at the finer 106 µm grind size, indicating allanite is becoming liberated and is lost to non-magnetics.

Passing first-stage 3,000 Gauss non-magnetic materials through the WHIMS unit at 6,000 Gauss saw spikes in the TREO + yttrium grade and recovery, which is a more predictable response and supports mineralogical findings of a high degree of allanite liberation. Cumulative recoveries became normalized in a narrow band of 87–91%.

At 10,000 Gauss the stage grade and recovery fell away, which indicated co-recovery of partially locked minerals and less magnetic iron minerals such as goethite and iron feldspars. TREO + yttrium recovery tapered off due to falling grades and stage mass yields. In this stage, allanite was most likely partially locked with silica / silicates.

At 17,000 Gauss, most of the remaining REO + yttrium and iron oxides were recovered, with all three tests returning similar cumulative recoveries of around 93.5%. However, this incremental recovery step had a deleterious effect on cumulative grade, primarily due to the increased addition of lower-grade material, likely to be mostly locked.

#### 13.3.8.2 Secondary WHIMS

Wood selected a primary grind P80 size of 500 µm as optimal from sighter testing as the slight reduction in concentrate grade is more than compensated for by the energy savings at this coarse grind size. This grind size was adopted for continuous WHIMS testing with field strengths of 300 and 6,000 Gauss for rougher and scavenger stages.

For continuous WHIMS operation, 300 kg of ore was ground to a P80 of 500 µm. Initially only rougher and single scavenger stages were adopted, with field strengths of 3,000 and 6,000 Gauss, respectively. The results showed that with only two stages of WHIMS, REO recovery was poor. Wood decided to include two additional scavenging stages to boost yield and recovery. However, overall TREO+Y recovery did not reach the levels achieved in batch testing. Results for the bulk run are shown in Table 13-10.

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*Table 13-10: Bulk Primary and Secondary WHIMS Mass and Elemental Deportment Summary*

| Product | Yield | TREO + Y2O3 | | NdPrO | | SiO2 | | Fe | | Al2O3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fraction** | **%** | **ppm** | **Dist. %** | **ppm** | **Dist %** | **%** | **Dist. %** | **%** | **Dist. %** | **%** | **Dist. %** |
| Primary WHIMS | | | | | | | | | | | |
| Ro Magnetic | 7.6 | 10580 | 23.1 | 2638 | 24.3 | 43.9 | 5.3 | 21.4 | 33.2 | 9.0 | 4.3 |
| Scav 1 Mags | 5.9 | 11317 | 19.2 | 2747 | 19.6 | 47.1 | 4.4 | 18.0 | 21.6 | 10.6 | 3.9 |
| Scav 2 Mags | 5.3 | 11693 | 17.9 | 2772 | 17.8 | 50 | 4.2 | 15.1 | 16.4 | 11.9 | 3.9 |
| Scav 3 Mags | 4.6 | 9146 | 12.1 | 2165 | 12.1 | 56.5 | 4.1 | 9.7 | 9.1 | 14.1 | 4.1 |
| Scav 3 Non-Mags | 76.7 | 1247 | 27.7 | 280 | 26.2 | 66.5 | 81.9 | 1.3 | 19.7 | 17.4 | 83.8 |
| **Total Primary WHIMS** | **23.4** | **10736** | **72.3** | **2603** | **73.8** | **49.0** | **18** | **17.0** | **80.3** | **11.0** | **16.2** |
| Secondary WHIMS | | | | | | | | | | | |
| Cl Magnetic | 3.6 | 8206 | 8.3 | 1862 | 8.3 | 36.9 | 2.1 | 28.0 | 20.2 | 6.8 | 1.5 |
| Cl-Sc 1 Mags | 8.3 | 16632 | 39.3 | 3789 | 39.6 | 39.9 | 5.3 | 23.7 | 39.8 | 8.6 | 4.5 |
| Cl-Sc 2 Mags | 3.0 | 17693 | 14.9 | 4138 | 15.4 | 41.5 | 2.0 | 22.1 | 13.3 | 9.2 | 1.7 |
| Cl-Sc 3 Mags | 1.3 | 18404 | 6.8 | 3704 | 6 | 44.4 | 0.9 | 19.5 | 5.1 | 10.2 | 0.8 |
| Cl-Sc 3 Non-Mags | 7.3 | 1974 | 4.1 | 453 | 4.1 | 66.7 | 7.8 | 1.8 | 2.6 | 16.2 | 7.4 |
| **Total Secondary WHIMS** | **16.1** | **15105** | **69.2** | **3420** | **69.3** | **39.9** | **10.3** | **24.0** | **78.4** | **8.46** | **8.59** |
| Combined WHIMS non-mags | 83.9 | | 30.8 | | 30.7 | | 89.7 | | 21.6 | | 91.4 |

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## 13.3.9 Leaching

Wood engaged ALS Global in Perth Australia to perform preliminary leaching testwork using Cowboy State Mine WHIMS concentrate. Wood and ALS defined five technologies for leach testing: Acid bake-water leach (ABWL), High Pressure Acid Leach (HPAL), Alkali bake-water leach-HCl leach, Sulfuric acid tank leach, and a proprietary process from Watts & Fisher. Wood determined that sulfuric acid tank leach testwork was the most effective process for the material. Solids for all tests were wet milled to a P80 size of 38 microns.

### 13.3.9.1 Sulfuric Acid Tank Leaching

Sulfuric Acid Tank Leaching Acid Dosage Series Six Sulfuric acid tank leach tests were undertaken with varying acid contents, initially 250, 500, 750, and 1000 kg/t solids, then also evaluating 150 and 200 kg/t test conditions (Figure 13-11). The requisite amount of deionized water was added to the leach reactor for each test, followed by the measured acid dose. The contents were continuously agitated and brought up to the required 90 °C operating temperature before adding in the required feed solids mass. The combined slurry was leached for 6 hours, periodically checking the temperature and adding more deionized water as necessary to maintain the operating level. The leach slurry was then filtered, and the solids were rinsed and filtered again. Solids, filtrate, and wash were weighted and assayed separately for recovery calculation purposes. The final free acid of the leach slurry prior to filtration was measured and recorded. Results of the six tests are summarized in Table 13-11, with extraction trends included for REE elements and gangue minerals.

*Table 13-11: Sulfuric Acid Tank Leach Test Results – Acid Dosage Series*

| Parameter | Unit | Test 5 HY578 | Test 6 HY579 | Test 1 HY16574 | Test 2 HY16575 | Test 3 HY16576 | Test 4 HY16577 |
|---|---|---|---|---|---|---|---|
| Acid leach | | | | | | | |
| Leach temperature | °C | 90 | 90 | 90 | 90 | 90 | 90 |
| Leach duration | h | 6 | 6 | 6 | 6 | 6 | 6 |
| Acid addition | kg $H_2SO_4$/t solids | 150 | 200 | 250 | 500 | 750 | 1000 |
| Pulp density | % solids w/w | 30 | 30 | 30 | 30 | 30 | 30 |
| Final free acid | g/L | 1.3 | 2 | 39 | 101.4 | 179.8 | 366.9 |
| Extraction | | | | | | | |
| La | % | 75 | 84.4 | 91.7 | 58.2 | 80.6 | 53.9 |
| Ce | % | 72.2 | 81.1 | 89.5 | 49.5 | 78.2 | 53.1 |
| Pr | % | 76.3 | 82.9 | 86.2 | 49.8 | 82.6 | 61.3 |
| Nd | % | 71.2 | 77.4 | 82.8 | 48.8 | 79.9 | 60 |
| Sm | % | 57.3 | 63.8 | 69.3 | 46.5 | 69.7 | 48.9 |
| Dy | % | 20.9 | 23.6 | 36.3 | 40.5 | 36.2 | 20.7 |
| Y | % | 29.5 | 32.1 | 32.7 | 43.7 | 46.8 | 36.4 |
| Si | % | 3.9 | 3.9 | 4.4 | 0.6 | 0.3 | 0.3 |
| Fe | % | 13.8 | 17.2 | 22.3 | 33.3 | 34.9 | 47.2 |
| Al | % | 8.5 | 10.8 | 18.9 | 29.4 | 30.8 | 44.6 |

Note: Recovery (%) = (solution assay x vol)/(solution assay x vol + residue assay x mass) x 100

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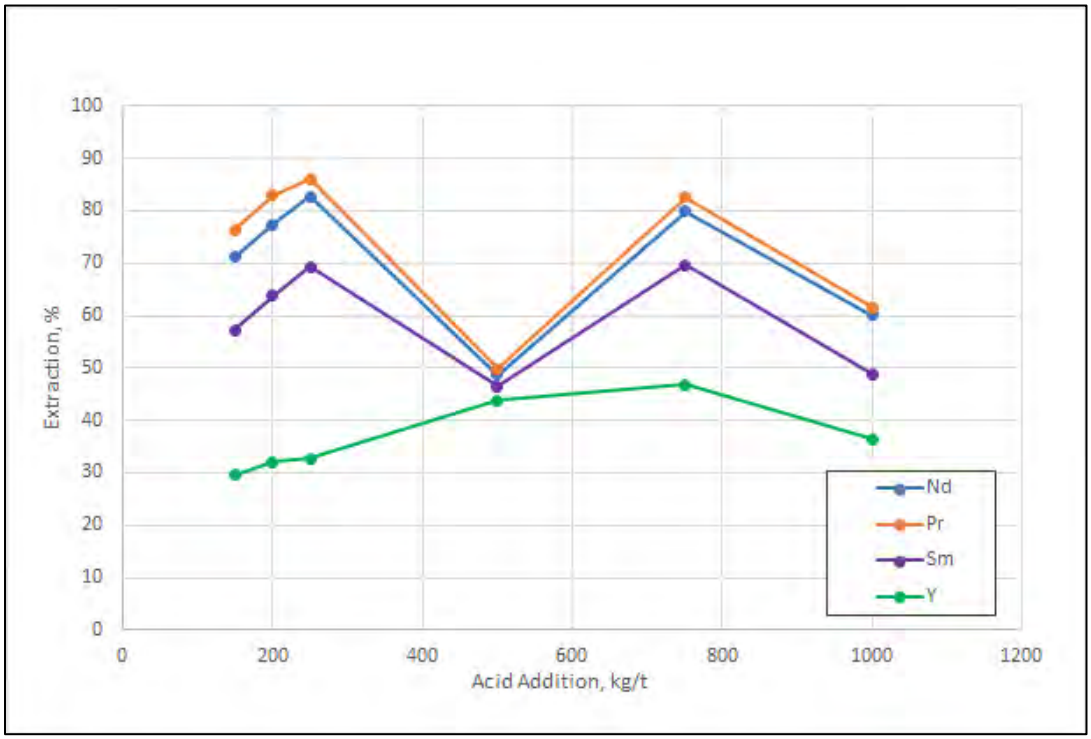


*Table 13-12: Sulfuric Acid Tank Leach Extraction Trends – Nd, Pr, Sm, Y*

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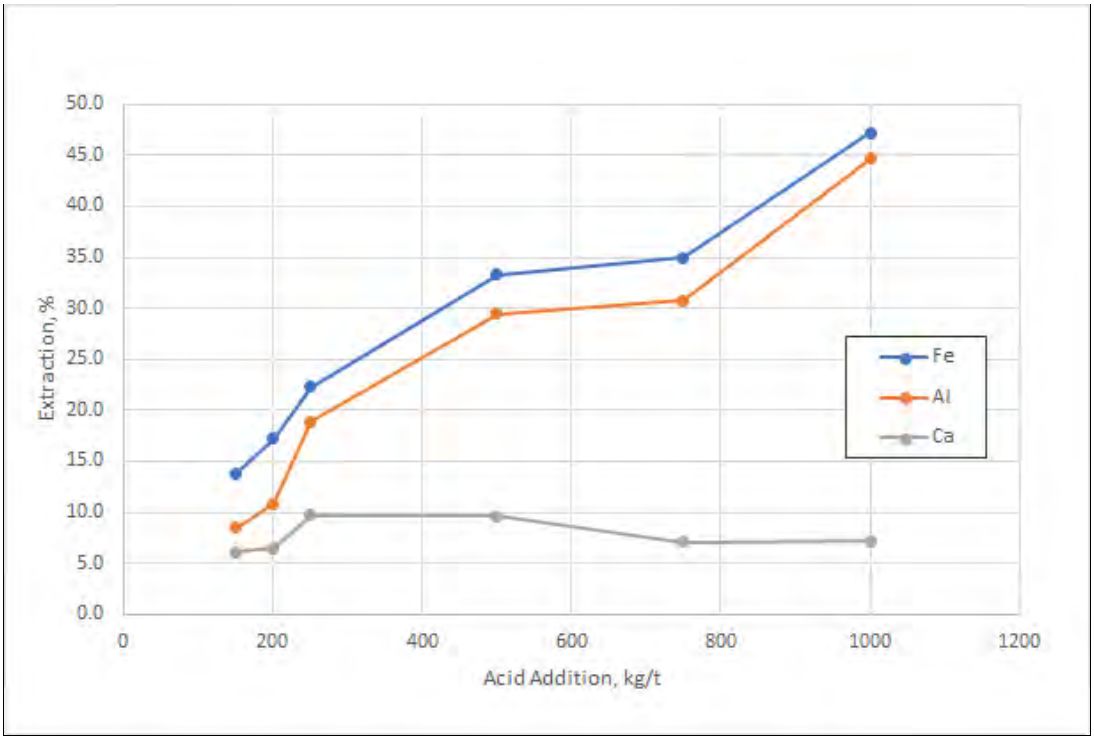


*Table 13-13: Sulfuric Acid Tank Leach Extraction Trends – Fe, Al, Ca*

### 13.3.9.2 General Sulfuric Acid Tank Leach Results

The results of the general sulfuric acid tank leach tests are as follows.

- Light REEs – La, Ce, Nd and Pr follow similar trends of increasing extraction up to 250 kg/t acid dosage, followed by a sharp fall away at 500 kg/t, then restored extraction at 750 kg/t and another drop at 1000 kg/t. The result for 500 kg/t is considered anomalous and extractions between 250 and 750 kg/t data points are expected if the test were to be repeated. With high acid dosage, free acid on completion of the leach is extremely high which may be forcing the REEs to precipitate as double sulphate salts.
- Mid REEs – represented by Sm, the mid REEs followed a similar trend to the LREEs but at an overall lower % extraction level.
- HREEs – represented by Y, the extraction profile was much shallower, peaking at 46.8% for 750 kg/t acid dosage. At 250 kg/t, extraction was 32.7%. The reason for the lower extraction should be explored further.
- Fe – iron extraction steadily increases with increasing levels of free acid. Without the oxyhydrolysis that occurs within autoclaves above 225 °C, iron remains in the ferrous sulphate form and does not precipitate as jarosite or hematite. The oxidation state was not confirmed for leach solutions and should be established in future work.
- Al – aluminum closely follows the Fe extraction profile, forming aluminum sulphate that is highly soluble.

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- Ca – net calcium extraction is limited due to the solubility in the sulphate system, precipitating as calcium sulphate (gypsum). ALS advised that gypsum formation at the higher free acid levels may be encapsulating allanite particles, retarding leaching kinetics.

From the results, a lower acid dosage is desirable in terms of achieving optimum leach extraction while minimizing gangue reactions that could impair REE leach extraction.

### 13.3.9.3 Leaching Time and Temperature Optimization

Adopting 250 kg/t acid dosage, three timed leach tests were undertaken at temperatures of 50, 70, and 90 °C. Timed sample aliquots were taken from the leach vessel at times of 2, 4, 8 and 24-hour to assess leach extraction over time based on solution assays, and also to measure free acid levels. Extractions for selected REES and gangue elements are presented in Table 13-14.

Nd and Pr show trends of increasing extraction with time. Comparative plots for Nd and Pr are presented in Figure 13-8 and Figure 13-9, demonstrating that retaining the current 90 °C operating temperature is beneficial for maximizing extraction.

Al and Fe extraction show a similar trend but with much lower overall extractions and in a tighter band of ultimate extraction.

Y and Sm also show that the higher temperature is beneficial for leaching, though extraction is very low for Y. It was noted earlier that the HREE metal extractions were much lower than the mid and light REEs, which bears further investigation, especially if these elements contribute to the basket price of MREC. Investigation into the use of catalysts or accelerants is recommended.

*Table 13-14: Kinetic Acid Leach Tests at Varying Temperatures*

| | | **Extractions (solution based), 90 °C Leach** | | | | | |
|---|---|---|---|---|---|---|---|
| **Time (h)** | **Free Acid (g/L)** | **Nd (%)** | **Pr (%)** | **Y (%)** | **Sm (%)** | **Al (%)** | **Fe (%)** |
| 1 | 117 | 24.6 | 26.9 | 4.2 | 18.3 | 4.8 | 5.2 |
| 2 | 114 | 45.2 | 48.8 | 9 | 35 | 10.4 | 10.9 |
| 4 | 97 | 57.6 | 61.7 | 12.8 | 46.4 | 14.8 | 15.4 |
| 8 | 24 | 70.4 | 75 | 17 | 57.7 | 20.1 | 20.8 |
| 24 | 12 | 81.9 | 86.9 | 20.6 | 67.6 | 24.8 | 25.1 |
| | | **Extractions (solution based), 70 °C Leach** | | | | | |
| **Time (h)** | **Free Acid (g/L)** | **Nd (%)** | **Pr (%)** | **Y (%)** | **Sm (%)** | **Al (%)** | **Fe (%)** |
| 1 | 132 | 17.9 | 19.1 | 3.9 | 14 | 4.2 | 4.9 |
| 2 | 114 | 37 | 39.9 | 8.1 | 29 | 8.9 | 10.2 |
| 4 | 97 | 51.7 | 55.7 | 11.1 | 40.5 | 12.6 | 14.4 |
| 8 | 25 | 66.1 | 70.9 | 14.4 | 51.3 | 16.7 | 18.9 |

| | | **Extractions (solution based), 90 °C Leach** | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | 17 | 80.5 | 86.2 | 17.7 | 62.2 | 21 | 23.5 |
| | | **Extractions (solution based), 50** °C Leach | | | | | |
| **Time (h)** | **Free Acid (g/L)** | **Nd (%)** | **Pr (%)** | **Y (%)** | **Sm (%)** | **Al (%)** | **Fe (%)** |
| 1 | 142 | 14.8 | 17.2 | 2.7 | 12.7 | 3.5 | 3.9 |
| 2 | 136 | 29.2 | 34 | 5.4 | 25.1 | 7.5 | 8.4 |
| 4 | 100 | 40.6 | 47.5 | 7.6 | 35.1 | 10.7 | 12.2 |
| 8 | 33 | 51.8 | 60.3 | 9.7 | 44.6 | 14.1 | 16.3 |
| 24 | 22 | 63.7 | 74.1 | 11.9 | 54.4 | 18 | 20.8 |

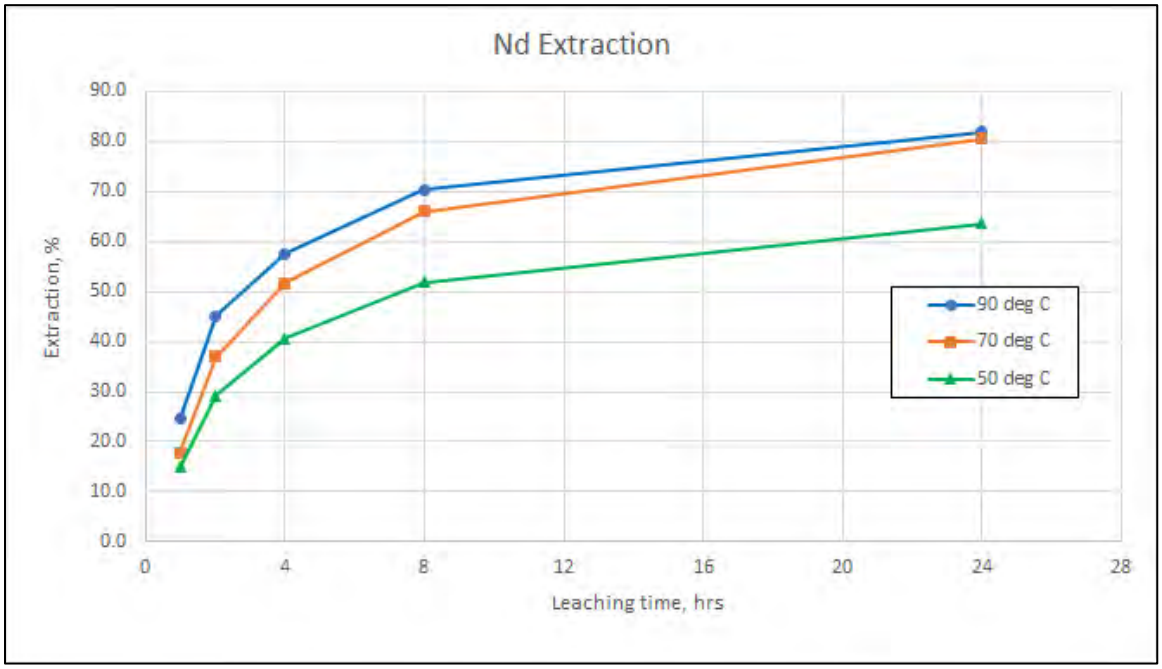


*Figure 13-8: Effect of Temperature on Leach Extraction with Time – Nd*

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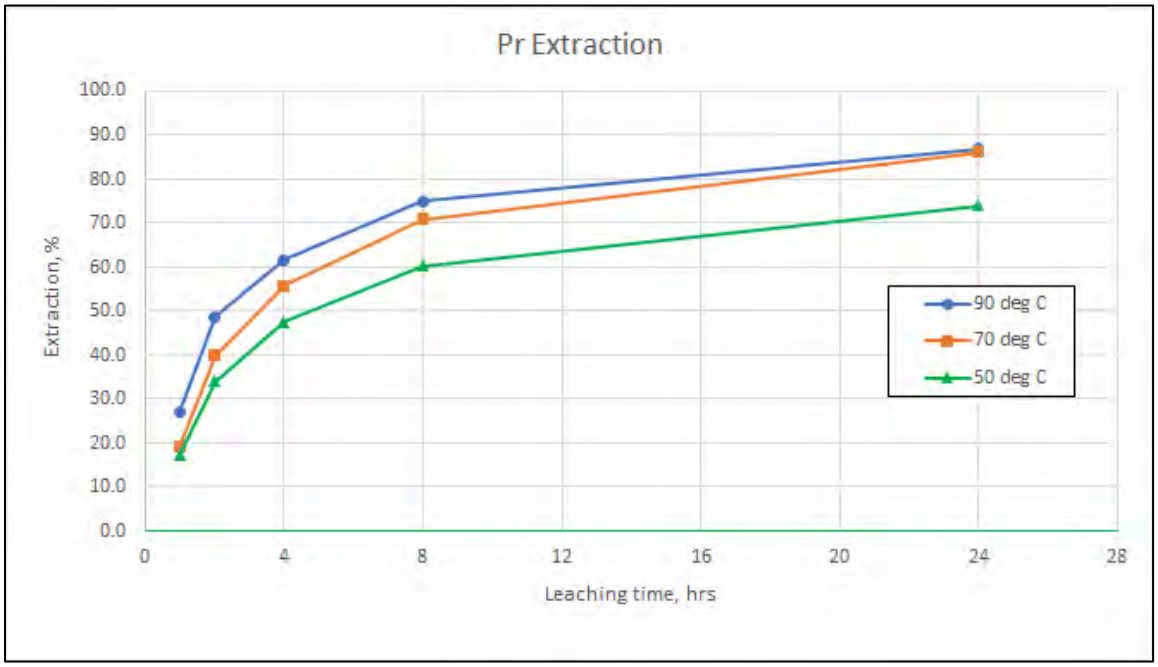


*Figure 13-9: Effect of Temperature on Leach Extraction with Time - Pr*

It was noted that unleached metals remained in filter cakes after washing for the times of 1 to 8 hr. The remaining metals were recovered in the 24-hr extraction time as shown. Further testwork at 90 °C was undertaken to evaluate individual batch leach extractions at times of 6, 8, 12, and 24 hr to firm up the optimum leach time. Comparative plots for Nd, Pr, Sm and Y are presented as Figure 13-10.

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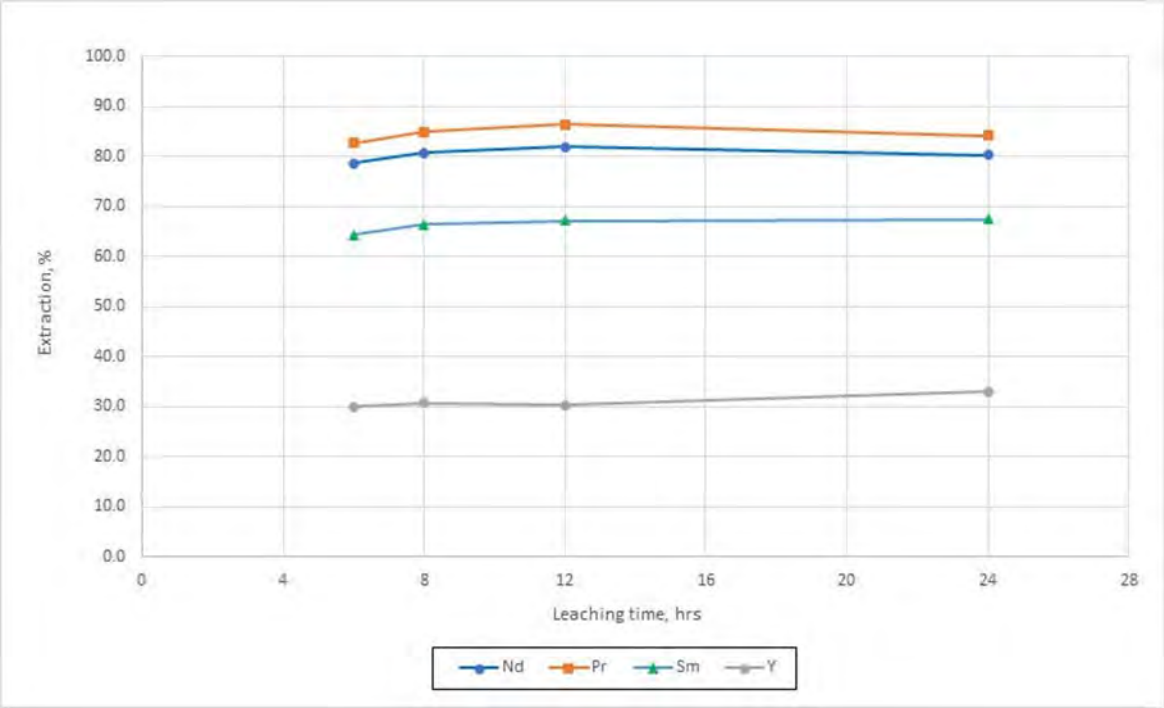


*Figure 13-10: Individual Acid Leach Time Series REE Extractions at 90 °C*

Unlike the kinetic test with timed solution sampling that predicts increasing recovery with time up to 24 hr, Nd, Pr, and Sm extractions appear to peak at 12 hr, dropping away at 24 hr. The dip in recovery is related to extended calcium leaching, which forms gypsum and possibly provides a nucleation site for the precipitation of REE sulphates. The Nd and Pr extractions at 6 hr are 78.7 and 82.7%, compared with 82.8 and 86.2%, respectively, for the initial batch leach test at 6 hr, which are significant differences in performance for what are essentially the same conditions on the same feed material.

The initial results at 6 hr leaching time included in Table 13-14 were used to support the updated desktop study design basis. Further work is needed in the next phase of work to optimize conditions and obtain firm recovery figures with reliable assay reconciliation given the significant differences in results between these tests.

## 13.4 Comminution Testing

### 13.4.1 FLSmidth

FLSmidth performed comminution testing at their Salt Lake City UT laboratory using material from the Test Pit at Cowboy State Mine. Approximately 7.8 tonnes of ore were sent to FLSmidth. High Pressure Grinding Roll (HPGR) and Vertical Roller Mill (VRM) were tested with oversize (>300 micron) separated and recycled using an air classifier in both cases. An additional air classifier was used to separate the fines (<50 micron)

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from the ground product. Figure 13-11, Figure 13-12, and Figure 13-13 represent the process flow for the tests conducted.

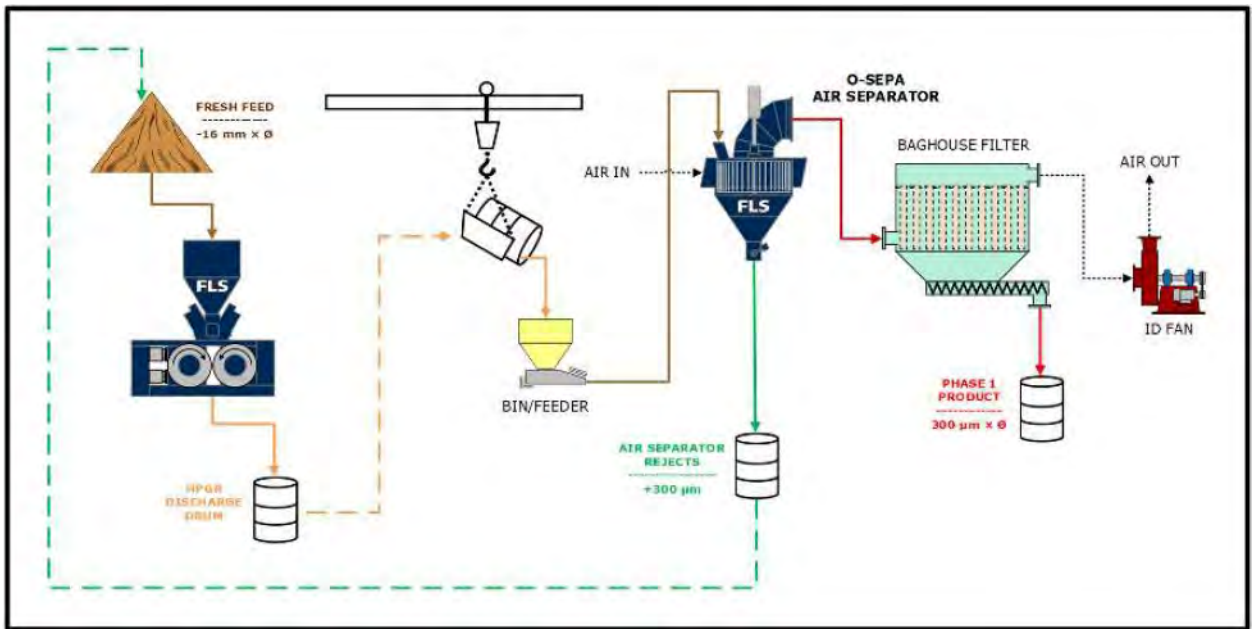


*Figure 13-11: High Pressure Grinding Process Flow*

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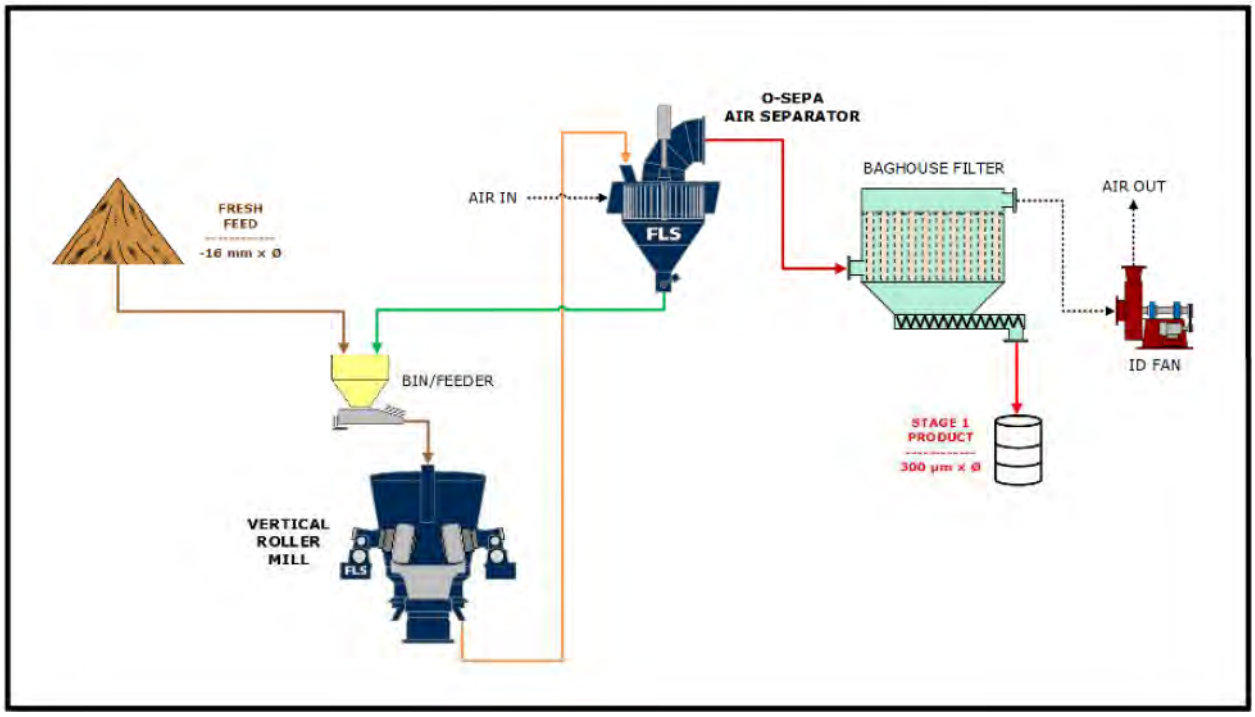


*Figure 13-12: Vertical Roller Mill Process Flow*

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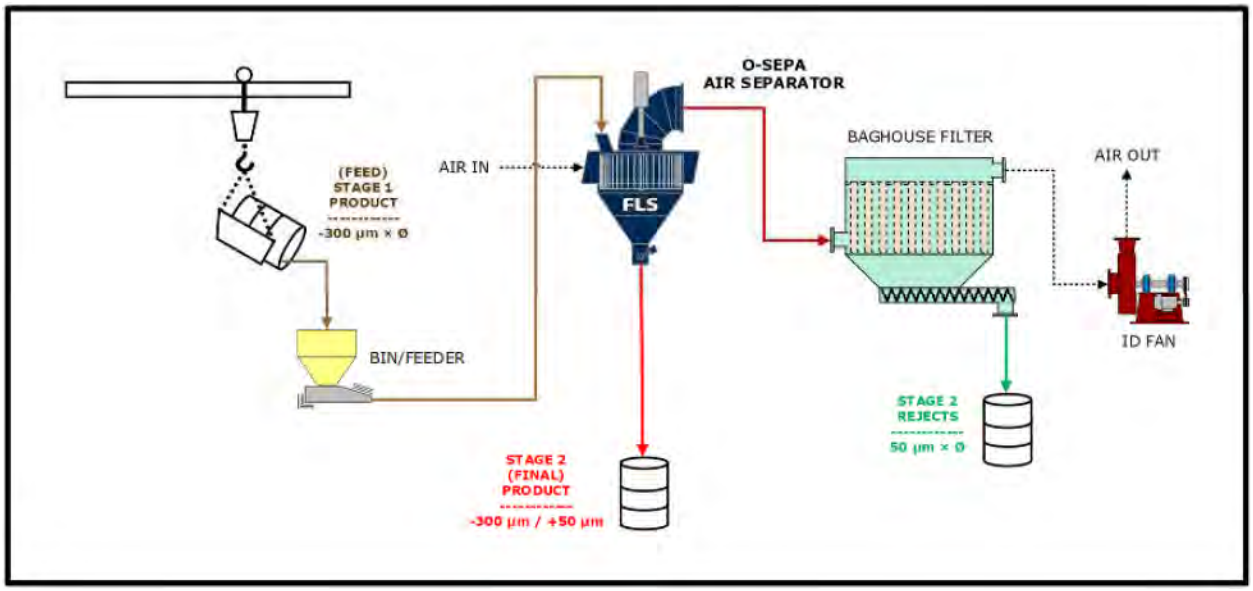


*Figure 13-13: Separation of Fines Process Flow*

## 13.4.2 Loesche

Loesche performed comminution testing at their Neuss Germany laboratory using 4.7 tonnes of ore from the Test Pit at Cowboy State Mine. Loesche performed testing using Vertical Roller Mills with air classification. A standard grinding test was performed where particle size is varied to understand the relationship of particle size versus throughput. The remaining ore was ground to generate 3 bulk samples with different particle size distributions.

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*Figure 13-14: Loesche Testing with Vertical Roller Mills*

### 13.4.3 COREM/Weir

COREM performed comminution testing using a Weir HPGR at their Quebec Canada laboratory using 1.1 tonnes material from the Test Pit at Cowboy State Mine. The test consisted of one locked cycle HPGR test with three cycles using a 300 micron screen for recirculation of oversize. Material that was <300 micron in the feed sample as a result of blasting and jaw crushing was removed via wet Sweco screen prior to testing. Using COREM standard parameters all of teh testing material was convered into ultrafines, with lower recoveries this process was no longer under consideration.

### 13.4.4 DISA/HPSA

DISA Technologies performed comminution testing using their High Pressure Slurry Ablation (HPSA) in a closed-circuit configuration in Mills, Wyoming. Testing was conducted on 1 ton which was split and conducted in 2 tests. Feed material had a P80 of 4360um and was reduced to 158 micron and 282 micron respectively. Further testing is recommended as the fines ranged from 28% to 39% of the product, but there is room for optimization.

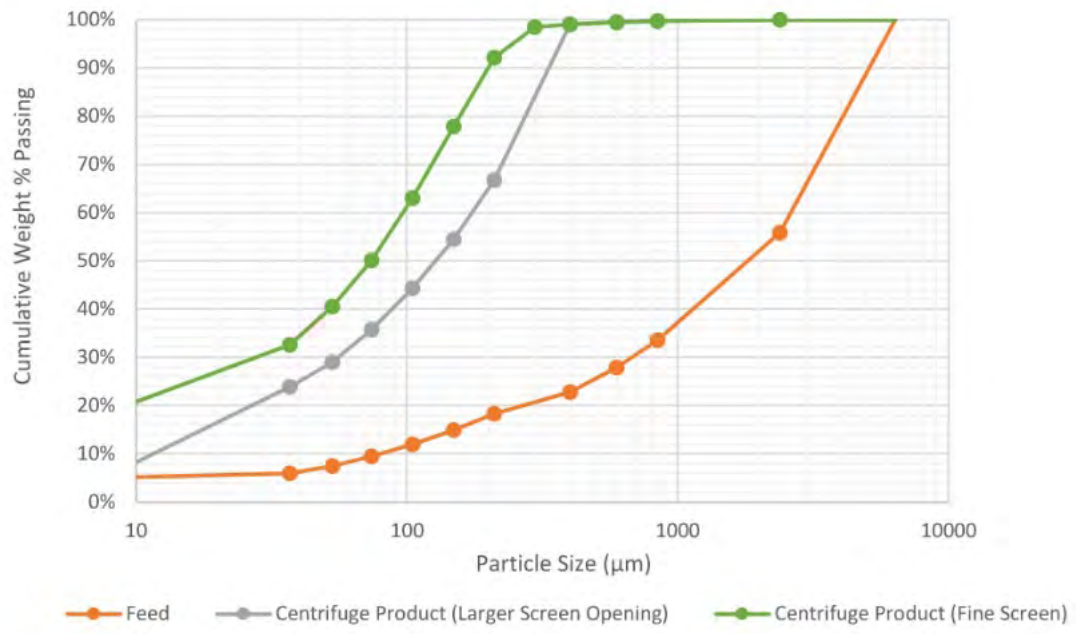


*Figure 13-15 Cumulative Weight Percent Passing Curves for Feed and HPSA Products*

## 13.5 Concentration Testing

### 13.5.1 Sepro Mineral Systems

Sepro Mineral Systems was contracted to perform testing on the Halleck Creek Ore using Gravity Spiral Concentration and their Falcon C Centrifugal Concentrator. The ore (71 kg half core) was stage ground using a cone crusher and further ground using a rod mill to a P80 of 250 micron. The head assay of the ground core was 4,127 ppm Total Rare Earth Oxides (TREO). The particle size distribution is shown in the Table below.

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*Table 13-15: Sepro Mineral Systems Particle Size Distribution*

| Particle Size Distribution | | | |
|---|---|---|---|
| **Sieve Size (Microns)** | **Weight (%)** | **Cumulative (%)** | |
| | | Retained | Passing |
| 1,180 | 20.70 | 20.70 | 79.30 |
| 850 | 13.47 | 34.16 | 65.84 |
| 600 | 11.73 | 45.89 | 54.11 |
| 425 | 10.35 | 56.24 | 43.76 |
| 300 | 7.94 | 64.18 | 35.82 |
| 212 | 6.79 | 70.97 | 29.03 |
| 150 | 6.48 | 77.45 | 22.55 |
| 106 | 4.50 | 81.95 | 18.05 |
| 75 | 4.42 | 86.37 | 13.63 |
| 53 | 2.92 | 89.30 | 10.70 |
| 38 | 3.32 | 92.61 | 7.39 |
| 20 | 2.33 | 94.94 | 5.06 |
| -20 | 5.06 | 100.00 | 0.00 |
| Total | 100 | | |

The size fraction analysis is shown in Table 13-16. The table indicates there is a concentrating effect of TREO in the size fraction of 212 micron and smaller. However, this concentrating effect is not dramatic enough to result in a process step that rejects the +300 micron fraction.

*Table 13-16: Sepro Mineral Systems Size Fraction Analysis*

| Size Fraction Analysis | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Particle Size (Microns)** | **Weight (%)** | **TREO** | | **$Al_2O_3$** | | **$SiO_2$** | | **$Fe_2O_3$** | |
| | | (%) | Distribution | (%) | Distribution | (%) | Distribution | (%) | Distribution |
| 300 | 64.2 | 3929.6 | 59.8 | 17.11 | 65.8 | 62.63 | 64.6 | 6.06 | 58.6 |
| 212 | 6.79 | 4500.6 | 7.3 | 16.39 | 6.7 | 63.44 | 6.9 | 6.36 | 6.5 |
| 150 | 6.48 | 4743.5 | 7.3 | 16.11 | 6.2 | 62.44 | 6.5 | 6.92 | 6.8 |
| 106 | 4.50 | 4750.0 | 5.1 | 16.16 | 4.4 | 62.88 | 4.6 | 7.37 | 5.0 |
| 75 | 4.42 | 4888.0 | 5.1 | 15.74 | 4.2 | 61.30 | 4.4 | 7.63 | 5.1 |
| 53 | 2.92 | 4903.1 | 3.4 | 15.78 | 2.8 | 61.33 | 2.9 | 8.32 | 3.7 |
| 38 | 3.32 | 4826.9 | 3.8 | 15.52 | 3.1 | 58.60 | 3.1 | 9.12 | 4.6 |
| 20 | 2.33 | 4683.5 | 2.6 | 15.64 | 2.2 | 60.18 | 2.3 | 9.26 | 3.3 |
| -20 | 5.06 | 4705.8 | 5.6 | 15.72 | 4.8 | 58.96 | 4.8 | 8.56 | 6.5 |
| Calculated Head | 100.02 | 4215.5 | 100 | 16.7 | 100 | 62.21 | 100 | 6.63 | 100 |
| Assayed Head | | 4127.73 | | 16.4 | | 62.44 | | 6.54 | |

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Falcon C Centrifugal Separator Rougher Testing

- Falcon C testing showed 16.7% mass yield to the concentrate and 16.3% TREO Recovery.
- This indicates that the Falcon C unit was unable to concentrate the TREO at all. Impurity results show the same result.

Gravity Spiral Rougher Testing

- The concentrate from the gravity spiral recovered 4.8% mass yield but only 23.5% TREO Recovery
- The middlings recovered an additional 22.1% TREO with a grade of 0.7% TREO for a combined
- TREO recovery of 45.7% at a grade of 1.10% in 16.9% of the mass.
- TREO grade increased 4.9x from 3,769ppm to 18,379ppm
- These results show an increase in grade but the corresponding TREO recovery is too low to implement.

*Table 13-17: Gravity Spiral Rougher Testing Results*

| Products | Weight | | TREO | SiO2 | Al2O3 | Fe2O3 | ZrO2 | LREO | MREO | HREO |
|---|---|---|---|---|---|---|---|---|---|---|
| | (g) | (%) | (ppm | (ppm) | (ppm) | (ppm) | (ppm | (ppm) | (ppm) | (ppm) |
| Concentrate | 308.5 | 4.8 | 18,379.4 | 48.1 | 11.5 | 23.0 | 22700.0 | 16136.8 | 952.4 | 1290.1 |
| Middling | 770.5 | 12.1 | 6,912.6 | 60.1 | 15.2 | 10.2 | 1335.9 | 5955.9 | 389.1 | 567.6 |
| **Concentrate + Middlings** | **1,079.0** | **16.9** | **10,191.1** | **56.6** | **14.1** | **13.8** | **7444.2** | **8866.8** | **550.2** | **774.2** |
| Tails | 5,311.7 | 83.1 | 2,464.2 | 64.5 | 17.1 | 4.5 | 478.18 | 2083.3 | 149.3 | 231.6 |
| **Calculated Head** | **6,390.7** | **100.0** | **3,768.8** | **63.2** | **16.6** | **6.0** | **1654.3** | **3228.6** | **217.0** | **323.2** |
| Assayed Head | | | 4,127.7 | 62.4 | 16.4 | 6.5 | 1659.5 | 3545.0 | 234.0 | 348.7 |

*$ZrO_2$ assay was back calculated (ZrO2 grade was above detection limit of >10,000 ppm)

| Products | Weight | | Distrubution(%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (g) | (%) | TREO | SiO2 | Al2O3 | Fe2O3 | ZrO2 | LREO | MREO | HREO |
| Concentrate | 308.5 | 4.8 | 23.5 | 3.7 | 3.4 | 18.4 | 66.2 | 24.1 | 21.2 | 19.3 |
| Middling | 770.5 | 12.1 | 22.1 | 11.5 | 11.0 | 20.3 | 9.7 | 22.2 | 21.6 | 21.2 |
| **Concentrate + Middlings** | **1,079.0** | **16.9** | **45.7** | **15.1** | **14.4** | **38.7** | **76.0** | **46.4** | **42.8** | **40.4** |
| Tails | 5,311.7 | 83.1 | 54.3 | 84.9 | 85.6 | 61.3 | 24.0 | 53.6 | 57.2 | 59.6 |
| **Total** | **6,390.7** | **100.0** | **54.3** | **84.9** | **85.6** | **61.3** | **24.0** | **53.6** | **57.2** | **59.6** |

## 13.5.2 Mineral Technologies

### 13.5.2.1 Rougher Release Curve Testing (MTNA24185), 100% passing 1.0mm

Mineral Technologies (MT) was supplied an ore sample consisting of half core segments (~400 kg of ore from Red Mountain collected in 2022) to their North American Metallurgical Laboratory in Starke, FL. The core was run through a jaw crusher to reduce the size to ~1.5cm and then processed in a roll crusher with a 1mm screen. The oversized product was recycled back to the roll crusher to create a 100% passing 1 mm. This material was then screened at 0.5mm to create three particle size fractions; -1.0mm, -1.0mm +0.5mm and -0.5mm. These three feedstocks were then run on the MG 12 gravity spiral pilot test unit to create release curves. The MG 12 test unit is a full-size spiral with one “start” which means there is only one spiral helix on the center support pipe, whereas full production spirals will have three starts. The feedrate was targeted at 1.5 mtph and 30% solids which is also equivalent to full scale production. The sizing and feedrate of the test unit is at full scale so there is no risk for scale up issues when specifying full production units.

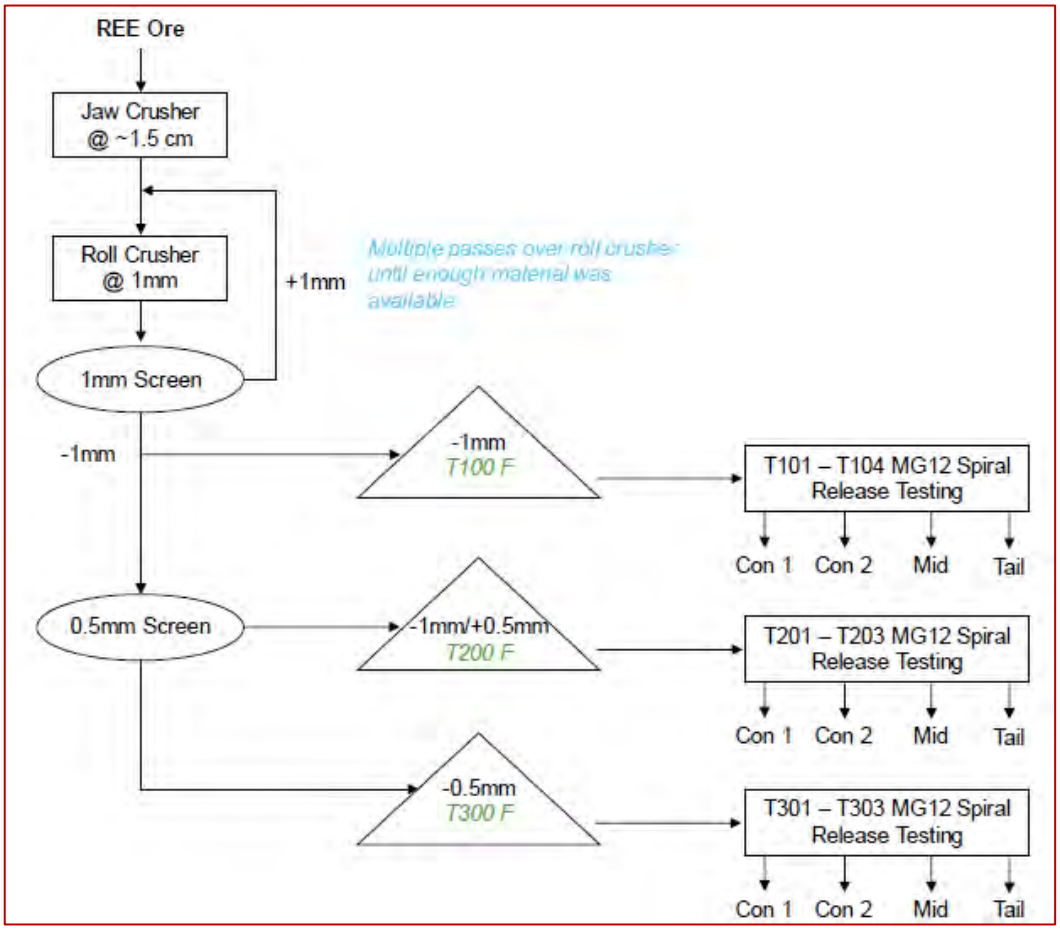


*Figure 13-16: Roll Crusher Feedstock Preparation*

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*Figure 13-17: Technologies MG 12 Test Unit*

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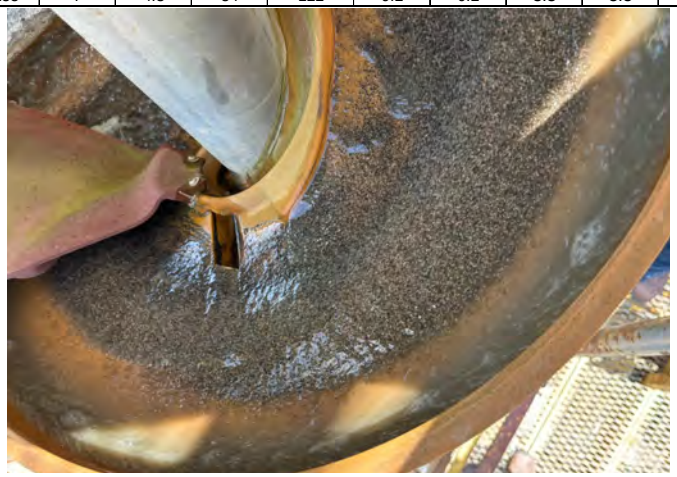
*Figure 13-18 Mineral Technologies Ore Samples*

*Table 13-18: Feed Assays Particle Size Distribution*

| Particle Size Distribution | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed | TREO ppm | Zr ppm | U ppm | Fe % | Th ppm | Nb ppm | Al % | Ti % | Na % | K % | Ca % | Mn % | Sr ppm | Ba ppm |
| T100 (-1mm) | 4421 | 966 | 7 | 4.3 | 70 | 136 | 9.2 | 0.3 | 3.3 | 5.3 | 2.0 | 0.1 | 219 | 1630 |
| T200 (-1mm / +0.5mm) | 3478 | 782 | 6 | 3.9 | 52 | 107 | 9.5 | 0.2 | 3.4 | 5.6 | 1.9 | 0.1 | 192 | 1620 |
| T300 (-0.5mm) | 3779 | 1155 | 7 | 4.3 | 54 | 122 | 9.2 | 0.2 | 3.3 | 5.5 | 2.1 | 0.1 | 277 | 1980 |



Note: Con 1 collected from a sliding valve which is down the center support pipe.

*Figure 13-19: "Con 1" from Sliding Valve*

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*Figure 13-20: Feedstock, 0.5mm, exiting MG12 Spiral*

The middle dart splitter directs the slurry to the spiral mid-product (middlings) leaving the slurry in the outer area to the spiral tail product. The heavier material which is darker can be seen congregating on the inside while the lighter gangue material is on the outside of the spiral.

#### *13.5.2.1.1 Rougher Release Curve Testing Results*

The TREO recovery curves are shown in Figure 13-21 for each of the three feedstocks (particle size fractions). The -0.5mm feed shows the best performance due to the steeper slope of the curve. The reason behind this is most likely due to the smaller particle size and increased liberation. Confirming that hypothesis is the fact that the -1.0mm+0.5mm has the lowest slope due to the lack of smaller size fraction.

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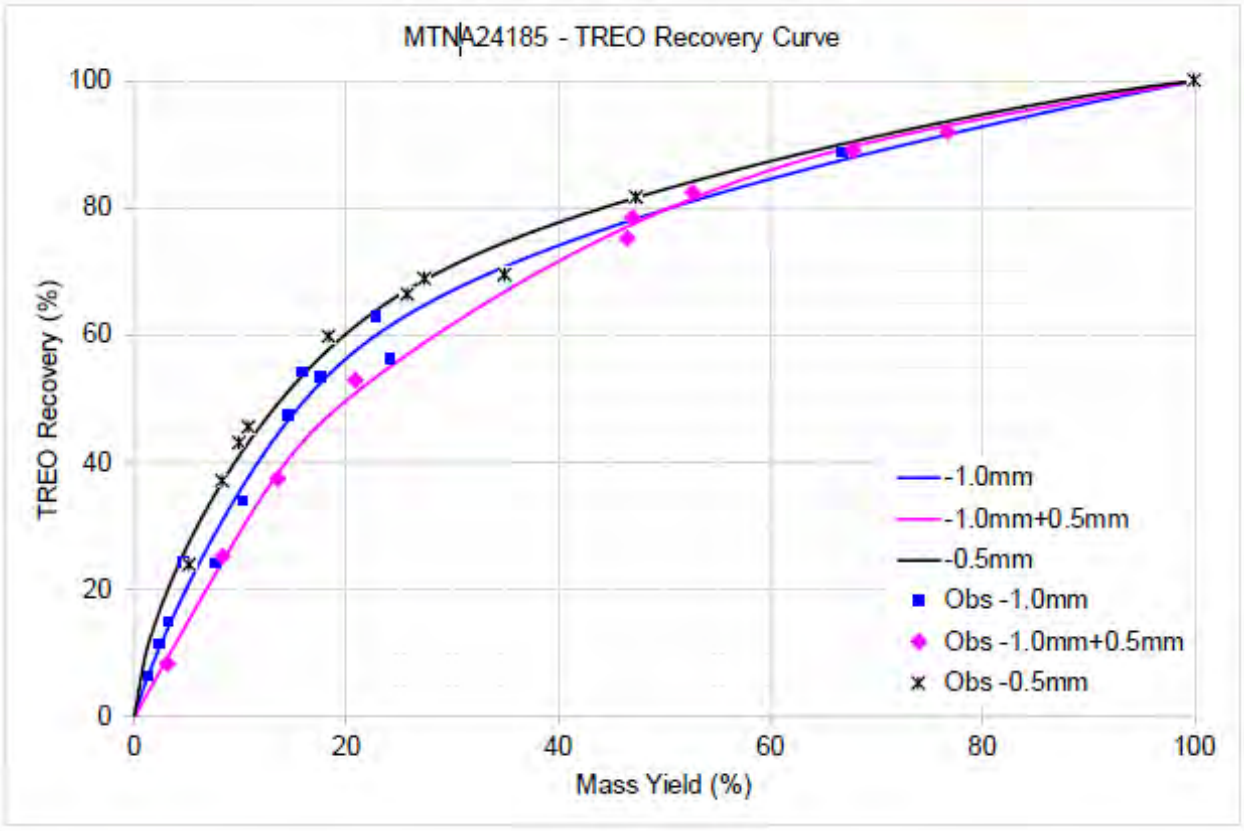


*Figure 13-21: Rougher Release TREO Recovery Curve*

The TREO grade curve is shown in Figure 13-22 for the three feedstocks. Again the -0.5mm feed has the greatest slope with the -1.0mm+0.5mm having the lowest slope.

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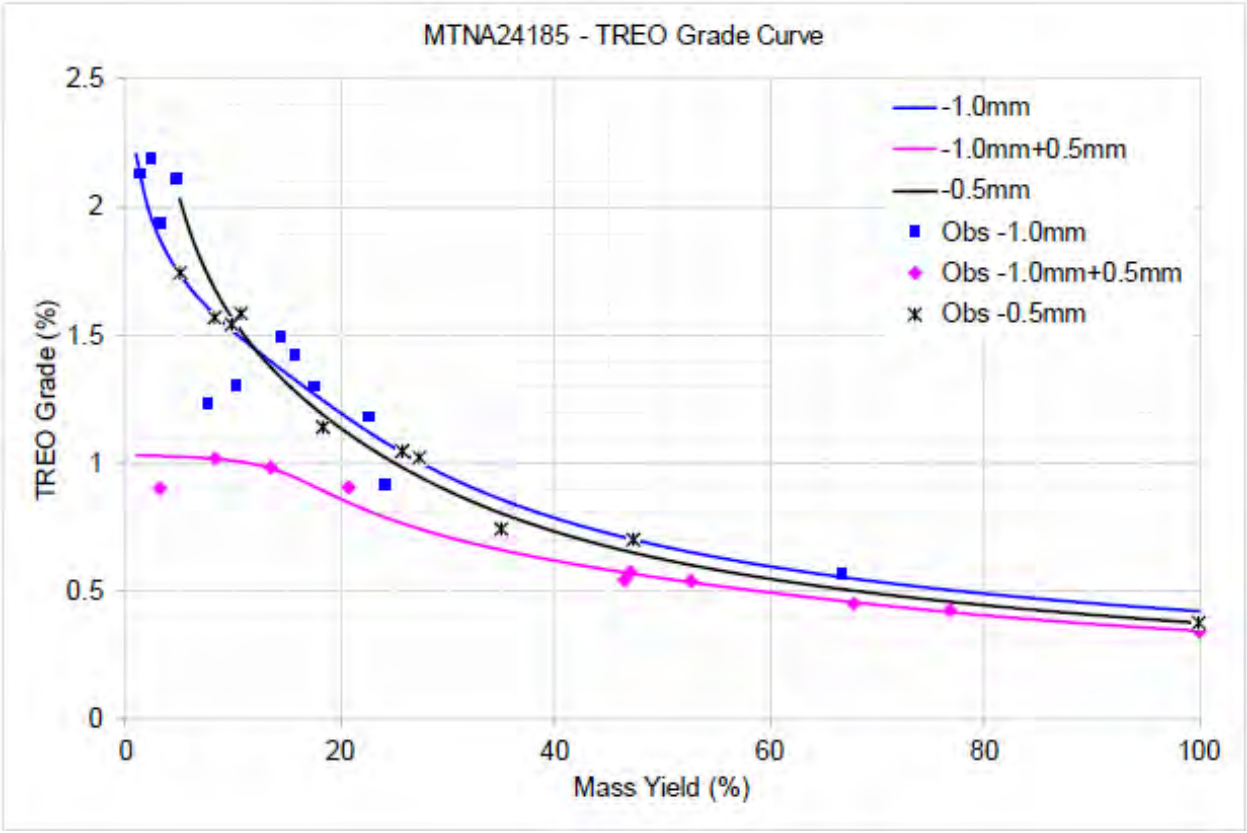


*Figure 13-22: TREO Grade Curve*

The TREO separation efficiency curve shown in Figure 13-23 is again achieved by the -0.5mm feedstock. The maximum separation efficiency can be seen at 26% mass yield.

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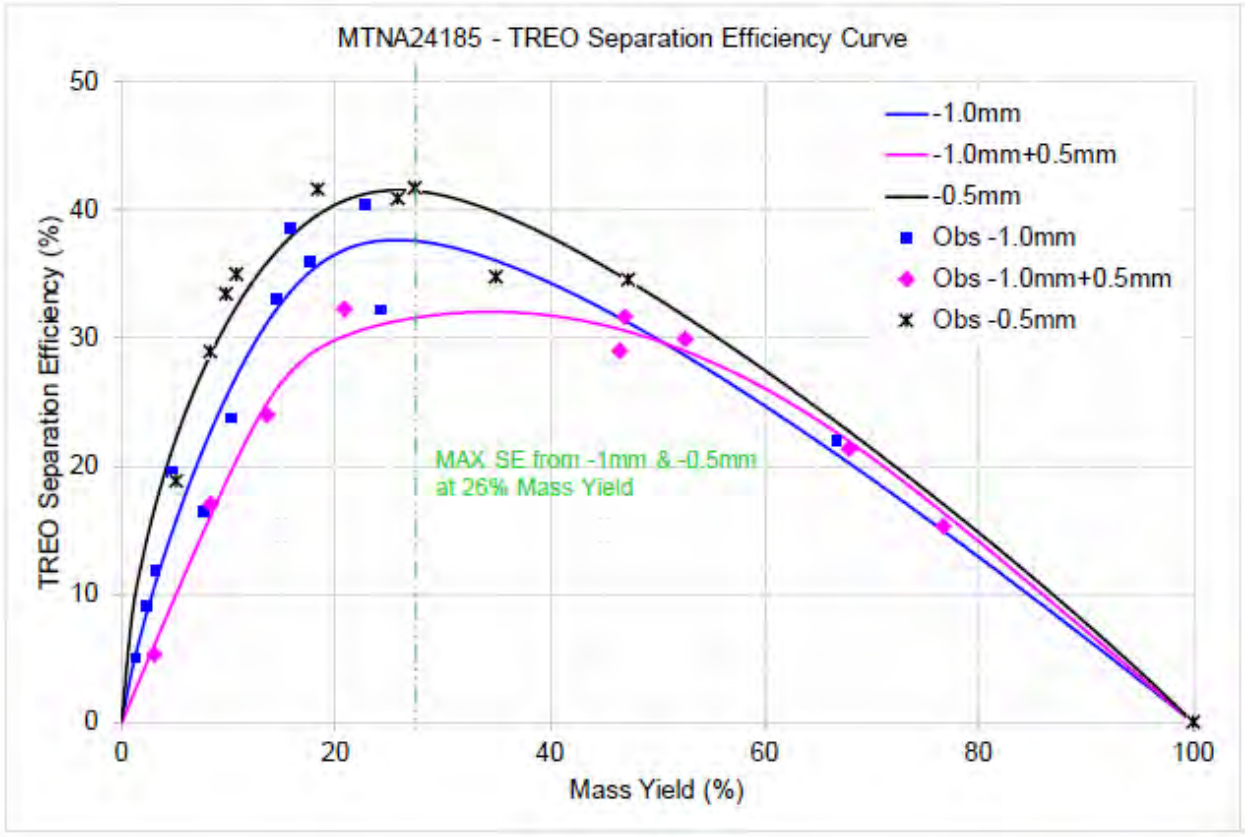


*Figure 13-23: TREO Separation Efficiency Curve*

Table 13-19 shows the performance of each feedstock at the mass split corresponding to the maximum separation efficiency of TREO. At a 26% mass yield, a similar TREO grade of 1% can be made with both the -1mm and -0.5mm feedstocks. However, the 0.5mm feedstock gives a significantly higher TREO recovery (67.4%) compared to the -1mm feedstock (63.5%), a difference of 4%.

*Table 13-19: Feedstock Performance*

| Feedstock Performance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spiral Model | Feed | | | Concentrate | | | Reject Grade (%) | Max Separation Efficiency (%) |
| | % Solids | Loading | Grade (%) | Mass | Grade (%) | Recovery (%) | | |
| | % wt | Dry tph | TREO | Yield % | TREO | TREO | TREO | TREO |
| T100 (-1mm) | 30.8 | 1.43 | 0.35 | 34 | 0.67 | 65.9 | 0.18 | 32.0 |
| T200 (-1mm / +0.5mm) | 27.7 | 1.36 | 0.38 | 26 | 0.98 | 67.4 | 0.17 | 41.5 |
| T300 (-0.5mm) | 31.2 | 1.52 | 0.43 | 26 | 1.04 | 63.5 | 0.21 | 37.6 |

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Release curves for Zr, U and Fe are created to understand the concentrating effect of the spiral on these impurities. A 26% mass yield will maximize the performance with regards to the TREO. See Table 13-20 for performance data.

*Table 13-20: Rougher Release Test Performance*

| Performance | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed | Mass Yield | Separation Efficiency | | | | Grade | | | | Recovery | | | |
| | | TREO (%) | Zr (%) | U (%) | Fe (%) | TREO (%) | Zr (%) | U (ppm) | Fe (%) | TREO (%) | Zr (%) | U (%) | Fe (%) |
| T100 (-1mm) | 26 | 37.62 | 57.34 | 29 | 33.5 | 1.04 | 0.35 | 16 | 9.6 | 66.92 | 57.70 | 54 | 60.8 |
| T200 (-1mm / +0.5mm) | 35 | 32.04 | 22.72 | 19 | 26.9 | 0.66 | 0.12 | 9 | 6.8 | 64.36 | 83.27 | 55 | 58.0 |
| T300 (-0.5mm) - Recommended | 26 | 41.53 | 57.68 | 32 | 36.9 | 0.98 | 0.39 | 16 | 10.5 | 67.37 | 83.61 | 58 | 61.3 |

These release testing results demonstrate that gravity separation using spiral separators is certainly amenable to concentrating valuable TREO product and rejecting gangue material. Based on these promising results it was decided that grinding to 100% passing 0.3mm will aid in the liberation and therefore separation performance on the gravity spirals. Additional testing at -0.3mm will be conducted along with adding cleaner and scavenger steps to further improve the grade and recovery.

MT also recommends testing for magnetic separation amenability using an Induced Roll Magnetic Separator (IRMS).

MT recommends electrostatic testing to upgrade the Zr to create a saleable by-product. This testing was later abandoned due to the lack of interest in selling Zr due to the amount of material and revenue balanced against the added equipment cost and complexity. Electrostatic separation also adds the need for heating the feedstock and a concern for dust generation and buildup in the machine due to the need to create a finer grind for liberation of the TREO.

#### 13.5.2.2 Rougher/Cleaner/mid-Scavenger (MTNA24292),100% passing 0.5mm

The results of the initial rougher testing showed that the feedstock sized at -0.5mm was the most effective for gravity spiral separation. The previous test work showed that the TREO could be upgraded from 0.38% to 0.98% at a mass yield of 26% with a single rougher pass. Under the same project, MTNA24292, more -0.5mm material was produced and was processed on the MG12 spiral to produce bulk products. The rougher bulk concentrate underwent MG12 spiral release testing to test cleaner stage effectiveness. Rougher bulk middlings product underwent MG12 spiral release testing to test scavenger stage effectiveness. The figure below depicts the testing undertaken during this test program.

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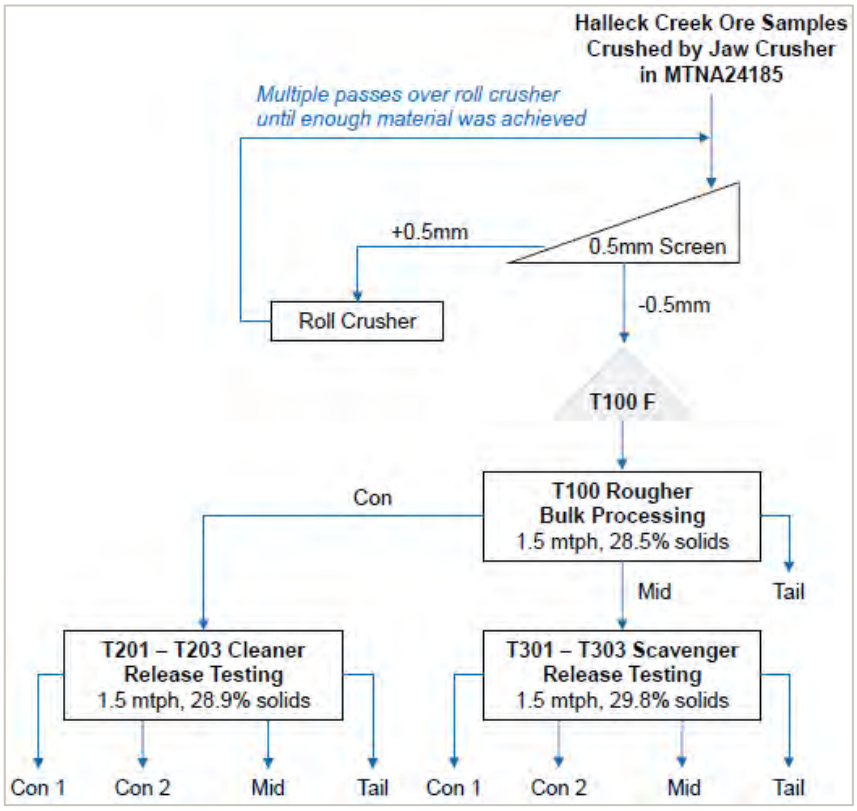


*Figure 13-24 Testing Protocol*

The remaining material (~248kg) from the initial test work (MTNA24185, Rougher Release Curve Testing) was sized and crushed to 100% passing 0.5mm using a roll crusher and a 0.5mm screen. The -0.5mm product was fed to the gravity circuit. Table 13-21 shows the testing conditions by circuit stage. Target conditions are the same as the rougher release testing, 1.5 mtph and a slurry density of 30% solids.

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*Table 13-21: Testing Conditions by Circuit*

| Testing Conditions by Circuit Stage | | | | |
|---|---|---|---|---|
| **Conducted Test Conditions** | **Units** | **Rougher Bulk Processing** | **Cleaner Slage** | **Scavenger Slage** |
| Loadings | Dry mtph | 1.5 | 1.5 | 1.5 |
| Slurry Density | % wt | 28.5 | 28.9 | 29.8 |
| Test ID | - | T100 | T200<br>T201<br>T202<br>T203 | T301<br>T302<br>T303 |
| Sampled Products | - | Con<br>Mid<br>Tail | Con 1<br>Con 2<br>Mid<br>Tail | Con 1<br>Con 2<br>Mid<br>Tail |

#### *13.5.2.2.1 Rougher Bulk Testing*

The rougher bulk testing conditions were set to a 30% mass yield and a middlings product of 26%. The initial rougher spiral testing (MTNA24185) optimal efficiency point was determined to be around 26% mass yield and 67.4% TREO Recovery. This testing program was run at 30% mass yield and a corresponding 70% TREO Recovery to generate more rougher concentrate and middlings. This was then fed to the cleaner spiral and mid-scavenger spiral without having to send more core to Mineral Technologies and expediency.

#### *13.5.2.2.2 Cleaner Release Curve Testing*

Cleaner release testing was performed on the -0.5mm rougher bulk concentrate material. During testing a visual color difference was seen on the spirals (dark band on the inside and lighter material on the outside). The purpose of the cleaner is to upgrade the concentrated mineral stream from the rougher.

#### *13.5.2.2.3 Mid-Scavenger Release Curve Testing*

Mid-Scavenger release testing was performed on the -0.5mm rougher middlings stream. The purpose of the mid-scavenger spiral is to recover valuable mineral that reported to the rougher middlings stream.

#### *13.5.2.2.4 Test Work Results*

The feed to each step (F100 rougher, F200 cleaner and F300 mid-scavenger) was sampled and analyzed. The data is shown in Table 13-22.

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*Table 13-22: Mid-Scavenger Feed Sample Analysis*

| Feed Sample Analysis | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed | TREO ppm | Zr ppm | U ppm | Fe % | Th ppm | Nb ppm | Al % | Ti % | Na % | K % | Ca % | Mn % | Sr ppm | Ba ppm |
| F100 | 4570 | 1520 | 8 | 4.9 | 82 | 157 | 8.8 | 0.3 | 3.2 | 5.2 | 2.1 | 0.1 | 169 | 1630 |
| F200 | 10811 | 4558 | 18 | 10.5 | 185 | 420 | 7.4 | 0.8 | 2.6 | 3.6 | 3.6 | 0.3 | 219 | 1620 |
| F300 | 2087 | 318 | 4 | 2.6 | 35 | 60 | 9.4 | 0.1 | 3.5 | 5.8 | 1.5 | 0.1 | 157 | 1980 |

### *13.5.2.2.5 T100 - Rougher Bulk Results*

The rougher release testing results (MTNA24185) on 0.5mm ore feed showed that the optimal mass yield would be 26% for the concentrate and 32% for the middlings. However, due to the limited available material the bulk rougher stage was conducted with a 30% mass yield to concentrate and a 29% mass yield to middlings to generate sufficient material for the subsequent cleaner and mid-scavenger stages. Table 13-23 shows the mass and metallurgical balance results from the bulk rougher stage.

*Table 13-23: Bulk Rougher Material Balance*

| Bulk Rougher Material Balance | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T100 - MG12 Bulk Rougher Stage | | | | | Assay % | | | | | Stage Distribution % | | | |
| Description | Dry tph | % Solids (wt) | % Mass | | TREO (%) | Zr (%) | U (ppm) | Fe (%) | | TREO | Zr | U | FE |
| Con | 0.46 | 56.4 | 30.1 | | 1.05 | 0.45 | 17 | 10.6 | | 69.4 | 88.3 | 64.0 | 64.5 |
| Mid | 0.44 | 59.9 | 28.8 | | 0.23 | 0.03 | 5 | 2.87 | | 14.6 | 5.07 | 18.0 | 16.7 |
| Tail | 0.65 | 16.5 | 41.1 | | 0.18 | 0.02 | 4 | 2.26 | | 16.0 | 6.65 | 20.5 | 18.8 |
| Feed (calc) | 1.52 | 28.6 | 100.0 | | 0.46 | 0.15 | 8 | 4.94 | | 100.0 | 100.0 | 102.6 | 100.0 |

Figure 13-25 show that the bulk rougher stage performance in this campaign agrees well with the previous release testing results (MTNA24185). The red dots show the current value on the rougher release testing curves.

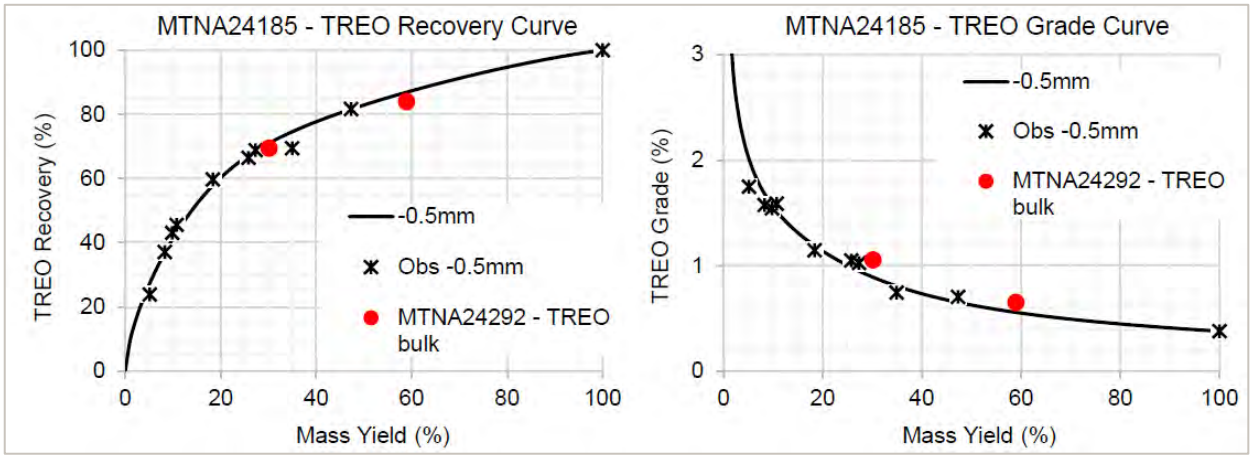


*Figure 13-25 Bulk Processing Results: TREO Recovery and Grade Curves*

#### *13.5.2.2.6 T200 – Cleaner Release Curve Results*

Figure 13-26 and Figure 13-27 show the cleaner curve results. Separation efficiency curves for TREO, Zr, U and Fe can be found in Figure 13-28. The best efficiency point for the TREO is at a 39% mass yield, resulting in a grade of 1.7% TREO and a 62.6% recovery.

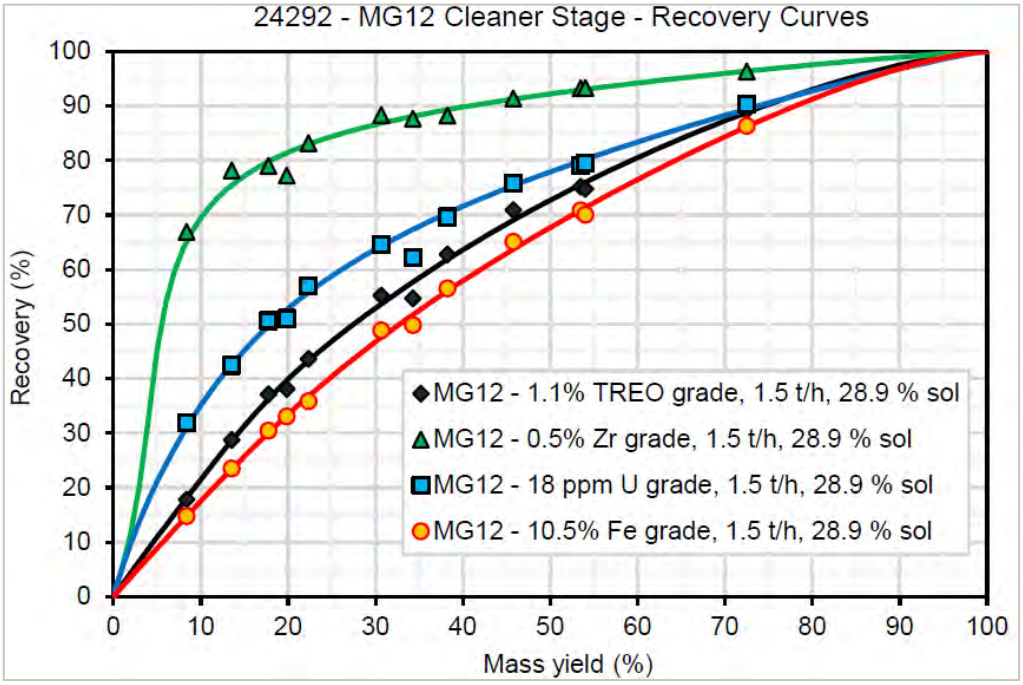


*Figure 13-26: Cleaner Recovery Curves*

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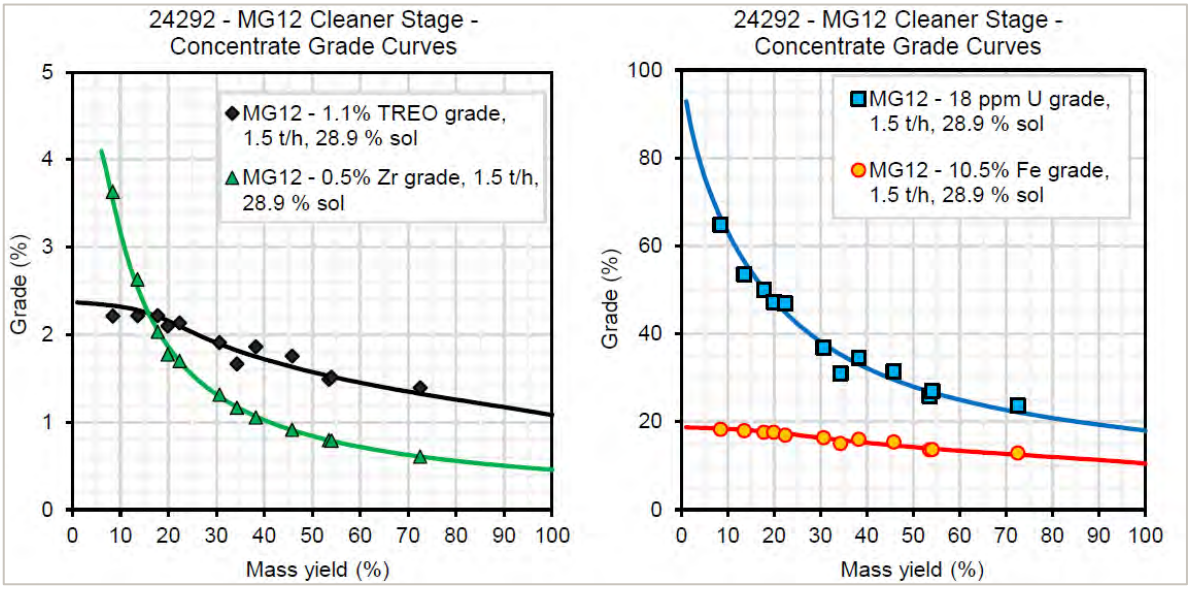


*Figure 13-27: Cleaner Concentrate Grade Curves*

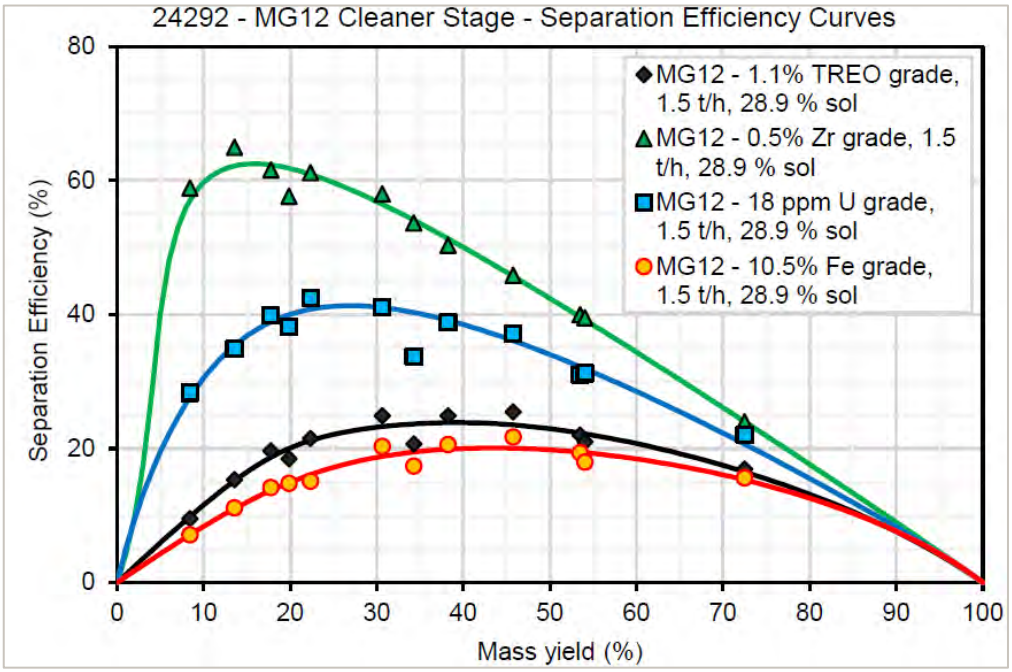


*Figure 13-28: Cleaner Separation Efficiency Curves*

Table 13-24 provides a summary of the cleaner release curve testing.



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*Table 13-24: Summary of Cleaner Release Curve Testing*

| Cleaner Release Curve Testing | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage | | | Assay % | | | | Stage Distribution % | | | | Overall Distribution % | | | |
| Description | % Mass$^0$ | % Mass$^1$ | TREO | Zr | U | Fe | TREO | Zr | U | FE | TREO | Zr | U | FE |
| Con | 39.0 | 11.8 | 1.74 | 1.05 | 0.0033 | 15.3 | 62.6 | 89.5 | 70.9 | 56.9 | 44.4 | 78.5 | 45.8 | 37.1 |
| Tail | 61.0 | 18.4 | 0.66 | 0.08 | 0.0009 | 7.43 | 37.4 | 10.50 | 29.1 | 43.1 | 26.5 | 9.19 | 18.8 | 28.2 |
| Feed (calc) | 100.0 | 30.1 | 1.08 | 0.46 | 0.0018 | 10.5 | 100.0 | 100.0 | 100.0 | 100.0 | 71.0 | 87.7 | 64.7 | 65.5 |

%Mass$^0$ is relative to stage feed
%Mass$^1$ is relative to circuit feed

### *13.5.2.2.7 T300 - Mid-Scavenger Release Curve Results*

The middlings from the rougher are the feed for the Mid Scavenger release curves. Figure 13-29, Figure 13-30 and Figure 13-31 show the recovery and separation efficiency curves.

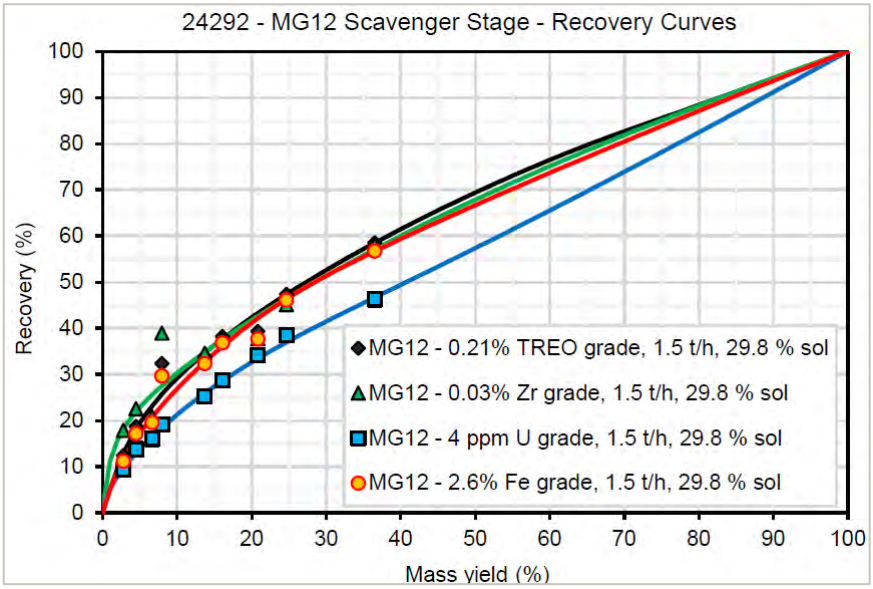


*Figure 13-29: Scavenger Recovery Curves*

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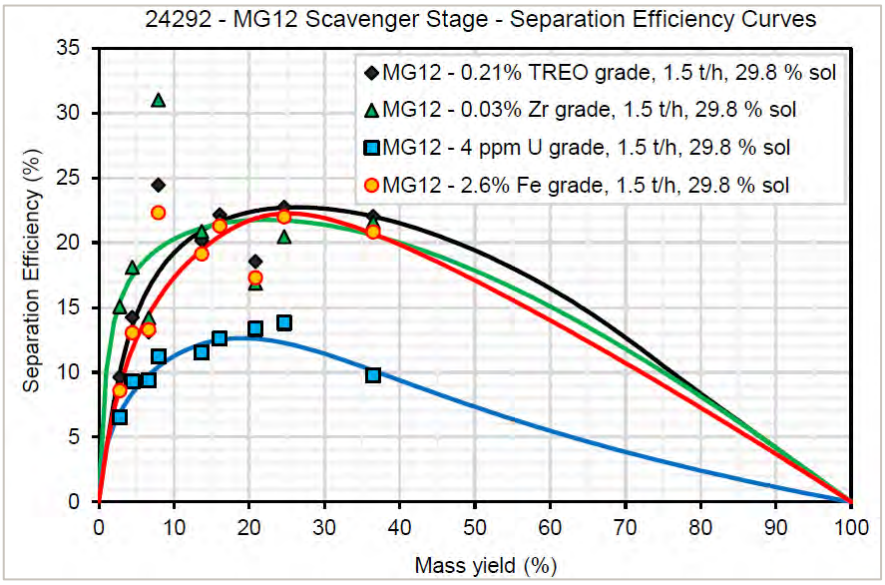


*Figure 13-30: Scavenger Separation Efficiency Curves*

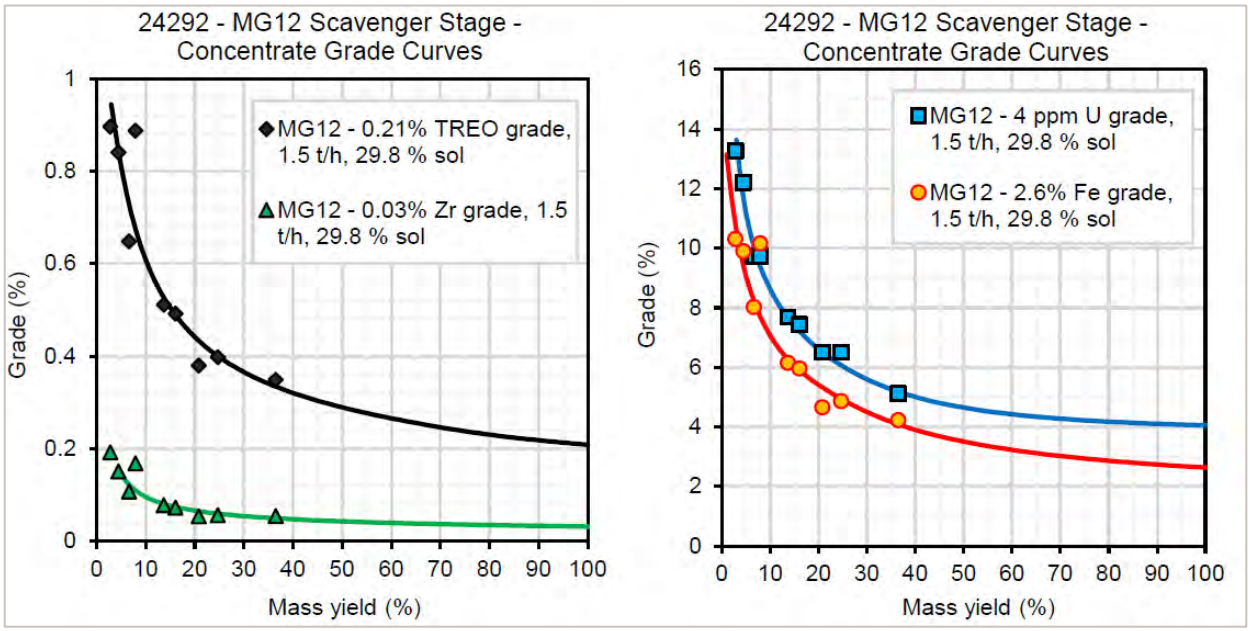


*Figure 13-31: Scavenger Concentrate Grade Curves*

Table 13-25 provides a summary of the mid-scavenger release curve testing. The max separation efficiency occurs at 26% mass yield and 48.7% TREO recovery resulting in a 0.39% TREO grade.

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*Table 13-25: Mid-Scavenger Release Curve Testing*

| Mid-Scavenger Release Curve Testing | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage | | | Assay % | | | | Stage Distribution % | | | | Overall Distribution % | | | |
| Description | % Mass[0] | % Mass[1] | TREO | Zr | U | Fe | TREO | Zr | U | FE | TREO | Zr | U | FE |
| Con | 26.0 | 7.49 | 0.39 | 0.06 | 0.0006 | 4.82 | 48.7 | 47.7 | 38.1 | 47.7 | 6.4 | 2.8 | 5.31 | 7.45 |
| Tail | 74.0 | 21.3 | 0.14 | 0.02 | 0.0003 | 1.86 | 51.3 | 52.30 | 61.9 | 52.3 | 6.72 | 3.06 | 8.63 | 8.18 |
| Feed (calc) | 100.0 | 28.8 | 0.21 | 0.03 | 0.00 | 2.63 | 100.0 | 100.0 | 100.0 | 100.0 | 13.1 | 5.9 | 13.9 | 15.6 |

%Mass[0] is relative to stage feed
%Mass[1] is relative to circuit feed

Based on these results the cleaner stage shows positive upgrading results. The mid-scavenger, as it was tested, did not improve recovery or grade of the TREO due to the low feed grade entering the scavenger circuit. One possible solution would be to combine the rougher middlings with the tails from the cleaner step which would increase the grade to be comparable to the rougher feed. Due to the limited amount of feed, the mass split settings were not optimal, resulting in a mid-scavenger feed grade that was significantly lower than that of the rougher step ore (0.21% vs. 0.46% TREO).

Concluded from feedback provided by MT, a -0.5 mm x 0 range is too wide of a size fraction for the spirals to operate at the highest efficiency. TREO recovery is positive, but a smaller particle size would most likely improve liberation and therefore recovery and grade.

#### 13.5.2.3 Allanite Upgrading Flowsheet Testing (MTNA25032), 100% passing 0.3mm

Further testing was performed at Mineral Technologies (MT) to evaluate a finer grind, IRMS testing and to produce a bulk sample that can be sent to SGS for leaching and impurity removal testing. Two types of ore were crushed and ground, “altered (oxidized)” and “unaltered”, to 100% passing 0.3mm to evaluate any negative effects of either type of ore. Core from the 2023 drilling campaign was sent to SGS to be ground with the following process. Ore was crushed using a jaw crusher (2 choke feed passes with jaw set to a gap of 1.5”) then screened with a 10 mesh screen (2.0mm), the oversize was run through a cone crusher with the gap at 6.3mm screening between each pass on the same 10 mesh screen. The final grinding operation was conducted in a wet rod mill to get to 100% passing 0.3mm.

The final material, 100% passing 0.3mm, was then screened at 86 micron fines to remove the fines before conducting the gravity spiral testing. The feed for this batch of testing and processing at MT is -300micron+86micron. Table 13-26 and Table 13-27 provide the mass balance and size fraction distribution and Table 13-28 summarizes core sample analysis. There is little difference between the Unaltered and Altered ore types with regards to size fraction after grinding.

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*Table 13-26: Mass Balances*

| Unaltered | | | Altered | | | Totals - Product | | |
|---|---|---|---|---|---|---|---|---|
| Mass Balance & Distribution | | | Mass Balance & Distribution | | | Mass Balance & Distribution | | |
| Stream | Weight (kg) | Distribution (%) | Stream | Weight (kg) | Distribution (%) | Stream | Weight (kg) | Distribution (%) |
| Grinding Feed | 1,723 | 100.0 | Grinding Feed | 1,277 | 100.0 | Total Grind Mass | 3,000 | 100.0 |
| 86 µm Oversize | 1,105 | 64.1 | 86 µm Oversize | 781 | 61.2 | Total 86 µm Oversize | 1,886 | 62.9 |
| 86 µm Undersize | 618 | 35.9 | 86 µm Undersize | 496 | 38.8 | Total 86 µm Undersize | 1,114 | 37.1 |

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*Table 13-27: Size Fraction Distribution*

| Size Fraction | p80 Avg Size (um) | | | p50 Avg Size (um) | | |
|---|---|---|---|---|---|---|
| | Unaltered | Altered | %Diff | Unaltered | Altered | %Diff |
| -300 x 0 | 195 | 186 | 4.6% | 106 | 92 | 13.2% |
| -300 x + 86 | 233 | 229 | 1.7% | 161 | 158 | 1.9% |
| -86 x 0 | 58 | 63 | -8.6% | - | - | - |

*Table 13-28: Core Sample Analysis*

| Unaltered Core Samples | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Type** | **Sample ID** | **Mass** | **% Fraction** | **La g/t** | **Ce g/t** | **Pr g/t** | **Nd g/t** | **Sm g/t** | **Eu g/t** | **Gd g/t** | **Tb g/t** | **Dy g/t** | **Ho g/t** | **Er g/t** | **Tm g/t** | **Yb g/t** | **Lu g/t** | **Y g/t** | **TREE+Y** | **TREE+Y-Ce** |
| Head | PP-03 SN 300 US | 1,723.18 | 100.0% | 628 | 1,260 | 145 | 553 | 81 | 11 | 62 | 7 | 37 | 7 | 17 | 2 | 13 | 2 | 137 | 2,963 | 1,703 |
| +300 x +86 | PP-03 SN 86 OS | 1,105.25 | 64.1% | 656 | 1,320 | 151 | 587 | 84 | 11 | 58 | 7 | 37 | 7 | 17 | 2 | 15 | 2 | 129 | 3,082 | 1,762 |
| -86 x 0 | PP-03 SN 86 US | 617.93 | 35.9% | 743 | 1,480 | 170 | 648 | 108 | 13 | 76 | 9 | 51 | 8 | 21 | 3 | 21 | 3 | 184 | 3,538 | 2,058 |
| **Altered Core Samples** | | | | | | | | | | | | | | | | | | | | |
| **Sample Type** | **Sample ID** | **Mass** | **% Fraction** | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Tm g/t | Yb g/t | Lu g/t | Y g/t | **TREE+Y** | **TREE+Y-Ce** |
| Head | PP-202 (Survey) SN 300 US | 1,276.55 | 100.0% | 631 | 1,290 | 149 | 562 | 85 | 10 | 61 | 7 | 39 | 7 | 17 | 2 | 16 | 2 | 154 | 3,032 | 1,742 |
| +300 x +86 | PP-202 (Survey) SN 86 OS | 780.78 | 61.2% | 628 | 1,290 | 149 | 540 | 83 | 8 | 51 | 6 | 33 | 6 | 16 | 2 | 14 | 2 | 131 | 2,959 | 1,669 |
| -86 x 0 | PP-202 (Survey) SN 86 US | 495.77 | 38.8% | 958 | 1,950 | 225 | 857 | 146 | 13 | 95 | 13 | 61 | 12 | 33 | 5 | 33 | 5 | 253 | 4,658 | 2,708 |

| Unaltered Core Samples | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Type** | **Sample ID** | **Mass** | **% Fraction** | **U g/t** | **Th g/t** | **Rad g/t** | **Zr g/t** | **NDPr** | **SiO2 %** | **Al2O3 %** | **Fe2O3 %** | **MgO %** | **CaO %** | **Na2O %** | **K2O %** | **TiO2 %** | **P2O5 %** | **MnO %** | **Cr2O3 %** | **V2O5 %** | **LOI %** | **Sum %** |
| Head | PP-03 SN 300 US | 0.00 | 0.0% | 5 | 53 | 58 | 300 | 698 | 62.0 | 16.1 | 6.7 | 0.1 | 2.6 | 4.2 | 6.2 | 0.4 | 0.1 | 0.2 | < 0.01 | < 0.01 | 0.6 | 99.3 |
| +300 x +86 | PP-03 SN 86 OS | 0.00 | 0.0% | 4 | 57 | 61 | 368 | 738 | 63.0 | 16.2 | 6.0 | 0.1 | 2.4 | 4.3 | 6.3 | 0.5 | 0.0 | 0.1 | < 0.01 | < 0.01 | 0.4 | 99.4 |
| -86 x 0 | PP-03 SN 86 US | 0.00 | 0.0% | 10 | 60 | 70 | 579 | 818 | 59.7 | 15.6 | 8.6 | 0.2 | 3.2 | 4.0 | 6.1 | 0.6 | 0.1 | 0.2 | 0.0 | < 0.01 | 0.8 | 99.1 |
| **Altered Core Samples** | | | | | | | | | | | | | | | | | | | | |
| **Sample Type** | **Sample ID** | **Mass** | **% Fraction** | U g/t | Th g/t | **Rad g/t** | Zr g/t | **NDPr** | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | Cr2O3 % | V2O5 % | LOI % | Sum % |
| Head | PP-202 (Survey) SN 300 US | 0.00 | 0.0% | 6 | 53 | 59 | 410 | 711 | 62.5 | 15.8 | 6.69 | 0.38 | 2.21 | 4.24 | 6.1 | 0.45 | 0.06 | 0.16 | 0.01 | < 0.01 | 1.21 | 99.8 |
| +300 x +86 | PP-202 (Survey) SN 86 OS | 0.00 | 0.0% | 5 | 55 | 59 | 441 | 689 | 62.9 | 15.7 | 5.47 | 0.23 | 1.96 | 4.35 | 6.23 | 0.45 | 0.03 | 0.13 | 0.01 | < 0.01 | 0.78 | 98.3 |
| -86 x 0 | PP-202 (Survey) SN 86 US | 0.00 | 0.0% | 20 | 80 | 100 | 1,660 | 1,082 | 57.9 | 14.7 | 10.2 | 0.54 | 3.07 | 3.86 | 5.33 | 0.91 | 0.11 | 0.25 | 0.02 | < 0.01 | 1.37 | 98.2 |

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The REE concentrations were very consistent between the Unaltered and Altered ore types as shown in Figure 13-32.

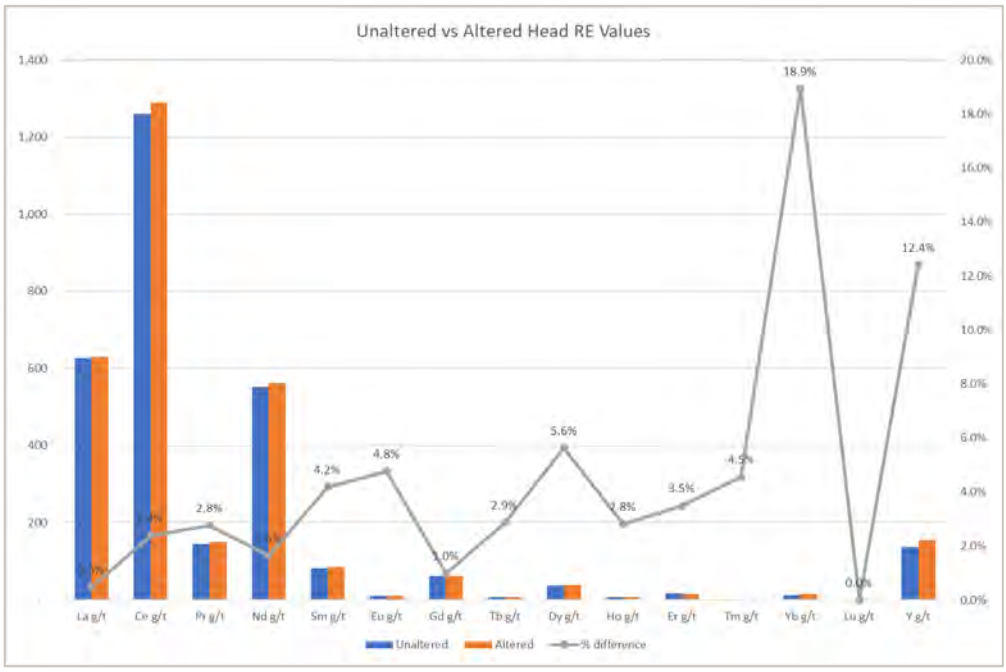


*Figure 13-32: REE Concentrations in Ore Types*

Figure 13-33 and

Figure 13-34 show the particle size distribution of the Unaltered 100% passing 300 micron on in 13-33 and Altered 100% passing 300 micron in Figure 13-34.

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**SGS Minerals Services**
**Size Distribution Analysis**

Project No. **20383-03**

Sample: **Altered SN300 US** Test No.: **PP-202**

| Size | | Weight | % Retained | | % Passing |
|---|---|---|---|---|---|
| Mesh | µm | grams | Individual | Cumulative | Cumulative |
| 35 | 425 | 0.0 | 0.0 | 0.0 | 100.0 |
| 48 | 300 | 0.4 | 0.3 | 0.3 | 99.7 |
| 65 | 212 | 17.0 | 12.9 | 13.3 | 86.7 |
| 100 | 150 | 22.0 | 16.8 | 30.0 | 70.0 |
| 150 | 106 | 19.7 | 15.0 | 45.0 | 55.0 |
| 200 | 75 | 15.4 | 11.7 | 56.7 | 43.3 |
| 270 | 53 | 12.0 | 9.1 | 65.9 | 34.1 |
| 400 | 38 | 8.7 | 6.6 | 72.5 | 27.5 |
| Pan | -38 | 36.1 | 27.5 | 100.0 | 0.0 |
| **Total** | **-** | **131.3** | 100.0 | **-** | **-** |
| **K86** | **209** | | | | |

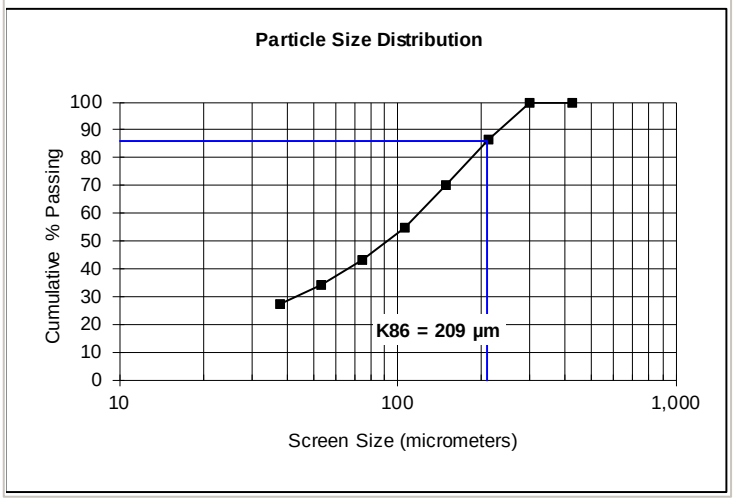


*Figure 13-33: Altered Ore Size Distribution Analysis*

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**SGS Minerals Services**
**Size Distribution Analysis**

Project No. **20383-03**

Sample: **Unaltered SN300 US** Test No.: **PP-03**

| Size Mesh | Size µm | Weight grams | % Retained Individual | % Retained Cumulative | % Passing Cumulative |
|---|---|---|---|---|---|
| 35 | 425 | 0.0 | 0.0 | 0.0 | 100.0 |
| 48 | 300 | 0.8 | 0.5 | 0.5 | 99.5 |
| 65 | 212 | 22.1 | 14.3 | 14.8 | 85.2 |
| 100 | 150 | 30.1 | 19.4 | 34.2 | 65.8 |
| 150 | 106 | 24.3 | 15.7 | 49.9 | 50.1 |
| 200 | 75 | 18.7 | 12.1 | 61.9 | 38.1 |
| 270 | 53 | 13.4 | 8.6 | 70.6 | 29.4 |
| 400 | 38 | 9.9 | 6.4 | 77.0 | 23.0 |
| Pan | -38 | 35.7 | 23.0 | 100.0 | 0.0 |
| **Total** | **-** | **155.0** | 100.0 | **-** | **-** |
| **K80** | **195** | | | | |

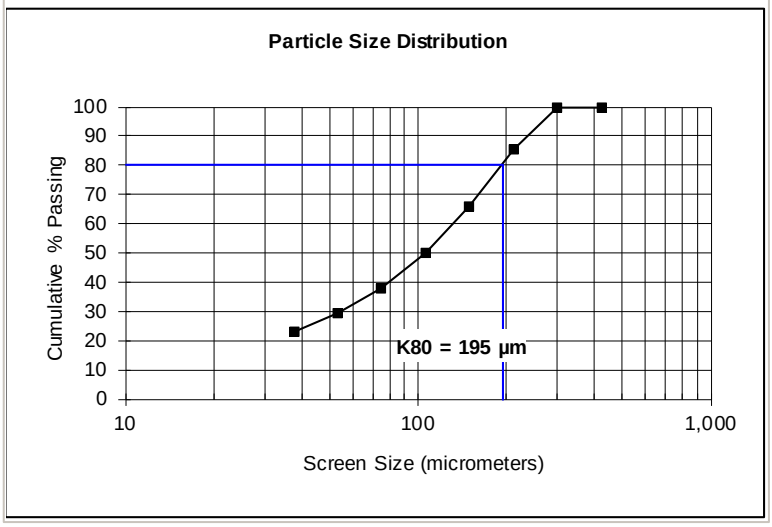


*Figure 13-34: Unaltered Ore Size Distribution Analysis*

#### *13.5.2.3.1 Rougher Spiral Release Test Results (MTNA25032) Unaltered, 100% Passing 0.3mm*

The rougher spirals experienced an improvement using a 100% passing 0.3mm feed. The rougher separation efficiency curve in Figure 13-35 indicates the max efficiency is at 22% mass yield for the concentrate and 16% for the mid-cut (middlings).

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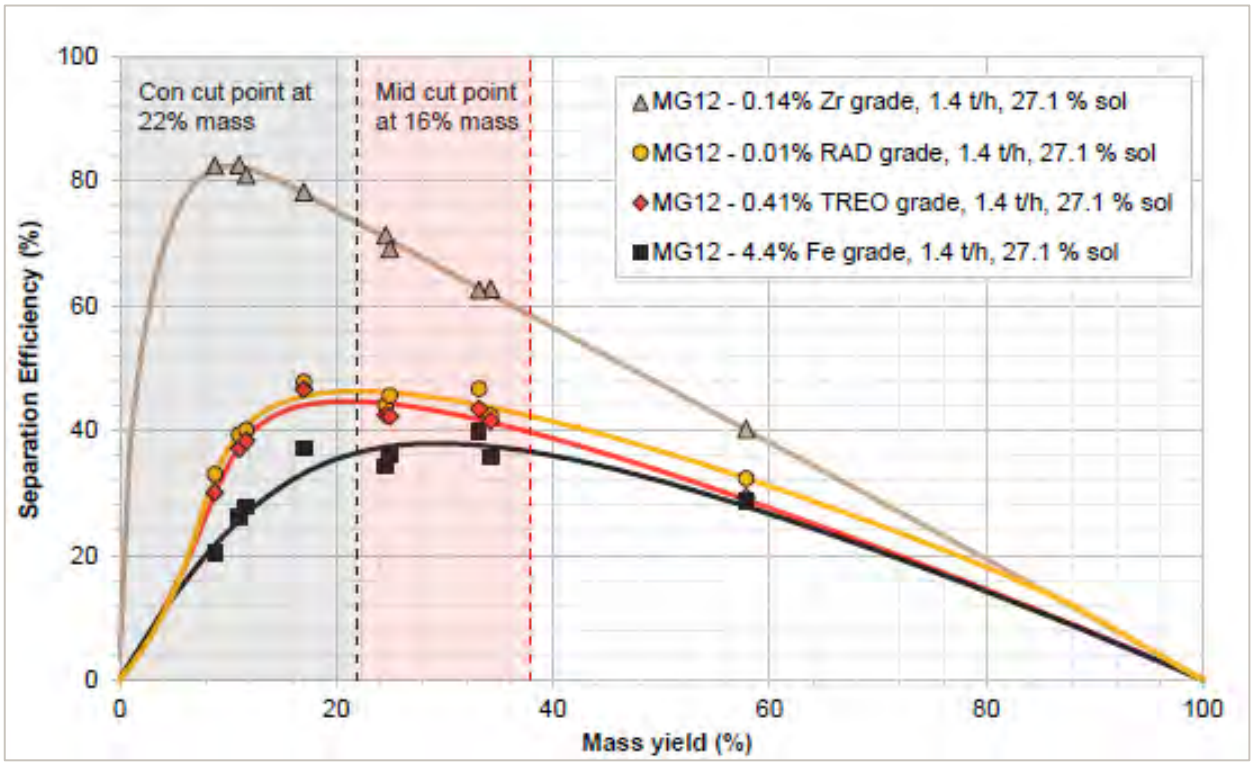


*Figure 13-35: Rougher Separation Efficiency*

The rougher recovery curve in Figure 13-36 indicates a 22% mass yield translates to a 66.5% TREO recovery. The resulting grade is 1.19% TREO with a feed of 0.292% TREO (2,923ppm), or a 4.1 upgrade factor.

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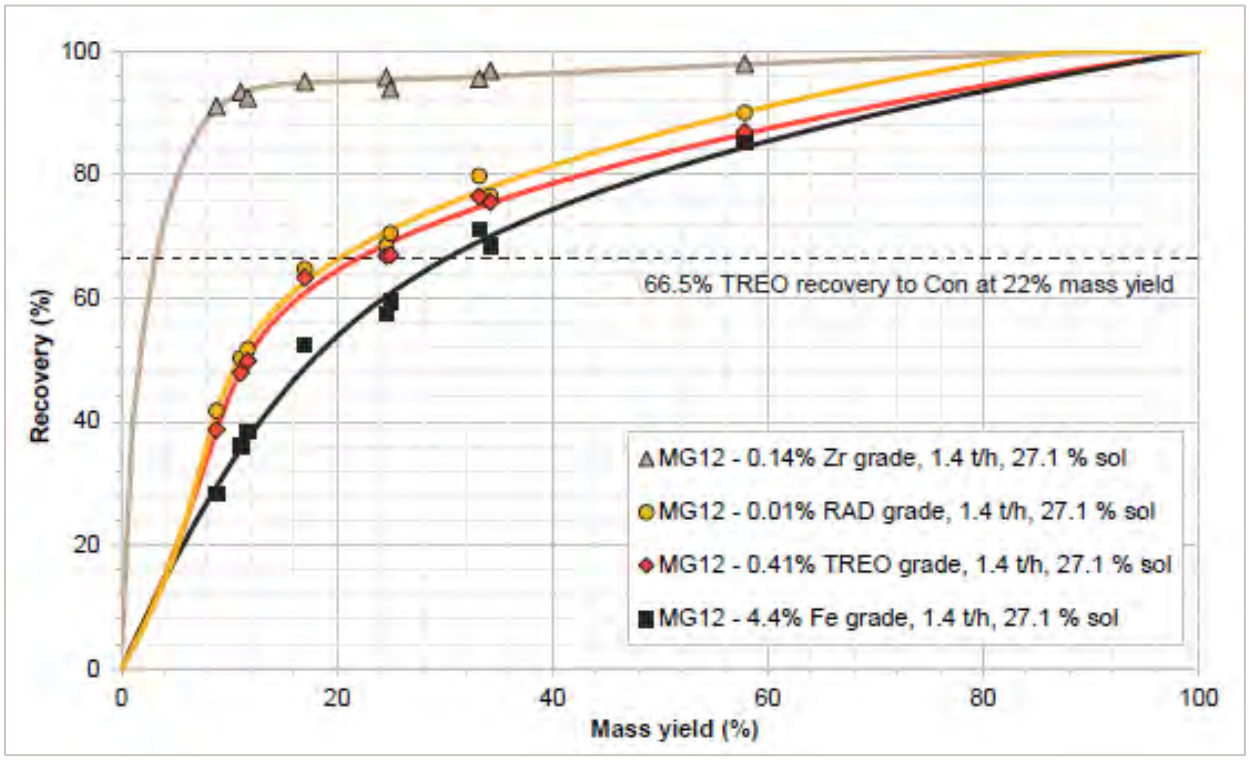


*Figure 13-36: Rougher Recovery*

Table 13-29 provides the rougher spiral feed composition and the rougher spiral concentrate (Con) composition. The composition of Si, Al, Na, K and P show a depletion due to their presence in the feldspar and quartz where the other elements are concentrated due to their presence in the Hastingsite and allanite.

*Table 13-29: Rougher Spiral Composition Analysis*

| Rougher Spiral Compostion Analysis | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Location** | **TREO %** | **RAD ppm** | **SiO2 %** | **Al2O3 %** | **Fe2O3 %** | **MgO %** | **CaO %** | **Na2O %** | **K2O %** | **TiO2 %** | **P2O5 %** | **MnO %** |
| Rougher Spiral Feed Composition | 0.410 | 74.4 | 62.7 | 16.2 | 6.22 | 0.13 | 2.51 | 4.23 | 6.19 | 0.45 | 0.04 | 0.15 |
| Rougher Spiral Concentrate Composition | 1.178 | 215.4 | 54.2 | 13.3 | 15.30 | 0.23 | 5.00 | 3.38 | 4.19 | 1.41 | 0.07 | 0.36 |

Table 13-30 shows the cut points for the Con, Mid and Tails according to the rougher spiral release curve testing along with the corresponding mass yields, TREO Recovery and TREO Grade.

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*Table 13-30: Rougher Spiral Cut Points with Mass Yields*

| Cut Points with Mass Yields | | | |
|---|---|---|---|
| **Recommended Cut Points** | **Mass Yield (%)** | **TREO Recovery (%)** | **TREO Grade (%)** |
| Con | 22 | 66.5 | 1.24 |
| Mid | 16 | 11.0 | 0.28 |
| Tail | 62 | 22.5 | 0.15 |

#### *13.5.2.3.2 Rougher Spiral Bulk Results (MTNA25032) Unaltered, 100% passing 0.3mm*

Bulk processing was performed on the unaltered sample with splits determined in the earlier release curve testing. Table 13-31 indicates a 24.8% mass yield and a 71.2% TREO recovery to the Con product.

*Table 13-31: Rougher Spiral Bulk Sample Unaltered Results*

| Rougher Spiral Bulk Sample Unaltered Results | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **T1100 Bulk Spiral** | | | **Assay %** | | | | | **Stage Recovery %** | | | |
| **Description** | **% Mass** | | **TREO (%)** | **Zr (%)** | **Fe (%)** | **RAD (%)** | | **TREO (%)** | **Zr (%)** | **Fe (%)** | **RAD (%)** |
| Con | 24.8 | | 1.18 | 0.53 | 10.7 | 0.022 | | 71.2 | 94.9 | 61.4 | 56.6 |
| Mid | 21.2 | | 0.24 | 0.01 | 3.35 | 0.005 | | 12.6 | 2.26 | 16.5 | 11.1 |
| Tail | 54.0 | | 0.12 | 0.01 | 1.76 | 0.006 | | 16.2 | 2.87 | 22.1 | 32.3 |
| Feed (calc) | 100.0 | | 0.41 | 0.14 | 4.31 | 0.009 | | 100.0 | 100.0 | 100 | 100.0 |

#### *13.5.2.3.3 Rougher Spiral Bulk with Mid Recycle Test Results (MTNA25032) Unaltered, 100% passing 0.3mm*

Recycling of middlings (mids) stream of 21.2% (as measure against the fresh feed) results in an increase in the %TREO Recovery from 71.2% with a rougher only to 79% with mids recycle. The mass yield remains at 24.8%.

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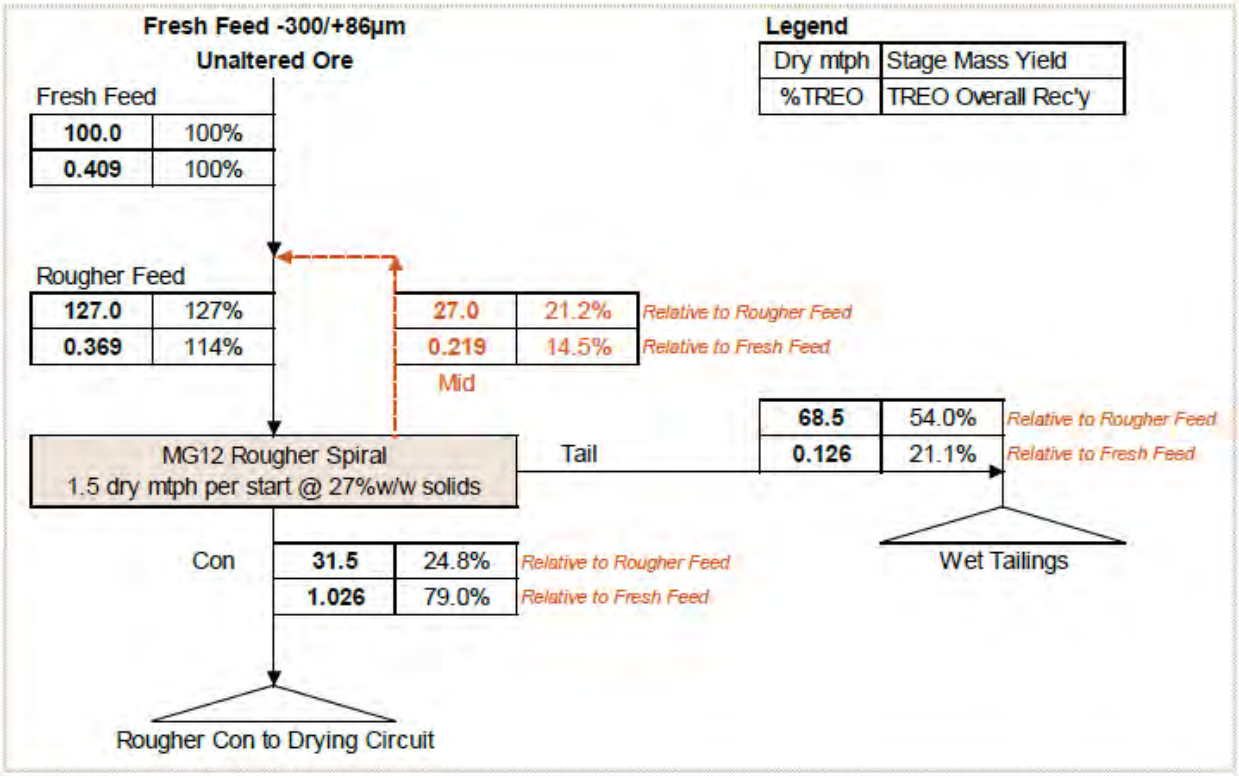


*Figure 13-37: Rougher Spiral Bulk with Mid Recycle Test Results*

#### *13.5.2.3.4 Cleaner Release Test Results (MTNA25032) Unaltered, 100% passing 0.3mm*

Cleaner Release Testing was performed using the concentrate produced from the rougher bulk processing above. Figure 13-38 and Figure 13-39 show a 48% mass yield and 74% TREO Recovery. This performance was deemed to be detrimental to the overall worksheet and therefore no spiral cleaner steps were incorporated into the final processing flowsheet.

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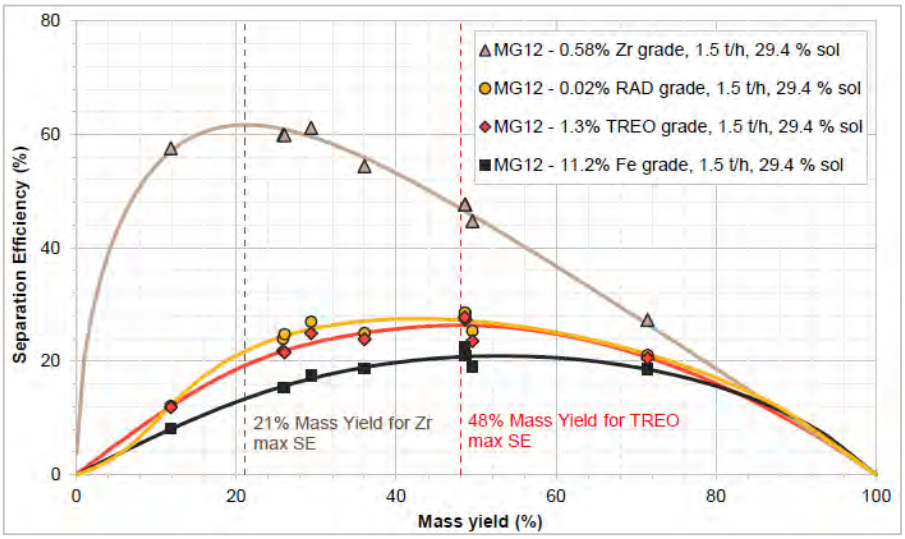


*Figure 13-38: Cleaner Release Test Results: Separation Efficiency*

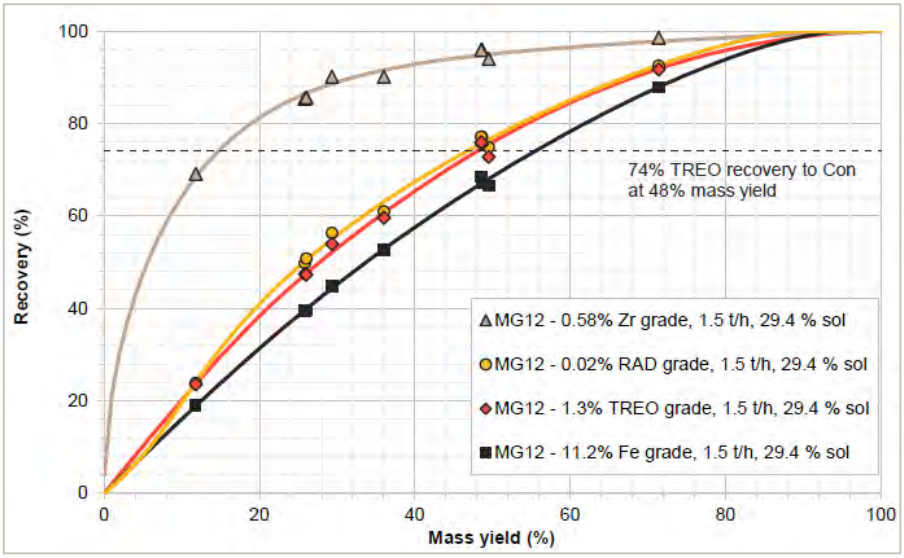


*Figure 13-39: Cleaner Release Test Results: Recovery*

#### *13.5.2.3.5 Gravity Spiral Results Summary, 100% passing 0.3mm*

Table 13-32 provides a summary of all unaltered spiral testing conducted by Mineral Technologies under MTNA25032. The values highlighted in Table 10-26 were incorporated into the processing flowsheet.

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*Table 13-32: Gravity Spiral Results*

| Gravity Spiral Results | | | | |
|---|---|---|---|---|
| | **Spiral Rougher, Bulk** | **Spiral Rougher, Bulk with 21.2% Mid Recycle** | **Spiral Rougher, Release Curve** | **Spiral Cleaner, Release Curve** |
| Mass Yield | 0.248 | 0.248 | 0.22 | 0.48 |
| TREO Recovery | 0.712 | 0.79 | 0.665 | 0.74 |

### 13.5.2.4 Induced Roll Magnet Separation (IRMS) Release Curve Results - (MTNA25032),100% passing 0.3mm

Induced Roll Magnet Separation (IRMS) uses an electromagnet to generate high-intensity magnetic fields. These magnetic fields enable the separation of weak and para-magnetic minerals (e.g. mica, iron-coated silica, etc) from non-metallic minerals (e.g. feldspar, silica sand, zircon, etc) in a dry state. A diagram of the integral parts of an IRMs, a photo of a small laboratory scale model and a full scale model is shown below. The strength of the magnetic field can be varied by the amperage of the power to the electromagnet. The roll speed can be adjusted to vary the retention time. The gap between the induced roll and pole can be adjusted to accommodate different feed sizes. Feed must be dry and >50 micron.



*Figure 13-40: Skid Mounted IRMS Unit*

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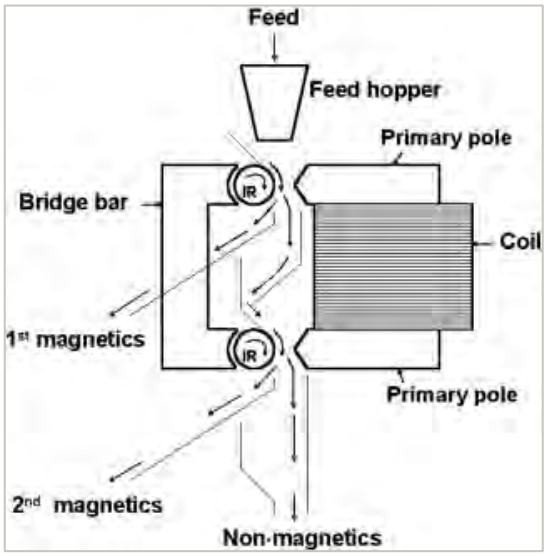


*Figure 13-41: High Level Schematic of IRMS Unit*



*Figure 13-42: IRMS Unit*

A release curve was generated on a lab scale IRMS unit at MT using the rougher spiral concentrate from the 100% passing 300-micron ore feed testing. The amperage (strength of magnetic field) was increased in a stepwise fashion with samples taken at each step. Figure 13-43 provides the release curve with the

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TREO, Rad, and Fe analysis with the individual recovery shown with a bar graph and the cumulative recovery shown with a line graph (2nd Y axis).

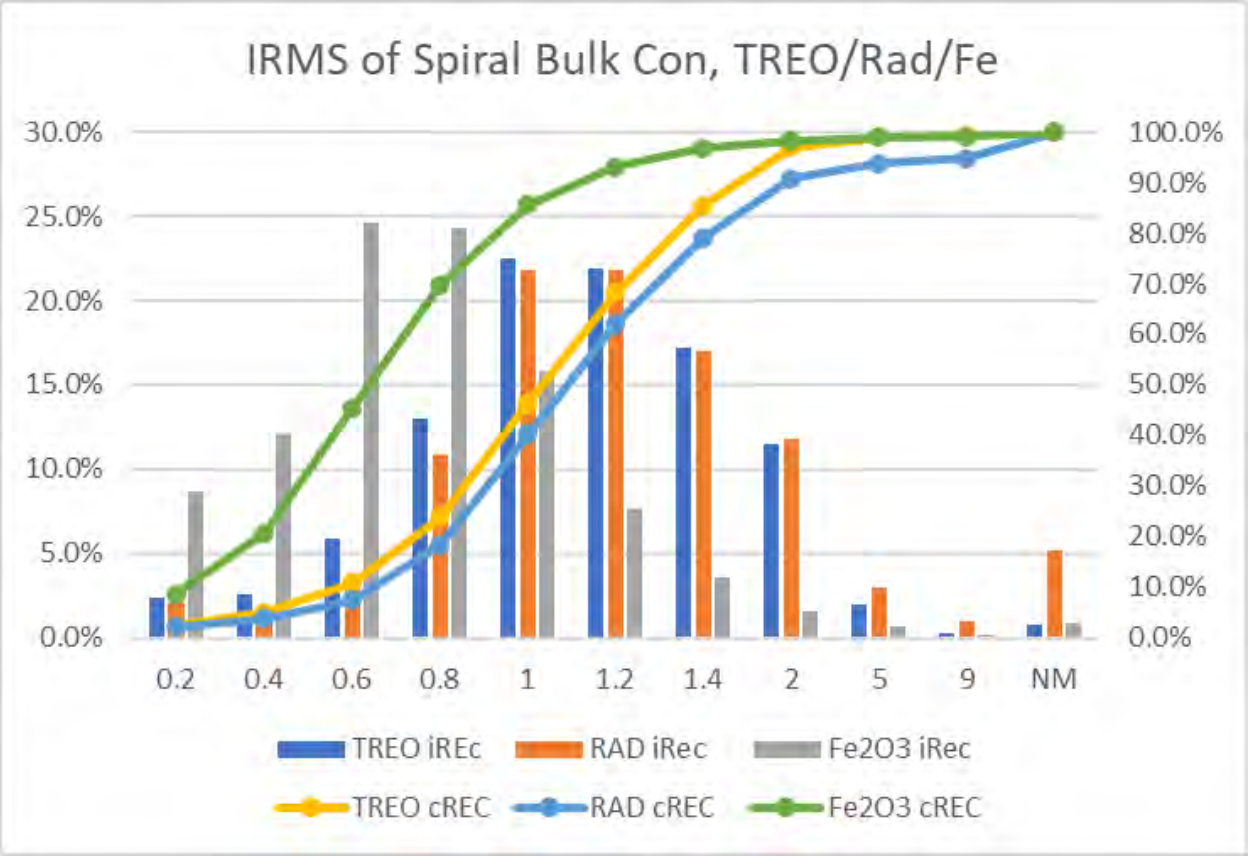


*Figure 13-43: IRMS Release Curve*

The amount of Fe present from 0.2 amps to 0.6 amps is high especially compared to the amount of TREO. The material from 0.2 amps to 0.6 amps would be discarded as tailings, this material would remove 45.4% of the Fe with a 10.8% TREO yield loss while rejecting 20.1% of the total mass. In the production plant this material would be removed together as the magnetic fraction at a 0.6 amp setting. The material from 5 amp setting, 9 amps setting and non-magnetic material would also be discarded as Tails. In the production plant this material would be removed together as the non-magnetic fraction at a 2.0 amp setting. This material would remove 62.4% of SiO2, 65.8% of Al2O3, 75.4% of the CaO, 80.0% of K2O, a yield loss of 3.0% TREO while rejecting 50.4% of the total mass.

The final results for the IRMS treatment in the step-wise release curve testing is 29.5% mass yield, 86.2% TREO recovery and a concentrate that is 3.72% TREO or an upgrade factor of 2.92 as compared to the rougher concentrate. Table 13-33 provides the IRMS Feed and IRMS Concentrate compositions.

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*Table 13-33: IRMS Treatment Results*

| IRMS Compostion Analysis | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | TREO % | RAD ppm | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % |
| IRMS Feed Composition | 1.28 | 232.1 | 54.0 | 13.3 | 15.2 | 0.22 | 5.03 | 3.35 | 4.14 | 1.42 | 0.07 | 0.35 |
| IRMS Spiral Concentrate Composition | 3.72 | 655.0 | 42.3 | 9.9 | 27.3 | 0.31 | 8.93 | 1.78 | 1.79 | 2.34 | 0.10 | 0.63 |

Table 13-34 provides the rejection percentages across the IRMS step. In the case of TREO, it is the material lost to the IRMS tails. Note that the Table 13-33 is the composition and Table 13-34 is Rejection. The weights of the concentrate and tails are not the same.

*Table 13-34: IRMS Rejection Analysis*

| IRMS Rejection Analysis | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TREO % | RAD ppm | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % |
| 13.8 | 16.7 | 76.9 | 78.1 | 47.1 | 59.0 | 47.6 | 84.3 | 87.2 | 51.5 | 58.7 | 47.4 |

*Table 13-35: Individual Recovery Analysis*

| | | | | Individual Recovery | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amps | Mass | Wt % | TREE ppm | TREO iREc | RAD iRec | SiO2 iRec | Al2O3 iRec | Fe2O3 iRec | MgO iRec | CaO iRec | Na2O iRec | K2O iRec | TiO2 iRec | P2O5 iRec | MnO iRec |
| 0.2 | 18.8 | 3.8% | 6,664 | 2.4% | 2.1% | 2.8% | 2.1% | 8.7% | 17.3% | 5.3% | 1.6% | 1.4% | 5.4% | 11.1% | 7.5% |
| 0.4 | 26.9 | 5.4% | 5,079 | 2.6% | 1.8% | 3.8% | 3.3% | 12.0% | 11.2% | 9.7% | 2.5% | 2.0% | 18.0% | 7.2% | 13.3% |
| 0.6 | 54.2 | 10.9% | 5,755 | 5.9% | 3.7% | 7.8% | 6.9% | 24.6% | 18.1% | 21.1% | 4.8% | 3.8% | 27.1% | 13.1% | 25.3% |
| 0.8 | 55.8 | 11.2% | 12,301 | 13.0% | 10.9% | 8.2% | 7.3% | 24.3% | 18.6% | 21.9% | 5.2% | 4.1% | 22.8% | 15.0% | 24.1% |
| 1 | 40.2 | 8.1% | 29,684 | 22.5% | 21.7% | 6.0% | 5.6% | 15.8% | 12.0% | 15.3% | 3.8% | 2.9% | 13.8% | 11.9% | 15.5% |
| 1.2 | 23.4 | 4.7% | 49,570 | 21.9% | 21.8% | 3.7% | 3.6% | 7.6% | 5.9% | 8.2% | 2.4% | 1.9% | 6.6% | 6.9% | 7.6% |
| 1.4 | 15 | 3.0% | 60,849 | 17.2% | 17.0% | 2.6% | 2.6% | 3.5% | 2.8% | 4.4% | 1.9% | 1.7% | 3.3% | 4.0% | 3.6% |
| 2 | 12.7 | 2.5% | 47,902 | 11.5% | 11.8% | 2.6% | 2.7% | 1.5% | 1.7% | 2.6% | 2.4% | 2.2% | 2.0% | 3.4% | 1.8% |
| 5 | 21.7 | 4.4% | 4,752 | 1.9% | 2.9% | 5.0% | 5.4% | 0.7% | 2.0% | 2.1% | 6.2% | 5.7% | 0.8% | 6.4% | 1.0% |
| 9 | 13.5 | 2.7% | 1,037 | 0.3% | 1.0% | 3.2% | 3.5% | 0.2% | 0.7% | 0.9% | 4.1% | 3.8% | 0.1% | 3.3% | 0.3% |
| Non Magnetic | 216 | 43.4% | 195 | 0.8% | 5.2% | 54.2% | 56.9% | 0.9% | 9.7% | 8.5% | 65.1% | 70.5% | 0.0% | 17.5% | 0.0% |
| TOTAL | 498.2 | 100.0% | 10,626 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| -0.6 amps - Tails | 99.9 | 20.1% | 5,744 | 10.8% | 7.6% | 14.4% | 12.3% | 45.4% | 46.5% | 36.0% | 8.9% | 7.3% | 50.5% | 31.5% | 46.1% |
| +0.6 x -2.0 - Con | 147.1 | **29.5%** | **31,004** | **86.2%** | 83.3% | 23.1% | 21.9% | 52.9% | 41.0% | 52.4% | 15.7% | 12.8% | 48.5% | 41.3% | 52.6% |
| +2.0 amps - Tails | 251.2 | 50.4% | 634 | 3.0% | 9.2% | 62.4% | 65.8% | 1.8% | 12.4% | 11.5% | 75.4% | 80.0% | 1.0% | 27.2% | 1.3% |
| **Rejection to Tails** | | **70.5%** | | **13.8%** | **16.7%** | **76.9%** | **78.1%** | **47.1%** | **59.0%** | **47.6%** | **84.3%** | **87.2%** | **51.5%** | **58.7%** | **47.4%** |

*Table 13-36: IRMS Concentrations Analysis*

| | | | | Concentrations | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Amps** | **Mass** | **Wt %** | **TREE ppm** | **TREO %** | **RAD ppm** | **RAD %** | **SiO2 %** | **Al2O3 %** | **Fe2O3%** | **MgO %** | **CaO %** | **Na2O %** | **K2O %** | **TiO2 %** | **P2O5 %** | **MnO %** |
| 0.2 | 18.8 | 3.8% | 6,664 | 0.80% | 129.5 | 0.01% | 39.6% | 7.5% | 35.0% | 1.0% | 7.0% | 1.4% | 1.6% | 2.0% | 0.2% | 0.7% |
| 0.4 | 26.9 | 5.4% | 5,079 | 0.61% | 75.6 | 0.01% | 38.5% | 8.3% | 34.0% | 0.5% | 9.1% | 1.5% | 1.6% | 4.8% | 0.1% | 0.9% |
| 0.6 | 54.2 | 10.9% | 5,755 | 0.69% | 79.1 | 0.01% | 38.8% | 8.4% | 34.5% | 0.4% | 9.7% | 1.5% | 1.5% | 3.5% | 0.1% | 0.8% |
| 0.8 | 55.8 | 11.2% | 12,301 | 1.48% | 225.3 | 0.02% | 39.7% | 8.8% | 33.1% | 0.4% | 9.8% | 1.6% | 1.5% | 2.9% | 0.1% | 0.8% |
| 1 | 40.2 | 8.1% | 29,684 | 3.56% | 625.7 | 0.06% | 40.4% | 9.3% | 29.9% | 0.3% | 9.5% | 1.6% | 1.5% | 2.4% | 0.1% | 0.7% |
| 1.2 | 23.4 | 4.7% | 49,570 | 5.95% | 1,077.3 | 0.11% | 42.6% | 10.3% | 24.8% | 0.3% | 8.8% | 1.7% | 1.7% | 2.0% | 0.1% | 0.6% |
| 1.4 | 15 | 3.0% | 60,849 | 7.30% | 1,313.8 | 0.13% | 46.4% | 11.7% | 17.9% | 0.2% | 7.4% | 2.2% | 2.3% | 1.6% | 0.1% | 0.4% |
| 2 | 12.7 | 2.5% | 47,902 | 5.75% | 1,075.4 | 0.11% | 54.5% | 14.0% | 9.2% | 0.2% | 5.2% | 3.2% | 3.6% | 1.1% | 0.1% | 0.3% |
| 5 | 21.7 | 4.4% | 4,752 | 0.57% | 156.4 | 0.02% | 62.5% | 16.5% | 2.4% | 0.1% | 2.4% | 4.8% | 5.4% | 0.3% | 0.1% | 0.1% |
| 9 | 13.5 | 2.7% | 1,037 | 0.12% | 85.6 | 0.01% | 63.5% | 17.1% | 1.2% | 0.1% | 1.7% | 5.0% | 5.8% | 0.1% | 0.1% | 0.0% |
| Non Magnetic | 216 | 43.4% | 195 | 0.02% | 28.0 | 0.00% | 67.5% | 17.5% | 0.3% | 0.1% | 1.0% | 5.0% | 6.7% | 0.0% | 0.0% | 0.0% |
| TOTAL | 498.2 | 100.0% | 10,626 | 1.28% | 232.1 | 0.02% | 54.0% | 13.3% | 15.2% | 0.2% | 5.0% | 3.4% | 4.1% | 1.4% | 0.1% | 0.4% |
| -0.6 amps - Tails | 99.9 | 20.1% | 5,744 | 0.69% | 88 | 0.01% | 38.9% | 8.2% | 34.5% | 0.5% | 9.0% | 1.5% | 1.5% | 3.6% | 0.1% | 0.8% |
| +0.6 x -2.0 - Con | 147.1 | **29.5%** | **31,004** | 3.72% | 655 | 0.07% | 42.3% | 9.9% | 27.3% | 0.3% | 8.9% | 1.8% | 1.8% | 2.3% | 0.1% | 0.6% |
| +2.0 amps - Tails | 251.2 | 50.4% | 634 | 0.08% | 42 | 0.00% | 66.9% | 17.4% | 0.5% | 0.1% | 1.2% | 5.0% | 6.6% | 0.0% | 0.0% | 0.0% |
| **Rejection to Tails** | | **70.5%** | | | | | | | | | | | | | | |

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Figure 13-44 shows the deportment of all the other impurities as the amperage was increased. The individual recovery is shown as a bar chart and the cumulative recovery is shown as a line chart (2nd Y axis). A very dramatic rejection of impurities is removed at the 0.2 to 0.6 amps.

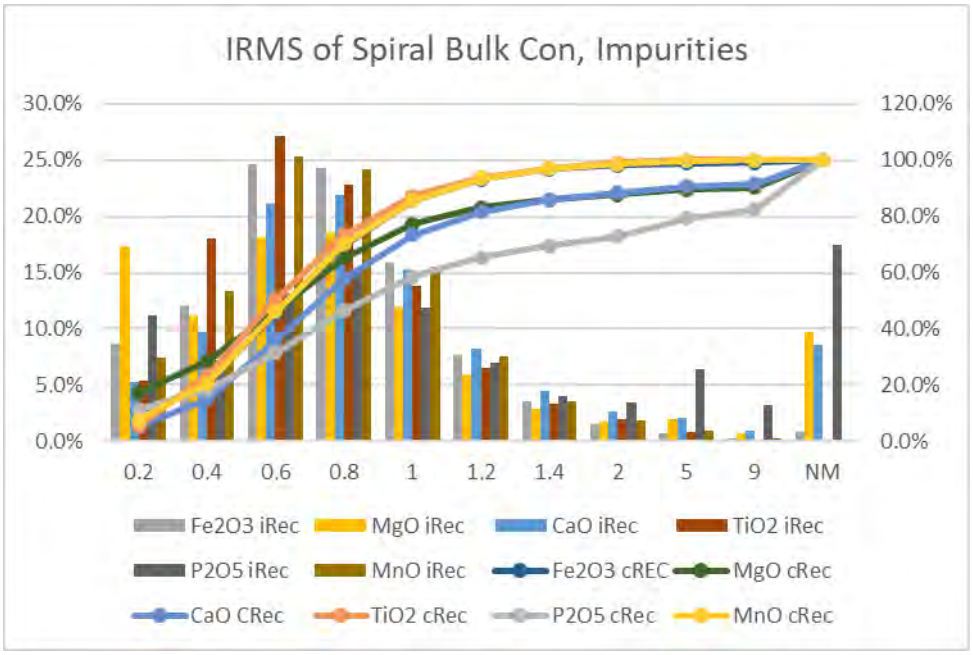


*Figure 13-44: IRMS Impurities Removal Chart*

Figure 13-45 shows the concentration of SiO2, Al2O3, Na2O and K2O which are the building blocks for feldspar and quartz (major gangue minerals). As can be seen, the majority of these elements are removed since they are non-magnetic (NM).

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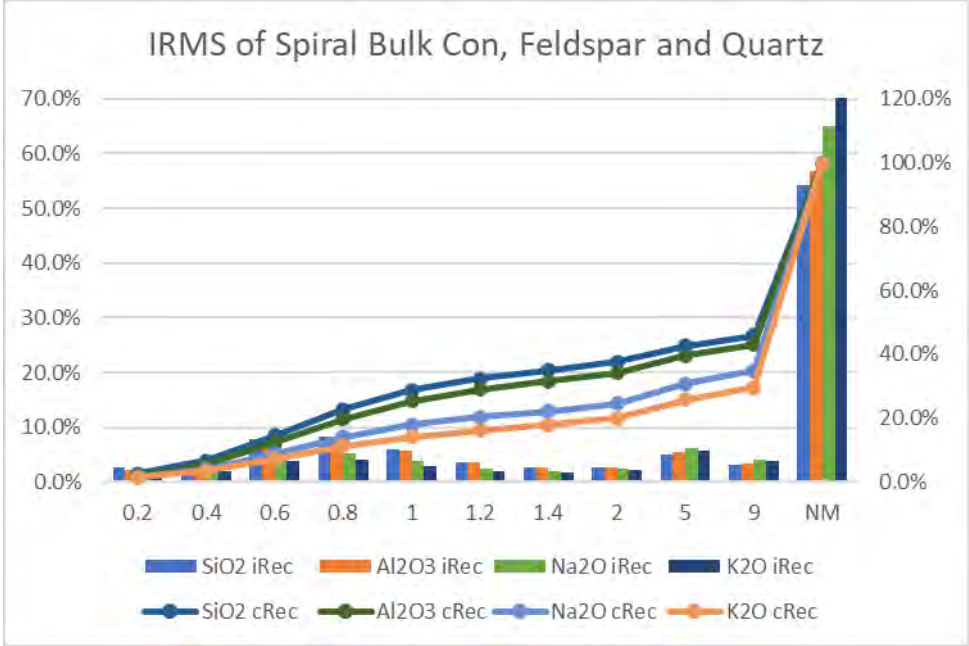


*Figure 13-45: IRMS Select Impurities Removal Chart*

#### *13.5.2.4.1 Induced Roll Magnet Separation (IRMS) Bulk Results - (MTNA25032),100% passing 0.3mm*

Two samples of Spiral Rougher Bulk Concentrate (T1100) were tested on the IRMS lab scale unit at Mineral Technologies in two passes, 0.6 Amps and 2.0 Amps, named T1300 and T1310. T1300 was 18 kg while T1310 was 155 kg. T1300 results were 28.9% mass yield and 71.5% TREO Recovery while T1310 was 31% mass yield and 74.8% TREO Recovery. These results were averaged which resulted in 30% mass yield and 73% TREO Recovery which was much lower than the Release Curve Testing result of 29.5% mass yield and 86.2% TREO Recovery. Mineral Technologies believes that the bulk test results are more indicative of full-scale operation due to the sample being produced at two different amp settings rather than individual distinct amp settings over a range of values to generate the release curve. Figure 13-46 and Figure 13-47 summarizes the results for T1300 and T1310.

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| T1300 IRM Cleaner Stage | | | Assay % | | | | Stage Recovery % | | | | Overall Recovery % | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESCRIPTION | % Mass[0] | % Mass[2] | %TREO | %Zr | %Fe | %RAD | %TREO | %Zr | %Fe | %RAD | %TREO | %Zr | %Fe | %RAD |
| 0.2 A Mag (Tail) | 2.97 | 0.74 | 0.66 | 0.25 | 25.8 | 0.010 | 1.81 | 1.52 | 7.28 | 1.61 | 1.29 | 1.44 | 4.47 | 0.91 |
| 0.6 A Mag (Tail) | 12.2 | 3.03 | 0.57 | 0.09 | 24.5 | 0.007 | 6.44 | 2.19 | 28.4 | 4.26 | 4.59 | 2.08 | 17.5 | 2.41 |
| 2.0 A Mag (Product) | 28.9 | 7.15 | 2.69 | 0.07 | 21.6 | 0.045 | 71.5 | 4.37 | 59.2 | 68.7 | 50.9 | 4.15 | 36.4 | 38.9 |
| NM | 55.9 | 13.8 | 0.40 | 0.80 | 0.97 | 0.009 | 20.3 | 91.9 | 5.12 | 25.4 | 14.4 | 87.2 | 3.14 | 14.4 |
| Feed (calc.) | 100.0 | 24.8 | *1.09* | *0.49* | *10.6* | *0.019* | 100.0 | 100.0 | 100.0 | 100.0 | 71.2 | 94.9 | 61.4 | 56.6 |

***Note:***
*%Mass[0]: Mass yield relative to roll/pass/stage feed*
*%Mass[1]: Mass yield relative to unit feed*
*%Mass[2]: Mass yield relative to plant feed*

*Figure 13-46: IRMS T1300 Results*

| T1310 IRM Bulk Processing | | | Assay % | | | |
|---|---|---|---|---|---|---|
| Description | % Mass[0] | % Mass[2] | %TREO | %Zr | %Fe | %RAD |
| RED Scalper | 3.06 | 0.76 | | | | |
| 0.6 A Mag (Tail) | 9.93 | 2.46 | | | | |
| 2.0 A Mag (Product) | 31.0 | 7.66 | 2.63 | 0.08 | 21.63 | 0.049 |
| NM | 56.1 | 13.9 | | | | |

*Figure 13-47: IRMS T1310 Results*

#### *13.5.2.4.2 Induced Roll Magnet Separation (IRMS) Simulations/Additional Tests - (MTNA25032),100% passing 0.3mm*

The IRMS lab scale unit that was used for testing consisted of single magnetic roller whereas the full-scale production unit utilizes two rollers in series which increases efficiency. In the full scale plant, there will be an IRMS unit set at 0.6 Amps and a second unit set at 2.0 Amps. Mineral Technologies proposed two Options to be simulated via calculations: Option 1 Mag Retreat at 0.6 Amps and Option 2 Non-Mag Retreat at 2.0 Amps. Figure 13-48 and Figure 13-49 show the two options.

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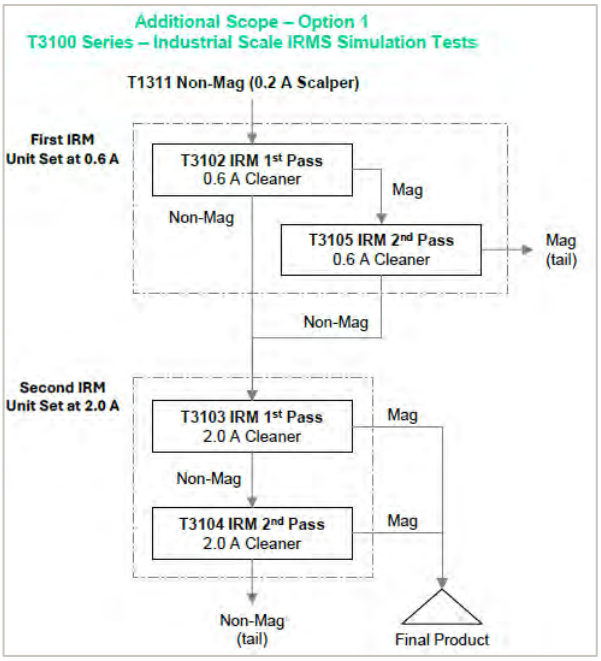


*Figure 13-48: Option 1: T3100 Series*

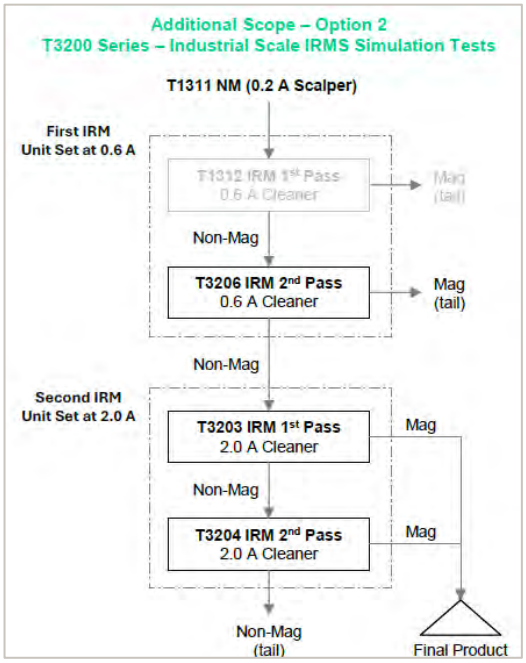


*Figure 13-49: Option 2: T3200 Series*

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Adding a second roller to the IRMS units in full production increases the recovery in either Option 1 or Option 2. However, Option 2 offers an 11% reduction in mass yield which has a large impact on operating costs, due to the fact that leach acid consumption is based on the tons of concentrate, not the amount of contained TREO. As mentioned priorly, the spiral cleaner did not perform well and will not be pursued. IRMS Testing using ore performed well in regard to mass rejection and TREO recovery but is not practical due to the IRMS low throughput specification of 4 mtph. Assuming 4.5MM mtpa of ore, with 4 mtph throughput in IRMS series, 2 units in each series, there would be ~285 units for the full-scale plant.

| | FINAL PRODUCT | PERFORMANCE RELATIVE TO ROUGHER CON (DRY CIRCUIT FEED) | | | PERFORMANCE RELATIVE TO PLANT FEED | | | |
|---|---|---|---|---|---|---|---|---|
| Description | %TREO Grade | Feed Grade %TREO[1] | %Mass[1] | Recovery %TREO[1] | Feed Grade %TREO[2] | %Mass[2] | Recovery %TREO[2] | Sep Eff %TREO[2] |
| Option 1 Mag Retreat[3] | 2.72 | 1.175 | 38.7 | 89.6 | 0.409 | 9.58 | 63.8 | 54.4 |
| Option 2 NM Retreat[3] | 3.58 | 1.176 | 27.9 | 84.9 | 0.409 | 6.91 | 60.4 | 53.8 |
| Initial Mag Sep no Retreat[4] | 2.86 | 1.176 | 30.0 | 72.9 | 0.409 | 7.44 | 51.9 | 44.7 |
| Spiral Cleaner Concentrate[4] | 2.00 | 1.297 | 48.0 | 74.0 | 0.409 | 11.9 | 58.1 | 46.4 |
| Mag Frac on Ore (benchmark)[4] | 2.29 | 0.394 | 13.6 | 78.8 | 0.394 | 13.6 | 78.8 | 65.5 |

*Figure 13-50: Mineral Technologies Overall Performance Results*

Weathered (oxidized) material designated as Altered was tested on the gravity spirals and IRMS equipment with very similar results as the Unaltered. The data can be found in the Mineral Technologies Test Work Report dated 6/17/2025

The block flow diagram in Figure 13-51 shows how the two-stage IRMS, fits within the Comminution and Concentration steps. The first IRMS step (0.6 Amp Setting) shows the disposal of the magnetic fraction, and the non-magnetic fraction moves forward to the second step IRMS (2.0 Amp Setting) where the non-magnetic fraction is sent to tailings and the magnetic fraction is the concentrate that is sent to Leach.

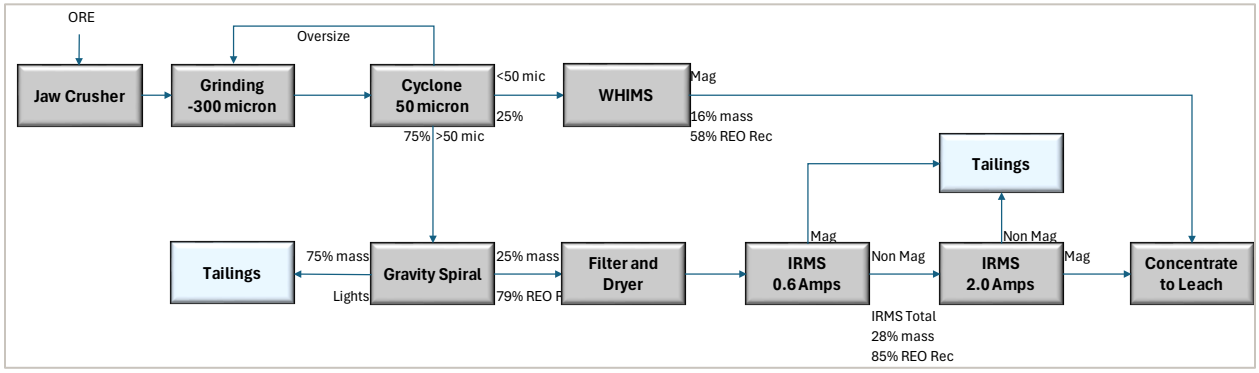


*Figure 13-51: Proposed Block Flow Diagram*

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## 13.5.3 Nagrom

### 13.5.3.1 Reflux Classifier Concentrator (RCC) Testing

Ore was sent to Nagrom (Perth, AUS) for Reflux Classifier Concentrator testing with FLSmidth, who is providing technical oversight since the test equipment and full-scale equipment would be supplied by FLSmidth. The full-scale unit from FLSmidth is called GradePro Classifier. The RCC would be an alternative to the gravity spirals for the initial gravity separation and concentration of the ore. Fresh ore samples were combined with ground ore that was present at Nagrom from the previous Wood Group testing that was completed.

### 13.5.3.2 Reflux Classifier Concentrator (RCC) Technology and Equipment

The following paragraphs is a description from FLSmidth of the RCC unit and its technology.

“Developed with your entire minerals processing plant in mind, the REFLUX Classifier (RCTM) separates small particles based on a difference in density or particle size. The RC combines a conventional fluidised bed separator with a set of parallel inclined plates that form lamella channels. The feed slurry enters the RC below the lamella plates. As the fluidised bed builds up below the feed chambers, material with a higher density than the bed will sink, whereas material with a lower density than the bed will float. At the bottom of the mixing chamber, a higher-density bed of settling solids forms, jets of incoming fluidisation water keep it in suspension. Two pressure probes in the mixing chamber’s lower and middle sections measure the bed apparent bed density. The RC uses the relative density of the fluidised bed between the two probes to determine the discharge rate of the high-density solids via a single central underflow valve. The automated underflow valve is manufactured from highly wear-resistant materials that are ideal for reducing wear. The underflow typically will discharge into a collection tundish or launder. The underflow contains high-density particles and is generally coarser than the feed. At the same time, the coarse and fine low-density particles that may have been trapped in the dense fluidised bed will rise and migrate to the lamella section of the classifier. The low density and finer particles overflow from the RC lamellas, along with the process water and any slimes. The slightly denser and larger particles encounter the autogenous process density within the vessel, enabling them to rise and be displaced to overflow. The lamella channels enhance the settling rate of any misplaced fine, high- density solids, which slide down the plates and slowly re-circulate back into the feed zone of the mixing chamber. The internal launders at the top of the RC direct the overflow slurry into a single discharge “overflow” collector.”

“The GradePro Classifier operates on the same principles as the original RC but with significant enhancements that allow it to handle even finer particles. The technology uses inclined lamella plates to create a large surface area for fine particle sedimentation. At the same time, the fluidised bed at the unit's base allows for precise separation based on particle density. This bed operates with secondary fluidisation, which further enhances the recovery of valuable minerals by allowing the bed to achieve greater stability and better separation. This additional fluidisation also helps to improve the recovery of ultra-fine particles.”

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*Figure 13-52: Reflux Classifier Concentrator*

### 13.5.3.3 Reflux Classifier Concentrator (RCC) Feed Material

250 kg of split core was sent to Nagrom and was ground to 100% passing 300 microns. The material was wet screened at 150 micron and 45 micron to create a -300 +150 micron sub sample and a -150 +45 micron sub sample. These two sub samples are referred to as coarse and fine, respectively. The -45 micron material was not tested due to anticipated poor performance according to Nagrom and FLSmidth. The -45 micron portion would represent a yield loss since no suitable treatment is currently known. If the -45 micron material was forward processed to leaching without concentration it would result in dilution of the TREO concentration and result in increased sulfuric acid dosing since the amount of acid is based on the mass of concentrate not the amount of rare earths in the material.

### 13.5.3.4 Reflux Classifier Concentrator (RCC) Test Results – Scoping

The RCC testing at Nagrom consisted of scoping testing at different particle size ranges

- Coarse (-300 micron/+150 micron) at both 20% and 38% solids feed.



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- Fines (-150 micron/+ 45 micron) at both 20% and 38% solids feed.

Ultra fines, less than 45 microns, were not tested. A weighted average (factored) performance was calculated for the C3 and F3 tests which showed promise at 15.7% mass yield and 72.2% TREO recovery. Larger bulk runs were run at the same size distributions and 20% mass feed in an attempt to get the test to steady state conditions. The factored combined results were 21.5% mass yield and 77.7% TREO recovery which compares well to the gravity spirals with middlings recycle performance of 25% mass yield and 79% TREO recovery.

*Table 13-37: Reflux Classifier Concentrator Test Results: Split Core*

| Test ID | Description | Feed Mass % | Feed/ Head Grade | | | Stage Mass Yield % | Test Result Grade | | | | Stage Recovery | | | Stage Enrichment Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TREO (ppm) | Zr % | Fe % | | TREO (ppm) | Zr % | Fe % | RAD (ppm) | TREO % | Zr % | Fe % | |
| Ultra Fine | p100 -45µm - no tests | 20.1% | 3,908 | 0.13 | 8.42 | | | | | | | | | |
| Coarse Test1 | p100 -300µm x +150µm | 42.5% | 3,201 | 0.14 | 6.13 | 15.1% | 13,748 | 0.80 | 22.11 | 307 | 64.7% | 88.1% | 54.3% | 4.3 |
| Coarse Test2 | p100 -300µm x +150µm 38% mass feed | 42.5% | 3,128 | 0.12 | 6.24 | 7.2% | 16,778 | 1.37 | 24.19 | 363 | 38.7% | 81.9% | 28.0% | 5.4 |
| Coarse Test3 | p100 -300µm x +150µm 20% mass feed | 42.5% | 4,220 | 0.19 | 7.52 | 17.3% | 19,423 | 1.02 | 30.64 | 416 | 79.8% | 92.7% | 70.6% | 4.6 |
| Fines Test 1 | p100 -150µm x +45µm 38% mass feed | 37.4% | 3,404 | 0.27 | 7.19 | 52.1% | 5,825 | 0.52 | 11.79 | 130 | 89.1% | 98.8% | 85.4% | 1.7 |
| Fines Test 2 | p100 -150µm x +45µm 20% mass feed | 37.4% | 2,662 | 0.23 | 5.68 | 7.6% | 17,937 | 2.94 | 31.58 | 407 | 50.9% | 95.7% | 42.0% | 6.7 |
| Fines Test 3 | p100 -150µm x +45µm 20% mass feed | 37.4% | 2,558 | 0.20 | 5.53 | 13.8% | 11,760 | 1.39 | 22.40 | 261 | 63.5% | 95.4% | 56.0% | 4.6 |
| Factored RCC Combined C3 and F3 Tests | | 79.9% | 3,442 | 0.20 | 6.59 | 15.7% | 16,266 | 1.17 | 27.25 | 352 | 72.2% | 94.0% | 63.8% | 4.7 |
| | | | | | | | | | | | | | | |
| Coarse Bulk | p100 -300µm x +150µm 20% mass feed | 42.5% | 3,118 | 0.14 | 6.06 | 16.8% | 14,582 | 0.76 | 25.21 | 308 | 78.3% | 88.4% | 69.6% | 4.7 |
| Fines Bulk | p100 -150µm x +45µm 20% mass feed | 37.4% | 3,327 | 0.28 | 6.99 | 26.9% | 9,528 | 1.02 | 18.75 | 204 | 77.0% | 97.3% | 72.1% | 2.9 |
| Factored RCC Combined Bulk | | 79.9% | 3,216 | 0.21 | 6.50 | 21.5% | 12,239 | 0.88 | 22.22 | 260 | 77.7% | 92.6% | 70.8% | 3.8 |

The RCC performance showed promise but was hampered by small sample size which prevented getting to steady state and running there for a prolonged period of time. Therefore, additional feedstock in the form of Reverse Circulation (RC) cuttings from resource drilling was sent to Nagrom for additional testing.

#### 13.5.3.5 Reflux Classifier Concentrator (RCC) Test Results – Bulk using RC Cuttings

Additional RCC testing at Nagrom was conducted on RC Cuttings from previous ore drilling.

- Coarse (-300 micron/+106 micron) at 20% slurry feed.
- Fines (-106 micron/+ 45 micron) at 20% slurry feed.

Ultra fines, less than 45 micron, were not tested. A weighted average (factored) performance was calculated for the C1 and F2 tests which showed promise at 14.0% mass yield and 78.4% TREO recovery.

*Table 13-38: Reflux Classifier Concentrator Test Results: RC Cuttings*

| Test ID | Description | Feed Mass % | Feed/ Head Grade | | | Stage Mass Yield % | Test Result Grade | | | | Stage Recovery | | | Stage Enrichment Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TREO (ppm) | Zr % | Fe % | | TREO (ppm) | Zr % | Fe % | RAD (ppm) | TREO % | Zr % | Fe % | |
| Ultra Fine | p100 -45µm - no tests | 34.2% | 4,194 | 0.14 | 8.22 | | | | | | | | | |
| Coarse Test1 | p100 -300µm x +106µm, 20% Solids | 43.7% | 3,300 | 0.16 | 5.40 | 13.1% | 19,938 | 1.16 | 26.30 | 429 | 79.0% | 93.6% | 63.7% | 6.0 |
| Coarse Test2 | p100 -300µm x +106µm, 20% Solids | 43.7% | 3,233 | 0.11 | 5.39 | 20.8% | 12,620 | 0.51 | 17.91 | 270 | 82.0% | 93.0% | 69.2% | 3.9 |
| Fines Test 1 | p100 -106µm x +45µm, 20% Solids | 22.2% | 3,774 | 0.21 | 6.99 | 25.8% | 12,260 | 0.82 | 20.02 | 282 | 83.9% | 98.6% | 73.9% | 3.2 |
| Fines Test 2 | p100 -106µm x +45µm, 20% Solids | 22.2% | 3,369 | 0.18 | 6.23 | 15.9% | 16,305 | 1.14 | 24.91 | 353 | 77.1% | 98.6% | 63.7% | 4.8 |
| Factored RCC Combined C1 and F2 Tests | | 65.9% | 3,323 | 0.17 | 5.68 | 14.0% | 18,736 | 1.15 | 25.84 | 404 | 78.4% | 95.3% | 63.7% | 5.6 |

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#### 13.5.3.6 Reflux Classifier Concentrator (RCC) Test Results – Test Pit/VRM Material

An additional 2.5 metric tonnes of material was sent to Nagrom to complete further testing. At this time, we are waiting for finalized results.

## 13.5.4 SGS

### 13.5.4.1 SGS WHIMS Testing – 100% passing 0.3mm

Two types of ore were crushed and ground, altered and unaltered, to 100% passing 0.3mm in order to evaluate any negative effects of either type of ore. Core from the 2023 drilling campaign was sent to SGS to be ground with the following process. Ore was crushed using a jaw crusher (2 choke feed passes with jaw set to a gap of 1.5") then screened with a 10-mesh screen (2.0mm), the oversize was run through a cone crusher with the gap at 6.3mm screening between each pass on the same 10 mesh screen. The final grinding operation was conducted in a wet rod mill to get to 100% passing 0.3mm.

The final material, 100% passing 0.3mm, was then screened at 86 microns to remove the fines before conducting the gravity spiral testing. The feed for this batch of testing and processing at SGS is the minus 86micron fines. The mass balance can be found in Table 13-39; and the size fraction distribution can be found in Table 13-40. There is little difference between the Unaltered and Altered ore types with regards to size fraction after grinding.

*Table 13-39: SGS WHIMS Mass Balance and Distribution*

| Mass Balance and Distribution | | | | | | |
|---|---|---|---|---|---|---|
| Stream Description | Unaltered | | Altered | | Totals - Product | |
| | Weight (kg) | Distribution (%) | Weight (kg) | Distribution (%) | Weight (kg) | Distribution (%) |
| Grinding Feed | 1,723 | 100.0 | 1,277 | 100.0 | 3,000 | 100.0 |
| 86 µm Oversize | 1,105 | 64.1 | 781 | 61.2 | 1,886 | 62.9 |
| 86 µm Undersize | 618 | 35.9 | 496 | 38.8 | 1,114 | 37.1 |

*Table 13-40: SGS WHIMS Size Distribution*

| Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| Size Fraction | p80 Average Size (µm) | | | p50 Average Size (µm) | | |
| | Unaltered | Altered | % Difference | Unaltered | Altered | % Difference |
| -300 x 0 | 195 | 186 | 4.6 | 108 | 92 | 13.2 |
| -300 x +86 | 233 | 229 | 1.7 | 161 | 158 | 1.9 |
| -86 x 0 | 58 | 63 | -8.6 | - | - | - |

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#### *13.5.4.1.1 WHIMS Rougher Scoping Testing*

WHIMS Scoping tests were performed to determine the optimal magnetic field strength. The feed material for these tests is the -86 micron fraction from the 100% passing 300-micron grind. The test results at five different magnetic field strengths ranging from 2,700 to 12,850 Gauss for unaltered and altered ore types, with the maximum values highlighted in yellow, can be found in Table 13-41 and Table 13-42. A strength of 10,530 Gauss was chosen as a compromise between REE grade, HREE grade and REE Recovery%. The same magnetic strength, 10,530 Gauss, will be used for both unaltered and altered ore types going forward in testing as well as in full production since separating ore and concentration equipment would add cost and complexity.

*Table 13-41: SGS WHIMS Test Results: Unaltered*

| SGS WHIMS TESTING SCOPING UNALTERED -86micron | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gauss | Feed | Recovered Grade | | | | REE | Yield | Recovery (%) | | | |
| Gauss | REE | REE | Zr | Fe | HREE | Uprgade | | REE | Zr | Fe | HREE |
| 2700 | 3,506 | 10,997 | 269 | 28.6 | 843 | 3.14 | 19.11 | 61.71 | 22.69 | 67.30 | 61.86 |
| 5580 | 3,514 | 10,520 | 288 | 27.0 | 819 | 2.99 | 23.89 | 70.06 | 20.68 | 76.91 | 72.15 |
| 8100 | 3,522 | 11,003 | 325 | 26.8 | 835 | 3.12 | 21.72 | 68.79 | 21.41 | 74.63 | 71.89 |
| **10530** | **3,643** | **11,242** | **324** | **27.8** | **884** | **3.09** | **22.16** | **66.41** | **20.44** | **73.04** | **69.97** |
| 12850 | 3,535 | 11,332 | 288 | 27.8 | 852 | 3.21 | 23.10 | 65.03 | 7.54 | 74.29 | 60.65 |

*Table 13-42: SGS WHIMS Test Results: Altered*

| SGS WHIMS TESTING SCOPING ALTERED -86micron | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gauss | Feed | Recovered Grade | | | | REE | Yield | Recovery (%) | | | |
| | REE | REE | Zr | Fe | HREE | Uprgade | | REE | Zr | Fe | HREE |
| 2700 | 3,389 | 10,906 | 326 | 29.3 | 917 | 3.22 | 17.7 | 57.0 | 11.0 | 64.4 | 53.2 |
| 5580 | 3,403 | 10,617 | 326 | 28.2 | 913 | 3.12 | 20.5 | 61.4 | 15.9 | 68.1 | 60.8 |
| 8100 | 3,633 | 10,701 | 338 | 28.0 | 912 | 2.95 | 21.0 | 64.8 | 14.7 | 69.6 | 63.3 |
| **10530** | **3,498** | **10,918** | **357** | **28.2** | **927** | **3.12** | **22.0** | **68.9** | **22.4** | **73.6** | **68.2** |
| 12850 | 3,431 | 10,919 | 380 | 28.8 | 948 | 3.18 | 20.5 | 67.0 | 21.1 | 72.5 | 67.8 |

#### *13.5.4.1.2 WHIMS Rougher Bulk Testing*

Table 13-43 provides the summary of the bulk WHIMS rougher tests, Unaltered and Altered, with 3 grab samples taken of the Feed, Magnetic and Non-Magnetic during the pilot plant run. The altered feed shows a higher REE Enrichment Ratio (Upgrade Factor), 3.10 vs 2.86 for the unaltered, even after taking the higher feed REE concentration into account.

Bulk WHIMS processing was conducted on both ore types and are presented in the Table below. The Unaltered sample results show a 21% mass yield and a 64% TREE Recovery to the magnetic material. The Altered sample results show a 22% mass yield and a 65% TREE Recovery. Note, the concentrations of Holmium and heavier were excluded from Table 13-44 and Table 13-45 but are available in the raw data. Chrome and vanadium were also excluded from the Figure since they were below detection limits.

*Table 13-43: Whims Rougher Bulk Test Results: Summary*

**UNALTERED**

| Feed | | | | | |
|---|---|---|---|---|---|
| | LREE (g/t) | HREE (g/t) | REE (g/t) | Fe2O3 (%) | Zr (%) |
| PP3-U1 | 2,920 | 255 | 3,174 | 7.74 | 0.16 |
| PP3-U2 | 3,125 | 270 | 3,395 | 7.72 | 0.16 |
| PP3-U3 | 3,037 | 279 | 3,316 | 7.75 | 0.19 |
| **Average** | **3,027** | **268** | **3,295** | **7.74** | **0.17** |
| Scoping | 3,361 | 283 | 3,643 | 8.21 | 0.04 |

| Magnetic Product | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-U1 | 8,775 | 755 | 9,529 | 24.60 | 0.11 |
| PP3-U2 | 8,511 | 740 | 9,252 | 22.80 | 0.11 |
| PP3-U3 | 7,793 | 742 | 8,535 | 22.60 | 0.15 |
| **Average** | **8,643** | **746** | **9,391** | **23.33** | **0.12** |
| Scoping | 10,358 | 884 | 11,242 | 27.80 | 0.03 |

| NonMagnetic Product | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-U1 | 1,337 | 115 | 1,452 | 2.66 | 0.13 |
| PP3-U2 | 1,293 | 104 | 1,397 | 2.51 | 0.13 |
| PP3-U3 | 1,250 | 121 | 1,370 | 2.54 | 0.18 |
| **Average** | **1,293** | **114** | **1,407** | **2.57** | **0.15** |
| Scoping | 1,510 | 108 | 1,618 | 2.92 | 0.04 |

| Enrichment Ratio | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-U1 | 3.01 | 2.97 | 3.00 | 3.18 | 0.71 |
| PP3-U2 | 2.72 | 2.74 | 2.72 | 2.95 | 0.69 |
| PP3-U3 | 2.57 | 2.66 | 2.57 | 2.92 | 0.79 |
| **Average** | **2.86** | **2.79** | **2.86** | **2.93** | **0.74** |

**ALTERED**

| Feed | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-A1 | 3,148 | 182 | 3,330 | 7.74 | 0.13 |
| PP3-A2 | 3,153 | 279 | 3,432 | 8.02 | 0.16 |
| PP3-A3 | 3,062 | 340 | 3,403 | 7.80 | 0.19 |
| **Average** | **3,108** | **310** | **3,417** | **7.91** | **0.17** |
| Scoping | 3,190 | 308 | 3,498 | 8.54 | 0.04 |

| Magnetic Product | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-A1 | 10,491 | 911 | 11,402 | 28.00 | 0.10 |
| PP3-A2 | 9,614 | 831 | 10,445 | 25.00 | 0.10 |
| PP3-A3 | 9,854 | 870 | 10,725 | 26.20 | 0.10 |
| **Average** | **9,734** | **851** | **10,585** | **25.60** | **0.10** |
| Scoping | 9,991 | 927 | 10,918 | 28.20 | 0.04 |

| NonMagnetic Product | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-A1 | 1,556 | 210 | 1,766 | 3.32 | 0.13 |
| PP3-A2 | 1,536 | 141 | 1,677 | 3.32 | 0.12 |
| PP3-A3 | 1,482 | 130 | 1,612 | 3.23 | 0.14 |
| **Average** | **1,509** | **135** | **1,644** | **3.28** | **0.13** |
| Scoping | 1,267 | 122 | 1,389 | 2.85 | 0.03 |

| Enrichment Ratio | | | | | |
|---|---|---|---|---|---|
| | **LREE (g/t)** | **HREE (g/t)** | **REE (g/t)** | **Fe2O3 (%)** | **Zr (%)** |
| PP3-A1 | 3.33 | 5.00 | 3.42 | 3.62 | 0.76 |
| PP3-A2 | 3.05 | 2.98 | 3.04 | 3.12 | 0.67 |
| PP3-A3 | 3.22 | 2.56 | 3.15 | 3.36 | 0.56 |
| **Average** | **3.13** | **2.77** | **3.10** | **3.24** | **0.61** |

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*Table 13-44: WHIMS Rougher Bulk Test Results: Unaltered*

| Operational parameter | | Comment |
|---|---|---|
| Sample | Unalter | |
| Mag intensity | 10530 | |
| Water pulsation (rpm) | 200 | |
| Feed solid % | 30 | |
| Feed rate (kg/h) | 100 | |

| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PP3-U-Feed-Average | 60.4 | 16.0 | 7.7 | 0.2 | 3.0 | 4.0 | 6.3 | 0.5 | 0.1 | 0.2 | 0.2 | 699.3 | 1393.3 | 161.3 | 601.7 | 94.1 | 10.9 | 66.6 | 7.8 | 43.2 | 6.9 | 56.6 | 169.7 | 509.1 |
| PP3-U-Mag-Average | 47.1 | 11.5 | 23.7 | 0.4 | 6.8 | 2.5 | 3.2 | 1.5 | 0.2 | 0.5 | 0.1 | 1950.0 | 3990.0 | 468.5 | 1745.0 | 278.0 | 22.4 | 189.0 | 24.0 | 124.0 | 12.5 | 176.5 | 467.0 | 107.0 |
| PP3-U-NonMag-Average | 64.4 | 17.4 | 2.6 | 0.1 | 1.8 | 4.5 | 7.2 | 0.1 | 0.1 | 0.1 | 0.2 | 315.3 | 593.3 | 67.1 | 247.3 | 36.9 | 7.8 | 25.2 | 3.6 | 16.6 | 4.9 | 22.8 | 71.3 | 402.1 |

| | Assay and Weight Data | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (%) |
| PP3-U-Feed-Average | 60.4 | 16.0 | 7.7 | 0.2 | 3.0 | 4.0 | 6.3 | 0.5 | 0.1 | 0.2 | 0.2 | 699.3 | 1393.3 | 161.3 | 601.7 | 94.1 | 10.9 | 66.6 | 7.8 | 43.2 | 6.9 | 56.6 | 169.7 | 100.0 |
| PP3-U-Mag-Average | 47.1 | 11.5 | 23.7 | 0.4 | 6.8 | 2.5 | 3.2 | 1.5 | 0.2 | 0.5 | 0.1 | 1950.0 | 3990.0 | 468.5 | 1745.0 | 278.0 | 22.4 | 189.0 | 24.0 | 124.0 | 12.5 | 176.5 | 467.0 | 21.0 |
| PP3-U-NonMag-Average | 64.4 | 17.4 | 2.6 | 0.1 | 1.8 | 4.5 | 7.2 | 0.1 | 0.1 | 0.1 | 0.2 | 315.3 | 593.3 | 67.1 | 247.3 | 36.9 | 7.8 | 25.2 | 3.6 | 16.6 | 4.9 | 22.8 | 71.3 | 79.0 |
| Feed Adjusted | 60.8 | 16.1 | 7.0 | 0.2 | 2.8 | 4.1 | 6.4 | 0.4 | 0.1 | 0.2 | 0.2 | 658.9 | 1307.2 | 151.5 | 562.1 | 87.5 | 10.9 | 59.7 | 7.9 | 39.1 | 6.5 | 55.1 | 154.5 | 100.0 |

| | Distribution (%) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t |
| PP3-U-Mag-Average | 16.3 | 14.9 | 71.0 | 48.9 | 50.5 | 12.6 | 10.7 | 76.5 | 36.7 | 70.2 | 16.8 | 62.2 | 64.2 | 65.0 | 65.2 | 66.7 | 43.2 | 66.6 | 64.1 | 66.6 | 40.4 | 67.3 | 63.5 |
| PP3-U-NonMag-Average | 83.7 | 85.1 | 29.0 | 51.1 | 49.5 | 87.4 | 89.3 | 23.5 | 63.3 | 29.8 | 83.2 | 37.8 | 35.8 | 35.0 | 34.8 | 33.3 | 56.8 | 33.4 | 35.9 | 33.4 | 59.6 | 32.7 | 36.5 |

| | Assay and Weight (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % | Weight(%) |
| Feed Adjusted | 2837.8 | 246.8 | 3084.6 | 7.0 | 0.2 | 100.0 |
| PP3-U-Mag-Average | 8642.9 | 747.7 | 9390.5 | 23.7 | 0.1 | 21.0 |
| PP3-U-NonMag-Average | 1293.1 | 113.5 | 1406.6 | 2.6 | 0.2 | 79.0 |

| | Distribution (%) | | | | |
|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % |
| PP3-U-Mag-Average | 64.0 | 63.7 | 64.0 | 71.0 | 16.8 |
| PP3-U-NonMag-Average | 36.0 | 36.3 | 36.0 | 29.0 | 83.2 |

| | Enrichment Ratio | | | | |
|---|---|---|---|---|---|
| Sample ID | LEE | HREE | REE | Fe2O3 | ZrO2 |
| PP3-U-Mag-Average | 3.0 | 3.0 | 3.0 | 3.4 | 0.8 |
| PP3-U-NonMag-Average | 0.5 | 0.5 | 0.5 | 0.4 | 1.1 |

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*Table 13-45: WHIMS Rougher Bulk Test Results: Altered*

| Operational parameter | | Comment |
|---|---|---|
| Sample | Altered | |
| Mag intensity | 10530 | |
| Water pulsation (rpm) | 200 | |
| Feed solid % | 30 | |
| Feed rate (kg/h) | 100 | |

| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PP3-A-Feed-Average | 60.0 | 15.7 | 7.9 | 0.5 | 2.5 | 4.1 | 5.9 | 0.5 | 0.1 | 0.2 | 0.2 | 722.5 | 1425.0 | 163.0 | 622.0 | 96.9 | 11.1 | 67.1 | 8.5 | 43.7 | 5.4 | 57.2 | 207.1 | 369.2 |
| PP3-A-Mag-Average | 44.8 | 10.8 | 25.6 | 1.2 | 6.7 | 2.0 | 2.6 | 1.7 | 0.2 | 0.6 | 0.1 | 2190.0 | 4540.0 | 514.0 | 1940.0 | 312.5 | 24.2 | 213.5 | 26.4 | 140.0 | 13.5 | 184.5 | 534.6 | 81.4 |
| PP3-A-NonMag-Average | 64.3 | 16.9 | 3.3 | 0.4 | 1.5 | 4.6 | 6.8 | 0.2 | 0.1 | 0.1 | 0.2 | 362.0 | 684.0 | 76.8 | 299.5 | 47.6 | 8.1 | 31.3 | 4.2 | 20.7 | 4.6 | 26.6 | 83.9 | 287.8 |

| | Assay and Weight Data | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (%) |
| PP3-A-Feed-Average | 60.0 | 15.7 | 7.9 | 0.5 | 2.5 | 4.1 | 5.9 | 0.5 | 0.1 | 0.2 | 0.2 | 722.5 | 1425.0 | 163.0 | 622.0 | 96.9 | 11.1 | 67.1 | 8.5 | 43.7 | 5.4 | 57.2 | 207.1 | 100.0 |
| PP3-A-Mag-Average | 44.8 | 10.8 | 25.6 | 1.2 | 6.7 | 2.0 | 2.6 | 1.7 | 0.2 | 0.6 | 0.1 | 2190.0 | 4540.0 | 514.0 | 1940.0 | 312.5 | 24.2 | 213.5 | 26.4 | 140.0 | 13.5 | 184.5 | 534.6 | 22.0 |
| PP3-A-NonMag-Average | 64.3 | 16.9 | 3.3 | 0.4 | 1.5 | 4.6 | 6.8 | 0.2 | 0.1 | 0.1 | 0.2 | 362.0 | 684.0 | 76.8 | 299.5 | 47.6 | 8.1 | 31.3 | 4.2 | 20.7 | 4.6 | 26.6 | 83.9 | 78.0 |
| Feed Adjusted | 60.0 | 15.6 | 8.2 | 0.5 | 2.6 | 4.0 | 5.9 | 0.5 | 0.1 | 0.2 | 0.2 | 765.0 | 1534.2 | 173.2 | 661.2 | 106.0 | 11.6 | 71.4 | 9.0 | 47.0 | 6.6 | 61.4 | 183.2 | 100.0 |

| | Distribution (%) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t |
| PP3-A-Mag-Average | 16.4 | 15.3 | 68.9 | 49.0 | 55.6 | 11.0 | 9.8 | 74.5 | 38.4 | 70.1 | 18.5 | 63.1 | 65.2 | 65.4 | 64.7 | 65.0 | 45.7 | 65.9 | 64.2 | 65.7 | 45.3 | 66.2 | 64.3 |
| PP3-A-NonMag-Average | 83.6 | 84.7 | 31.1 | 51.0 | 44.4 | 89.0 | 90.2 | 25.5 | 61.6 | 29.9 | 81.5 | 36.9 | 34.8 | 34.6 | 35.3 | 35.0 | 54.3 | 34.1 | 35.8 | 34.3 | 54.7 | 33.8 | 35.7 |

| | Assay and Weight (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % | Weight(%) |
| Feed Adjusted | 3322.6 | 292.9 | 3615.5 | 8.2 | 0.2 | 100.0 |
| PP3-A-Mag-Average | 9734.2 | 850.6 | 10584.7 | 25.6 | 0.1 | 22.0 |
| PP3-A-NonMag-Average | 1509.2 | 135.2 | 1644.4 | 3.3 | 0.2 | 78.0 |

| | Distribution (%) | | | | |
|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % |
| PP3-A-Mag-Average | 64.6 | 64.0 | 64.5 | 68.9 | 18.5 |
| PP3-A-NonMag-Average | 35.4 | 36.0 | 35.5 | 31.1 | 81.5 |

| | Enrichment Ratio | | | | |
|---|---|---|---|---|---|
| Sample ID | LEE | HREE | REE | Fe2O3 | ZrO2 |
| PP3-A-Mag-Average | 2.9 | 2.9 | 2.9 | 3.1 | 0.8 |
| PP3-A-NonMag-Average | 0.5 | 0.5 | 0.5 | 0.4 | 1.0 |

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#### *13.5.4.1.3 WHIMS Cleaner Scoping Testing*

A small sample of unaltered rougher magnetic concentrate was run through the Longi WHIMS unit to evaluate a cleaner step to increase REE grade. Two runs were conducted where the "base case" was a feedrate of 30 kg/hr and a second where the feedrate was increased to 50 kg/hr and the water pulsation was increased from 200 rpm to 300 rpm. The mass yield for base case run was 75% mass yield to the magnetic material and 89% REE Recovery. The second run at higher feedrate and higher water pulsation resulted in 77% mass yield and 92% REE Recovery. Higher water pulsation is designed to remove gangue particles that were present in the magnetic stream. The higher water pulsation rate seems to have been compromised by the higher feedrate since both the mass yield and REE Recovery increased when the water pulsation and feedrate were increased in the second test.

Combining the Unaltered rougher with the second run at a higher feedrate and higher water pulsation resulted in a 16% mass yield and 58% REE Recovery as shown in Table 13-46.

*Table 13-46: WHIMS Cleaner Test Summary*

| Results Summary | | |
|---|---|---|
| **Description** | **Mass Yield (%)** | **REE Recovery (%)** |
| Unaltered Rougher | 21 | 64 |
| Unaltered Cleaner (higher water pulsation) | 77 | 92 |
| **Combined Rougher/Cleaner** | **16** | **58** |

*Table 13-47: WHIMS Cleaner Analysis for 50 kg/h Feedrate and 300 rpm*

| Operational parameter | | Comment |
|---|---|---|
| Sample | Unaltered | No change |
| Mag intensity | 10530 | No change |
| Water pulsation (rpm) | 300 | Higher |
| Feed solid % | 30 | No change |
| Feed rate (kg/h) | 50 | Base-case feed rate |

| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LONGI Feed 10530-UC1 | 46.7 | 11.5 | 24.1 | 0.43 | 6.9 | 2.39 | 3.16 | 1.48 | 0.16 | 0.54 | 0.13 | 1960 | 4010 | 467 | 1750 | 283 | 21.9 | 201 | 23.6 | 125 | 17.8 | 171 | 509 | 8.7 |
| LONGI Mag 10530-UC1 | 42.7 | 10 | 29.2 | 0.47 | 8.15 | 1.86 | 2.22 | 1.86 | 0.14 | 0.65 | 0.1 | 2380 | 4890 | 562 | 2130 | 348 | 24.7 | 225 | 28.8 | 147 | 15.5 | 201 | 609 | 6.7 |
| LONGI Nonmag 10530-UC1 | 61.4 | 16.5 | 5.6 | 0.2 | 2.88 | 4.25 | 6.33 | 0.3 | 0.2 | 0.14 | 0.21 | 695 | 1370 | 159 | 597 | 96.2 | 11.3 | 63.4 | 8.1 | 41.9 | 11.4 | 57.2 | 196 | 2 |

| | Assay and Weight Data | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Y g/t | Weight (%) |
| LONGI Feed 10530-UC1 | 46.7 | 11.5 | 24.1 | 0.43 | 6.9 | 2.39 | 3.16 | 1.48 | 0.16 | 0.54 | 4010 | 467 | 1750 | 283 | 21.9 | 201 | 23.6 | 125 | 21.8 | 56.5 | 509 | 100.00 |
| LONGI Mag 10530-UC1 | 42.7 | 10 | 29.2 | 0.47 | 8.15 | 1.86 | 2.22 | 1.86 | 0.14 | 0.65 | 4890 | 562 | 2130 | 348 | 24.7 | 225 | 28.8 | 147 | 27.4 | 63 | 609 | 77.01 |
| LONGI Nonmag 10530-UC1 | 61.4 | 16.5 | 5.6 | 0.2 | 2.88 | 4.25 | 6.33 | 0.3 | 0.2 | 0.14 | 1370 | 159 | 597 | 96.2 | 11.3 | 63.4 | 8.1 | 41.9 | 8.5 | 18.9 | 196 | 22.99 |
| Feed Adjusted | 47.00 | 11.49 | 23.77 | 0.41 | 6.94 | 2.41 | 3.16 | 1.50 | 0.15 | 0.53 | 4080.80 | 469.36 | 1777.59 | 290.11 | 21.62 | 187.85 | 24.04 | 122.84 | 23.06 | 52.86 | 514.06 | 100.00 |

| | Distribution (%) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Y g/t |
| LONGI Mag 10530-UC1 | 69.97 | 67.00 | 94.59 | 88.73 | 90.46 | 59.45 | 54.02 | 95.41 | 70.10 | 93.96 | 92.28 | 92.21 | 92.28 | 92.38 | 87.98 | 92.24 | 92.25 | 92.16 | 91.52 | 91.78 | 91.23 |
| LONGI Nonmag 10530-UC1 | 30.03 | 33.00 | 5.41 | 11.27 | 9.54 | 40.55 | 45.98 | 4.59 | 29.90 | 6.04 | 7.72 | 7.79 | 7.72 | 7.62 | 12.02 | 7.76 | 7.75 | 7.84 | 8.48 | 8.22 | 8.77 |

| | Assay and Weight (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % | Weight (%) |
| Feed Adjusted | 8819.98 | 795.82 | 9615.80 | 23.77 | 0.13 | 100.00 |
| LONGI Mag 10530-UC1 | 10559.7 | 944.9 | 11504.60 | 29.2 | 0.1 | 77.01 |
| LONGI Nonmag 10530-UC1 | 2991.9 | 296.4 | 3288.30 | 5.6 | 0.21 | 22.99 |

| | Distribution (%) | | | | |
|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % |
| LONGI Mag 10530-UC1 | 92.20 | 91.44 | 92.14 | 94.59 | 61.47 |
| LONGI Nonmag 10530-UC1 | 7.80 | 8.56 | 7.86 | 5.41 | 38.53 |

| | Enrichment Ratio | | | | |
|---|---|---|---|---|---|
| Sample ID | LEE | HREE | REE | Fe2O3 | ZrO2 |
| LONGI Mag 10530-UC1 | 1.20 | 1.19 | 1.20 | 1.23 | 0.80 |
| LONGI Nonmag 10530-UC1 | 0.34 | 0.37 | 0.34 | 0.24 | 1.68 |

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*Table 13-48: WHIMS Cleaner Analysis for 30 kg/h Feedrate and 200 rpm*

| Operational parameter | | Comment |
|---|---|---|
| Sample | Unalt | No change |
| Mag intensity | 10530 | No change |
| Water pulsation (rpm) | 200 | Base-case water pulsation |
| Feed solid % | 30% | No change |
| Feed rate (kg/h) | 30 | Lower feed rate |

| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LONGI Feed 10530-UC2 | 46.5 | 11.4 | 24.2 | 0.4 | 6.9 | 2.4 | 3.1 | 1.5 | 0.2 | 0.5 | 0.1 | 2010 | 4100 | 477 | 1810 | 284 | 23.1 | 206.0 | 25.2 | 130.0 | 14.1 | 178.0 | 520.0 | 9.1 |
| LONGI Mag 10530-UC2 | 43.3 | 10.3 | 28.1 | 0.5 | 7.9 | 2.0 | 2.4 | 1.7 | 0.2 | 0.6 | 0.1 | 2270 | 4670 | 536 | 2060 | 324 | 24.0 | 227.0 | 27.1 | 150.0 | 14.8 | 197.0 | 591.0 | 6.8 |
| LONGI Nonmag 10530-UC2 | 59.8 | 16.0 | 7.4 | 0.2 | 3.1 | 4.1 | 6.1 | 0.4 | 0.2 | 0.2 | 0.2 | 823 | 1630 | 189 | 708 | 108 | 13.6 | 77.1 | 9.2 | 49.5 | 8.6 | 68.6 | 198.0 | 2.3 |

| | Assay and Weight Data | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | Weight (%) |
| LONGI Feed 10530-UC2 | 46.5 | 11.4 | 24.2 | 0.4 | 6.9 | 2.4 | 3.1 | 1.5 | 0.2 | 0.5 | 0.1 | 2010 | 4100 | 477 | 1810 | 284 | 23.1 | 206.0 | 25.2 | 130.0 | 14.1 | 178.0 | 520.0 | 100.0 |
| LONGI Mag 10530-UC2 | 43.3 | 10.3 | 28.1 | 0.5 | 7.9 | 2.0 | 2.4 | 1.7 | 0.2 | 0.6 | 0.1 | 2270 | 4670 | 536 | 2060 | 324 | 24.0 | 227.0 | 27.1 | 150.0 | 14.8 | 197.0 | 591.0 | 74.7 |
| LONGI Nonmag 10530-UC2 | 59.8 | 16.0 | 7.4 | 0.2 | 3.1 | 4.1 | 6.1 | 0.4 | 0.2 | 0.2 | 0.2 | 823 | 1630 | 189 | 708 | 108 | 13.6 | 77.1 | 9.2 | 49.5 | 8.6 | 68.6 | 198.0 | 25.3 |
| Feed Adjusted | 47.5 | 11.7 | 22.9 | 0.4 | 6.7 | 2.5 | 3.3 | 1.3 | 0.2 | 0.5 | 0.1 | 1904 | 3902 | 448 | 1718 | 269 | 21.4 | 189.1 | 22.6 | 124.6 | 13.2 | 164.5 | 491.7 | 100.0 |

| | Distribution (%) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | ZrO2 % | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | U g/t | Th g/t | Y g/t | |
| LONGI Mag 10530-UC2 | 68.2 | 65.6 | 91.8 | 87.6 | 88.2 | 58.5 | 54.1 | 92.6 | 75.9 | 91.6 | 59.6 | 89.1 | 89.4 | 89.3 | 89.6 | 89.9 | 83.9 | 89.7 | 89.7 | 90.0 | 83.6 | 89.5 | 89.8 | |
| LONGI Nonmag 10530-UC2 | 31.8 | 34.4 | 8.2 | 12.4 | 11.8 | 41.5 | 45.9 | 7.4 | 24.1 | 8.4 | 40.4 | 10.9 | 10.6 | 10.7 | 10.4 | 10.1 | 16.1 | 10.3 | 10.3 | 10.0 | 16.4 | 10.5 | 10.2 | |

| | Assay and Weight (%) | | | | | |
|---|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % | Weight(%) |
| Feed Adjusted | 8452 | 767 | 9220 | 22.9 | 0.1 | 100.0 |
| LONGI Mag 10530-UC2 | 10111 | 922 | 11033 | 28.1 | 0.1 | 74.7 |
| LONGI Nonmag 10530-UC2 | 3549 | 312 | 3861 | 7.4 | 0.2 | 25.3 |

| | Distribution (%) | | | | |
|---|---|---|---|---|---|
| Sample ID | LREE g/t | HREE g/t | REE g/t | Fe2O3 % | ZrO2 % |
| LONGI Mag 10530-UC2 | 89.4 | 89.7 | 89.4 | 91.8 | 59.6 |
| LONGI Nonmag 10530-UC2 | 10.6 | 10.3 | 10.6 | 8.2 | 40.4 |

| | Enrichment Ratio | | | | |
|---|---|---|---|---|---|
| Sample ID | LEE | HREE | REE | Fe2O3 | ZrO2 |
| LONGI Mag 10530-UC2 | 1.2 | 1.2 | 1.20 | 1.2 | 0.8 |
| LONGI Nonmag 10530-UC2 | 0.4 | 0.4 | 0.4 | 0.3 | 1.6 |

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### 13.5.4.2 SGS Concentration Testing: 100% Passing 1,000 microns

SGS in Lakefield Ontario Canada was supplied with a sample of core. The sample was ground to 100% passing 1,000 micron (1 mm) and then screened to create three particle size fractions: -1,000/+425 micron, -425/+106 micron, and -106 micron.

1. The -1000/+425um is approximately 41% of the feed mass, 34% of the feed REE
2. The 425/+104um is approximately 34% of the feed, 35% of the feed REE
3. The -104um fraction is approximately 25% of the feed, 31% of the feed REE

The -106 micron fraction is enriched in REE while the -425/+106 micron fraction is depleted and the +425 micron is unchanged. This indicates that the -1,000/+425 fraction has experienced no liberation. Grind size must be finer to experience improved liberation.

Results from this concentration testing (100% passing 1,000 microns) should not be used to draw any conclusions other than the grind size was too large. The testing results are included here to show what was tested in early scoping tests and lack of liberation.

Figure 13-49 compares the particle size fractions with regards to impurities and REE's.

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*Table 13-49: SGS Concentration Particle Size and Analysis*

| Assay data | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Weight (kg) | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % |
| Head | 37.2 | 61.4 | 16.6 | 6.3 | 0.1 | 2.6 | 4.3 | 6.2 | 0.43 | 0.06 | 0.15 |
| HPGR +425 | 15.3 | 61.5 | 16.5 | 6.4 | 0.3 | 2.6 | 4.3 | 6.2 | 0.46 | 0.05 | 0.15 |
| HPGR -425+106 | 12.5 | 63.2 | 17.3 | 4.4 | 0.2 | 2.1 | 4.5 | 6.7 | 0.29 | 0.06 | 0.1 |
| HPGR -106 | 9.4 | 57.8 | 15.7 | 9.6 | 0.4 | 3.6 | 4.0 | 5.5 | 0.63 | 0.11 | 0.22 |

| Adjusted Head | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Mass Fraction | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % |
| Head_Adj | 1 | 61.1 | 16.6 | 6.5 | 0.3 | 2.7 | 4.3 | 6.2 | 0.4 | 0.1 | 0.2 |

| Elemental content % in different size fractions | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Mass Fraction | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % |
| HPGR +425 | 0.41 | 41.4 | 41.0 | 40.0 | 39.9 | 39.8 | 41.2 | 41.0 | 42.4 | 30.0 | 40.9 |
| HPGR -425+106 | 0.34 | 34.7 | 35.1 | 22.7 | 20.9 | 26.2 | 35.3 | 36.4 | 21.9 | 29.4 | 22.3 |
| HPGR -106 | 0.25 | 23.9 | 23.9 | 37.2 | 39.2 | 34.0 | 23.5 | 22.6 | 35.7 | 40.6 | 36.8 |

| Distribution of elements in different size fractions (Element content %/ Mass fraction %) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Mass Fraction | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % |
| HPGR +425 | 0.41 | 1.01 | 1.00 | 0.97 | 0.97 | 0.97 | 1.00 | 1.00 | 1.03 | 0.73 | 0.99 |
| HPGR -425+106 | 0.34 | 1.03 | 1.04 | 0.68 | 0.62 | 0.78 | 1.05 | 1.08 | 0.65 | 0.88 | 0.66 |
| HPGR -106 | 0.25 | 0.95 | 0.95 | 1.47 | 1.55 | 1.34 | 0.93 | 0.89 | 1.41 | 1.61 | 1.46 |

| Assay data | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Tm g/t | Yb g/t | Lu g/t | U g/t | Th g/t | Zr g/t | Y g/t |
| Head | 674 | 1390 | 158 | 626 | 102 | 12.6 | 74.1 | 8.9 | 51.1 | 9.2 | 22.5 | 3.8 | 17.9 | 2.3 | 8.2 | 67.5 | TBD | TBD |
| HPGR +425 | 701 | 1390 | 164 | 623 | 103 | 10.4 | 76.6 | 9.6 | 49.8 | 7.8 | 22.3 | 2.5 | 15 | 2.4 | 8.4 | 70.1 | 275 | 163 |
| HPGR -425+106 | 583 | 1210 | 142 | 548 | 93 | 8.0 | 61.3 | 6.8 | 37 | 6.7 | 18.3 | 2.3 | 10 | 1.2 | 8.3 | 59 | 145 | 114 |
| HPGR -106 | 786 | 1640 | 197 | 762 | 138 | 13.5 | 107 | 13.7 | 73.9 | 13.3 | 34.8 | 4.7 | 29.2 | 5.1 | 13.6 | 78.5 | 508 | 281 |

| Adjusted Head | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Tm g/t | Yb g/t | Lu g/t | U g/t | Th g/t | Zr g/t | Y g/t |
| Head_Adj | 682.8 | 1392.7 | 164.9 | 632.9 | 108.4 | 10.4 | 79.1 | 9.7 | 51.6 | 8.8 | 24.1 | 3.0 | 16.9 | 2.7 | 9.7 | 68.5 | 290.2 | 176.4 |

| Elemental content % in different size fractions | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Tm g/t | Yb g/t | Lu g/t | U g/t | Th g/t | Zr g/t | Y g/t |
| HPGR +425 | 42.2 | 41.0 | 40.9 | 40.5 | 39.1 | 41.2 | 39.8 | 40.7 | 39.7 | 36.4 | 38.0 | 34.4 | 36.5 | 36.8 | 35.7 | 42.1 | 39.0 | 38.0 |
| HPGR -425+106 | 28.7 | 29.2 | 28.9 | 29.1 | 28.7 | 25.9 | 26.0 | 23.6 | 24.1 | 25.5 | 25.5 | 25.9 | 19.9 | 15.1 | 28.8 | 28.9 | 16.8 | 21.7 |
| HPGR -106 | 29.1 | 29.8 | 30.2 | 30.4 | 32.2 | 32.9 | 34.2 | 35.7 | 36.2 | 38.1 | 36.5 | 39.7 | 43.6 | 48.1 | 35.5 | 29.0 | 44.2 | 40.3 |

| Distribution of elements in different size fractions (Element content %/ Mass fraction %) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | La g/t | Ce g/t | Pr g/t | Nd g/t | Sm g/t | Eu g/t | Gd g/t | Tb g/t | Dy g/t | Ho g/t | Er g/t | Tm g/t | Yb g/t | Lu g/t | U g/t | Th g/t | Zr g/t | Y g/t |
| HPGR +425 | 1.03 | 1.00 | 0.99 | 0.98 | 0.95 | 1.00 | 0.97 | 0.99 | 0.97 | 0.88 | 0.92 | 0.84 | 0.89 | 0.90 | 0.87 | 1.02 | 0.95 | 0.92 |
| HPGR -425+106 | 0.85 | 0.87 | 0.86 | 0.87 | 0.86 | 0.77 | 0.77 | 0.70 | 0.72 | 0.76 | 0.76 | 0.77 | 0.59 | 0.45 | 0.86 | 0.86 | 0.50 | 0.65 |
| HPGR -106 | 1.15 | 1.18 | 1.19 | 1.20 | 1.27 | 1.30 | 1.35 | 1.41 | 1.43 | 1.51 | 1.44 | 1.57 | 1.73 | 1.90 | 1.40 | 1.15 | 1.75 | 1.59 |

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#### *13.5.4.2.1 -1000/+425um Separation*

SGS ran a combined rougher/cleaner Wilfley Table (proxy for spiral tests) on -1000/+425 material with a targeted split at +2.7 SG. Results were 29% mass yield and 61% REE Recovery

#### *13.5.4.2.2 -425/+104um Separation*

SGS ran three different circuit tests on -425/+104µm material. The results are as follows:

- SGS ran a combined rougher/cleaner Wilfley Table test (proxy for spirals) on -425/+104 material with a targeted split at +2.7 SG. Results for the Wilfley Table (rougher/cleaner) were 14% mass yield and 55% REE Recovery.
- Mozley table was run on the Wilfley Table concentrate to model a cleaner (proxy for +3.5 SG split), resulting in 71% mass yield and 62% REE Recovery.
- A Wilfley Table was run as a Scavenger with the concentrate routed to the Mosley Table, above, resulting in 10% mass yield and 28% REE Recovery.

The overall performance of the above circuits is 10% mass yield and 34% REE Recovery. SGS believes that the upper size of 425um contains unliberated allanite and an upper size of 350um would be better for the material.

#### *13.5.4.2.3 -104um Separation*

SGS ran several various tests on -104µm material. The results are as follows:

- Slon WHIMS did not work well on -104um material with a 46% mass yield and 47% REE Recovery.
- SGS ran Knelson (gravity concentrator) and WHIMS tests on -104 micron fine fractions with a 11% mass yield and a 24% REE Recovery
    - WHIMS Eriez test was performed on the Knelson concentrate stream with a 59% mass yield and 92% REE Recovery
    - WHIMS Eriez test was performed on the Knelson tails with a 29% mass yield and 72% REE Recovery.
    - The overall performance of the above circuit is 32% mass yield and 77% REE Recovery.
- WHIMS Eriez was run on -104 micron fine fraction with a 27% mass yield and a 62% REE Recovery
    - Knelson separator was run on the magnetic fraction from the WHIMS Eriez but did not perform well with a 53% mass yield and 51% REE Recovery
    - Kneslon separator was also run on the non-magnetic fraction from the WHIMS Eriez but did not perform well with a 15% mass yield and a 29% REE Recovery
    - The overall performance of the above circuit is 13% mass yield and 30% REE Recovery.

The Summary Table in Table 13-50 compares the different circuits as well as starting/ending REE concentration and upgrade factors.

*Table 13-50: SGS Test Results Summary*

| Test | Feed Stream # | Product Stream # | Particle Size Microns | Mass Yield % | REE Rec % | Feed REE ppm | Product REE ppm | Upgrade Factor |
|---|---|---|---|---|---|---|---|---|
| Screening #1 | 1 | 2 | -1000/425 | 41% | 34% | | | |
| | 1 | 3 | -425/+104 | 34% | 35% | | | |
| | 1 | 4 | -104 | 25% | 31% | | | |
| Wilfley Table #1, Rough/Clean | 2 | 5 | -1000/425 | 29% | 61% | **3,305** | **5,710** | **1.7** |
| Wilfley Table #2, Rough/Clean | 3 | 7 | -425/+104 | 14% | 55% | | | |
| Mozley Table #1, Clean | 10 (7+9) | 12 | -425/+104 | 71% | 62% | | | |
| Wilfley Table #3, Scav | 8 | 9 | -425/+104 | 10% | 28% | | | |
| **Combined** | | | | **10%** | **34%** | **3,305** | **11,338** | **3.4** |
| WHIMS Eriez #1 | 4 | 14 | -104 | 27% | 62% | | | |
| Knelson #2, mag | 14 | 16 | -104 | 47% | 49% | | | |
| Knelson #3, non-mag | 15 | 19 | -104 | 85% | 71% | | | |
| **Combined** | **4** | **19** | **-104** | **13%** | **30%** | **3,305** | **7,912** | **2.4** |
| Slon 100 #1 | 4 | 20 | -104 | 46% | 47% | 3,305 | 4,212 | 1.3 |
| Knelson #1, Tails | 4 | 22 | -104 | 89% | 76% | | | |
| WHIMS Eriez #2, Tails, Mag | 22 | 24 | -104 | 29% | 72% | | | |
| WHIMS Eriez #3, Con, Mag | 23 | 26 | -104 | 59% | 92% | | | |
| **Combined** | **4** | **24+26** | **-104** | **32%** | **77%** | **3,305** | **7,858** | **2.4** |

Figure 13-53 shows the 100% passing 1,000-micron tests performed at SGS

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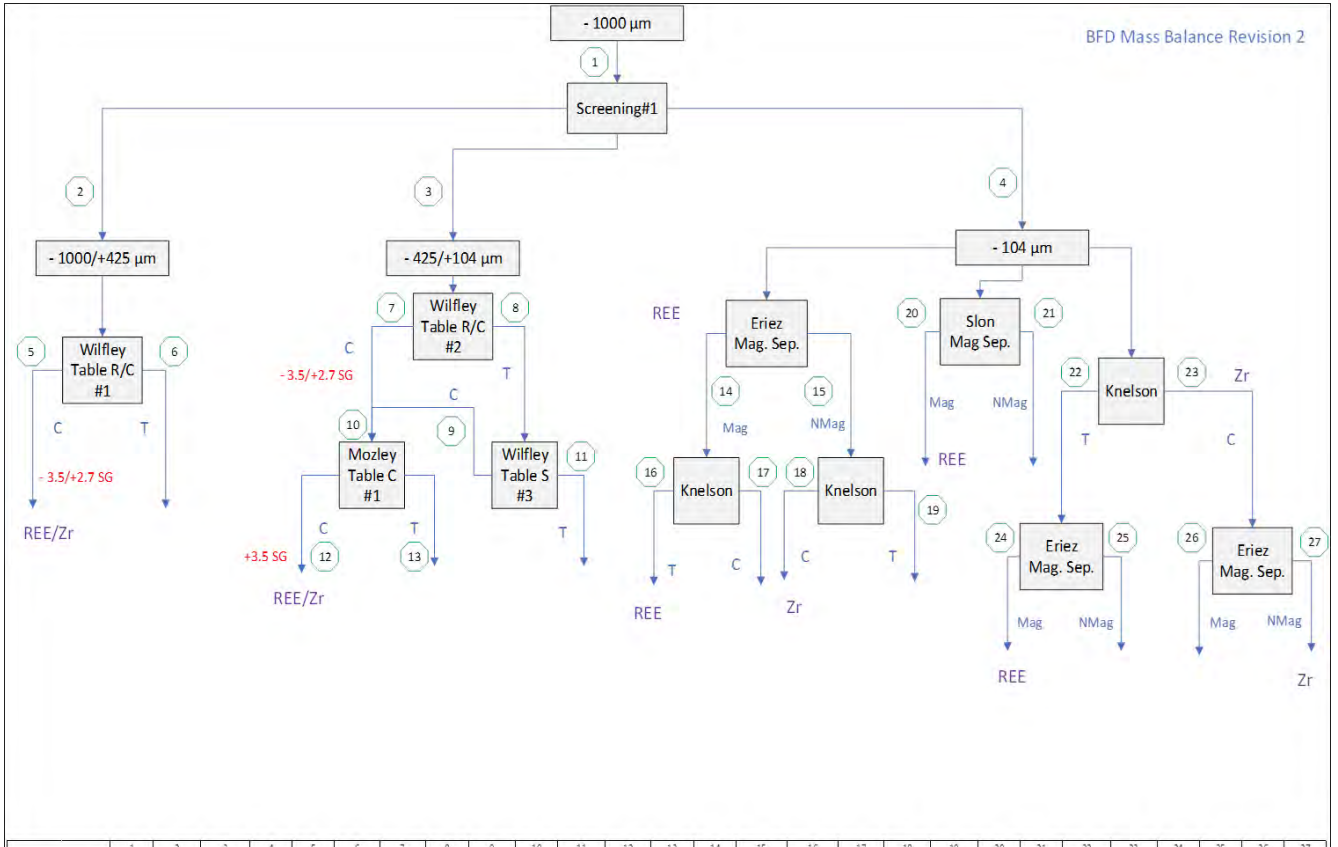


| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Head | -1000 +425 µm | -425+106 µm | -106 µm | Wilfley#1 C | Wilfley#1 T | Wilfley#2 C | Wilfley#2 T | Wilfley#3 C | [9+7] | Wilfley#3 T | Mozely#1 C | Mozely#1 T | Eriez#1 Mag | Eriez#1 NonMag | Knelson#2 C | Knelson#2 T | Knelson#3 C | Knelson#3 T | SLon#1 Mag | Slon#1 NonMag | Knelson#1 T | Knelson#1 C | Eriez#2 Mag | Eriez#2 NonMag | Eriez#3 Mag | Eriez#3 NonMag |
| Mass Fraction Global (%) | | 100.00 | 41.18 | 33.54 | 25.28 | 11.93 | 29.25 | 4.82 | 28.72 | 2.94 | 7.76 | 25.78 | 5.49 | 2.27 | 7.03 | 18.25 | 3.32 | 3.72 | 2.84 | 15.41 | 11.57 | 13.71 | 22.56 | 2.72 | 6.51 | 16.05 | 1.62 | 1.10 |
| Assay | REE (g/t) | 3305.04 | 2714.43 | 3454.06 | 4069.42 | 5709.55 | 1492.40 | 13313.40 | 1798.17 | 4851.23 | 10108.21 | 1449.87 | 11025.76 | 7894.20 | 9018.00 | 2162.12 | 9300.46 | 8765.89 | 3980.90 | 1826.97 | 4211.65 | 3949.49 | 3455.21 | 9158.21 | 8597.18 | 1370.24 | 14194.74 | 1768.07 |
| | Zr (g/t) | 291.74 | 161.03 | 286.54 | 511.58 | 197.85 | 146.00 | 1599.20 | 66.08 | 136.63 | 1045.23 | 58.03 | 1177.75 | 725.44 | 402.60 | 553.58 | 396.74 | 407.83 | 2654.55 | 166.43 | 843.87 | 231.35 | 210.14 | 3008.98 | 209.13 | 210.55 | 1020.29 | 5927.00 |
| Distribution Global | REE (%) | 100.00 | 33.82 | 35.05 | 31.13 | 20.61 | 13.21 | 19.43 | 15.62 | 4.32 | 23.74 | 11.31 | 18.31 | 5.43 | 19.19 | 11.94 | 9.33 | 9.86 | 3.42 | 8.52 | 14.74 | 16.39 | 23.58 | 7.54 | 16.93 | 6.65 | 6.95 | 0.59 |
| | Zr (%) | 100.00 | 22.73 | 32.94 | 44.33 | 8.09 | 14.64 | 26.44 | 6.90 | 1.38 | 27.81 | 5.13 | 22.16 | 5.66 | 9.71 | 34.62 | 4.51 | 5.19 | 25.83 | 8.79 | 33.45 | 10.88 | 16.25 | 28.08 | 4.66 | 11.58 | 5.66 | 22.42 |

*Figure 13-53: SGS 1000 µm Test Results*



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#### *13.5.4.2.4 Separation Key Results*

A grind size of +425um is too big, SGS recommends -350um as top size

- Fines are best processed using a Knelson Separator followed by Eriez WHIMS. Stage results: 6.5% mass yield, 69% recovery
- Wilfley Tables showed good rejection fractions and recoveries. Can probably be improved with better liberation of allanite. Stage results: 15.4% mass yield, 65% recovery, 4.22x upgrade from feed
- Combined results: 13.2% mass yield, 66% recovery, 5.01x upgrade

Grind size must be finer in order to realize liberation at all size fractions

### 13.5.4.3 SGS Mineralogy

A composite sample of Halleck Creek core was provided to SGS for mineralogical investigations in order to provide guidance for metallurgical test work. The mineralogical work was conducted with TIMA-X (Tescan Integrated Mineral Analyzer), Electron Probe Micro-Analysis (EPMA, X-ray diffraction analysis (XRD), and chemical assays. The purpose of this test program was to determine the overall mineral assemblage of the sample and define the liberation and association attributes of the Rare Earth Element (REE) Minerals (REM).

#### *13.5.4.3.1 X-Ray Diffraction Analysis*

The sample was analyzed with XRD to determine its bulk mineralogy. The sample consists mainly of albite (37.5%), microcline (30.5%), actinolite (15.1%), diopside (3.4%), quartz (5.8%), and minor (<2-3%) of other minerals. Note that the grade of the REM is very low to be detected with the XRD.

The samples were split into four size fractions: +212um, -212/+106um, -106/+25um, and -25um. Table 13-51 shows the particle size fraction and median particle size. Allanite is primary a rare earth mineral (REM) 1.28% of total with other REM accounting for 0.07% of total. Zircon is 0.31% of total which is a small percentage but concentrates well due to large specific gravity.

*Table 13-51: X-Ray Diffraction Sample Data*

| Sample Data | | | | | |
|---|---|---|---|---|---|
| Fraction | Combined | 212 | -212/+106 | -106/+25 | -25 |
| Mass % of Size Fraction, (%) | 100 | 18.7 | 23.9 | 29 | 28.4 |
| Median Particle Size, (µm) | 72 | 286 | 148 | 54 | 11 |

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### 13.5.4.4 General Mineralogy – Modal Occurrence

Mineral abundance is presented in wt% by size fraction and calculated head in Figure 13-53 through Figure 13-56. The mineral abundance for the calculated head includes quartz/feldspars (78.8%), amphibole (17.0%) (which includes minor pyroxene because it yields a chemical composition similar to that of the amphibole), and trace amounts (<1%) of biotite, garnets, carbonates, epidote, other silicates, apatite, sulphides, Fe-Oxides, ilmenite, and other minerals.

The main REM is allanite (1.28%), while chevkinite (0.01%), tornebohmite (0.03%), and synchysite/bastnasite (0.04%) are present in trace amounts. Note the presence of zircon (0.31%). Rare xenotime, monazite, niobates, and other REM are tentatively identified.

- SGS micro-probe did not show much REE in zircon
- Amphiboles are 17% of total
- Quartz and Feldspars are 78.8% of total

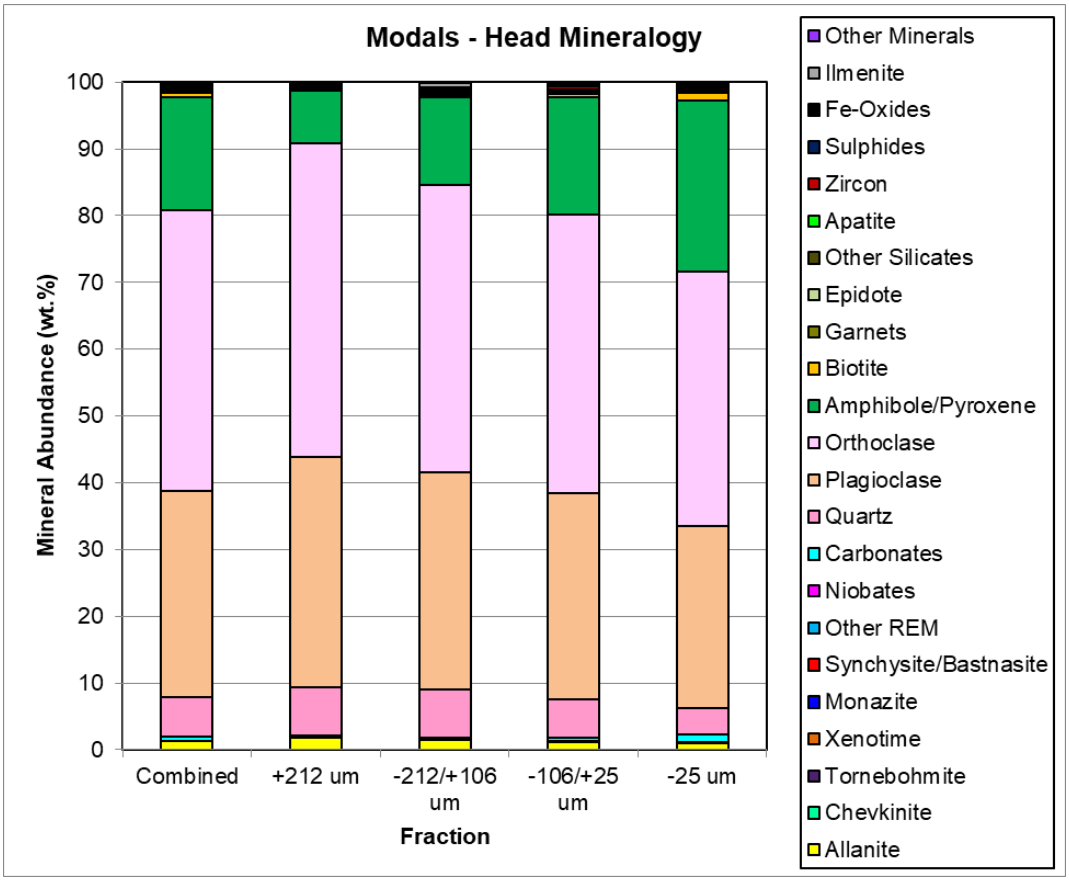


*Figure 13-54: Modals - Head Mineralogy*

| Survey | | CA20M-00000-110-20383-01 / MI5056-JUN24 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Project | | American REE | | | | | | | | |
| Sample | | Head Mineralogy | | | | | | | | |
| Fraction | | Combined | +212 um | | -212/+106 um | | -106/+25 um | | -25 um | |
| Mass % of Size Fraction [%] | | 100.0 | 18.7 | | 23.9 | | 29.0 | | 28.4 | |
| Median Particle Size (µm) | | 72 | 286 | | 148 | | 54 | | 11 | |
| | | Sample | Sample | Fraction | Sample | Fraction | Sample | Fraction | Sample | Fraction |
| Mineral Mass (%) | Allanite | 1.28 | 0.34 | 1.79 | 0.33 | 1.40 | 0.34 | 1.16 | 0.28 | 0.98 |
| | Chevkinite | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 |
| | Tornebohmite | 0.03 | 0.00 | 0.01 | 0.00 | 0.02 | 0.01 | 0.02 | 0.02 | 0.06 |
| | Xenotime | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Synchysite/Bastnasite | 0.04 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.03 | 0.02 | 0.07 |
| | Other REM | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 |
| | Niobates | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Carbonates | 0.59 | 0.05 | 0.29 | 0.08 | 0.35 | 0.15 | 0.51 | 0.31 | 1.08 |
| | Quartz | 5.92 | 1.36 | 7.27 | 1.72 | 7.19 | 1.69 | 5.83 | 1.16 | 4.07 |
| | Plagioclase | 30.9 | 6.45 | 34.5 | 7.78 | 32.5 | 8.96 | 30.9 | 7.72 | 27.2 |
| | Orthoclase | 42.0 | 8.79 | 47.0 | 10.3 | 43.0 | 12.1 | 41.6 | 10.8 | 38.1 |
| | Amphibole/Pyroxene | 17.0 | 1.46 | 7.82 | 3.13 | 13.1 | 5.11 | 17.6 | 7.28 | 25.6 |
| | Biotite | 0.58 | 0.05 | 0.26 | 0.08 | 0.35 | 0.15 | 0.50 | 0.31 | 1.08 |
| | Garnets | 0.09 | 0.02 | 0.13 | 0.02 | 0.08 | 0.03 | 0.09 | 0.02 | 0.08 |
| | Epidote | 0.17 | 0.04 | 0.19 | 0.04 | 0.18 | 0.05 | 0.18 | 0.04 | 0.13 |
| | Other Silicates | 0.30 | 0.06 | 0.33 | 0.07 | 0.29 | 0.08 | 0.29 | 0.09 | 0.32 |
| | Apatite | 0.16 | 0.02 | 0.09 | 0.02 | 0.08 | 0.04 | 0.12 | 0.09 | 0.31 |
| | Zircon | 0.31 | 0.00 | 0.03 | 0.09 | 0.37 | 0.15 | 0.51 | 0.07 | 0.24 |
| | Sulphides | 0.09 | 0.01 | 0.05 | 0.02 | 0.08 | 0.03 | 0.11 | 0.03 | 0.11 |
| | Fe-Oxides | 0.13 | 0.01 | 0.08 | 0.03 | 0.12 | 0.04 | 0.15 | 0.05 | 0.17 |
| | Ilmenite | 0.30 | 0.01 | 0.07 | 0.16 | 0.67 | 0.08 | 0.26 | 0.06 | 0.20 |
| | Other Minerals | 0.09 | 0.01 | 0.08 | 0.02 | 0.10 | 0.02 | 0.08 | 0.03 | 0.11 |
| | Total | 100.0 | 18.7 | 100.0 | 23.9 | 100.0 | 29.0 | 100.0 | 28.4 | 100.0 |
| Mean Line Intercept Length (µm) | Allanite | 29 | 82 | | 50 | | 25 | | 6 | |
| | Chevkinite | 12 | 0 | | 7 | | 19 | | 6 | |
| | Tornebohmite | 6 | 7 | | 9 | | 6 | | 4 | |
| | Xenotime | 6 | 8 | | 8 | | 6 | | 4 | |
| | Monazite | 8 | 10 | | 11 | | 6 | | 4 | |
| | Synchysite/Bastnasite | 9 | 10 | | 16 | | 12 | | 6 | |
| | Other REM | 8 | 11 | | 9 | | 8 | | 5 | |
| | Niobates | 6 | 7 | | 12 | | 6 | | 3 | |
| | Carbonates | 9 | 12 | | 14 | | 14 | | 6 | |
| | Quartz | 29 | 68 | | 51 | | 23 | | 6 | |
| | Plagioclase | 22 | 46 | | 39 | | 22 | | 6 | |
| | Orthoclase | 24 | 61 | | 47 | | 23 | | 7 | |
| | Amphibole/Pyroxene | 13 | 43 | | 42 | | 22 | | 5 | |
| | Biotite | 8 | 12 | | 12 | | 10 | | 5 | |
| | Garnets | 10 | 15 | | 10 | | 8 | | 5 | |
| | Epidote | 10 | 10 | | 11 | | 10 | | 7 | |
| | Other Silicates | 8 | 10 | | 9 | | 8 | | 5 | |
| | Apatite | 12 | 19 | | 16 | | 16 | | 7 | |
| | Zircon | 28 | 35 | | 64 | | 33 | | 8 | |
| | Sulphides | 17 | 32 | | 34 | | 21 | | 8 | |
| | Fe-Oxides | 11 | 14 | | 15 | | 12 | | 7 | |
| | Ilmenite | 32 | 34 | | 68 | | 25 | | 8 | |
| | Other Minerals | 7 | 7 | | 10 | | 7 | | 5 | |

*Figure 13-55: General Mineralogy Tabular Data for Modals – Head Mineralogy*

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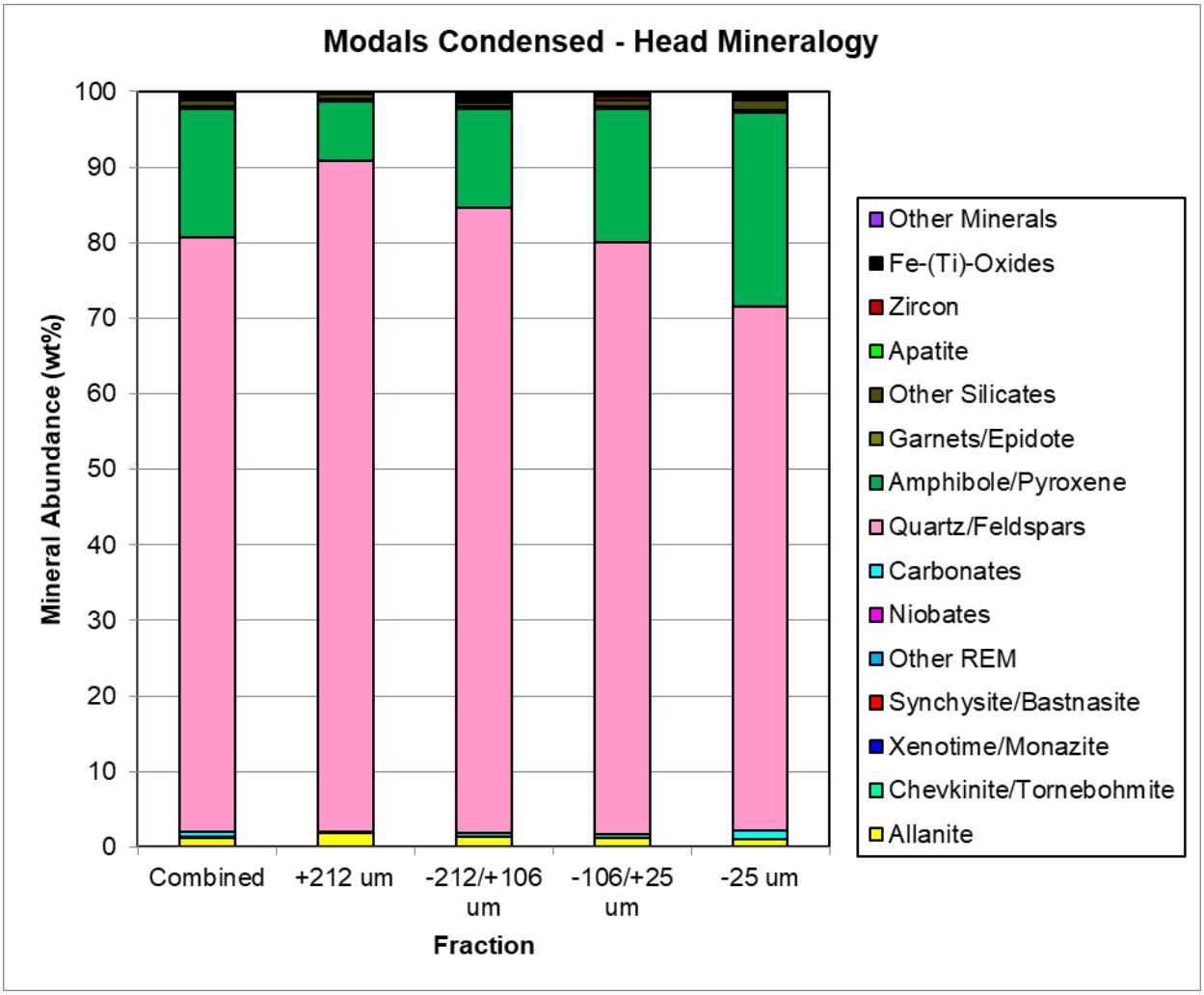


*Figure 13-56: Modals Condensed – Head Mineralogy*

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| Survey | | CA20M-00000-110-20383-01 / MI5056-JUN24 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Project | | American REE | | | | | | | | |
| Sample | | Head Mineralogy | | | | | | | | |
| Fraction | | Combined | +212 um | | -212/+106 um | | -106/+25 um | | -25 um | |
| Mass % of Size Fraction [%] | | 100.0 | 18.7 | | 23.9 | | 29.0 | | 28.4 | |
| Median Particle Size (µm) | | 72 | 286 | | 148 | | 54 | | 11 | |
| | | Sample | Sample | Fraction | Sample | Fraction | Sample | Fraction | Sample | Fraction |
| Mineral Mass (%) | Allanite | 1.28 | 0.34 | 1.79 | 0.33 | 1.40 | 0.34 | 1.16 | 0.28 | 0.98 |
| | Chevkinite/Tornebohmite | 0.04 | 0.00 | 0.01 | 0.00 | 0.02 | 0.01 | 0.03 | 0.02 | 0.07 |
| | Xenotime/Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Synchysite/Bastnasite | 0.04 | 0.00 | 0.01 | 0.01 | 0.03 | 0.01 | 0.03 | 0.02 | 0.07 |
| | Other REM | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 |
| | Niobates | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Carbonates | 0.59 | 0.05 | 0.29 | 0.08 | 0.35 | 0.15 | 0.51 | 0.31 | 1.08 |
| | Quartz/Feldspars | 78.8 | 16.6 | 88.8 | 19.8 | 82.8 | 22.7 | 78.3 | 19.7 | 69.4 |
| | Amphibole/Pyroxene | 17.0 | 1.46 | 7.82 | 3.13 | 13.1 | 5.11 | 17.6 | 7.28 | 25.6 |
| | Garnets/Epidote | 0.26 | 0.06 | 0.32 | 0.06 | 0.27 | 0.08 | 0.27 | 0.06 | 0.21 |
| | Other Silicates | 0.89 | 0.11 | 0.59 | 0.15 | 0.63 | 0.23 | 0.79 | 0.40 | 1.40 |
| | Apatite | 0.16 | 0.02 | 0.09 | 0.02 | 0.08 | 0.04 | 0.12 | 0.09 | 0.31 |
| | Zircon | 0.31 | 0.00 | 0.03 | 0.09 | 0.37 | 0.15 | 0.51 | 0.07 | 0.24 |
| | Fe-(Ti)-Oxides | 0.44 | 0.03 | 0.15 | 0.19 | 0.79 | 0.12 | 0.41 | 0.10 | 0.37 |
| | Other Minerals | 0.18 | 0.02 | 0.13 | 0.04 | 0.18 | 0.05 | 0.19 | 0.06 | 0.23 |
| | Total | 100.0 | 18.7 | 100.0 | 23.9 | 100.0 | 29.0 | 100.0 | 28.4 | 100.0 |
| Mean Line Intercept Length (µm) | Allanite | 29 | 82 | | 50 | | 25 | | 6 | |
| | Chevkinite/Tornebohmite | 6 | 7 | | 9 | | 9 | | 4 | |
| | Xenotime/Monazite | 8 | 9 | | 10 | | 6 | | 4 | |
| | Synchysite/Bastnasite | 9 | 10 | | 16 | | 12 | | 6 | |
| | Other REM | 8 | 11 | | 9 | | 8 | | 5 | |
| | Niobates | 6 | 7 | | 12 | | 6 | | 3 | |
| | Carbonates | 9 | 12 | | 14 | | 14 | | 6 | |
| | Quartz/Feldspars | 29 | 129 | | 72 | | 27 | | 7 | |
| | Amphibole/Pyroxene | 13 | 43 | | 42 | | 22 | | 5 | |
| | Garnets/Epidote | 10 | 12 | | 11 | | 9 | | 6 | |
| | Other Silicates | 8 | 11 | | 11 | | 9 | | 5 | |
| | Apatite | 12 | 19 | | 16 | | 16 | | 7 | |
| | Zircon | 28 | 35 | | 64 | | 33 | | 8 | |
| | Fe-(Ti)-Oxides | 20 | 19 | | 44 | | 18 | | 7 | |
| | Other Minerals | 9 | 9 | | 13 | | 11 | | 6 | |

*Figure 13-57: General Mineralogy Tabular Data for Modals Condensed – Head Mineralogy*

#### *13.5.4.4.1 REE Occurrence*

Allanite accounts for most of the cerium (87%), lanthanum (87%), neodymium (91%), and samarium (88%). Figure 13-57 and Figure 13-58 illustrate the neodymium (Nd) and samarium (Sm) distribution by mineral in the sample by size fraction. The highest deportment of Nd is in the +25µm fraction while the highest

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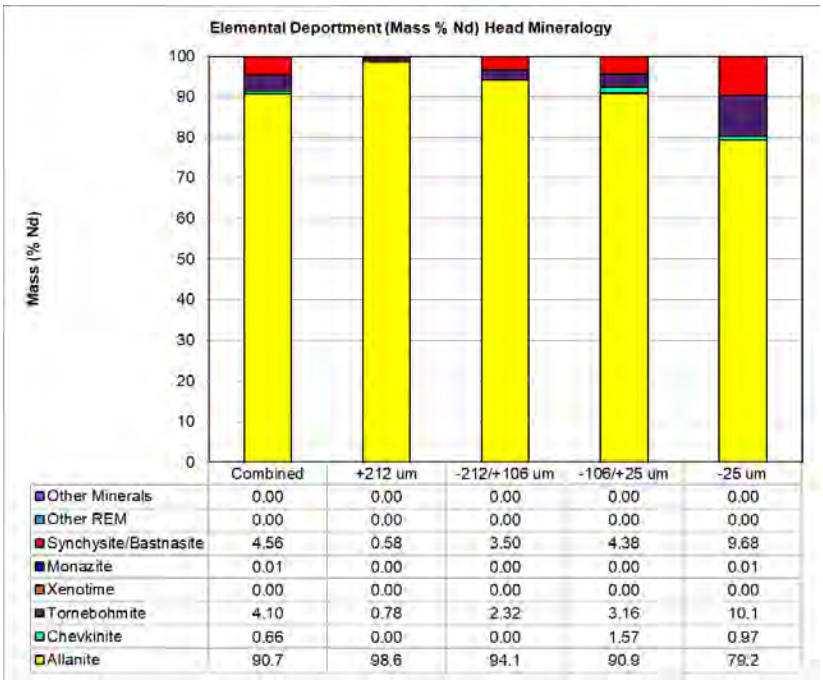
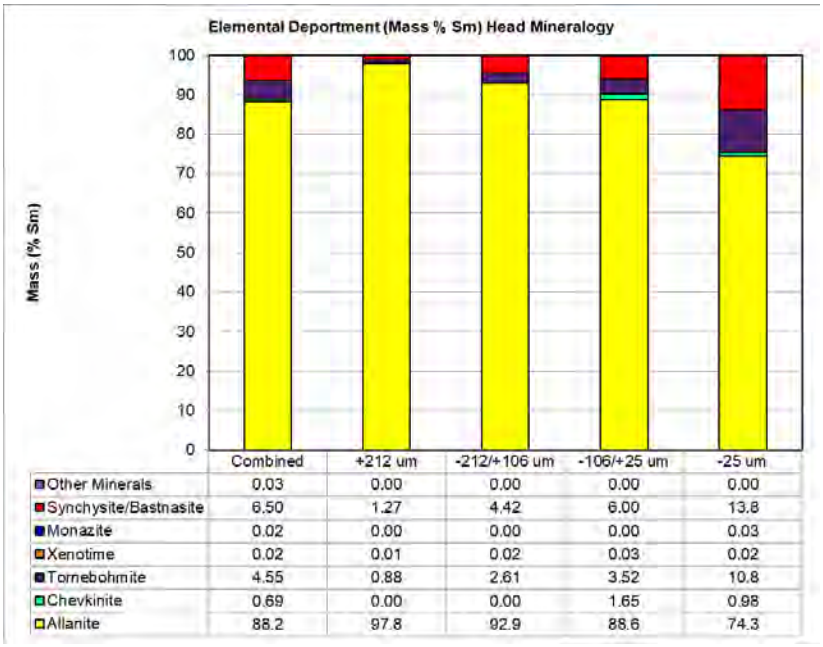



| | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| Other Minerals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other REM | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Synchysite/Bastnasite | 4.56 | 0.58 | 3.50 | 4.38 | 9.68 |
| Monazite | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| Xenotime | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Tornebohmite | 4.10 | 0.78 | 2.32 | 3.16 | 10.1 |
| Chevkinite | 0.66 | 0.00 | 0.00 | 1.57 | 0.97 |
| Allanite | 90.7 | 98.6 | 94.1 | 90.9 | 79.2 |

*Figure 13-58: Elemental Deportment of Nd by REM*




| | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| Other Minerals | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| Synchysite/Bastnasite | 6.50 | 1.27 | 4.42 | 6.00 | 13.8 |
| Monazite | 0.02 | 0.00 | 0.00 | 0.00 | 0.03 |
| Xenotime | 0.02 | 0.01 | 0.02 | 0.03 | 0.02 |
| Tornebohmite | 4.55 | 0.88 | 2.61 | 3.52 | 10.8 |
| Chevkinite | 0.69 | 0.00 | 0.00 | 1.65 | 0.98 |
| Allanite | 88.2 | 97.8 | 92.9 | 88.6 | 74.3 |

*Figure 13-59: Elemental Deportment of Sm by REM*

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#### *13.5.4.4.2 Grain size*

Figure  illustrates the head mineralogy grain size and cumulative mineral mass.  Table 13-52provides the median grain size and P80 for selected minerals.

- Allanite median size is 90um, p80 of sample is 218um
- Zircon median size is 67um, p80 of sample is 125um

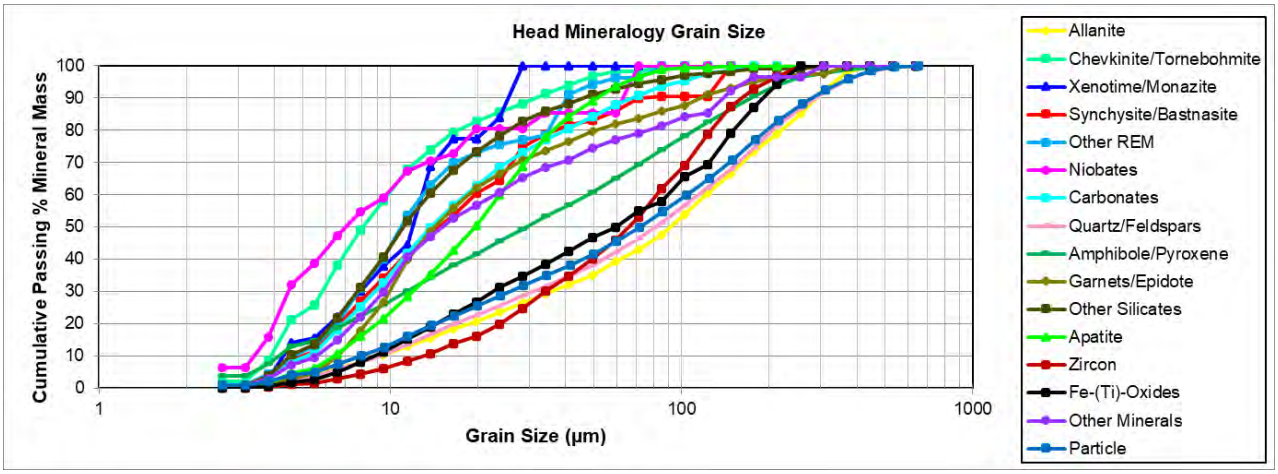


*Figure 13-60: Head Mineralogy Grain Size Chart*

*Table 13-52: Mean Grain Size*

| Sample | Head Mineralogy | |
|---|---|---|
| **Grain Size (µm)** | **Median** | **P80** |
| **Allanite** | 90 | 218 |
| **Chevkinite/Tornebohmite** | 8 | 17 |
| **Xenotime/Monazite** | 13 | 20 |
| **Synchysite/Bastnasite** | 15 | 35 |
| **Other REM** | 11 | 36 |
| **Niobates** | 7 | 19 |
| **Carbonates** | 14 | 40 |
| **Quartz/Feldspars** | 81 | 206 |
| **Amphibole/Pyroxene** | 29 | 112 |
| **Garnets/Epidote** | 14 | 50 |
| **Other Silicates** | 11 | 25 |
| **Apatite** | 19 | 36 |
| **Zircon** | 67 | 125 |
| **Fe-(Ti)-Oxides** | 59 | 151 |
| **Other Minerals** | 15 | 75 |
| **Particle** | 72 | 196 |

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#### *13.5.4.4.3 Allanite Liberation*

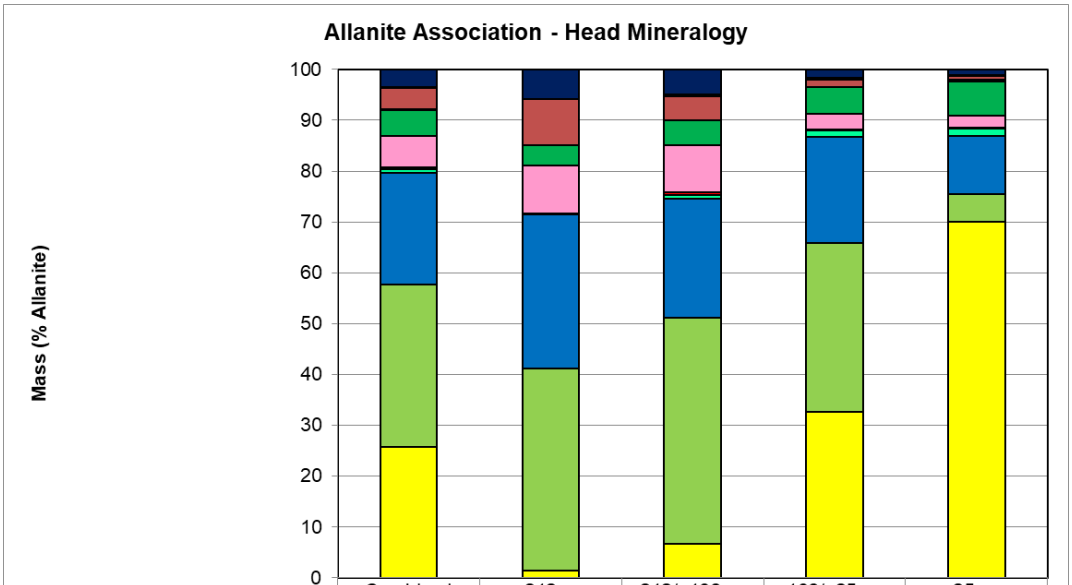
Liberated (pure, free, and liberated) allanite accounts for 79.6% in the sample. The remainder occurs as complex (ternary and quaternary middling particles) (3.5%), middlings with quartz/feldspars (6.2%), amphibole/pyroxene (5.1%), quartz/feldspars and amphibole/pyroxene (4.1%), other REM/niobates (1.1%), and other minerals in trace amounts (<1%). Liberation of allanite increases from 72% to 75% in +212 µm and -212/+106 µm size fractions to 87% in the -106/+25 µm and -25 µm size fractions.

- Combined liberation is highest in the -106/25um fraction at 86.8%, also highest mass feed split at 26.2%
    - Liberation for -25um split at 86.9%, with 21.6% mass feed split
- SGS adds “Exposed” grains to material for liberation
    - >30% Exposed Particles have calculated SG >= 3.0, which could be gravity separated

*Table 13-53: Normalized Mass of Allanite*

**Cumulative (desc) Normalized Mass of Allanite Across Fraction Head Mineralogy**

| Mineral Name | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um | Calc SG |
|---|---|---|---|---|---|---|
| **100% Exposed** | 29.4 | 3.51 | 13.9 | 36.9 | 70.4 | 3.6 |
| **>90-<100% Exposed** | 60.8 | 46.2 | 52.7 | 69.9 | 77.2 | 3.5 |
| **>80-<90% Exposed** | 73.8 | 63.2 | 67.4 | 81.9 | 84.7 | 3.4 |
| **>70-<80% Exposed** | 81.0 | 72.6 | 76.6 | 87.1 | 89.0 | 3.3 |
| **>60-<70% Exposed** | 84.6 | 76.4 | 80.1 | 90.6 | 92.5 | 3.2 |
| **>50-<60% Exposed** | 90.3 | 88.1 | 85.0 | 94.2 | 94.7 | 3.2 |
| **>40-<50% Exposed** | 93.3 | 91.3 | 91.4 | 94.8 | 96.2 | 3.1 |
| **>30-<40% Exposed** | 95.4 | 93.7 | 94.9 | 95.9 | 97.5 | 3.0 |
| **>20-<30% Exposed** | 97.0 | 96.2 | 96.6 | 97.0 | 98.6 | 2.9 |
| **>10-<20% Exposed** | 98.5 | 98.5 | 97.4 | 98.5 | 99.6 | 2.8 |
| **>0-10% Exposed** | 99.7 | 99.6 | 99.5 | 99.7 | 100.0 | 2.7 |
| **Locked** | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | |
| **Total** | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | |
| **% Exposed** | +90% | | | | allanite sg | 3.6 |
| **% Exposed** | +95% | | | | gangue sg | 2.7 |




| | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| Complex | 3.47 | 5.80 | 4.87 | 1.70 | 1.10 |
| Aln: Qtz/Feld : Amph/Px : Grt/Ep | 0.26 | 0.12 | 0.33 | 0.40 | 0.17 |
| Aln: Qtz/Feld : Amph/Px | 4.14 | 9.05 | 4.78 | 1.39 | 0.74 |
| Aln: Other Minerals | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| Aln: Fe-(Ti)-Oxides | 0.03 | 0.00 | 0.02 | 0.03 | 0.11 |
| Aln: Zircon | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| Aln: Apatite | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Aln: Other Silicates | 0.03 | 0.00 | 0.00 | 0.02 | 0.14 |
| Aln: Garnets/Epidote | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Aln: Amphibole/Pyroxene | 5.14 | 3.94 | 4.86 | 5.19 | 6.85 |
| Aln: Quartz/Feldspars | 6.17 | 9.49 | 9.25 | 3.05 | 2.22 |
| Aln: Carbonates | 0.02 | 0.00 | 0.02 | 0.02 | 0.05 |
| Aln: Niobates | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Aln: Other REM | 0.02 | 0.00 | 0.00 | 0.01 | 0.06 |
| Aln: Synchysite/Bastnasite | 0.24 | 0.00 | 0.64 | 0.14 | 0.18 |
| Aln: Xenotime/Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Chevkinite/Tornebohmite | 0.83 | 0.10 | 0.70 | 1.22 | 1.40 |
| Lib Allanite | 22.0 | 30.3 | 23.4 | 20.9 | 11.4 |
| Free Allanite | 31.9 | 39.8 | 44.5 | 33.2 | 5.54 |
| Pure Allanite | 25.8 | 1.38 | 6.67 | 32.7 | 70.0 |

*Figure 13-61: Allanite Head Mineralogy*

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*Table 13-54: Allanite Sample Data*

| Mass Feed | Combined | +212 um | -212/+106 um | -106/+25 um | -25 um |
|---|---|---|---|---|---|
| **Total Mass Feed (% in fraction)** | 100.0 | 26.1 | 26.0 | 26.2 | 21.6 |
| **Mineral Name** | **Combined** | **+212 um** | **-212/+106 um** | **-106/+25 um** | **-25 um** |
| **Pure Allanite** | 25.8 | 1.38 | 6.67 | 32.7 | 70.0 |
| **Free Allanite** | 31.9 | 39.8 | 44.5 | 33.2 | 5.54 |
| **Lib Allanite** | 22.0 | 30.3 | 23.4 | 20.9 | 11.4 |
| **Total Liberated** | **79.6** | **71.5** | **74.5** | **86.8** | **86.9** |

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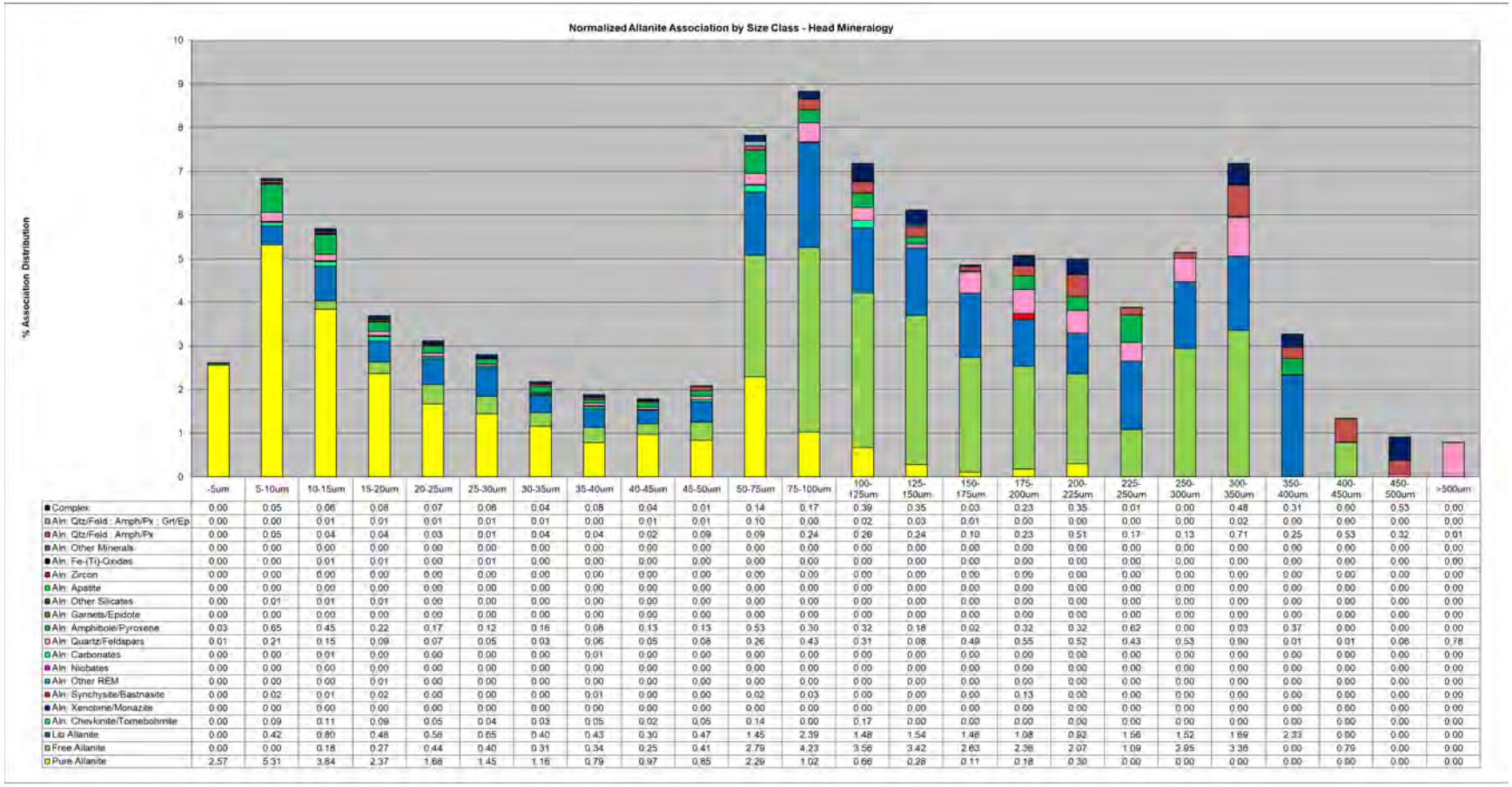


| | -5um | 5-10um | 10-15um | 15-20um | 20-25um | 25-30um | 30-35um | 35-40um | 40-45um | 45-50um | 50-75um | 75-100um | 100-125um | 125-150um | 150-175um | 175-200um | 200-225um | 225-250um | 250-300um | 300-350um | 350-400um | 400-450um | 450-500um | >500um |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Complex | 0.00 | 0.05 | 0.06 | 0.08 | 0.07 | 0.08 | 0.04 | 0.08 | 0.04 | 0.01 | 0.14 | 0.17 | 0.39 | 0.35 | 0.03 | 0.23 | 0.35 | 0.01 | 0.00 | 0.48 | 0.31 | 0.00 | 0.53 | 0.00 |
| Aln: Qtz/Feld : Amph/Px : Grt/Ep | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.10 | 0.00 | 0.02 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Qtz/Feld : Amph/Px | 0.00 | 0.05 | 0.04 | 0.04 | 0.03 | 0.01 | 0.04 | 0.04 | 0.02 | 0.09 | 0.09 | 0.24 | 0.26 | 0.24 | 0.10 | 0.23 | 0.51 | 0.17 | 0.13 | 0.71 | 0.25 | 0.53 | 0.32 | 0.01 |
| Aln: Other Minerals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Fe-(Ti)-Oxides | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Zircon | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Apatite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Other Silicates | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Garnets/Epidote | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Amphibole/Pyroxene | 0.03 | 0.65 | 0.45 | 0.22 | 0.17 | 0.12 | 0.16 | 0.08 | 0.13 | 0.13 | 0.53 | 0.30 | 0.32 | 0.18 | 0.02 | 0.32 | 0.32 | 0.62 | 0.00 | 0.03 | 0.37 | 0.00 | 0.00 | 0.00 |
| Aln: Quartz/Feldspars | 0.01 | 0.21 | 0.15 | 0.09 | 0.07 | 0.05 | 0.03 | 0.06 | 0.05 | 0.08 | 0.26 | 0.43 | 0.31 | 0.08 | 0.49 | 0.55 | 0.52 | 0.43 | 0.53 | 0.90 | 0.01 | 0.01 | 0.06 | 0.78 |
| Aln: Carbonates | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Niobates | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Other REM | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Synchysite/Bastnasite | 0.00 | 0.02 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.03 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Xenotime/Monazite | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aln: Chevkinite/Tornebohmite | 0.00 | 0.09 | 0.11 | 0.09 | 0.05 | 0.04 | 0.03 | 0.05 | 0.02 | 0.05 | 0.14 | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lib Allanite | 0.00 | 0.42 | 0.80 | 0.48 | 0.56 | 0.65 | 0.40 | 0.43 | 0.30 | 0.47 | 1.45 | 2.39 | 1.48 | 1.54 | 1.48 | 1.08 | 0.92 | 1.56 | 1.52 | 1.89 | 2.33 | 0.00 | 0.00 | 0.00 |
| Free Allanite | 0.00 | 0.00 | 0.18 | 0.27 | 0.44 | 0.40 | 0.31 | 0.34 | 0.25 | 0.41 | 2.79 | 4.23 | 3.56 | 3.42 | 2.63 | 2.38 | 2.07 | 1.09 | 3.95 | 3.36 | 0.00 | 0.79 | 0.00 | 0.00 |
| Pure Allanite | 2.57 | 5.31 | 3.84 | 2.37 | 1.68 | 1.45 | 1.16 | 0.79 | 0.97 | 0.85 | 2.29 | 1.02 | 0.66 | 0.28 | 0.11 | 0.18 | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Figure 13-62: Allanite by Size Class - Head Mineralogy*



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#### *13.5.4.4.4 Key Results*

The key findings from the General Mineralogy study are as follows:

- The primary REE mineral in the sample is allanite. There are trace amounts of chevkinite/tornebohmite and other REM.
- Median Allanite size is 90um with p80 of 218um
- Allanite best liberated at -106um
- REE highest in the +212um fraction, especially Nd
- REE in -25um is considerably lower even though liberation is higher
- Good allanite liberation break observed at -350um, -100um and -50um
- Allanite accounts for more than 87% to 91% of the total cerium, lanthanum, neodymium, and samarium.
- Allanite is well liberated in the sample at this grind target of a P80 of 196 µm. Liberation of allanite ranges from 72% to 75% in the +212 µm and -212/+106 µm size fractions. The liberation remains at 87% below 106 µm, indicating that additional grinding below 106 µm might not benefit the liberation of the allanite.
- The average chemical composition of the allanite from the EPMA will also be close to a perfect concentrate of the mineral. However, note the presence of ThO2 (0.47%) in the mineral.
- Zircon does not host detectable REE except for Y2O3 (avg. 0.18%).
- It is critical to note that these current results reflect the particular sample tested.

## 13.5.5 University of Kentucky (UK)

### 13.5.5.1 UK Size Density Fractionation Analysis of MT Spiral Material

As a bonus to the MT test work, UK performed a size distribution analysis on the cleaner/scavenger products prepared by MT. This work was performed under the DARPA EMBER project. The preliminary results are provided in this section. UK will finalize the results in the coming weeks.

### 13.5.5.2 Key Results

The key results from the UK size distribution study are as follows:

- UK created two size fractions: -500 x +300um, and -300um x +53um
- UK tested five density ranges: 2.7 float, 2.7x2.9, 2.9x3.1, 3.1x3.4, and 3.4sink using heavy liquid media
- In the 2.7 float, the rougher spiral concentrate contains significant percentage of material at both size fractions.
    - This indicates that liberation is not optimal
- Cleaner spiral concentrate showed very good separation
    - Recycling Cleaner tails in spiral circuit will improve separation

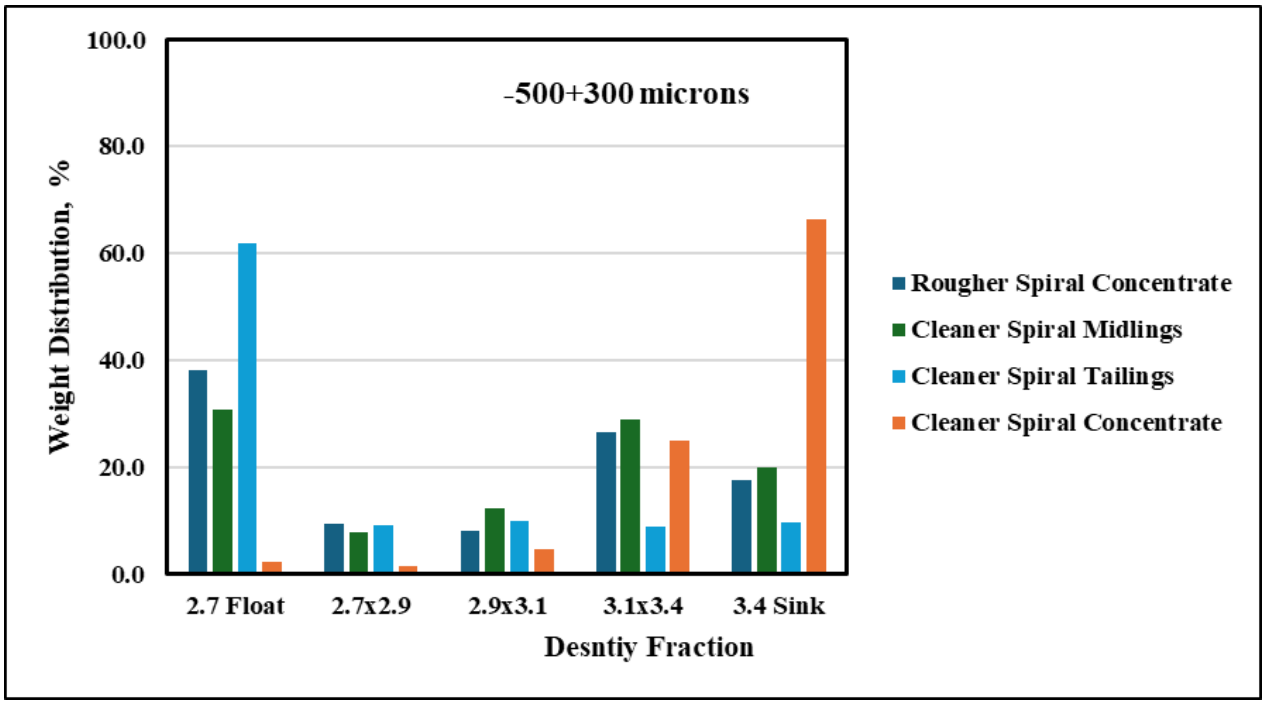


*Figure 13-63: UK Density Fraction Analysis Spiral Product: -500/+300 µm*

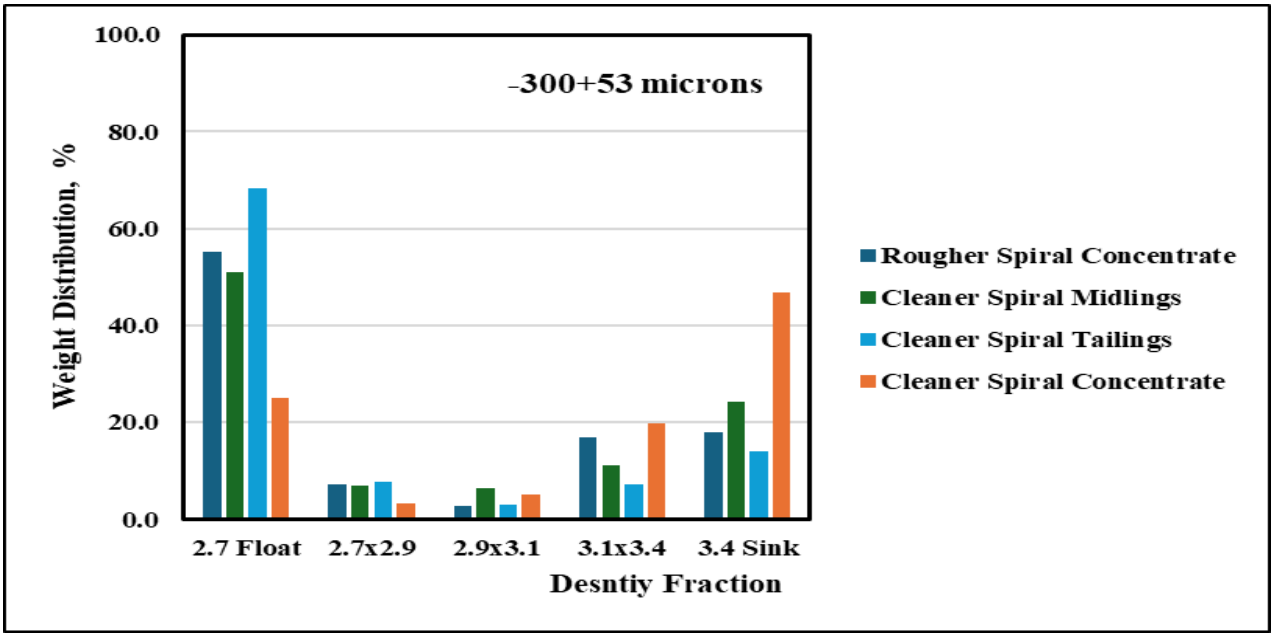


*Figure 13-64: UK Density Fraction Analysis Spiral Product: -300/+53 µm*

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# 13.6 Extraction Testing

## 13.6.1 SGS Extraction Testing

### 13.6.1.1 Overview And Summary:

The completion of a leach testing campaign of Cowboy State Mine ore marks a major milestone for the Wyoming Rare (USA) Inc project. The testing was completed at SGS located in Lakefield, Ontario, Canada. All testing in this current campaign was conducted using sulfuric acid as the lixiviant (leaching agent). Previous testing completed at Nagrom under the direction of Wood, University of Kentucky and Virginia Tech established that sulfuric acid was the ideal lixiviant when optimizing for recovery, reagent cost, and shipping/logistics.

The following leaching types and arrangements were tested:

- Atmospheric Tank Leach
- Acid Bake and Water Leach
- Counter-Current Leach

The Atmospheric Tank Leach was chosen as the preferred arrangement with the following operating conditions providing the best revenue minus raw material cost. Capital cost was also considered and future tradeoff studies should be considered to further study the case for Counter-Current Leaching.

Table 13-55 provides the selected atmospheric leach conditions for AL16. This run best represents the feed to the leaching circuit in the future plant operations. AL16 is composed of 80% Unaltered Concentrate that was created by gravity spiral separation followed by Induced Roll Magnetic Separation (IRMS), and 20% of fines created during comminution and then concentrated using Wet High Intensity Magnetic Separation (WHIMS). The combined feed was then processed through a regrind step for 100% passing 270 mesh (53 µm).

AL22 pregnant leach solution was used as the feedstock for many of the downstream impurity removal testing runs since it was about ten times larger in size than AL16.

*Table 13-55: Atmospheric Tank Leach Conditions and Results*

| Leach Condition | AL7 | AL12 | AL16 | AL22 | AL23 | AL24 |
|---|---|---|---|---|---|---|
| Feed | 100% Unaltered Concentrate | 100% Unaltered Concentrate | 80% Unaltered Conc, 20% WHIMS of Fines Conc | T1313 + WHIMS Bulk Conc Isamill Pail 1 | T1313 + WHIMS Bulk Conc Isamill Pail 1 | T1313 + WHIMS Bulk Conc Isamill Pail 1 |
| Regrind Particle Size | -53 µm | -53 µm | -53 µm | -53 µm | -53 µm | -53 µm |
| Acid Dosage | 400 kg/t | 400 kg/t | 400 kg/t | 400 kg/t | 400 kg/t | 400 kg/t |
| Retention Time | 12 hrs | 8 hrs | 8 hrs | 8 hrs | 6 hrs | 4 hrs |
| Temperature | 90°C | 90°C | 90°C | 90°C | 90°C | 90°C |
| % Solids | 10% | 15% | 10% | 15% | 15% | 15% |

| Leach Condition | AL7 | AL12 | AL16 | AL22 | AL23 | AL24 |
|---|---|---|---|---|---|---|
| **Leach Result** | | | | | | |
| La Extraction | 94% | 95% | 88% | 94% | 94% | 91% |
| Pr Extraction | 88% | 91% | 85% | 91% | 91% | 88% |
| Nd Extraction | 90% | 89% | 84% | 89% | 88% | 85% |
| Tb Extraction | 57% | 52% | 52% | 53% | 54% | 51% |
| Dy Extraction | 51% | 50% | 46% | 47% | 46% | 44% |
| Fe Extraction | 21% | 20% | 18% | 22% | 22% | 21% |
| Al Extraction | 26% | 23% | 23% | 25% | 25% | 24% |
| Mg Extraction | 31% | 34% | 28% | 33% | 35% | 36% |
| Ca Extraction | 22% | 11% | 20% | 16% | 12% | 12% |
| Final Acidity | 20 g/L | 33 g/L | 20 g/L | 30 g/L | 35 g/L | 32 g/L |

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*Table 13-56: Head Grade of Concentrates used in Leach Testing*

| | Unit | Unaltered Mag (T1303) (-270 mesh) | Altered Mag (T2303) (-270 mesh) | Comm Fines UC1-Mag WHIMS |
|---|---|---|---|---|
| La | ppm | 5,210 | 4,960 | 2,380 |
| Ce | ppm | 10,500 | 10,000 | 4,890 |
| Pr | ppm | 1,120 | 1,070 | 562 |
| Nd | ppm | 4,220 | 4,060 | 2,130 |
| Sm | ppm | 605 | 585 | 348 |
| Eu | ppm | 34.5 | 33 | 24.7 |
| Gd | ppm | 358 | 357 | 225 |
| Tb | ppm | 40.3 | 40.5 | 28.8 |
| Dy | ppm | 197 | 200 | 147 |
| Ho | ppm | 31.7 | 32.7 | 27.4 |
| Y | ppm | 701 | 759 | 609 |
| Er | ppm | 78.4 | 81.6 | 63 |
| Tm | ppm | 9.59 | 10.3 | 8.5 |
| Yb | ppm | 62.6 | 66.2 | 53.2 |
| Lu | ppm | 9.1 | 9.8 | 8 |
| Sc | ppm | <30 | 30 | - |
| Th | ppm | 473 | 466 | 201 |
| U | ppm | 24 | 22 | 15.5 |
| Si | % | 18.9 | 18.6 | 20.0 |
| Al | % | 4.84 | 4.77 | 5.29 |
| Fe | % | 21.3 | 21.47 | 20.4 |
| Mg | % | 0.21 | 0.44 | 0.28 |
| Ca | % | 6.67 | 6.32 | 5.82 |
| Na | % | 1.19 | 1.13 | 1.38 |
| K | % | 1.26 | 1.17 | 1.84 |
| Ti | % | 1.52 | 1.73 | 1.11 |
| P | % | 0.04 | 0.03 | 0.06 |
| Mn | % | 0.56 | 0.6 | 0.5 |
| Zn | % | 0.08 | 0.09 | - |

Note: Rare Earths are on elemental basis

## Leachate Concentration Comparison Against Wood WHIMS Conc:

Table 13-57 provides a comparative analysis for the difference in leachate concentrate for the major impurity elements for the Scoping Study concentrate with the current concentrate. The Pre-Feasibility study concentrate was generated using WHIMS only while the current concentrate was produced using gravity spiral followed by IRMS. The Pre-Feasibility study sulfuric acid tank leach test was performed at 250 kg/t and a 6 hr reaction time while the current spiral/IRMS concentrate was tested at 400 kg/t and a 12 hr reaction time. The Pre-Feasibility study WHIMS concentrate has a much higher concentration of Fe (400% higher) and Al (188% higher). It is theorized that the gravity spiral step removed some of the Fe and Al containing heavy minerals and the IRMS was able to separate out the highly magnetic minerals such as hematite and magnetite. These minerals were readily leached in the sulfuric acid tank leach tests resulting

in much higher impurity concentrations in the leachate. Impurity removal steps downstream should use less reagent and achieve lower concentrations.

*Table 13-57: Leachate Concentration Comparison*

| | Unit | SGS Spiral/IRMS Conc (AL16) | Scoping Study WHIMS Conc | % Change |
|---|---|---|---|---|
| Si | mg/L | 1,250 | 3,627 | 190% |
| Al | mg/L | 1,300 | 3,748 | 188% |
| Fe | mg/L | 4,450 | 22,230 | 400% |
| Mg | mg/L | 74 | 210 | 184% |
| Ca | mg/L | 1,670 | 1,495 | -10% |
| Na | mg/L | 92 | 292 | 217% |
| K | mg/L | 158 | 510 | 223% |
| Ti | mg/L | 231 | 562 | 143% |
| P | mg/L | 45 | 190 | 322% |
| Mn | mg/L | 111 | 541 | 387% |
| Zn | mg/L | 19 | 101 | 432% |

#### 13.6.1.2 Atmospheric Tank Leach Testing:

The following parameters and test ranges were evaluated during the Atmospheric Tank Leach testing:

- Acid Addition (kg sulfuric acid/ton of concentrate) – 250, 325, 400, 600 and 800
- Both ore types altered and unaltered weatherization, as well as a magnetic concentrate of the fines material (<86 micron) were tested individually and as a blend.
- % Solids – 10%, 15% and 20%
- Retention Time (hrs) – 4, 6, 8, 12, 24 with kinetic sampling
- Solids Particle Size (microns) – Concentrate from Gravity Spiral/dry magnet separation -300/+86 micron, as well as concentrate material ground to 100% passing 53 micron, and 100% passing 44 micron.
- Temperature (°C) – 40 and 90
- Single run to test an addition of hydrogen peroxide to create an oxidizing environment

The acid addition was the most tested parameter due to the initial acid addition having a direct impact on the Rare Earth Element (REE) extraction, gangue (impurity) extraction, terminal acidity (leftover acid), sales/revenue, acid and neutralizing agent usage. Multiple scenarios were run through our high-level material balance to calculate a simplified “profit” (Sales Revenue – Raw Material Cost). An acid dose of 400 kg/ton was deemed to be the optimal.

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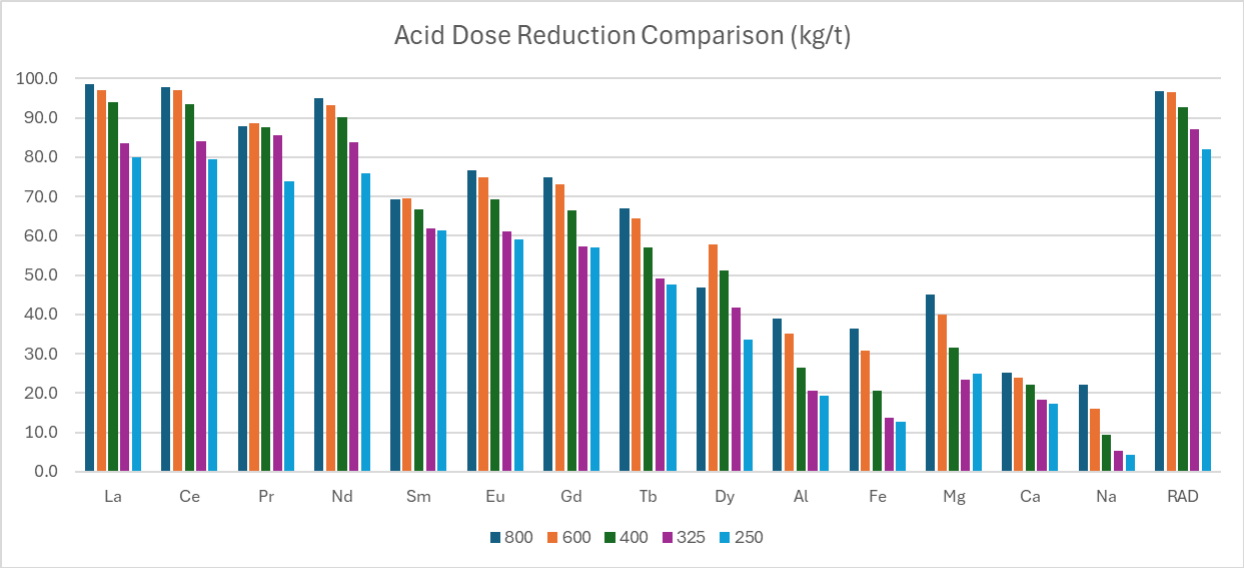


*Figure 13-65: Acid Dose Reduction Chart*

Figure 13-66 provides an economic analysis which indicates that there maybe be some economical benefits in higher acid dosage cases which is due to the increase market prices of rare earth products. Initially we found the highest leach recovery were not the most economical, however market changes justify looking into this further. The REE leach recoveries were entered into a high level mass balance to calculate the Revenue or Sales and compared to the Raw Material cost for sulfuric acid and the neutralization chemicals. The neutralization chemicals were taken into account as the residual acid will need to be neutralized; and the iron and aluminum will need to be precipitated as these are present in higher levels when a high acid dosage setting is used.

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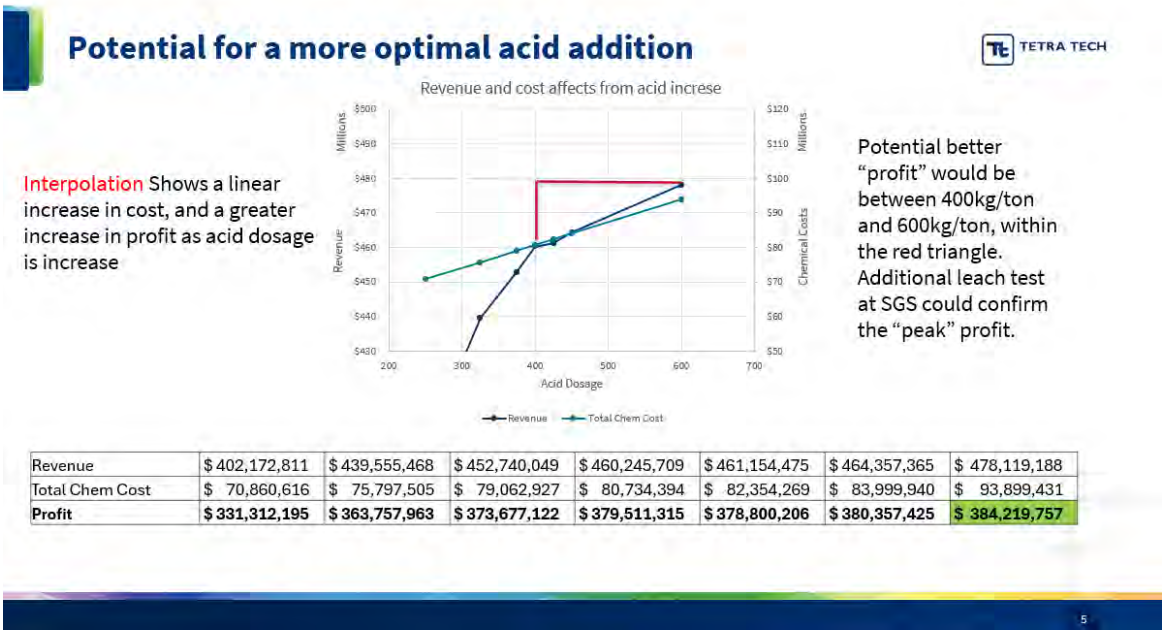


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Revenue | $ 402,172,811 | $ 439,555,468 | $ 452,740,049 | $ 460,245,709 | $ 461,154,475 | $ 464,357,365 | $ 478,119,188 |
| Total Chem Cost | $ 70,860,616 | $ 75,797,505 | $ 79,062,927 | $ 80,734,394 | $ 82,354,269 | $ 83,999,940 | $ 93,899,431 |
| **Profit** | **$ 331,312,195** | **$ 363,757,963** | **$ 373,677,122** | **$ 379,511,315** | **$ 378,800,206** | **$ 380,357,425** | **$ 384,219,757** |

*Figure 13-66: Economic Analysis*

Unaltered (AL6) and Altered (weathered) ore (AL14) were tested separately at a 600 kg/t acid dosage to check for detrimental impacts of the Altered ore which forms the top 10-12 ft of the deposit and ~10% of the mine plan material. The Altered ore shows slightly lower recovery than the Unaltered ore. The magnesium (Mg) leach extraction was ~15% higher from Altered ore vs. Unaltered. It is theorized that the Altered material is more oxidized which leads to lower extraction in the leach.

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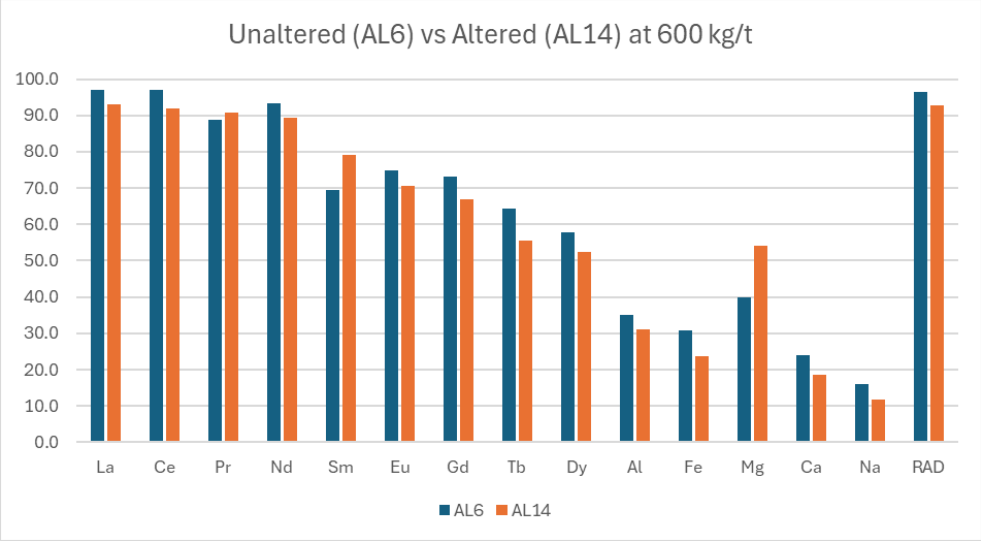


*Figure 13-67: Comparison of Acid Treated Unaltered and Altered Ore*

AL17 was compared to AL7. A leach test (AL17) was performed on the fines (<86 micron) fraction that was treated to form a concentrate using Wet High Intensity Magnetic Separator (WHIMS). The fines fraction is too small to be processed through the gravity spirals and Induced Roll Magnetic Separator (IRMS) that was used to form the bulk concentrate in the Concentration Circuit (AL7). Nd extraction was lower for the fines concentrate, 84.0% (AL17) vs. 90.2% (AL7), as well as Dy extraction being lower, 36.3% (AL7) vs. 51.1% (AL17).

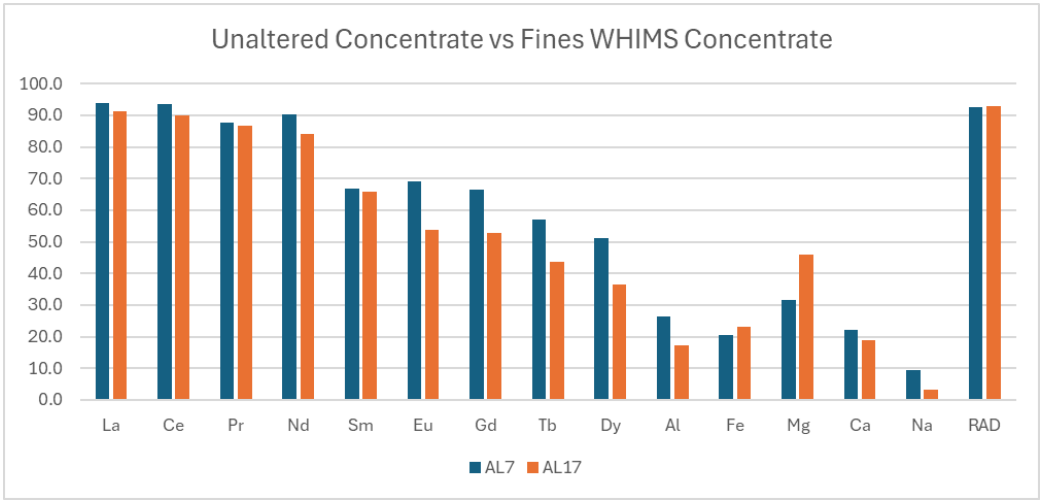


*Figure 13-68: Fines Leach Test Results*

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The percent solids was increased over the initial setting of 10% to 15% and 20% to evaluate the effect upon extraction. Running at a higher percent solids also result in creating a liquid that is more acidic due to less water being added to the slurry. This effect did not increase the extraction nor did the higher percent solids detrimentally effect the solubility of the REE or the gangue elements due to being well below the solubility limit. There was a notable exception with Ca which experienced lower extraction at both 15% and 20% solids due to it being a saturated solution.

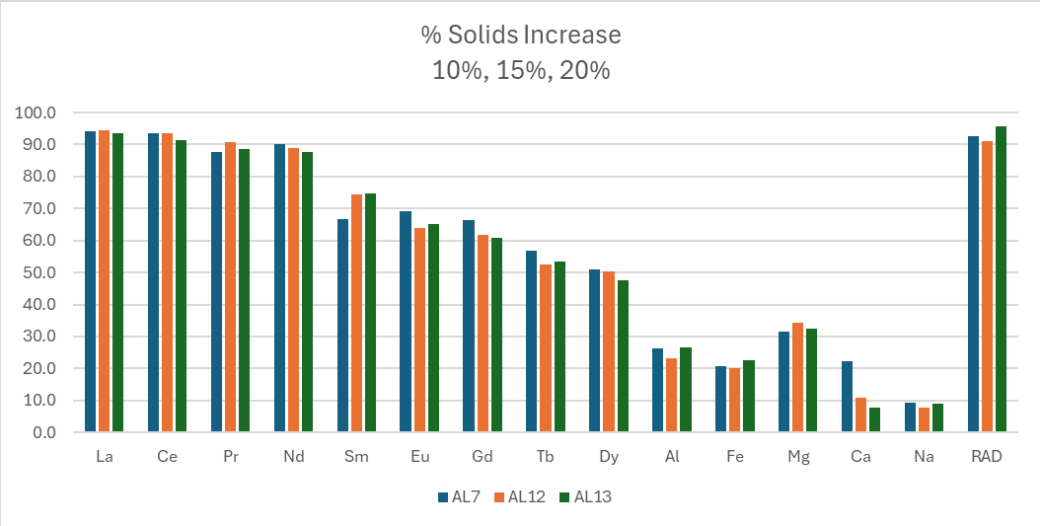


*Figure 13-69: Results for Testing % Solids in Leaching*

Reaction time (residence time) was run at 24 hrs for the first two tests on unaltered and altered ore material while maintaining 50g/L acidity during the entire run. Samples were taken over time to show the kinetic changes and therefore extraction levels in the reaction. Figure 13-69 and Figure 13-70 for AL2 show the Nd and Dy reaction rate for the REE starts to flatten at 8 hrs where the Fe and Al show no slowing or flattening of the curve, most likely due to an abundance of exposed Fe and Al grains to react with the acid whereas the number of exposed REE grains decreases.

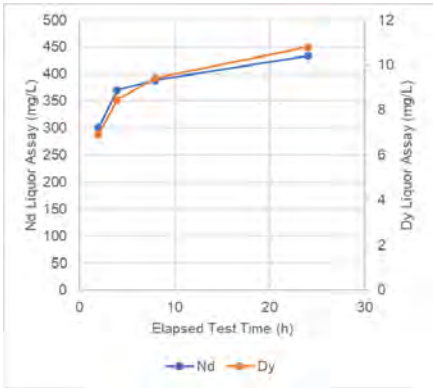


*Figure 13-70: Reaction Time for REE*

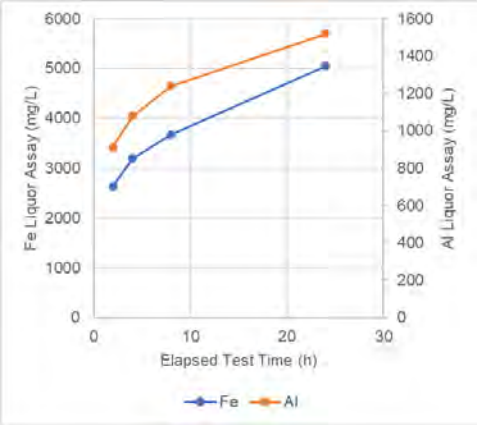


*Figure 13-71: Reaction Time for Fe and Al*

The filtration rate at the end of the reaction was very poor for the 24 hr. reaction time tests. A subsequent rection (AL4) was run for 8 hrs. along with a regrind of the concentrate to 100% passing 53 micron. The filtration was much improved at these settings which concludes that it was not the particle size causing slow filtration but more likely gypsum or silica gel formation created during the long reaction time. The best filtration was experienced at shorter reaction times and lower acid dosage levels, therefore, it is believed that this reaction can be “overdone” either in time or acid dosage leading to detrimental effects. During the filter cake wash, it was observed that there were a small amount of rare earth compounds precipitated as either “co-precipitation” in the gypsum or as a rare earth double salt sulfate. The cake wash increases recovery due to re-dissolving the rare earth compounds in the filter cake. The precipitated REE compounds in the filter cake will require a very effective cake wash which will be recycled back to leach to eliminate a yield loss to the leach residue cake.

Reaction AL1 was run on Unaltered material with a particle size of -300/+86 micron with acidity maintained at 50g/L throughout the reaction to simulate an excess of acid. AL4 was a duplicate to AL1 but the ore was subjected to a regrind of 100% passing 270 mesh (53 micron) to test the effect of particle size on reaction rate. The marked increase in Nd and Dy concentration in the leachate can be seen in the curves in Figure . Al and Fe also increase at an even higher rate due to increased surface area. Note that the reaction time in AL4 was shortened to 8 hrs to improve the filtration rate as previously discussed.

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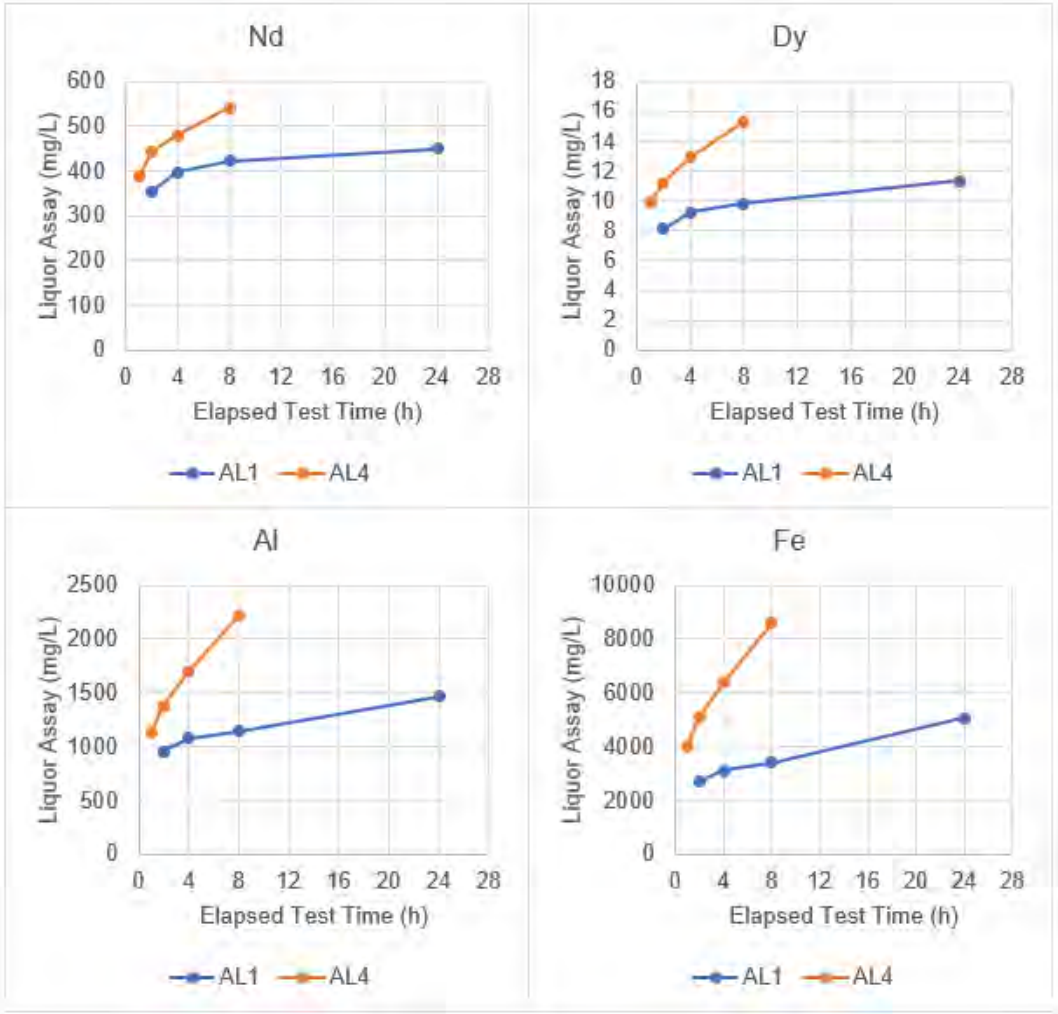


*Figure 13-72: Effect of Particle Size on Reaction Rate*

A test was conducted at a regrind size of 100% passing 325 mesh (44 microns) to evaluate if further improvements would be observed from a finer grind than the 100% passing 270 mesh (53 micron). A finer grind did not provide improvements to the REE extraction; in fact, it had an adverse effect as depicted in Figure .

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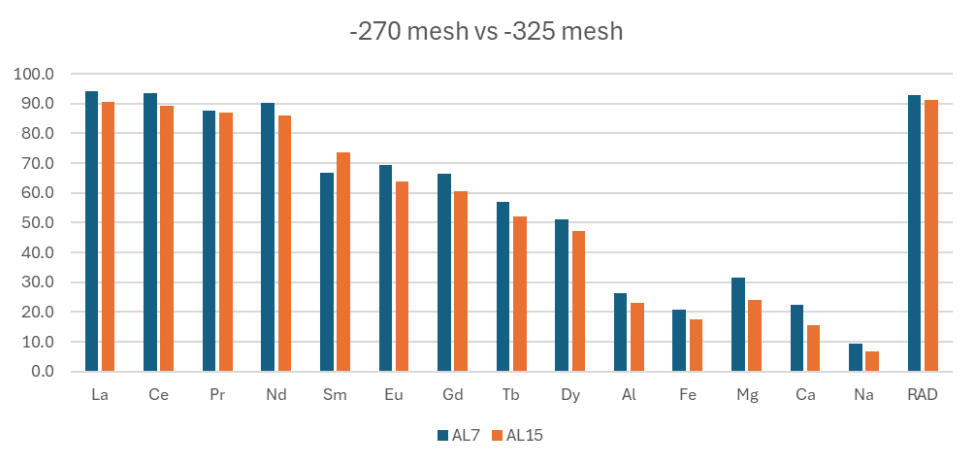


*Figure 13-73: Particle Size Impact on REE Extraction*

Based upon experience, previous allanite testing by SGS and technical reports, the temperature was initially set at 90°C. A trial test was run at 40°C to determine limits. It was determined the upper limit should be 90°C which is below the boiling point of water. With an upper limit set to 90°C and the process condition set to atmospheric pressure, it prevents water boiling in the slurry.

A single test was conducted to test the effect of adding hydrogen peroxide to the leach reaction which was shown to increase heavy rare earth recovery in an external technical report. The hydrogen peroxide was added at 2.0% v/v% relative to net acid/water volume. There was no beneficial impact to the REE extractions, Nd recovery went from 90.2% (AL7) to 87.9% (AL19) and Dy extraction went from 51.1% (AL7) to 46.1% (AL19).

### 13.6.1.3 Acid Bake and Water Leach Testing

A sulfuric acid bake consists of adding concentrated sulfuric acid (96+%) to the solid concentrate, mixing and then baking at high temperature. Since no water is added, this material will resemble a “dough” rather than a slurry in the atmospheric leach tests. The acid bake converts target rare earths and gangue elements to a metal sulfate which is then leached with water to dissolve. Five acid bake/water leach tests were run. Acid bake tests were conducted at 225°C for 4 hrs with the exception of WL-AB4. Based on experience and external technical reports, WL-AB4 was conducted at 300°C. All water leach tests were conducted at 90°C These tests were conducted at atmospheric pressure and below the liquid (sulfuric acid and water) boiling points to prevent vaporization of the chemicals.

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*Table 13-58: Testing Parameters*

| Test Paramters | | | | |
|---|---|---|---|---|
| Feed | WL-AB1 Unaltered -300/+86 µm | WL-AB2 Altered 300/+86 µm | WL-AB3 Unaltered 300/+86 µm | WL-AB4 Unaltered 300/+86 µm |
| Acid Addition (kg/t) | 749 | 749 | 817 | 816 |
| Bake Temp (°C) | 225 | 225 | 225 | 300 |
| Bake Time (hrs) | 4 | 4 | 4 | 4 |
| WL Temp (°C) | 90 | 90 | 90 | 90 |

Atmospheric Leaching run AL7 is shown for comparison which was run at 400 kg/t of acid. When AL7 is compared to WL-AB5 (which were both performed at 400 kg/t acid addition), it is noted that the acid bake offers no benefit in acid consumption nor REE Extraction and that it extracts more Al, Fe and Mg. Experience and external technical reports indicated that acid bake/water leach resulted in higher REE extraction than simple tank leaches especially the heavy rare earths but that was not the case with this ore. Additionally, the equipment for acid bake is more costly, complicated and experiences more corrosion/ erosion wear than the comparable atmospheric leach equipment. As a result, no further acid bake testing was conducted.

Note that WL-AB4 is not shown in Figure for simplicity. Due to the higher bake temperature, it experienced 27% weight loss (sulfuric acid boiled off) and resulted in the lowest REE extractions (Nd 71% and Dy 35%).

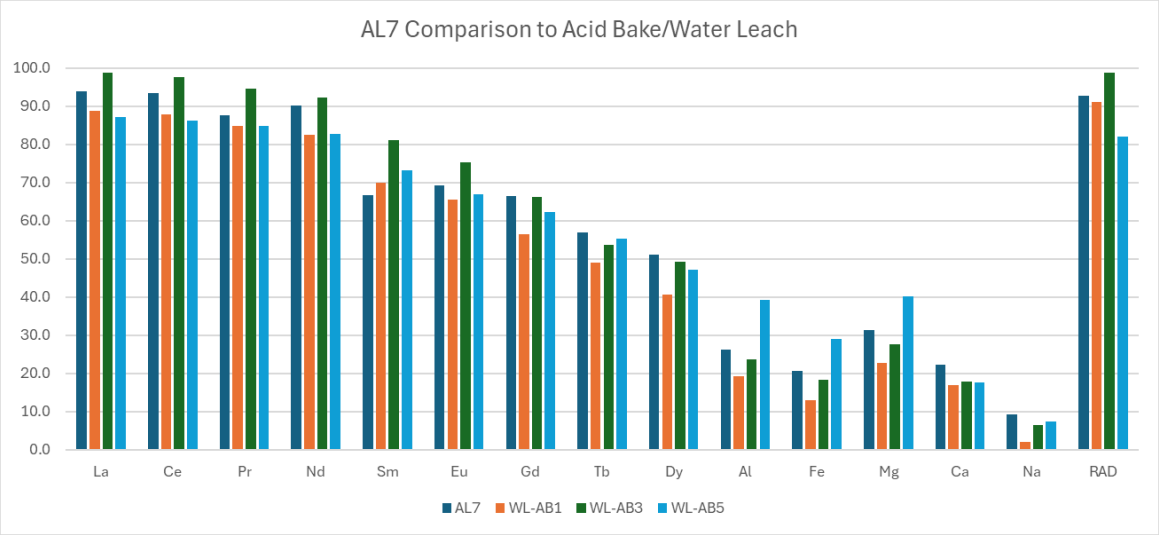


*Figure 13-74: Acid Bake and Water Leach Test Results*

### 13.6.1.4 Counter Current Leach Testing

The final type of leaching that was tested is referred to as counter-current leaching. This type of leaching refers to a system where the solids travel opposite to the liquid, hence the name counter-current as where the atmospheric tank leach operates in a co-current orientation. The counter-current orientation introduces the fresh acid at its highest concentration to the solids which have already been pre-leached by the spent leach liquor as a recycle stream. Theoretically contacting the solids which have not reacted with the strongest acid will result in higher recoveries. The other positive is that typically the ending acidity of the Pregnant Leach Solution (PLS) is lower than in an atmospheric tank leach.

Figure illustrates the addition points and flow of the solid versus the liquid. Abbreviations are as follows: Solid Liquid separation(S/L), Pre-Leach (PL), Acid Leach (AL).

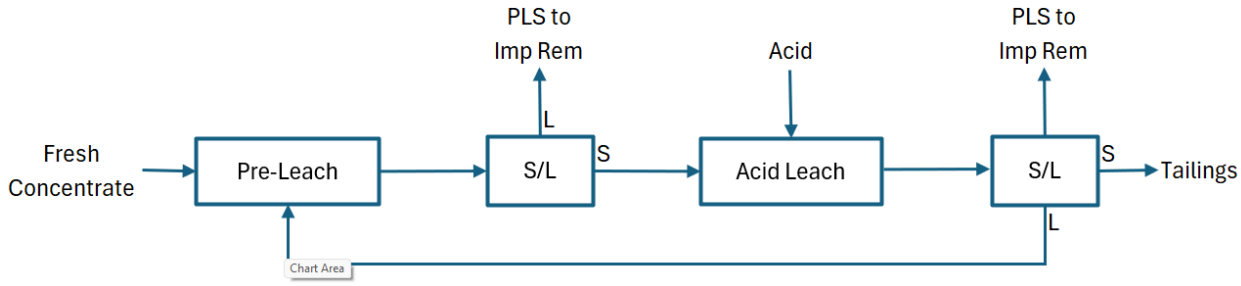


*Figure 13-75: Counter Current Leach Simplified Block Flow Diagram*

Atmospheric Leaching run No.7 is shown for comparison which was run at 400 kg/t of acid. The counter-current run, PL1/AL10 was run at 677 kg/t acid addition and PL2/AL11 was run at 433 kg/t of acid addition.

The Nd recovery is very comparable between AL7 and PL2/AL11. Heavy rare earth recoveries show slightly higher extractions in PL2/AL11 keeping in mind that the counter-current leach had 33 kg/t higher acid dosage. PL1/AL10 shows the highest heavy rare earth recovery but that is due to a much higher acid dosage of 677 kg/t. The counter-current runs show higher Al, Fe, Mg and Na which is a result of contacting spent solids with fresh acid in the acid leach step.

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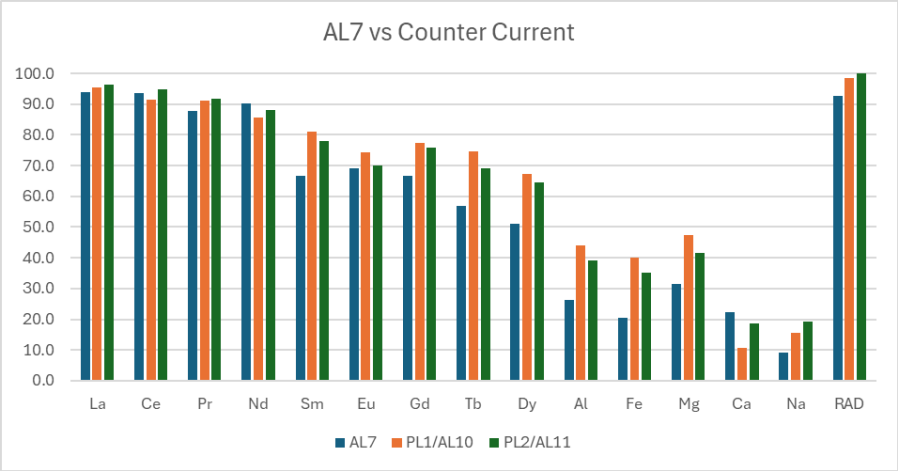


*Figure 13-76: Comparison of Acid Leach and Counter Current*

The disadvantages of a counter-current leach are listed below which will result in essentially doubling the capital cost of the leach equipment

- Filtration must be performed twice as compared to once in a simple tank leach. The filtration step is the likely the largest in the whole flowsheet and is the highest acidity (corrosion) and will have high erosion as well.
- The Acid Leach and Pre Leach are equivalent to two atmospheric acid leach circuits
- Quantities of Pumps, pipes, valves, controls and more will increase

These disadvantages result in essentially building two atmospheric tank leach circuits and will lead to an increase in capital costs in the range of US$15-20MM.

The counter-current leach is a continuous process that recycles all the leach liquor and filter washes back to the Pre Leach which makes testing and modeling using batch tests very difficult. In future studies, the counter-current leach could be modeled in a small pilot plant on a continuous basis and allow a tradeoff study to properly evaluate if the improved extraction is worth the large increase in the capital costs.

# 13.7 Impurity Removal Testing

## 13.7.1 Primary Neutralization (Fe/Th Removal)

The Pregnant Leach Solution (PLS) after Leach Residue Filtration is sent to the Primary Neutralization step where hydrogen peroxide is added to increase the ORP value to ~600mV to oxidize iron from ferrous ($Fe^{2+}$) to ferric ($Fe^{3+}$) allowing for precipitation at a pH of 3.15 as compared to a pH of ~8 without oxidation. Neutralizing agent is added to the PLS to neutralize the sulfuric acid (30 g/L free acidity) to a pH of ~3.15. The increase in pH results in precipitation of iron and thorium along with a portion of aluminum and uranium.

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Scoping tests were performed with three different pairs of neutralizing agents: magnesium, sodium, and calcium. Sodium hydroxide (NaOH) was added over the pH range of 2.5 – 4.5. The results indicate Nd precipitated and the loss was over 90%. Dy precipitation ranged from 26%-68% over the pH test range. See Figure for test results.

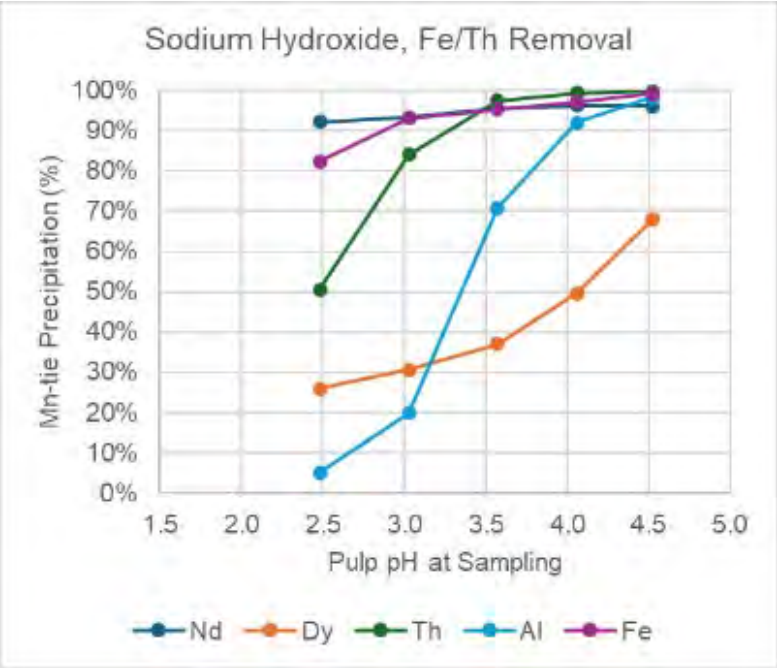


*Figure 13-77: Sodium Hydroxide Test Results*

Soda Ash ($Na_2CO_3$) was also used with very similar results as shown in Figure 13-78. The iron and thorium removal were high but the near complete loss of REE's rules out the sodium neutralization agents. The REE precipitation is a result of double salt formation ($REENa(SO_4)_2*xH_2O$).

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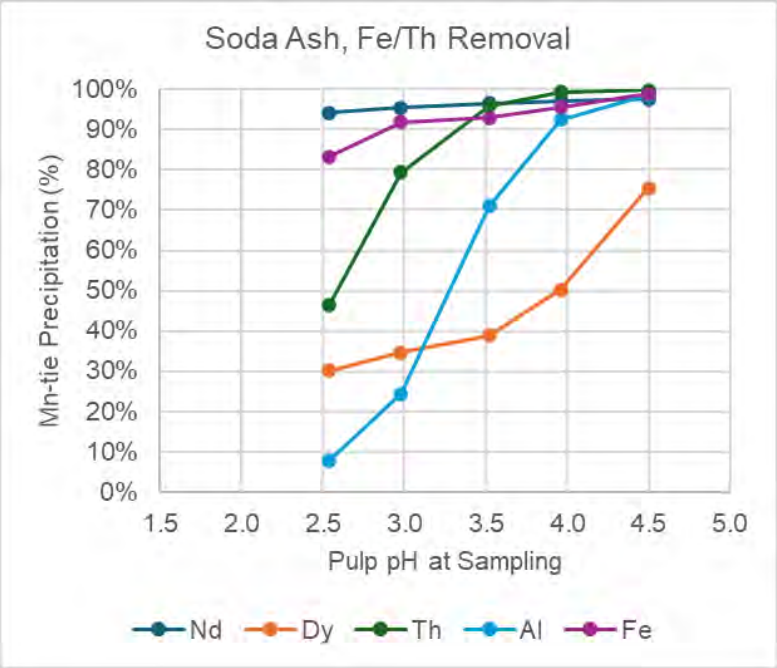


*Figure 13-78: Soda Ash Test Results*

The calcium neutralizing agents, Lime (CaO) and Limestone ($CaCO_3$), also resulted in unacceptable REE precipitation losses due to gypsum (CaSO4) formation and co-precipitation of the REE's. Fe/Th removal were near complete with Al removal increasing across the pH range.

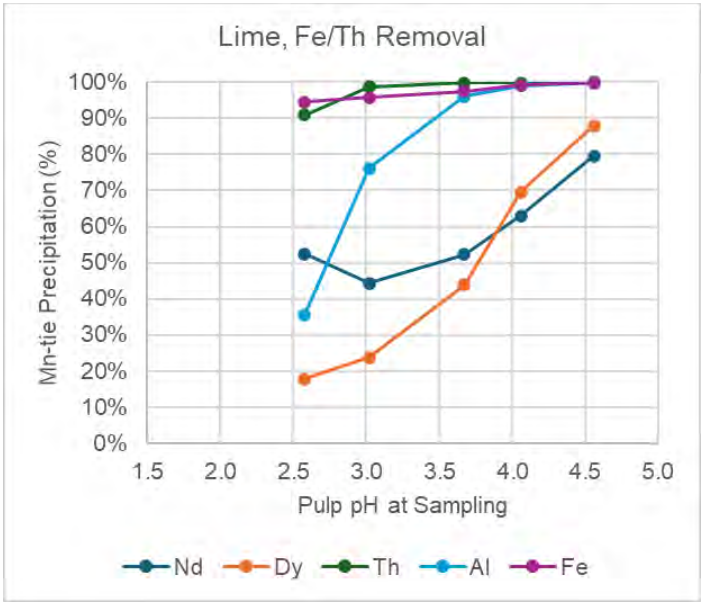


*Figure 13-79: Lime Test Results*

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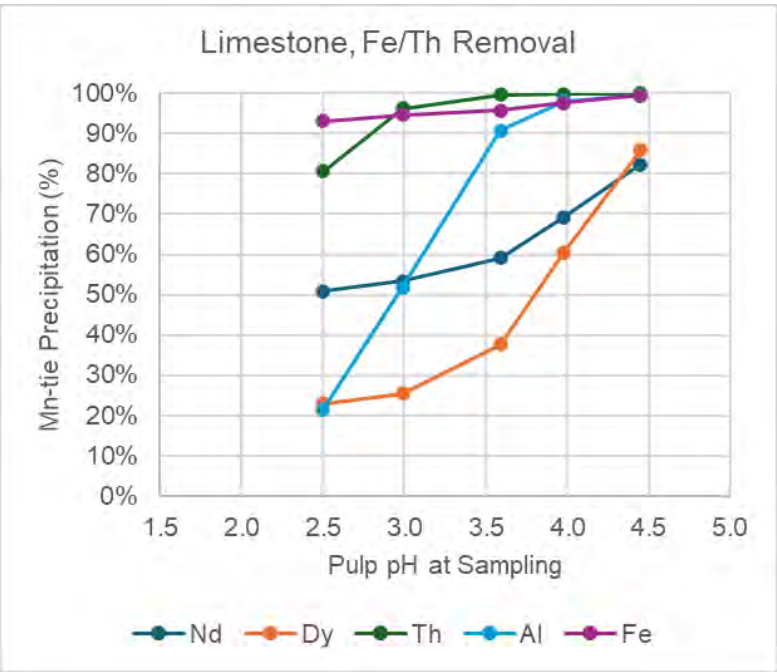


*Figure 13-80: Limestone Test Results*

The magnesium neutralizing agents, Magnesium Oxide (MgO) and Magnesium Carbonate ($MgCO_3$), showed great promise with Nd and Dy precipitation near 10%, removal of Fe near 90% and near complete Th removal at the upper end of the pH range, see Figure 13-80 and Figure 13-81.

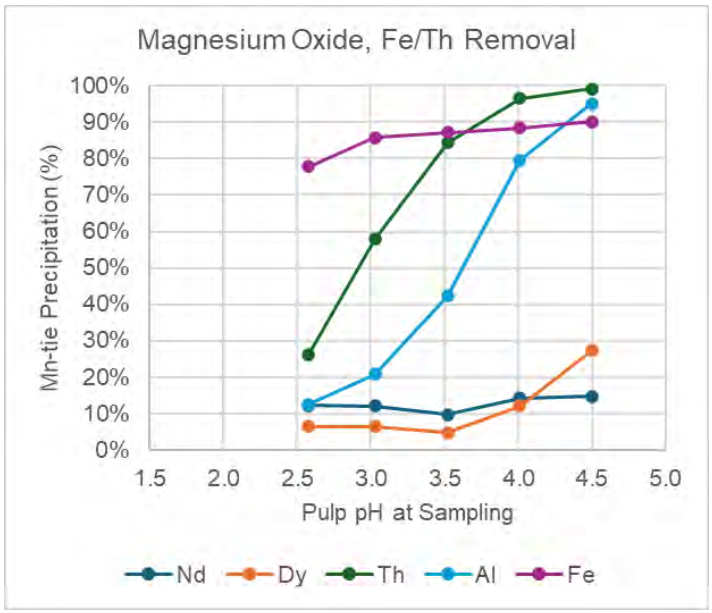


*Figure 13-81: Magnesium Oxide Test Results*

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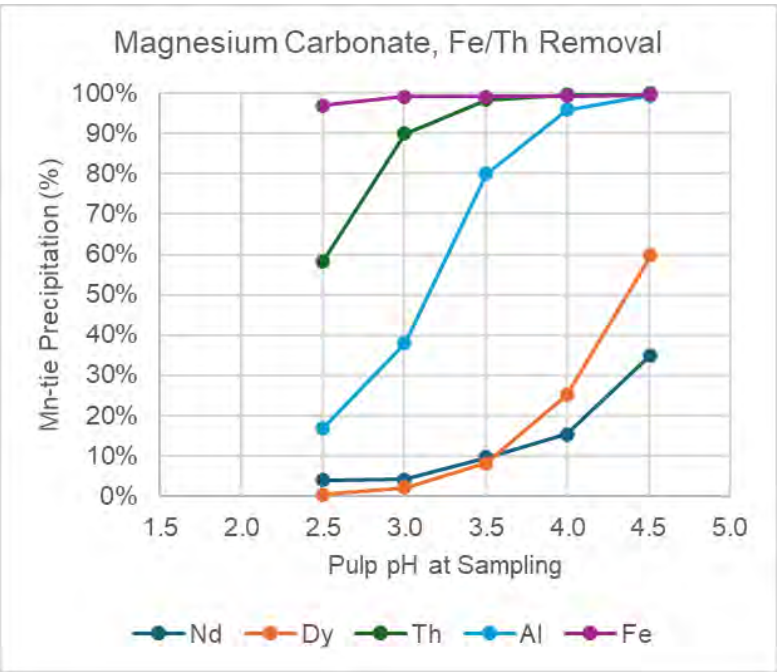


*Figure 13-82: Magnesium Carbonate Test Results*

The sodium and calcium neutralizing agents were eliminated from further testing based on the unacceptable REE losses to the precipitant.

Figure 13-82 through Figure 13-84 provide test result curves showing the performance of each of the neutralizing agents in precipitating Fe, Al and Th. All the neutralizing agents performed well with near complete removal of Fe, Al removal increased over the pH range for all neutralizing agents, and Th removal increased over the pH range with all nearing total removal at pH of 3.5+.

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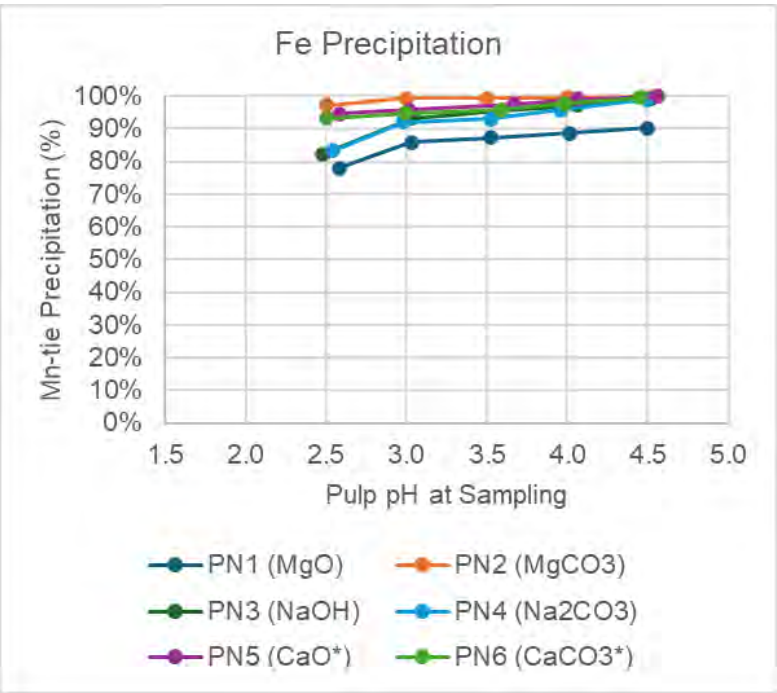


*Figure 13-83: Results of Neutralization Reagents: Fe Precipitation*

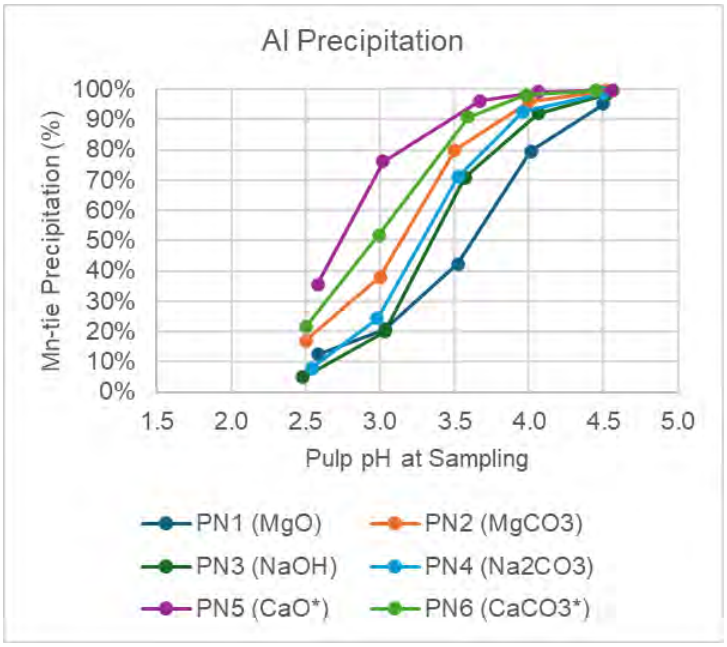


*Figure 13-84: Results of Neutralization Reagents: Al Precipitation*

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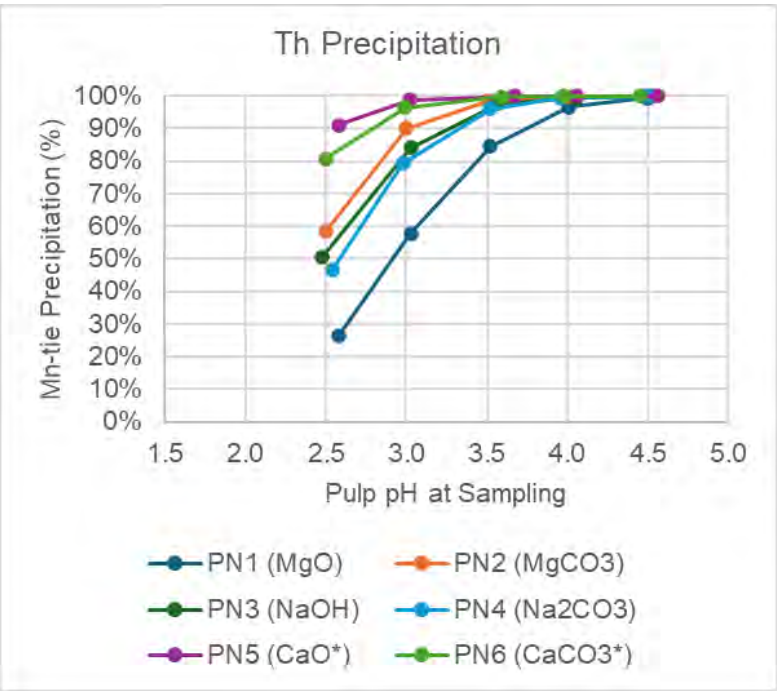


*Figure 13-85: Results of Neutralization Reagents: Th Precipitation*

Figure 13-85 and Figure 13-86 provide test result curves which show Nd and Dy precipitation by neutralizing agent and pH value. The pair of magnesium neutralizing agents show the lowest precipitation (loss) for both Nd and Dy which are used as indicative for the light REE and heavy REE.

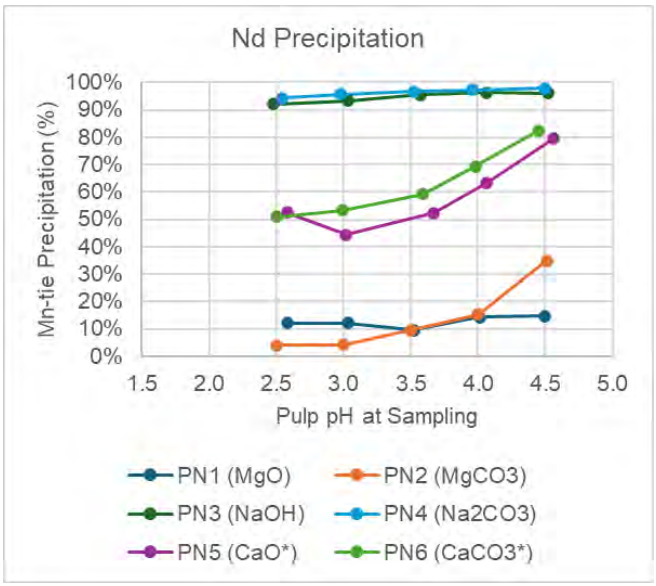


*Figure 13-86: Test Results for Nd Precipitation*

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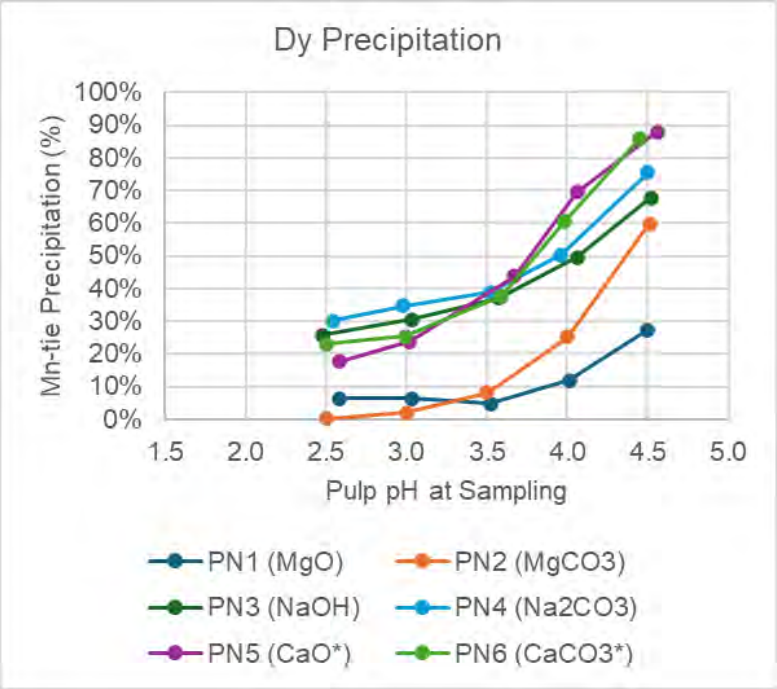


*Figure 13-87: Test Results for Dy Precipitation*

End Point testing was performed on the two magnesium neutralizing agents with a 3.25 pH target, retention time of 2 hrs, 15% reagent strength, and 75°C. The magnesium oxide test required 15 (kg/m3) reagent addition to reach a pH of 3.25 while the magnesium carbonate test required 35 (kg/m3) reagent addition. The MgO test resulted in 0.9% precipitation for Nd and 2.1% precipitation for Dy. The $MgCO_3$ test resulted in 1.0% precipitation for Nd and 2.0% precipitation for Dy. Fe and Th had greater than 90% precipitation. See Table 13-59 for test results.

*Table 13-59: End Point Test Results*

| End Point Test Results | | | | | |
|---|---|---|---|---|---|
| Precipitating Agent | Nd (%) | Dy (%) | Fe (%) | Th (%) | Al (%) |
| MgO | 0.9 | 2.1 | 90.8 | 95.0 | 57.3 |
| $MgCO_3$ | 1.0 | 2.0 | 93.0 | 95.5 | 52.7 |

Based on the usage rates (15 kg/$m^3$ for MgO vs. 35 kg/$m^3$ for MgCO3) and the prices of the reagents, $625/mT for MgO and $525/mT for MgCO3. 35/15 is a ratio of 2.33 times higher usage for the carbonate vs the oxide.
Due to the significantly higher consumption rate of magnesium carbonate, magnesium oxide is more economical. Therefore, MgO will be purchased and slaked on site as compared to buying a pre-slaked magnesium hydroxide suspension due to purchase price differences.

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Three end point tests were performed using MgO at the following pH values: 2.75, 3.0, and 3.25. Figure 13-88: End Point Test Results for MgO at Various pH indicates very low Nd precipitation (1.0%, 0.5% and 0.9% at 2.75, 3.0 and 3.25 pH) and low Dy precipitation (1.1%, 0.9% and 2.1% at 2.75, 3.0, and 3.25 pH). The figure also shows increasing precipitation for Al and Th, plus near total precipitation of Fe, Ti and P.

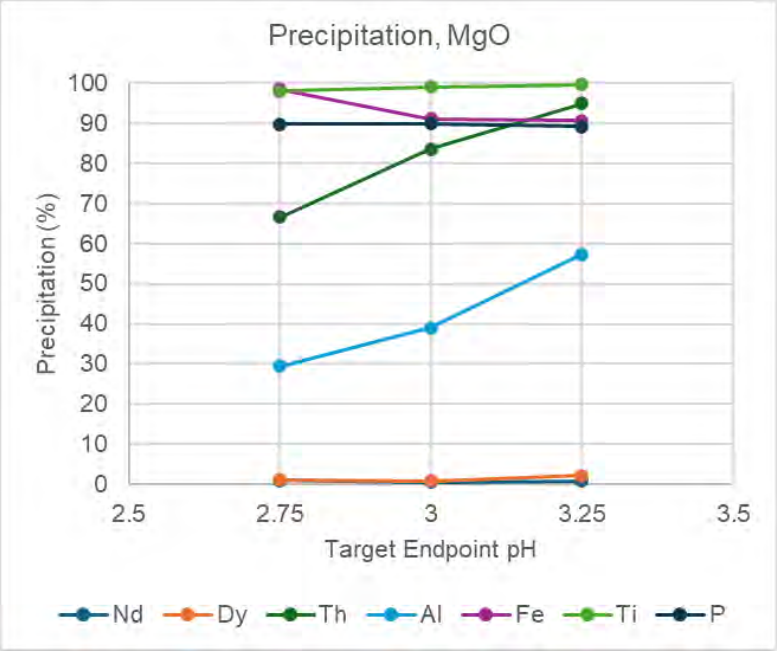


*Figure 13-88: End Point Test Results for MgO at Various pH*

## 13.7.2 Secondary Neutralization (Al/U Removal)

The filtrate from the Primary Neutralization is neutralized further with MgO raising the pH from 3.15 to 5 resulting in aluminum and uranium precipitating and being filtered out. In addition to the aluminum and uranium any remaining iron and thorium not removed in the Primary Neutralization is removed in this step.

The setpoint pH of 5.0 was selected as a balance between aluminum removal and rare earth precipitation and loss. Figure indicates the rare earth precipitation and loss increases very quickly as the pH is increased over 5.0. The removal of Fe, Al and Th reach 100% at a pH of 5.5; however, it should be noted that the absolute quantity of Fe and Th is very small due to the majority being removed in the Primary Neutralization as well as nearly 50% of the Al. Any remaining Fe, Th, Al and U will be subject to removal in downstream processes (Uranium IX and oxalic acid precipitation).

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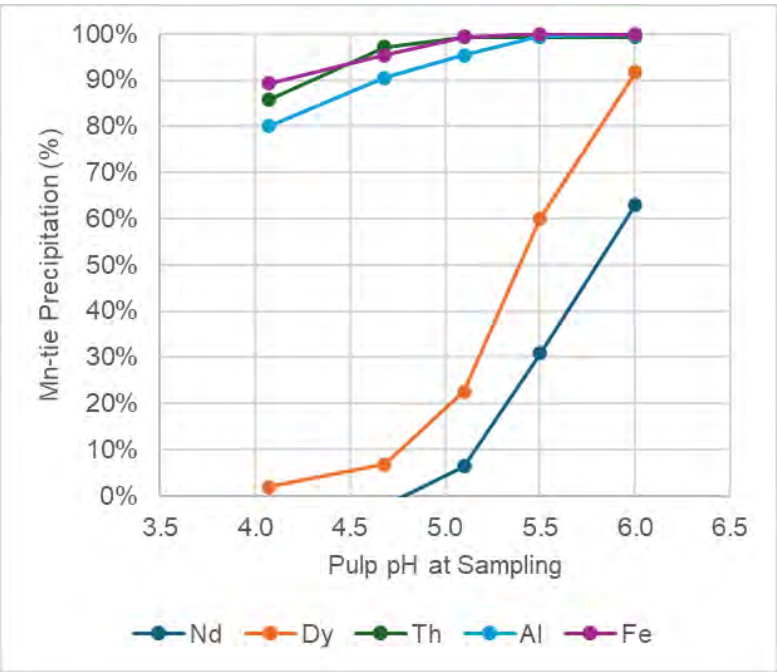


*Figure 13-89: Secondary Neutralization Test Results*

## 13.7.3 Uranium Removal (Uranium Ion-Exchange)

A batch shakeout was performed in the lab with the liquor from the Secondary Neutralization and a specific IX resin (Dowex/Ambersep 21K XLT, quaternary amine) that has an affinity to uranium. The uranium bonds to onto the chemically reactive site of the resin thus removing them from the solution. A stripping solution (sulfuric acid) is used to remove the uranium from the resin.

## 13.7.4 Rare Earth Precipitation (oxalate)

The uranium free solution from the uranium IX process step is treated with a 5% aqueous solution of oxalic acid to precipitate the rare earths as oxalates which are then thickened and filtered. An oxalate precipitation is used because it forms a rare earth oxalate solid at a low pH, other impurities are soluble at this pH so this step acts as an additional impurity removal step, as well as a concentration step.

The rare earth oxalate precipitation reaction is shown below.

$$2RE^{3+} + 3H_2C_2O_4 + 10H_2O \rightarrow RE_2(C_2O_4)_3 \bullet 10H_2O\ (s) + 6H^+$$

Oxalic acid is added at a factor compared to stoichiometric requirement to the rare earth contained. If too much oxalic acid is added, it will form calcium oxalate which will result in contamination of the rare earth oxalate material in addition to higher raw material costs. The charts in Figure 13-89 and Figure 13-90 indicate Rare Earth Precipitation (RP1 and RP2) with RP1 being at 90% oxalic acid stoichiometric dose and



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RP2 was 100% oxalic acid stoichiometric dose and both RP3 and RP4 were both at 110%. The charts also indicate an increasing recovery as the oxalic acid dosage is increased and the precipitation assay shows there was essentially zero Ca precipitation in RP1 and RP2 and increases at the 100% stoichiometric charge in RP3 and RP4.

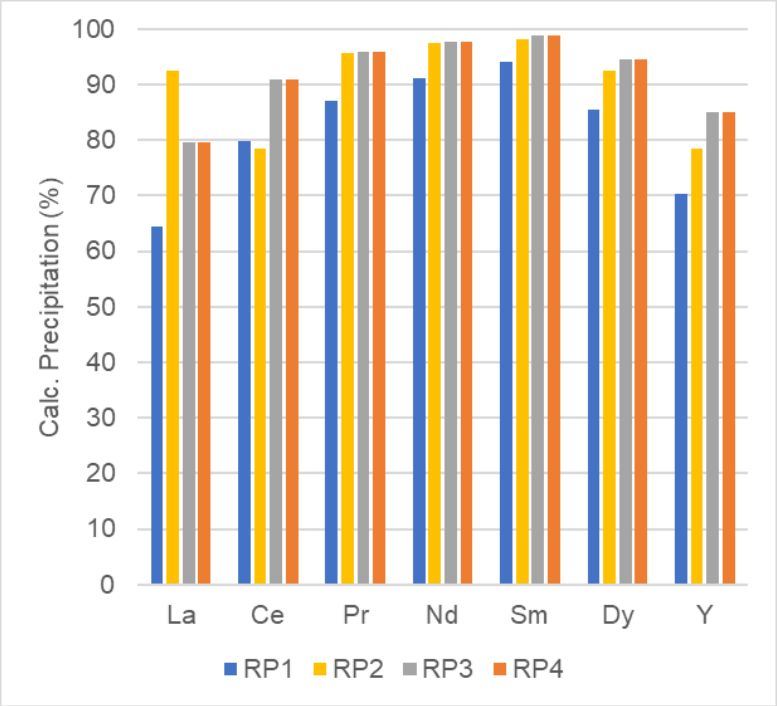


*Figure 13-90: Rare Earth Precipitation*

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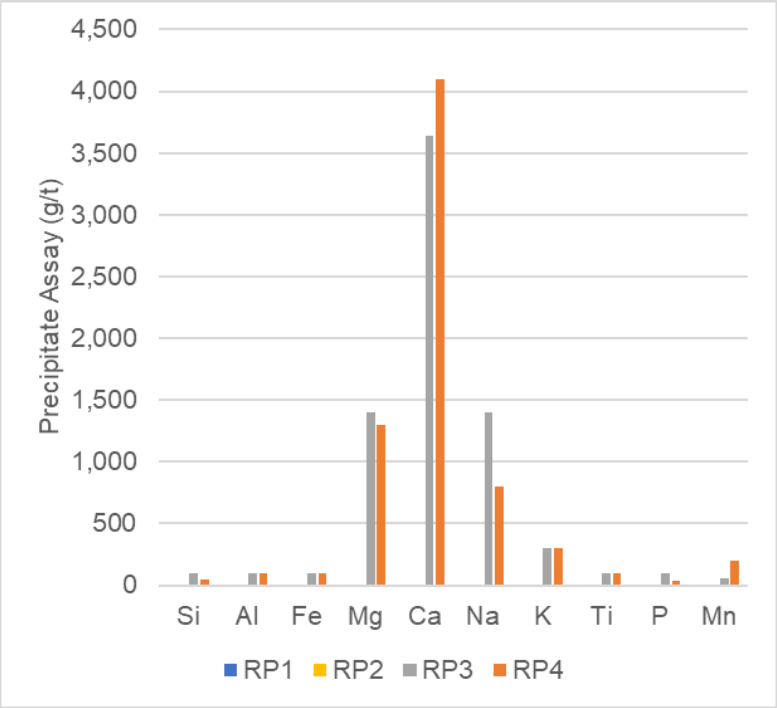


*Figure 13-91: Oxalic Acid Precipitation: Precipitate Assay*

### 13.7.5 Rare Earth Calcination

Calcination of the rare earth oxalate to rare earth oxides was performed in the lab using a simple lab scale muffle furnace at 1000°C. Conversion from oxalate to oxide is necessary to minimize the amount of HCl needed to dissolve the solid, with the insolubility of oxalates at low pH they would require higher doses of HCl to be placed in solution.

### 13.7.6 HCl Re-Leach

The rare earth oxides are dissolved using concentrated HCl in order to prepare a concentrated rare earth solution that will act as the feedstock for the solvent extraction circuits required to produce separated individual rare earth products.

The calcination step also oxidizes cerium (3+) to cerium (4+), rendering it nearly 100% insoluble in the downstream HCl re-leaching step. The insolubility will result in a great majority of the cerium remaining as a solid that will be filtered and disposed of as tailings.

The re-leach of the Rare Earth Precipitation (Rare Earth Oxalates) did not work well in the lab with little dissolution of the rare earth oxides into the HCl solution. The calcined rare earth oxide sample was very small (only 5 grams) which made the testing more difficult. Also, the calcination of such a small sample may have resulted in insoluble cerium oxide coating or containing the other rare earths.

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### 13.7.7 Bulk Solvent Extraction

To avoid precipitation losses bulk solvent extraction was analyzed by L3 Process Development using a METSIM Model. Without any chemical addition the Sulfuric acid solution can be mixed with an organic extractant to transfer 99.9% of the rare earths in into the organic phase. Once in the organic phase the rare earths can be separated and concentrated using an HCl matrix, into individual the desired rare earth products.

## 13.8 Recovery Estimates

The overall recovery of REO material is shown in Table 13-60. The largest yield losses are experienced in Gravity Separation/WHIMS with a 78% overall TREO recovery and Leach with an overall TREO recovery of 85%. The basis of the DMS operation is the University of Kentucky HLS testing, while the basis for the WHIMS recovery is based on testing completed at Nagrom under the supervision of Wood. The basis for the sulfuric acid tank leach recovery is based on testing completed by Nagrom under the supervision of Wood as well as the leach testing completed by Virginia Tech. The 2% TREO yield loss in the Partial Neutralization operation is due to co-precipitation of the rare earth compounds as well as precipitation due to localized high pH in the area of the caustic injection into the tank. In the separation and finishing area there are two mechanisms of yield loss, yield loss due to solvent extraction efficiency (not being able to make two high purity products on the raffinate and strip at the same time) and incomplete precipitation. For instance, the Nd/Pr losses are 2% due to lost Nd/Pr to the raffinate (La stream) and 2% due to an incomplete precipitation. The yield losses downstream of the leach are estimated based on Kelton Smith's rare earth processing experience due to the lack of laboratory testing.

*Table 13-60: Recovery Estimates by Unit Operation*

| **Process Area** | **Individual Recoveries** | **% Recovery (REO Basis)** |
|---|---|---|
| **Concentration** | WHIMS | 58% |
| | RCC | 78% |
| | IRMS | 85% |
| | **Total** | **65%** |
| **Leach** | Nd/Pr | 90% |
| | Tb | 53% |
| | Dy | 46% |
| | SEG | 72% |
| | **Total** | **71%** |
| **Neutralization** | Nd/Pr | 99% |
| | Tb | 98% |
| | Dy | 98% |

| Process Area | Individual Recoveries | % Recovery (REO Basis) |
|---|---|---|
| | SEG | 99% |
| | **Total** | **99%** |
| **Separation and Finishing** | Nd/Pr | 89% |
| | Tb | 97% |
| | Dy | 95% |
| | SEG | 98% |
| | **Total** | **90%** |

Table 13-61 shows the overall recovery of REO material.

*Table 13-61: Element Recovery Estimates by Product*

| | Overall Cumulative Recovery (REO Basis) |
|---|---|
| NdPr Oxide | 58.2% |
| SEG Concentrate | 25.8% |
| Terbium Oxide (Tb) | 28.7% |
| Dysprosium Oxide (Dy) | 12.4% |
| **TOTAL** | **54.6%** |

As noted in conclusions / recommendations, extensive refinery testwork is planned to confirm assumptions around the revised flowsheet – the early leaching tests were WHIMS-based and showed a lower leach recovery for Heavy Rare Earths, since that time the concentration work has improved, and flowsheet modified. Our consultant(s) [metallurgist and chemical engineer] evaluated the dataset during continued design work and opined the results were an analysis error due to the extreme low concentrations of the heavies in the leach solution. The heavy rare earths are believed to be coming from allanite, and as such all the REE will have the same chemical makeup and should behave the same.

## 13.9 Metallurgical Variability

Metallurgical and mineralogy studies have shown that REE recoveries are relatively consistent across the resource areas at Cowboy State Mine. The representative core material was tested from the Red Mountain and Overton Mountain areas to determine the mineral beneficiation flowsheet presented in this report. The mineralogical study also used representative drill core to characterize the mineral speciation, textures, and

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gangue mineral associations and to identify factors that may influence REE recoveries during the process. Geologist's logs and REE assays also demonstrate the homogeneity of the deposit.

## 13.10 Deleterious Elements

Two radionuclide elements (thorium and uranium) and associated daughter products are present at Cowboy State Mine mineralization at low levels. The combined concentration of these two radionuclides is approximately 68 ppm in ROM ore.

Further simulation and laboratory testing in future engineering studies is needed to determine the deportment and concentration of the radionuclides within the proposed process and products. The impurity removal plant is designed to remove both Th and U via a precipitation reaction followed by filtration and ion exchange to remove and precipitate, respectively.

Iron (Fe++ and Fe+++) occurs within allanite and hastingsite minerals. Fe2O3 makes up the second highest elemental abundance in allanite at 19.69%, after silica. Hastingsite typically contains 8.1% Fe2O3 but 29.0% FeO, the latter being a reduced form of Fe. Fe is removed during processing using conventional methods.

## 13.11 Qualified Person's Opinion on Data Adequacy

The test work is adequately representative of the anticipated process. The evaluation incorporated ore samples from multiple sources and geological settings, including drill core, reverse-circulation cuttings, and open-trench samples. Testing was conducted at several independent laboratories under the observation and direction of multiple investigating engineers. The breadth and diversity of the samples, together with the range of testing programs and laboratories involved, are considered sufficient to capture a meaningful degree of ore variability and process response. Accordingly, the resulting data provide a reasonable basis for process evaluation, preliminary design, and scale-up to the proposed operation, subject to the limitations and assumptions described in this report.

## 13.12 Fault Structures

There are no significant or active fault structures with the CSM area.

## 13.13 Historical seismic activity

The UWGS prepared a basic seismological characterization report for Albany County, Wyoming in 2002. There have never been any damaging earthquakes reported or measured in Albany County, Wyoming. (WSGS. 2002. Basic Seismological Characterization for Albany County, Wyoming).

# 14 Mineral Resource Estimates

WRI contracted Odessa Resources Pty, Ltd. (Odessa) in Perth, Western Australia, to update geological and rare earth grade models for the Red Mountain area including the Cowboy State Mine. Mr. Alf Gillman of



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Odessa is a Chartered Professional (Geology) and Fellow of the Australasian Institute of Mining and Metallurgy or the Australian Institute (AusIMM), number 107303. Mr. Gillman is a Qualified Person (QP), as defined by the JORC Code 2012 Edition, having sufficient experience relevant to the style of mineralization and type of deposit described in this report.

Odessa prepared a summary report detailing the resource models and Cowboy State Mine resource estimates entitled Halleck Creek REE Project, Wyoming Red Mountain Update Report Methodology and Resource Estimation Report Undertaken for American Rare Earths Ltd., November 2025. Excerpts of this report are presented in the following sections and are enclosed with quotations.

The block model used a parent block size of 20 x 20 x 10 m. The minimum block size was 5 x 5 x 2.5 m.

Odessa Resources created a geological resource model using the Leapfrog Edge geological modeling tools, developed by Seequent, a subsidiary of Bentley Systems. Odessa modeled the geologic domains (Figure 14-1) and established resource boundary limits based on variography of TREO.

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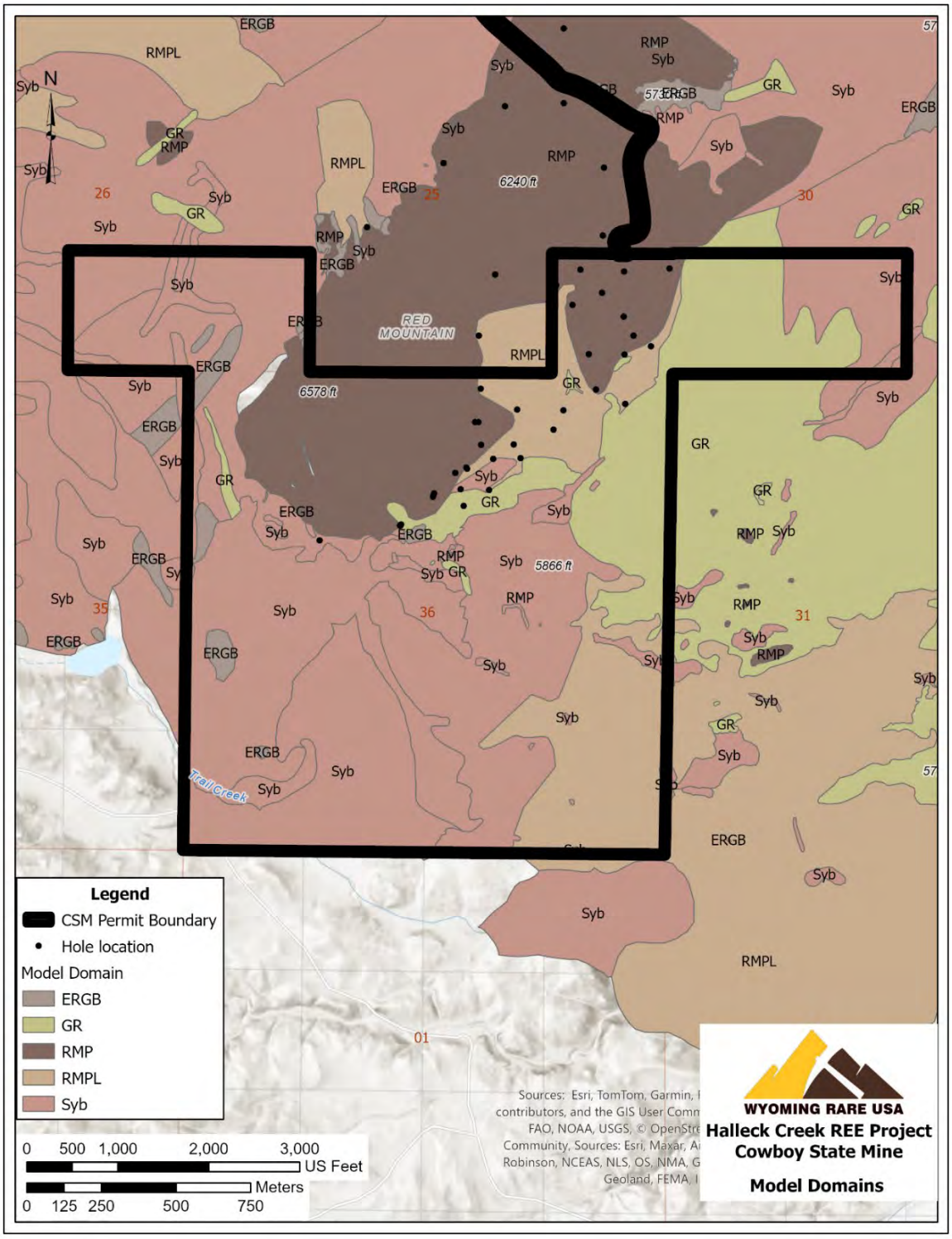


*Figure 14-1: Modeled Geological Domains*

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# 14.1 Geological Model and Interpretation

## 14.1.1 Geologic Information

### 14.1.1.1 Lithology

The domains that are modelled comprise the primary geological units as interpreted by WRI geologists. WRI interpreted lithological units and modeling domains within the drillhole data and incorporated surface mapping results to refine the geological model. A revised 3D geological model was developed to isolate the higher-grade RMP domain from the surrounding lithologies. The primary modeling domains consist of the following.

- QAL – Quaternary alluvium
- RMP – Red Mountain pluton comprising mostly clinopyroxene quartz monzonite (CQM)
- RMP1 – comprising mostly biotite-hornblende quartz syenite and fayalite monzonite
- ERGB – unmineralized Elmers Rock Greenstone belt
- SYB – low grade monzonite Sybille intrusions
- LAC – Laramie Anorthosite complex

### 14.1.1.2 Structural

Mineralization and grade are not structurally controlled in the model area. A separate structural model for the area has not been created

### 14.1.1.3 Minerology

The mineralogy at the CSM mine area is described in Section 7.3.5.

While allanite is the primary rare earth bearing mineral, the geological model defined specific elemental oxides as the modeling attributes. REE used for grade modeling include TREO, LREO, HREO, MREO, La2O3, Ce2O3, Pr6O11, Nd2O3, Sm2O3, Eu2O3, Gd2O3, Tb4O7, Dy2O3, Ho2O3, Er2O3, Tm2O3, Yb2O3, Lu2O3, Y2O3, ThO2, and UO2, as identified in the resource model. The $Ce_2O_3$ modeling attribute is distinguished from the $CeO_2$ convention used elsewhere in the report for TREO reporting.

### 14.1.1.4 Alteration

Alteration at the CSM mine area is described in Section 7.3.4.

### 14.1.1.5 Geotechnical

ARR collected 48 geotechnical core samples during the Fall 2024 drilling program (Table 14-1). ARR sent the samples to WSP in Burnaby, British Columbia for strength testing. Table 14-2 summarizes tests performed by WSP.

Geotechnical engineers from Stantec evaluated the geotechnical data for pit design.

*Table 14-1: Geotechnical Samples*

| DHID | No. Samples |
|---|---|
| HC24-RM023 | 0 |
| HC24-RM024 | 3 |
| HC24-RM025 | 1 |
| HC24-RM027 | 2 |
| HC24-RM029 | 1 |
| HC24-RM034 | 1 |
| HC24-RM035 | 12 |
| HC24-RM042 | 0 |
| HC24-RM043 | 13 |
| HC24-RM044 | 9 |
| HC24-RM045 | 6 |
| **Total** | **48** |

*Table 14-2: Geotechnical Tests*

| Geotechnical Test | No. Tests |
|---|---|
| Brazilian Tensile Strength | 12 |
| Unconfined Compression Test | 16 |
| Triaxial Compressive Strength | 11 |
| Direct Shear | 9 |
| Soil | 1 |
| **Total** | **49** |

### 14.1.2 Exploratory Data Analysis and Compositing

WRI drilled 17 RC holes and 11 diamond core holes in the CSM area at Cowboy State Mine in 2024. WRI currently has 50 drill holes as known data points to determine an updated JORC resource estimate for the CSM Project area. The geological model also incorporates information from 112 surface channel samples collected during the 2025 exploration program, which supported geological interpretation and refinement of the resource classification.

WRI provided Odessa with drill hole assay data that included the drill hole ID, domain, from depth, to depth, sample type, and rare earth element oxide values.

WRI exported locations, lithological descriptions, and assay data of surface samples across the Cowboy State Mine Project Area. Surface geochemical samples were excluded from direct grade interpolation but were used to support geological interpretation and define the outer limits of resource block domains.

Grades were composited to 1.5 m (5 ft), the dominant sampling interval.

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Histograms and log-probability graphs of the TREO grade at Cowboy State Mine are shown in Figure 14-2. At Red Mountain, the higher-grade peak corresponds to the RMP domain, which is associated with the clinopyroxene-rich quartz monzonite rock type containing the highest allanite concentrations. Lower-grade peaks correspond to the RMP1 and SYB domains. The RMP1 domain reflects TREO values from biotite–hornblende quartz syenite and fayalite monzonite, while the SYB domain represents the monzonitic and syenitic rocks of the Sybille intrusion. Despite containing less allanite, the SYB domain shows consistent TREO values across drillhole data.

Odessa compiled TREO grade information for the geological domains, lithological units, and discrete rock types, providing a comprehensive view of TREO distributions for the RMP, RMP1, and SYB domains. The boxplot for geological domains is shown in Figure 14-3.

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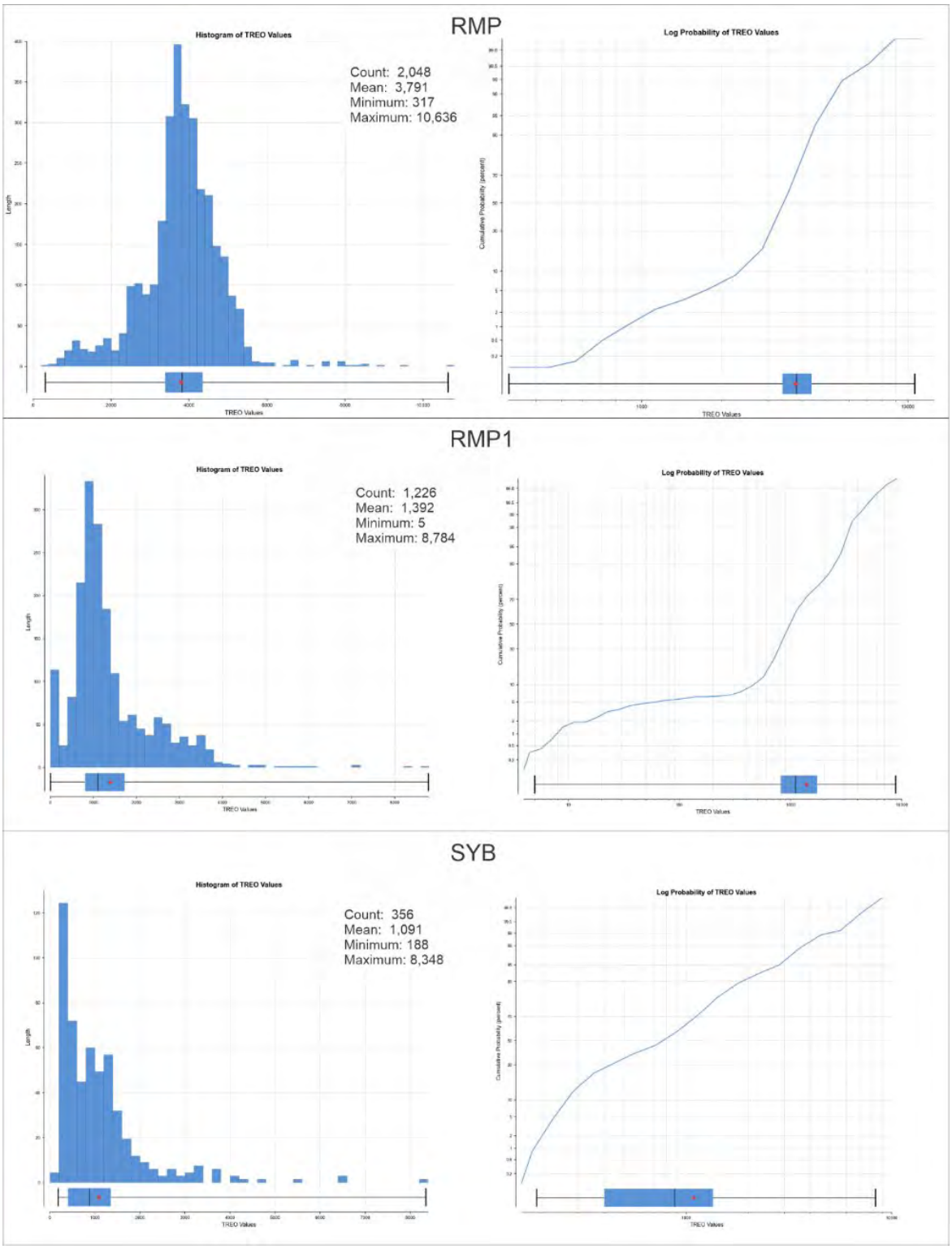


*Figure 14-2: Histograms and Log Probability Charts*

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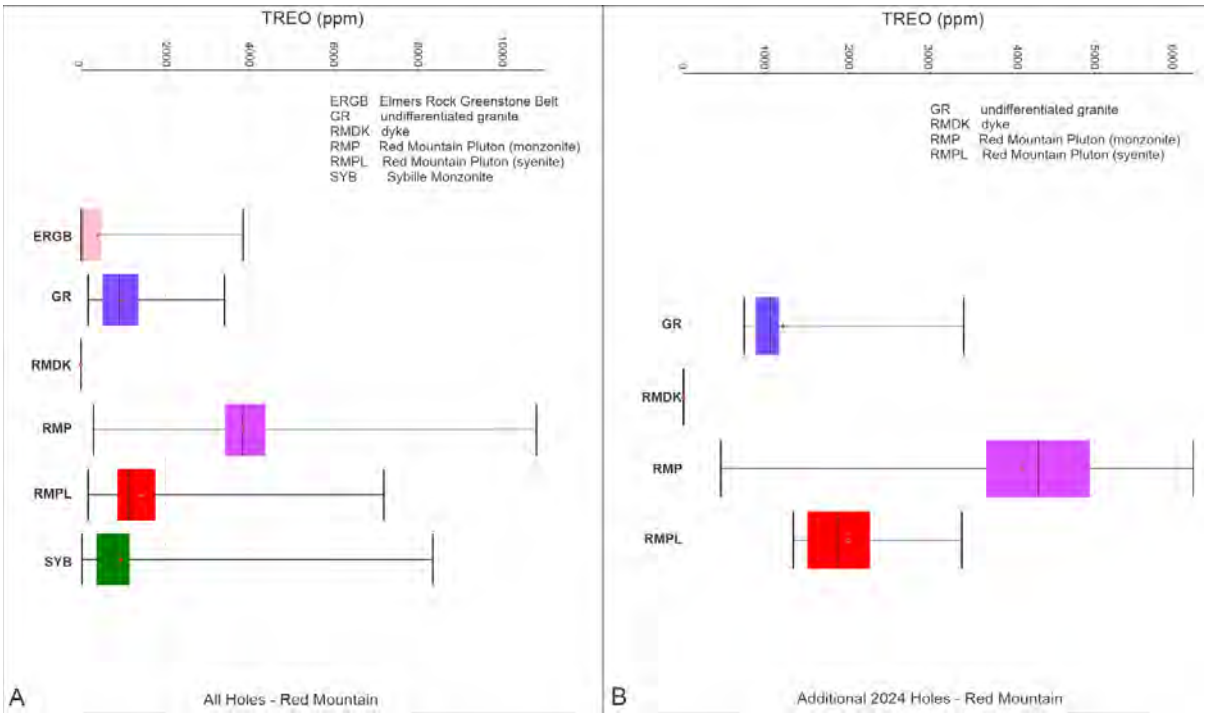


*Figure 14-3: Boxplot of TREE for Geological Domains*

## 14.2 Estimation / Interpolation Methods

### 14.2.1 Density Assignment

Hydrostatic testing was conducted on 10 core samples from the Cowboy State Mine core to determine specific gravity. Testing included both untreated and wax-impregnated samples. Based on the results, a fixed SG of 2.70 was adopted and applied as a constant value for all domains to derive the overall tonnage.

### 14.2.2 Grade Estimation

Odessa modeled grade for each of the rare earth parameters listed above. Odessa stated, “Grade estimation was carried out using an ordinary kriged (OK) interpolant. Kriging is a method for interpolating estimates for unknown points based on measured data. Instead of the inverse distance and nearest neighbor estimates, covariances and a Gaussian process are used to produce the prediction. The interpolant profile developed for TREO was applied to the individual rare-earth elements and minerals. Estimations were carried out on each rare earth element together with UO2, ThO2, ZrO2 and Fe.

The database-derived TREO value was used to model the variogram, which was then applied to each rare-element estimation (Figure 10). The final TREO, HREO, LREO and MREO grades are reported as sum

calculations of the respective rare earth element grades" The Leapfrog estimation parameters defined for block modeling are shown Table 14-3.

*Table 14-3: Search Parameters*

| General | | | Ellipsoid Ranges | | | Ellipsoid Directions | | | Number of Samples | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Interpolant Name** | **Domain** | **Numeric Values** | **Max.** | **Inter.** | **Min.** | **Dip** | **Dip Azimuth** | **Pitch** | **Min.** | **Max.** |
| RM Pass 1 | RM | TREO | 150 | 150 | 120 | 0 | 0 | 90 | 4 | 15 |
| RM Pass 2 | RM | TREO | 500 | 500 | 200 | 0 | 0 | 90 | 2 | 15 |

### 14.2.3 Grade Capping / Outlier Restrictions

Grades were not capped and no outlier restrictions were made on the data.

### 14.2.4 Variography

Using Leapfrog Edge, Odessa performed detailed variography for the Cowboy State Mine assay data to determine resource boundary limits and to provide input parameters for grade interpolation (Figure 14-4). A standard variogram was modeled for undomained TREO composites, featuring a normalized nugget of 0.1 and relatively large variogram ranges. These parameters reflect the homogenous nature of mineralization and grade continuity over large distances in all directions (Table 14-4).

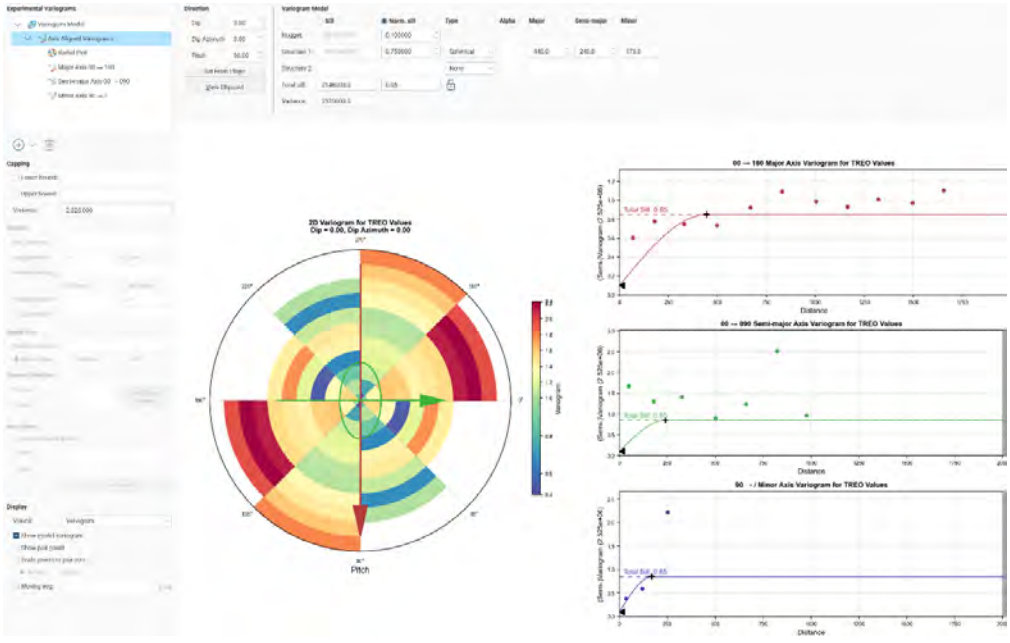

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*Figure 14-4: Variography of TREO for the Red Mountain Resource Area*

*Table 14-4: Variogram Parameters*

| General | Direction | | | Structure 1 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Variogram Name | Dip | Dip Azimuth | Pitch | Normalized Nugget | Normalized sill | Structure | Major | Semi-major | Minor |
| RM | 0 | 0 | 90 | 0.1 | 0.8 | Spherical | 445 | 240 | 170 |

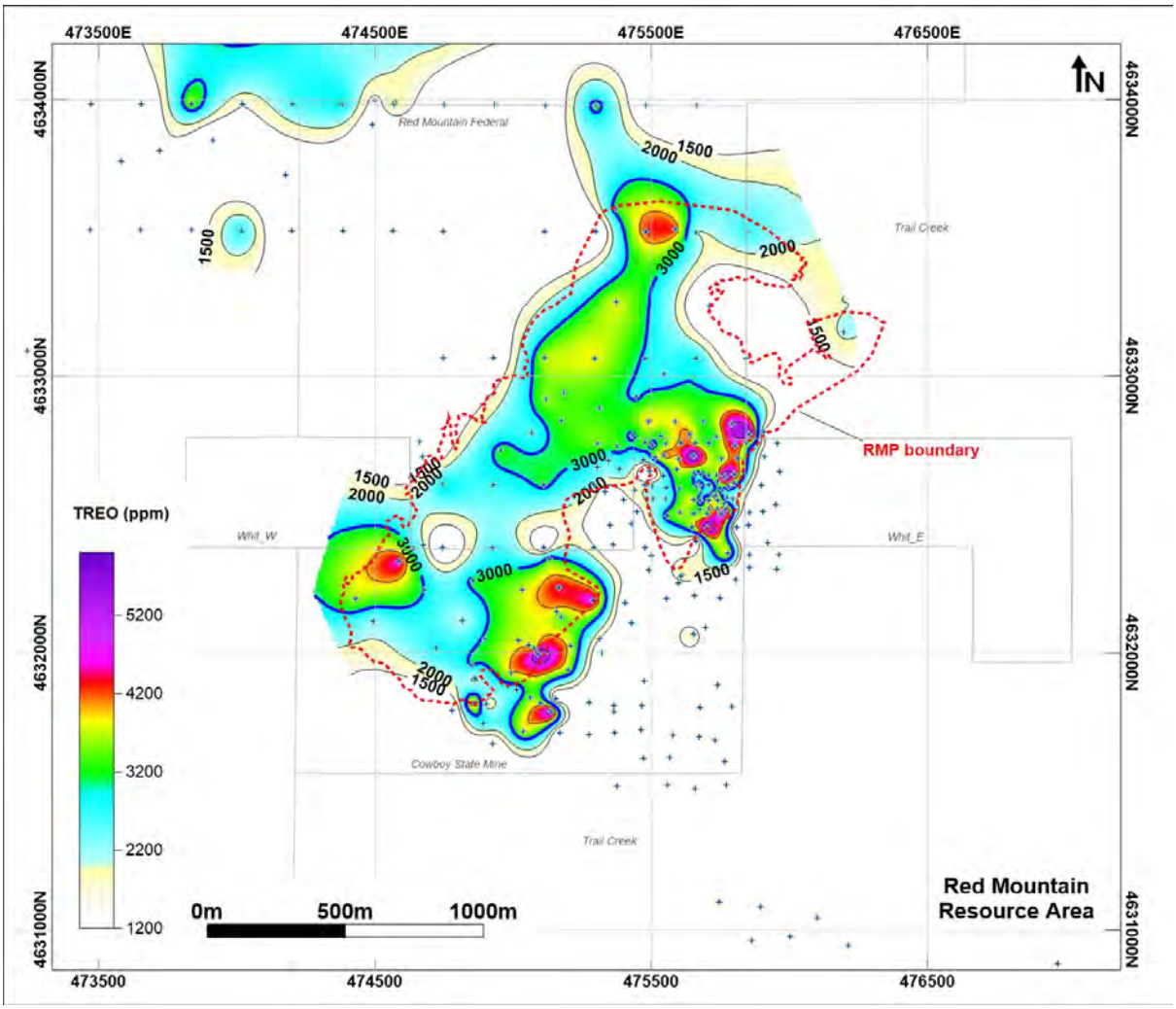


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*Figure 14-5: Plan View of Red Mountain Resource Extents with Geochemical Sampling Results*

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### 14.2.5 Validation

Several estimation runs were carried out on the RMP Indicated resource to check for any variance between estimated grades and the input data. The additional estimators comprised of the following items.

- Modelled Estimator
    - OK TREO RMP: Indicated ordinary kriged estimate with variogram model (150x150x120m search)
- The additional estimators
    - ID2 TREO RMP: Inverse Distance Squared (ID2) using horizontal plane (150x150x120m search)
    - ID2 TREO RMP: isotropic Inverse Distance Squared (ID2) using an iso-tropic 150m search ellipse
    - ID2 TREO RMP: with variogram Inverse Distance Squared (ID2) using the same estimation and variogram parameters as the kriged model (445x240x170m search)
    - Nearest Neighbor, RMP: nearest neighbor estimate (150x150x120m search)

Odessa stated “These validation runs, together with the kriged estimator, were compared against the raw composite data in east-west (X) and north-south (Y) swath plots across the Red Mountain area, Figure 14-6.

The data indicates that the kriged estimator has done a reasonable job in estimating a global resource grade with no systematic bias towards overestimating the grades. The smoothing effects of the kriging interpolant is consistent with both the inherent nature of the kriging process and the large search ellipses used.”

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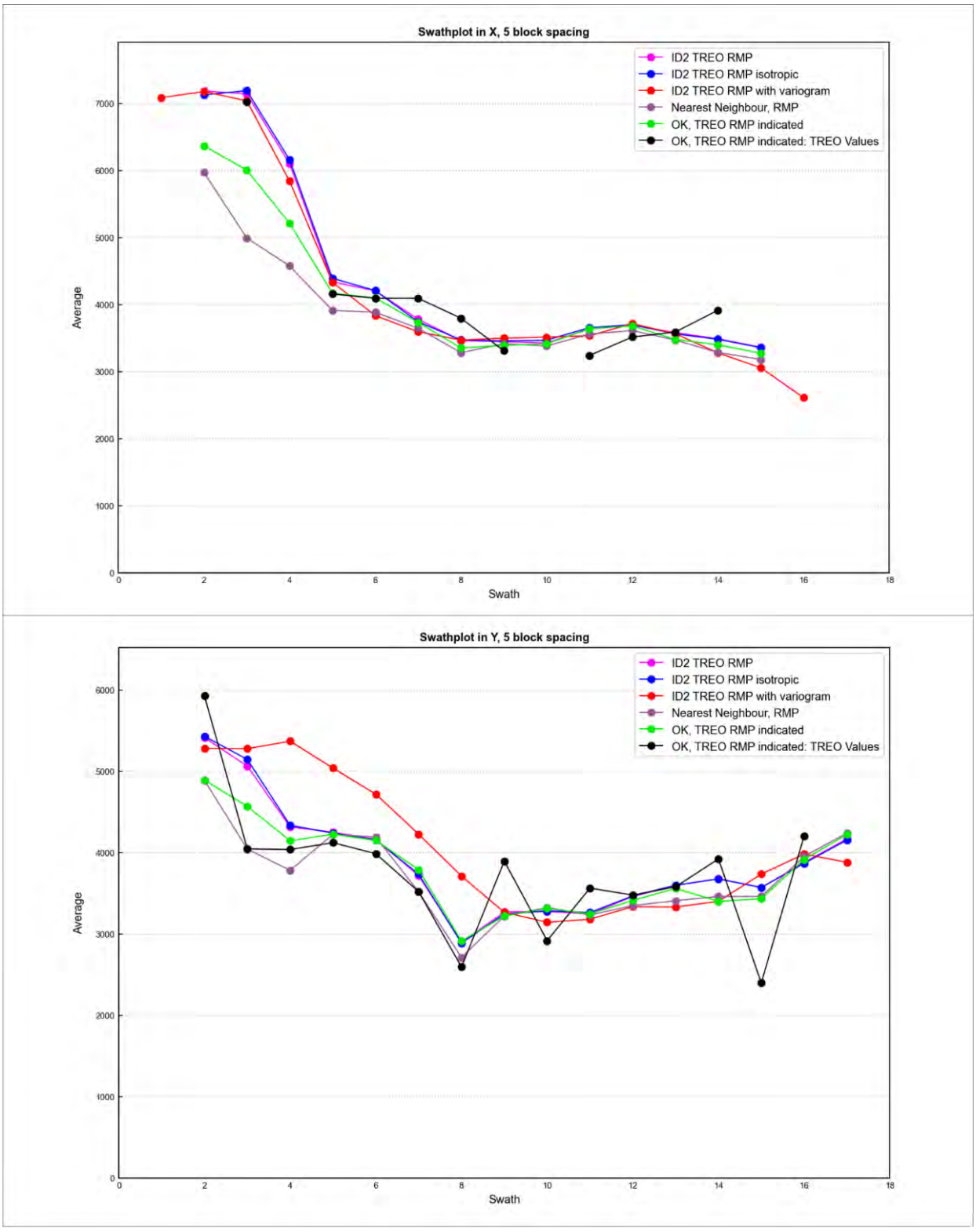


*Figure 14-6: Swath Plot in X and Y Axis: Red Mountain*

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### 14.2.6 By-products or Deleterious Elements

There are no by-products currently associated with the CSM project area.

Deleterious elements include iron, aluminum, silica, and calcium which occur in gangue minerals, feldspars, quartz, and amphiboles (hastingsite). Low levels of uranium and thorium occur within allanite. The average modeled grade for uranium oxide and thorium oxide are 7ppm and 50ppm, respectively.

### 14.2.7 Confidence Classification

Odessa reviewed resource classification categories for the Red Mountain model area. The resource is classified as either indicated or inferred, Figure 14-7 and Figure 14-7*: Resource Extent and Resource Classification Categories at Red Mountain*

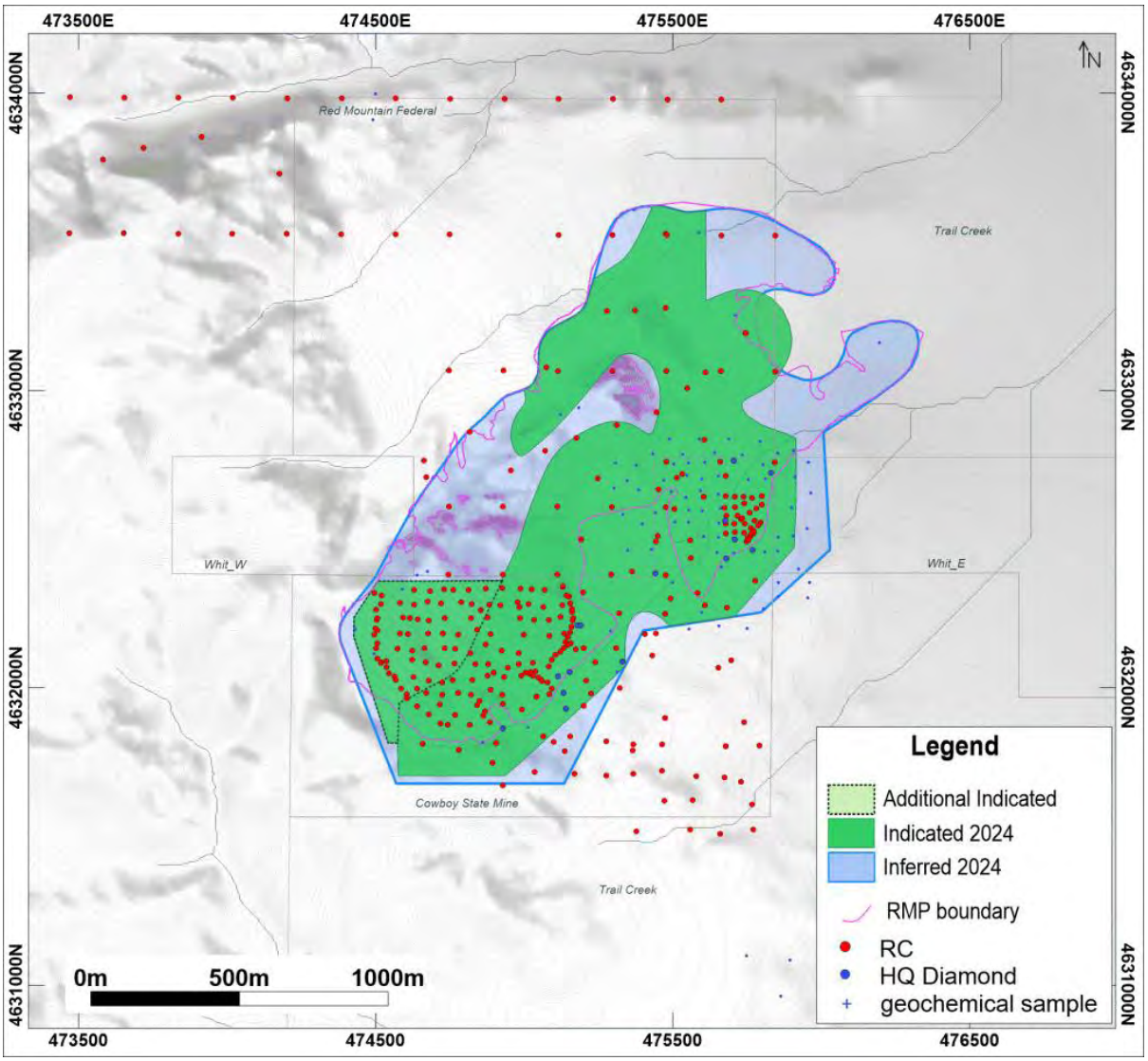
. The classification at Cowboy State Mine is based on the following key attributes.

- Geological continuity between drillholes.
    - Mineralization is controlled by batholith-scale fractionation. Hence, both empirical observations and statistical analysis confirm a very high degree of continuity with the respective rock masses at Overton Mountain and Red Mountain.
- Drill spacing and drill density.
    - The drill pattern is mostly irregular with drill spacing of approximately 200m.

Odessa stated: “With respect to previous [resource] estimates, the following main changes have been made to the current resource classification limits:

- Indicated limit extended to the west to approximately 200m below the surface based on positive indications provided by surface channel samples.
- Lateral limit of Inferred extended to the west to incorporate all of the Red Mountain Pluton.
- Vertical limit of Inferred extended to 510RL based on additional positive drilling results.

The QP considers the above classification strategy and methodology to be appropriate and reasonable for this style of mineralization”.




Odessa 2025

*Figure 14-7: Resource Extent and Resource Classification Categories at Red Mountain*

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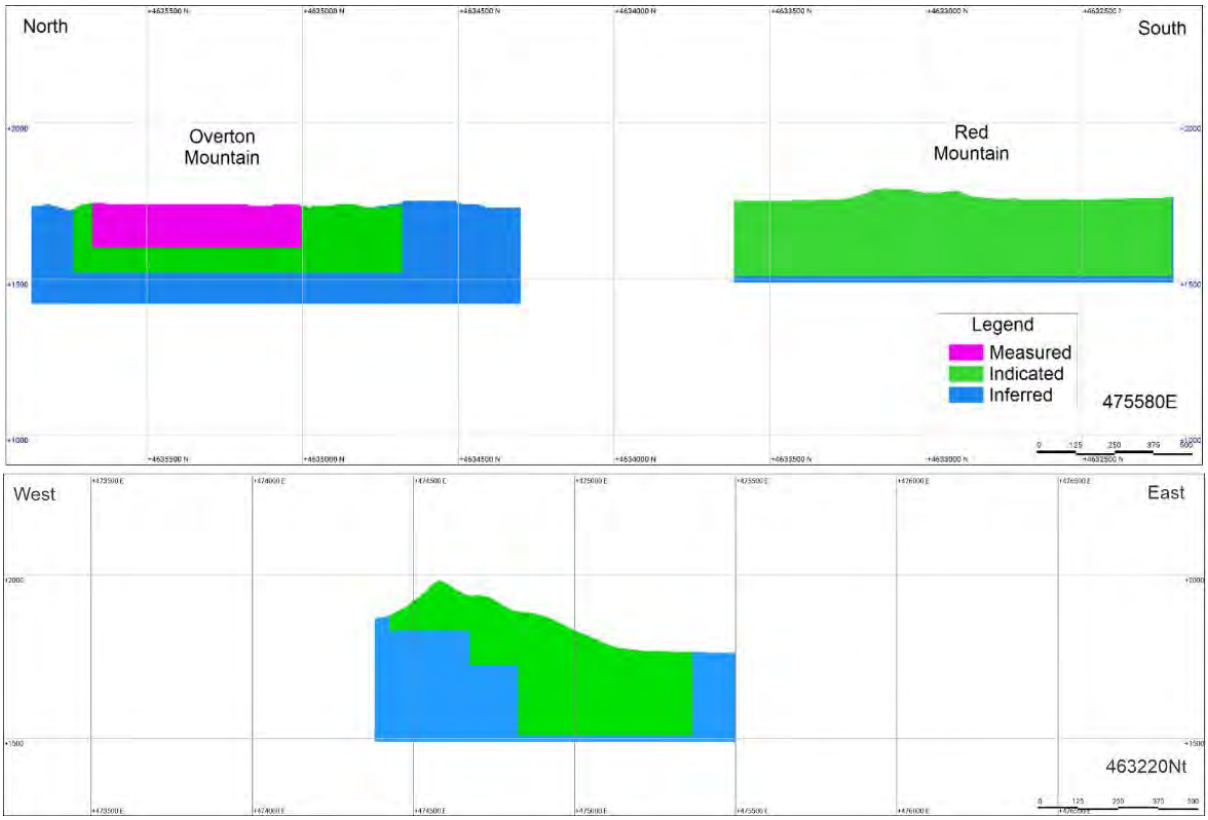


Odessa 2025

*Figure 14-8: Cross-Section View Showing Resource Classification Limits*

#### 14.2.7.1 Uncertainties Considered During Confidence Classification

Uncertainties regarding sampling and drilling methods, data processing and handling, geological modelling, and estimation were incorporated into the classifications assigned. The level of uncertainty is reflected in the assignment of the measured, indicated, and inferred categories to the resource blocks.

## 14.3 Topography

WRI acquired light detection and ranging (LiDAR) topographic data from the United States Geological Survey (USGS). This data was released to the public in August 2022 as part of the USGS Earth MRI project.

WRI personnel processed LiDAR imagery to prepare high resolution topographic models across Cowboy State Mine for use in ArcGIS and Leapfrog geological modeling software.

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## 14.4 Reasonable Prospects of Economic Extraction

### 14.4.1 Input Assumptions

Following input assumptions were applied to determine reasonable prospects for economic extraction.

- Resource material is at surface and can be mined with conventional open pit mining equipment.
- Uncontrolled minerals were excluded from resource estimates.
- NSR calculations determined that a cut-off grade of 1,000 ppm TREO provides ample economically viable material to be included in reasonable prospects for economic extraction.

## 14.5 Cut-Off

Stantec developed net smelter return (NSR) calculations based on recovering oxides of NdPr, La, Dy, Tb, and SEG (mixed samarium, europium, and gadolinium). The NSR calculated shows an economic cut-off grade of 1,000 ppm TREO for in situ resource estimates within proposed resource limits. This cut-off provides the basis of a reasonable expectation of economic extraction at Cowboy State Mine.

## 14.6 Mineral Resource Statement

summarizes estimated global in situ resources for the Red Mountain project area by resource area and category using a TREO cut-off of 1,000 ppm. These in situ resource estimates have not been optimized within any open pit designs. The total estimated in situ resource at Red Mountain project is 1,249 million tonnes with an average TREO grade of 3,200 ppm (0.32%), and an average Magnet Rare Earth Oxide (MREO) grade of 899 ppm (0.09%). MREO comprises approximately 28% of TREO. Table 14-6 summarizes resource estimates by mineral owner. Private unleased material is not included in the estimate.

The total in situ measured and indicated resources for the Cowboy State Mine area are 547.5 million tonnes with an average TREO grade of 3,344 ppm (0.33%), and an average Magnet Rare Earth Oxide (MREO) grade of 945 ppm (0.09%).

It should be clearly noted that Mineral Resources are not Mineral (Ore) Reserves and do not have demonstrated economic viability. There is no certainty that all or any part of the Mineral Resource will be converted into a Mineral Reserve. Areas where WRI does not control mineral resources have been excluded from resource estimates.

## 14.7 Resource Estimate Differences

Table 14-5 and Table 14-6 summarizes the differences between the current resource estimate and the resource estimated from the February 2025 Pre-Feasibility study report for the Cowboy State Mine area. The current resource estimate contains approximately 4.5 million tonnes more material than the February 2025 resource estimate; this is an increase of approximately 1%. The estimated TREO grade decreased by approximately 94 ppm, an increase of approximately -3.0%.

Based on the 2025 channel samples within the Cowboy State Mine area, Odessa reclassified a significant amount of resource from inferred to indicated. The reclassification resulted in the estimated indicated resources increasing by approximately 68.4 million tonnes (13%), shown on Table 14-7. The associated TREO grade increased by approximately 19 ppm, an increase of approximately 1%. Conversely, with the increase in indicated resource class, the estimated inferred resources decreased by approximately 63.9 million tonnes (-29%).

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*Table 14-5: Estimated Rare Earth Resources at Red Mountain (1,000 ppm TREO Cut-off)*

| **Classification** | **Area** | **Tonnage** | ***Grade*** | | | | ***Contained Material*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **TREO** | **LREO** | **HREO** | **MREO** | **TREO** | **LREO** | **HREO** | **MREO** |
| | | **t** | **ppm** | **ppm** | **ppm** | **ppm** | **kt** | **kt** | **kt** | **kt** |
| **Indicated** | Cowboy State Mine | 391,378,955 | 3,295 | 2,904 | 392 | 929 | 1,290 | 1,136 | 153 | 364 |
| | RM Fed | 372,632,038 | 3,044 | 2,681 | 363 | 849 | 1,134 | 999 | 135 | 316 |
| | Trail Creek | 3,105,163 | 3,354 | 2,947 | 407 | 955 | 10 | 9 | 1 | 3 |
| | **Total** | **767,116,157** | **3,173** | **2,796** | **378** | **890** | **2,434** | **2,145** | **290** | **683** |
| **Inferred** | Cowboy State Mine | 156,091,388 | 3,468 | 3,047 | 421 | 984 | 541 | 476 | 66 | 154 |
| | RM Fed | 291,316,452 | 3,161 | 2,796 | 366 | 887 | 921 | 814 | 107 | 258 |
| | Trail Creek | 34,062,736 | 2,909 | 2,556 | 353 | 830 | 99 | 87 | 12 | 28 |
| | **Total** | **481,470,576** | **3,243** | **2,860** | **383** | **914** | **1,561** | **1,377** | **184** | **440** |
| **Total** | Indicated | 767,116,157 | 3,173 | 2,796 | 378 | 890 | 2,434 | 2,145 | 290 | 683 |
| | Inferred | 481,470,576 | 3,243 | 2,860 | 383 | 914 | 1,561 | 1,377 | 184 | 440 |
| | **Total** | **1,248,586,733** | **3,200** | **2,821** | **380** | **899** | **3,996** | **3,522** | **474** | **1,123** |
| **Rounded** | | **1,249,000,000** | **3,200** | **2,800** | **400** | **900** | **4,000** | **3,500** | **500** | **1,100** |

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*Table 14-6: Resource Estimates by Mineral Owner (1,000 ppm TREO Cut-off)*

| **Area** | **Classification** | **Tonnage** | ***Grade*** | | | | ***Contained Material*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **TREO** | **LREO** | **HREO** | **MREO** | **TREO** | **LREO** | **HREO** | **MREO** |
| | | **t** | **ppm** | **ppm** | **ppm** | **ppm** | **kt** | **kt** | **kt** | **kt** |
| **Cowboy State Mine** | Indicated | 391,378,955 | 3,295 | 2,904 | 392 | 929 | 1,290 | 1,136 | 153 | 364 |
| | Inferred | 156,091,388 | 3,468 | 3,047 | 421 | 984 | 541 | 476 | 66 | 154 |
| | **Total** | **547,470,344** | **3,344** | **2,944** | **400** | **945** | **1,831** | **1,612** | **219** | **517** |
| **RM Fed** | Indicated | 372,632,038 | 3,044 | 2,681 | 363 | 849 | 1,134 | 999 | 135 | 316 |
| | Inferred | 291,316,452 | 3,161 | 2,796 | 366 | 887 | 921 | 814 | 107 | 258 |
| | **Total** | **663,948,490** | **3,096** | **2,731** | **364** | **865** | **2,055** | **1,813** | **242** | **575** |
| **Trail Creek** | Indicated | 3,105,163 | 3,354 | 2,947 | 407 | 955 | 10 | 9 | 1 | 3 |
| | Inferred | 34,062,736 | 2,909 | 2,556 | 353 | 830 | 99 | 87 | 12 | 28 |
| | **Total** | **37,167,899** | **2,946** | **2,589** | **358** | **841** | **110** | **96** | **13** | **31** |
| **Total** | Indicated | 767,116,157 | 3,173 | 2,796 | 378 | 890 | 2,434 | 2,145 | 290 | 683 |
| | Inferred | 481,470,576 | 3,243 | 2,860 | 383 | 914 | 1,561 | 1,377 | 184 | 440 |
| | **Total** | **1,248,586,733** | **3,200** | **2,821** | **380** | **899** | **3,996** | **3,522** | **474** | **1,123** |
| **Rounded** | | **1,249,000,000** | **3,200** | **2,800** | **400** | **900** | **4,000** | **3,500** | **500** | **1,100** |

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*Table 14-7: Cowboy State Mine differences between Current Resource Estimate and February 2025 Resource Estimate*

| **CSM MRE** | **Classification** | **Tonnage** | ***Grade*** | | | | ***Contained Material*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **TREO** | **LREO** | **HREO** | **MREO** | **TREO** | **LREO** | **HREO** | **MREO** |
| | | **t** | **ppm** | **ppm** | **ppm** | **ppm** | **t** | **t** | **t** | **t** |
| **Nov 2025 Update** | Indicated | 391,378,955 | 3,295 | 2,904 | 391.551 | 928.872 | 1,289,650 | 1,136,405 | 153,245 | 363,541 |
| | Inferred | 156,091,388 | 3,468 | 3,047 | 420.514 | 983.856 | 541,251 | 475,612 | 65,639 | 153,572 |
| | **Total** | **547,470,344** | **3,344** | **2,944** | **399.809** | **944.549** | **1,830,901** | **1,612,018** | **218,884** | **517,112** |
| **Feb 25 Scoping Study** | Indicated | 322,961,462 | 3,276 | 2,907 | 368.697 | 924.559 | 1,057,922 | 938,847 | 119,075 | 298,597 |
| | Inferred | 220,014,226 | 3,677 | 3,274 | 403.867 | 1019.98 | 809,092 | 720,236 | 88,856 | 224,411 |
| | **Total** | **542,975,688** | **3,438** | **3,056** | **382.948** | **963.225** | **1,867,014** | **1,659,083** | **207,932** | **523,008** |
| **Difference** | **Indicated** | *68,417,494* | *19* | *-3* | *23* | *4* | *231,729* | *197,559* | *34,170* | *64,944* |
| | | *13%* | *1%* | *0%* | *6%* | *0%* | *12%* | *12%* | *16%* | *12%* |
| | **Inferred** | *-63,922,837* | *-210* | *-227* | *17* | *-36* | *-267,841* | *-244,624* | *-23,218* | *-70,839* |
| | | *-29%* | *-6%* | *-7%* | *4%* | *-4%* | *-33%* | *-34%* | *-26%* | *-32%* |
| | **Total** | *4,494,656* | *-94* | *-111* | *17* | *-19* | *-36,113* | *-47,065* | *10,952* | *-5,895* |
| | | *1%* | *-3%* | *-4%* | *4%* | *-2%* | *-2%* | *-3%* | *5%* | *-1%* |

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## 14.8 Factors That May Affect the Mineral Resource Estimate

Factors which may affect the mineral resource estimates are as follows.

- Metal price and exchange rate assumptions.
- Changes to the assumptions used to generate cut-off grades.
- Changes in local interpretations of mineralization geometry and continuity of mineralized zones.
- Changes to geological and mineralization shapes.
- Changes to geological and grade continuity assumptions.
- Density and domain assignments.
- Changes to geotechnical, mining, and metallurgical recovery assumptions.
- Changes to the input and design parameter assumptions that pertain to mining assumptions used to constrain the estimates.
- Assumptions as to the continued ability to access the site, complete proposed exploration programs, and maintain the social license to operate.

# 15 Mining Methods

## 15.1 Introduction

The CSM deposit is planned to be mined via open pit methods using conventional truck and shovel extraction. The mine plan does not include any underground mining. A life-of-mine (LOM) schedule has been developed using Deswik to model mining, drilling, blasting, and haulage activities to meet project objectives for ore quantities and quality, while determining mining equipment requirements and physicals.

### 15.1.1 Annual Mining Limits

Excavated material was scheduled on an annual basis, accounting for mining, haulage, drilling, and blasting production activities. Final ore and waste designations are reliant on production / blast hole drill data to determine the in-situ grade of mined material. Material falling above the reported cut-off grade will be considered ore and sent to on-site processing facilities for further handling. All material falling below the economic cut-off grade will report to the designated WRSF or be used for construction materials as needed.

Annual mining quantities are limited by operational dig faces available and equipment productivity rates. Mining activities associated with the upper benches (top 3 to 5) will be less productive than those that occur at lower elevations, due to limited operating space. Until sufficient space is available, drilling of the bench below cannot occur until the entire bench has been mined, as associated drilling areas will fall within the path of material haulage. While upper benches will experience delays due to space limitations, ore lies close to the surface and does not require considerable quantities of waste to be mined or stripped to expose. Given this dynamic, ore delivery will ramp up to full production (4.5 Mtpa) in the second year of operation without utilizing additional equipment to increase material movement typically used during waste stripping activities.

Once mining operations are no longer space constrained, haulage equipment will be the limiting factor for material movement. While able to move more material than required, a single excavating unit will be utilized in a backhoe configuration able to achieve the mine design while efficiently loading haulage equipment. Equipment sizing considers a 7.4 $m^3$ bucket paired with 76.9 tonne haul trucks (agnostic to OEM). Current annual scheduled pit quantities do not exceed 6.7M tonnes.

### 15.1.2 Annual Production

Annual production targets 4.5M tonnes of ore with total material mined not exceeding 6.7 Mtpa. Production targets consider the stripping ratio for each period and the associated total recovered production for each period throughout the LOM. Total material movement will consider material movement from the pit to processing and waste storage facilities and subsequent rehandle required to facilitate tailings storage and auxiliary process operations. Ore production does not consider Inferred material.

### 15.1.3 Stockpiling

Given the homogeneity of the ore deposit, planned ore quantities available, and overall low stripping ratios, meeting and sustaining annual ore demand is achievable with low operational risk and does not require ore stockpiles. To buffer production and mill throughput fluctuations, there will be a ROM stockpile of approximately 60k tonnes adjacent to plant facilities.

## 15.2 Schedule Summary Tables

Total ore production ramps up during the first year of operations (Year 0) while mining dig faces and processing facilities are established. Full ore production is achieved in Year 1 and remains relatively constant with total material movement fluctuating between 4.7 and 6.7 Mtpa for the remainder of the LOM.

Over the 25+ year mine life, a total material movement of 135.0 Mt is required to expose and process 116 Mt of ore with an overall stripping ratio of 0.16 (waste to ore) and a PREO grade of 1,257 ppm. Total material movement by phase and PREO grade by year is displayed in Figure , with the overall material breakdown by year shown in Table 15-1 through Table 15-3.

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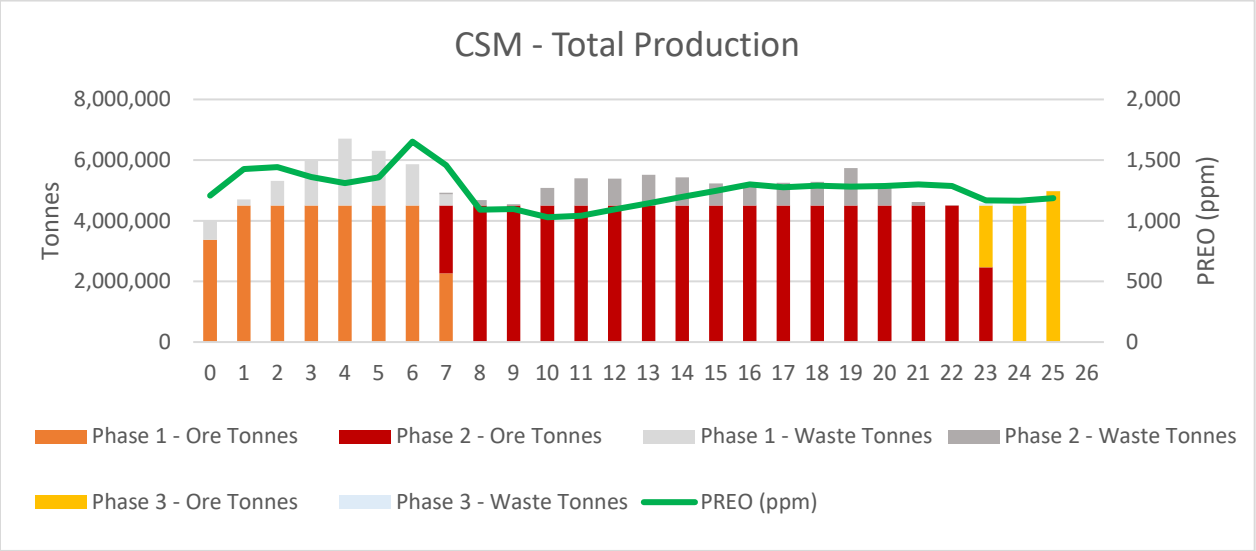


*Figure 15-1: Total Material Movement by Phase and PREO grade*

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*Table 15-1: Overall Material Breakdown Years 0 – 10*

| **LOM Schedule** | | **Pre-Production** | **Production** | **Production** | **Production** | **Production** | **Production** | **Production** | **Production** | **Production** | **Production** | **Production** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Description** | **LOM Year** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | **LOM Total** | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 |
| **Production Target (Mt)** | **4.5** | 3.4 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| **Ore Tonnes (Mt)** | **116.4** | 3.4 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| **PREO (ppm)** | **1,257** | 1,207 | 1,426 | 1,441 | 1,360 | 1,310 | 1,358 | 1,652 | 1,458 | 1,091 | 1,098 | 1,029 |
| **Waste Tonnes (Mt)** | **18.7** | 0.6 | 0.2 | 0.8 | 1.5 | 2.2 | 1.8 | 1.4 | 0.4 | 0.2 | 0.0 | 0.6 |
| **Total Tonnes Mined (Mt)** | **135.0** | 4.0 | 4.7 | 5.3 | 6.0 | 6.7 | 6.3 | 5.9 | 4.9 | 4.7 | 4.5 | 5.1 |
| **Strip Ratio** | **0.160** | 0.188 | 0.045 | 0.181 | 0.331 | 0.491 | 0.401 | 0.304 | 0.093 | 0.040 | 0.009 | 0.130 |
| **Cumulative Ton**nes (Mt) | **135.0** | 4.0 | 8.7 | 14.0 | 20.0 | 26.7 | 33.0 | 38.9 | 43.8 | 48.5 | 53.0 | 58.1 |
| **Remaining Tonnes (Mt)** | **0** | 131.0 | 126.3 | 121.0 | 115.0 | 108.3 | 102.0 | 96.1 | 91.2 | 86.5 | 82.0 | 76.9 |
| **Contained (ppm)** | | | | | | | | | | | | |
| **PREO (ppm)** | **1,257** | 1,207 | 1,426 | 1,441 | 1,360 | 1,310 | 1,358 | 1,652 | 1,458 | 1,091 | 1,098 | 1,029 |
| **NdPr (ppm)** | **958** | 896 | 1,067 | 1,080 | 1,018 | 982 | 1,028 | 1,263 | 1,120 | 809 | 817 | 768 |
| **SEG (ppm)** | **230** | 235 | 273 | 276 | 260 | 251 | 253 | 301 | 260 | 212 | 212 | 198 |
| **TB4O7 (ppm)** | **12** | 14 | 16 | 16 | 15 | 14 | 14 | 16 | 14 | 12 | 12 | 11 |
| **DY2O3 (ppm)** | **57** | 63 | 70 | 69 | 65 | 63 | 63 | 73 | 64 | 57 | 57 | 52 |
| **TREO (ppm)** | **4,016** | 3,812 | 4,490 | 4,559 | 4,309 | 4,143 | 4,251 | 5,096 | 4,573 | 3,468 | 3,512 | 3,290 |
| **Contained (Mkg)** | | | | | | | | | | | | |
| **PREO (Mkg)** | **146.3** | 4.1 | 6.4 | 6.5 | 6.1 | 5.9 | 6.1 | 7.4 | 6.6 | 4.9 | 4.9 | 4.6 |
| **NdPr (Mkg)** | **111.5** | 3.0 | 4.8 | 4.9 | 4.6 | 4.4 | 4.6 | 5.7 | 5.0 | 3.6 | 3.7 | 3.5 |
| **SEG (Mkg)** | **26.7** | 0.8 | 1.2 | 1.2 | 1.2 | 1.1 | 1.1 | 1.4 | 1.2 | 1.0 | 1.0 | 0.9 |
| **TB4O7 (Mkg)** | **1.4** | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |
| **DY2O3 (Mkg)** | **6.6** | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 |
| **TREO (Mkg)** | **467.3** | 12.9 | 20.2 | 20.5 | 19.4 | 18.6 | 19.1 | 22.9 | 20.6 | 15.6 | 15.8 | 14.8 |
| **Produced (M**kg) | | | | | | | | | | | | |
| **NdPr (Mkg)** | **60.2** | 1.6 | 2.6 | 2.6 | 2.5 | 2.4 | 2.5 | 3.1 | 2.7 | 2.0 | 2.0 | 1.9 |
| **SEG (Mkg)** | **6.4** | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 |
| **TB4O7 (Mkg)** | **0.3** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **DY2O3 (Mkg)** | **1.2** | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| **Total PREO (Mkg)** | **68.2** | 1.9 | 3.0 | 3.0 | 2.8 | 2.7 | 2.8 | 3.5 | 3.1 | 2.3 | 2.3 | 2.1 |

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*Table 15-2: Overall Material Breakdown Years 11 – 20*

| LOM Schedule | | Production | Production | Production | Production | Production | Production | Production | Production | Production | Production |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Description** | **LOM Year** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| | **LOM Total** | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 |
| **Production Target (Mt)** | **4.5** | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| **Ore Tonnes (Mt)** | **116.4** | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| **PREO (ppm)** | **1,257** | 1,042 | 1,093 | 1,144 | 1,196 | 1,246 | 1,299 | 1,276 | 1,290 | 1,281 | 1,286 |
| **Waste Tonnes (Mt)** | **18.7** | 0.9 | 0.9 | 1.0 | 0.9 | 0.7 | 0.7 | 0.8 | 0.8 | 1.2 | 0.7 |
| **Total Tonnes Mined (Mt)** | **135.0** | 5.4 | 5.4 | 5.5 | 5.4 | 5.2 | 5.2 | 5.3 | 5.3 | 5.7 | 5.2 |
| **Strip Ratio** | **0.160** | 0.200 | 0.197 | 0.225 | 0.208 | 0.161 | 0.156 | 0.168 | 0.174 | 0.274 | 0.151 |
| **Cumulative Tonnes (Mt)** | **135.0** | 63.5 | 68.9 | 74.4 | 79.9 | 85.1 | 90.3 | 95.5 | 100.8 | 106.6 | 111.7 |
| **Remaining Tonnes (Mt)** | **0** | 71.5 | 66.1 | 60.6 | 55.2 | 50.0 | 44.7 | 39.5 | 34.2 | 28.5 | 23.3 |
| **Contained (ppm)** | | | | | | | | | | | |
| **PREO (ppm)** | **1,257** | 1,042 | 1,093 | 1,144 | 1,196 | 1,246 | 1,299 | 1,276 | 1,290 | 1,281 | 1,286 |
| **NdPr (ppm)** | **958** | 786 | 833 | 881 | 925 | 964 | 1,006 | 987 | 997 | 991 | 993 |
| **SEG (ppm)** | **230** | 196 | 200 | 204 | 211 | 219 | 228 | 224 | 227 | 224 | 225 |
| **TB4O7 (ppm)** | **12** | 11 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 12 |
| **DY2O3 (ppm)** | **57** | 49 | 49 | 49 | 50 | 52 | 54 | 54 | 55 | 54 | 55 |
| **TREO (ppm)** | **4,016** | 3,332 | 3,496 | 3,682 | 3,864 | 4,025 | 4,198 | 4,171 | 4,185 | 4,128 | 4,101 |
| **Contained (Mkg)** | | | | | | | | | | | |
| **PREO (Mkg)** | **146.3** | 4.7 | 4.9 | 5.1 | 5.4 | 5.6 | 5.8 | 5.7 | 5.8 | 5.8 | 5.8 |
| **NdPr (Mkg)** | **111.5** | 3.5 | 3.7 | 4.0 | 4.2 | 4.3 | 4.5 | 4.4 | 4.5 | 4.5 | 4.5 |
| **SEG (Mkg)** | **26.7** | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **TB4O7 (Mkg)** | **1.4** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **DY2O3 (Mkg)** | **6.6** | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **TREO (Mkg)** | **467.3** | 15.0 | 15.7 | 16.6 | 17.4 | 18.1 | 18.9 | 18.8 | 18.8 | 18.6 | 18.5 |
| **Produced (Mkg)** | | | | | | | | | | | |
| **NdPr (Mkg)** | **60.2** | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| **SEG (Mkg)** | **6.4** | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **TB4O7 (Mkg)** | **0.3** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **DY2O3 (Mkg)** | **1.2** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total PREO (Mkg)** | **68.2** | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |

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*Table 15-3: Overall Material Breakdown Years 21 – LOM*

| LOM Schedule | | Production | Production | Production | Production | Production |
|---|---|---|---|---|---|---|
| **Description** | **LOM Year** | 21 | 22 | 23 | 24 | 25 |
| | **LOM Total** | 2052 | 2053 | 2054 | 2055 | 2056 |
| **Production Target (Mt)** | **4.5** | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| **Ore Tonnes (Mt)** | **116.4** | 4.5 | 4.5 | 4.5 | 4.5 | 5.0 |
| **PREO (ppm)** | **1,257** | 1,299 | 1,287 | 1,168 | 1,164 | 1,187 |
| **Waste Tonnes (Mt)** | **18.7** | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 |
| **Total Tonnes Mined (Mt)** | **135.0** | 4.6 | 4.5 | 4.6 | 4.6 | 5.0 |
| **Strip Ratio** | **0.160** | 0.027 | 0.001 | 0.016 | 0.024 | 0.003 |
| **Cumulative Tonnes (Mt)** | **135.0** | 116.4 | 120.9 | 125.4 | 130.0 | 135.0 |
| **Remaining Tonnes (Mt)** | **0** | 18.7 | 14.2 | 9.6 | 5.0 | - |
| **Contained (ppm)** | | | | | | |
| **PREO (ppm)** | **1,257** | 1,299 | 1,287 | 1,168 | 1,164 | 1,187 |
| **NdPr (ppm)** | **958** | 1,001 | 989 | 896 | 896 | 911 |
| **SEG (ppm)** | **230** | 229 | 229 | 208 | 206 | 212 |
| **TB4O7 (ppm)** | **12** | 12 | 12 | 11 | 11 | 11 |
| **DY2O3 (ppm)** | **57** | 57 | 58 | 53 | 51 | 52 |
| **TREO (ppm)** | **4,016** | 4,170 | 4,136 | 3,718 | 3,812 | 3,873 |
| **Contained (Mkg)** | | | | | | |
| **PREO (Mkg)** | **146.3** | 5.8 | 5.8 | 5.3 | 5.2 | 5.9 |
| **NdPr (Mkg)** | **111.5** | 4.5 | 4.4 | 4.0 | 4.0 | 4.5 |
| **SEG (Mkg)** | **26.7** | 1.0 | 1.0 | 0.9 | 0.9 | 1.1 |
| **TB4O7 (Mkg)** | **1.4** | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 |
| **DY2O3 (Mkg)** | **6.6** | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 |
| **TREO (Mkg)** | **467.3** | 18.8 | 18.6 | 16.7 | 17.2 | 19.3 |
| **Produced (Mkg)** | | | | | | |
| **NdPr (Mkg)** | **60.2** | 2.4 | 2.4 | 2.2 | 2.2 | 2.4 |
| **SEG (Mkg)** | **6.4** | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 |
| **TB4O7 (Mkg)** | **0.3** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **DY2O3 (Mkg)** | **1.2** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total PREO (Mkg)** | **68.2** | 2.7 | 2.7 | 2.5 | 2.5 | 2.8 |

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## 15.3 Drill and Blast

Drill and blast patterns are configured to accommodate 10 m benches and incorporate controlled blasting practices to establish good highwall stability with the use of trim shots, pre-shear, and no large production blasts against the final highwalls. While material is planned to be mined in 5 m flitches, drilling and blasting activities will occur at the full bench height. Design parameters consider drilling 115 mm holes, with a typical burden and spacing of 3.2 m x 3.7 m, subdrill of 1 m and a stemming column of approximately 3.8 m.

Blasting will utilize a bulk emulsion / ANFO blend as the bulk explosive product. A 70 / 30% emulsion / ANFO blend by weight will be used for both wet and dry holes. The blast pattern designs, hole diameter, and explosives column heights result in an average estimated powder factor of 0.74 kg/$m^3$ for both ore and waste using an ANFO / emulsion blend. Blasts are anticipated to occur twice, weekly. Drill patterns will be continuously evaluated to minimize potential dilution and damage on pit walls, control fragmentation, maximize equipment productivity, and reduce the overall cost of drilling and blasting. Production blast pattern parameters are summarized in Table 15-4.

*Table 15-4: Drill and Blast Design Parameters*

| Drill and Blast Design | Units | Value |
|---|---|---|
| Bench Height | m | 10.00 |
| Hole Diameter | mm | 115.00 |
| Burden | m | 3.20 |
| Spacing | m | 3.68 |
| Distance Hole to Hole | m | 4.88 |
| Sub Drill | m | 1.00 |
| Hole Length | m | 11.00 |
| Stemming | m | 3.84 |
| Area of Influence | $m^2$ | 11.78 |
| Powder Column | m | 7.16 |
| Powder/hole | kg | 87.71 |
| ANFO SG | SG | 1.15 |
| Emulsion SG | SG | 1.25 |
| %Emulsion Blend | % | 30% |
| Blended SG | SG | 1.2 |
| Rock SG | SG | 2.7 |
| Tonnes per Hole - Ore | t/hl | 318.0 |
| Tonnes per Length | t/m | 28.9 |
| Tonnes per Hole - Waste | t/hl | 318.0 |
| Powder Factor | kg/tonne | 0.28 |
| Powder Factor | kg/$m^3$ | 0.74 |
| Powder Factor | lbs/ton | 0.55 |

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# 15.4 Mine Equipment

## 15.4.1 Time Usage Model

The time model structure used for calculating open pit equipment hours is shown in Table 15-5 with the corresponding definitions and criteria shown below. A breakdown of each metric is shown for the major equipment in Table 15-6. Time delay details and assumptions associated with standby and operational losses for major mining equipment used to calculate use of availability and operating efficiency are shown in Table 15-7. Delay times for loading equipment, dozers, and support equipment utilize fixed time assumptions for a given time interval, while the haul trucks and drills incorporate cycle-based delays that are a function of the final production numbers, i.e. final number of haulage cycles and holes drilled.

*Table 15-5: Time Model Structure*

| | | | | |
|---|---|---|---|---|
| Calendar Hours | Total Available Hours | | | |
| Availability | Available Hours | | | Maintenance |
| Use of Availability | Operational Hours | | Standby | Maintenance |
| Operating Efficiency | Effective Hours | Operational Losses | Standby | Maintenance |

The following are the definitions used in the time model.

- Total Available Hours
  - Hours in a calendar year. At 24 hr/d and 365 d/yr, the total available hours are 8,760 hr/y.
- Available Hours
  - Total available hours less maintenance hours per piece of equipment.
- Maintenance Hours
  - Includes waiting for maintenance personnel, waiting for maintenance equipment or spare parts, travel time to and from the shop, actual maintenance time, movements, and waiting time within the shop.
- Standby Hours
  - The unit is mechanically operable but is not manned or used (e.g., schedule loss, safety meetings, meals, breaks, blasting, shift change, weather outages, refueling, and training).
- Operational Hours
  - Available hours less standby time – used for labor and fuel costing purposes.
- Operational Loss Hours
  - The equipment is operating but not performing its specific production duty (truck queue time), drill rig setup, shovel / drill moves, cleaning of work faces).
- Effective Hours
  - Operational hours, less operational loss hours.

The criteria for lost time were applied through the following factors.

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- Availability – (measure of maintenance down time) is expressed as available hours divided by total available hours. Availabilities remained constant throughout LOM, although actual mechanical availability is likely to decrease over time as the equipment ages.
- Use of availability – operational hours divided by available hours.
- Operating efficiency – effective hours divided by operational hours.
- Overall effective utilization – product of availability, use of availability, and operating efficiency.

On this basis, the target equipment availability, use of availability, and operating efficiency were defined for each of the major equipment units and displayed in Table 15-7.

*Table 15-6: Time Model Metrics for Major Equipment*

| Year | Units | Excavators | Haul Trucks | Drills | Dozers | Support |
|---|---|---|---|---|---|---|
| Availability | % | 90% | 88% | 85% | 75% | 75% |
| Use of Availability | % | 85.0% | 81.9% | 79.1% | 78.7% | 78.7% |
| Operating Efficiency | % | 81.2% | 69.1% | 83.7% | 80.6% | 80.6% |
| Effective Utilization | % | 62.1% | 49.8% | 56.3% | 47.6% | 47.6% |

*Table 15-7: Standby and Operating Delays for Major Equipment*

| **Use of Availability** | **Units** | **Excavators** | **Haul Trucks** | **Drills** | **Dozers** | **Support** |
|---|---|---|---|---|---|---|
| Unplanned Non-Operating Days | hr / day | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| Standby (No-Operator) | hr / day | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| Shift Change, Inspection | hr / day | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Lunch | hr / day | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Fueling | hr / day | 0.00 | 0.60 | 0.60 | 0.60 | 0.60 |
| Blasting | hr / day | 0.14 | 0.14 | 0.57 | 0.14 | 0.14 |
| Other | hr / day | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Operating Delays per Day | hr / day | 3.23 | 3.83 | 4.26 | 3.83 | 3.83 |
| Operational Hours | hr / day | 18.37 | 17.29 | 16.14 | 14.17 | 14.17 |
| **Use of Availability** | **%** | **85.0%** | **81.9%** | **79.1%** | **78.7%** | **78.7%** |
| Operating Efficiency | Units | Excavators | Haul Trucks | Drills | Dozers | Support |
| Face / Loading Area Cleanup | hr / day | 0.87 | | | | |
| Short Moves | hr / day | 1.73 | | | | |
| Shovel Wait for Trucks | hr / day | 0.87 | | | | |
| Support: Idle | hr / day | | | | 2.75 | 2.75 |
| Truck: Dump Time | hr | | 2,062 | | | |
| Truck: Load, Spot, and Queue Time | hr | | 9,461 | | | |
| Truck: Travel Time | hr | | 25,755 | | | |
| Drill: Move and Setup | min / hole | | | 7.50 | | |
| Drill: Pattern Setup | min / pattern | | | 30.00 | | |
| Drill: Pullout Hole | min / hole | | | 5.00 | | |

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| Use of Availability | Units | Excavators | Haul Trucks | Drills | Dozers | Support |
|---|---|---|---|---|---|---|
| Total Production Holes Drilled | holes | | | 481,473 | | |
| Total Operational Losses | hr | | 11,524 | 101,270 | | |
| Total Effective Hours | hr | | 25,755 | 520,802 | | |
| Total Operational Losses per day | hr / day | 3.46 | 5.34 | 2.63 | 2.75 | 2.75 |
| Effective Hours | hr / day | 14.91 | 11.95 | 13.51 | 11.42 | 11.42 |
| **Operating Efficiency** | **%** | **81.2%** | **69.1%** | **83.7%** | **80.6%** | **80.6%** |

## 15.4.2 Excavator Productivity

Production requirements can be achieved by utilizing a single loading unit with a bucket capacity of 7.4 $m^3$. A CAT 6015 with a backhoe configuration was chosen as the primary loading unit, matching a fleet of 76.9 tonne Komatsu HD605 haul trucks. This fleet combination requires 5 to 6 passes for the excavator to fill a truck.

A secondary loading unit was incorporated to assist with site activities and operations but was not required to achieve production targets. A CAT 844 front end loader was selected for this role.

The excavator has a 90% availability, with a use of availability of 85%. Production rates were developed using a first principles approach and then used for scheduling. Material properties for ore and waste were considered to be the same. The loading unit productivity includes waiting, maneuvering, and unproductive time estimates and are shown in Table 15-8. It does not consider operational losses, standby time, or maintenance time; those metrics are used as inputs within Deswik and applied to the production rates.

*Table 15-8: Excavator and Truck Rates*

| Material Parameters | Units | Ore / Waste |
|---|---|---|
| Bank Density | t / m3 | 2.70 |
| Swell | % | 33% |
| Loose Density | t / m3 | 2.03 |
| | | |
| Excavator Parameters | CAT 6015 | |
| Bucket Capacity | m3 | 7.40 |
| Bucket Fill Factor | % | 90% |
| Loose Capacity | m3 | 6.66 |
| Bucket Payload per Pass | t | 13.52 |
| Cycle Time per Pass | sec | 30.00 |
| | | |
| Truck Parameters | Komatsu HD605 | |
| Haul Truck Capacity | t | 76.90 |
| Spot Time | sec | 30.00 |
| Time for First Bucket | sec | 10.00 |

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| | | |
|---|---|---|
| Total Buckets for Load | # | 6.00 |
| Loading Time | min | 3.17 |
| Truck Loads per Hour | | 18.95 |
| | | |
| Hourly Production - No Delays | t / hr | **1,457** |
| Daily Production - No Delays | t / d | 34,969 |

## 15.4.3 Truck Productivities

Haul trucks were selected based on the loading fleet, production targets, and operational conditions. A fleet of Komatsu HD605, with a payload of 76.9 tonnes, matches the selected excavator (7.4m3) requiring 5 to 6 passes. Haul road widths will be designed at 20 m for 2-lane roads.

Deswik's Landform and Haulage Suite were used to calculate the truck hours required for the associated mining schedule. Operating hours for haulage equipment were calculated in Deswik and are based on the shovel position, haul route(s), and dump progression. Deswik uses truck specific data to calculate the loaded and unloaded haul times, plus fixed loading and dump times, to determine an overall cycle time.

Once the schedule was finalized, the appropriate availability and use of availability were applied to determine the number of trucks required for production. The trucks are assumed to have an 88% Availability, a Use of Availability of 81.9%, and an Operating Efficiency of 69.1%.

The truck fleet and dump time at destinations are described in Table 15-9.

*Table 15-9: Dump Time at Destinations*

| Dump Time at Destinations | Units | Value |
|---|---|---|
| Dump Time @ Crusher | min / load | 0.80 |
| Dump Time @ Dump | min / load | 0.80 |

## 15.4.4 Drill Productivities

Drills capable of drilling 11 m holes with a diameter of at least 115 mm to accommodate 10 m benches were identified as the ideal match for the mining fleet. Epiroc's PowerROC T50s were selected for production drilling with a single smaller drill used for pre-split holes.

Production drills assumed a penetration rate of 4 minutes per meter, capable of drilling between 4,750 and 5,300 tonnes per day, assuming the time model metrics listed in section 16.4.1 above.

## 15.4.5 Fleet Estimation

Final fleet determination for production equipment considered the Deswik Landform and Haulage model in combination with the time model assumptions to quantify the required hours and equipment quantities given the desired annual production targets.

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The quantity of support equipment required was based on operational factors, such as the quantity of primary equipment to service, the number of active mining and dumping areas, and roads to maintain.

*Figure 15-2: Required Production and Support Equipment*

| **Production Equipment** | **LOM Max Quantity** |
|---|---|
| Excavator (CAT 6015) | 1 |
| Front End Loader (CAT 844) | 1 |
| Haulage Trucks (Komatsu HD605-10) | 4 |
| Production Drills (PowerROC T50) | 4 |
| **Support / Ancillary Equipment** | **LOM Max Quantity** |
| Backhoe | 1 |
| F-250 / 2500 | 4 |
| Fuel/Lube Trucks | 1 |
| Light Plants | 8 |
| Mobile Scalper | 1 |
| Motor Grader | 2 |
| Pre-Split Drill | 1 |
| Service Truck | 1 |
| Skid Steers | 1 |
| Telescopic Handler | 1 |
| Track Dozer (D6) | 1 |
| Water Truck | 1 |
| Wheel Dozer | 1 |

### 15.4.6 Mining Fleet Numbers

## 15.5 Workforce

Indirect and direct labor headcounts were developed for the CSM based on the required equipment fleet to meet production expectations as well as to support operations. *Figure* summarizes the estimated headcounts

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for both classes. Indirect labor includes mine management, maintenance personnel, and operations support staff. Direct labor includes equipment operators directly involved in pit production operation.

| | Description | Qty |
|---|---|---|
| Indirect Labor | CSM - General Manager | 1 |
| | CSM - Mine/Engineer Superintendent | 1 |
| | CSM - Admin | 2 |
| | CSM - Engineer 1 | 1 |
| | CSM - Geologist | 1 |
| | CSM - Surveyor | 2 |
| | CSM - Office Staff | 2 |
| | CSM - HR Manager | 1 |
| | CSM - HSE Supervisor | 1 |
| | CSM - Mine Supervisor | 2 |
| | CSM - Maintenance Supervisor | 1 |
| | CSM - Maintenance Planner | 1 |
| | CSM - Mechanic | 6 |
| | CSM - Electrician | 1 |
| | CSM - Heavy Equipment Operator | 5 |
| | CSM - Laborer | 2 |
| | | |
| Direct Labor | CSM - Haul Truck Driver | 4 |
| | CSM - Excavator Operator | 2 |
| | CSM - Driller | 8 |

*Figure 15-3: Direct/Indirect Labor Headcounts*

Labor rates used in the PFS are based on current average contractor quotes from Stantec's database as well as Costmine MME. All of the labor rates presented in Figure 15-3 and Figure 15-4 include a base rate, bonuses, allowances, and overtime. It should be noted that corporate overhead rates are excluded from the PFS cost estimate.

| | Description | Cost per Hour (USD) |
|---|---|---|
| Indirect Labor | CSM - General Manager | $ 168.27 |
| | CSM - Mine/Engineer Superintendent | $ 127.40 |
| | CSM - Admin | $ 64.24 |
| | CSM - Engineer 1 | $ 98.56 |
| | CSM - Geologist | $ 92.56 |
| | CSM - Surveyor | $ 50.39 |
| | CSM - Office Staff | $ 43.69 |
| | CSM - HR Manager | $ 69.71 |
| | CSM - HSE Supervisor | $ 79.66 |

*Figure 15-4: Indirect Labor Rates*

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| | | | |
|---|---|---|---|
| | | | |
| Direct Labor | CSM - Haul Truck Driver | $ | 66.30 |
| | CSM - Excavator Operator | $ | 84.39 |
| | CSM - Driller | $ | 84.39 |
| | CSM - Heavy Equipment Operator | $ | 61.40 |
| | CSM - Laborer | $ | 54.10 |
| | CSM - Mine Supervisor | $ | 88.41 |
| | CSM - Maintenance Supervisor | $ | 83.36 |
| | CSM - Maintenance Planner | $ | 83.36 |
| | CSM - Mechanic | $ | 63.98 |
| | CSM - Electrician | $ | 89.09 |

*Figure 15-5: Direct Labor Rates*

# 15.6 Closure

## 15.6.1 Closure Planning

Closure of the Cowboy State Mine will be conducted in accordance with the applicable permit stipulations and post-mining land use objectives established for the site. The extent and nature of closure activities are contingent upon which operational scenario is achieved during mining operations. Two primary closure scenarios were evaluated, a Best Case and a Worst Case, with an intermediate option also considered. Each scenario carries different operational, financial, and environmental implications, and each is described in detail below.

## 15.6.2 Best Case-Continued Mining

The preferred closure scenario assumes continued northward mining expansion onto Federal lands. Under this scenario, WRI retains control of the greater Halleck Canyon Deposit. The Red Mountain area is split between State mineral rights covering the southern portion and Federal mineral rights covering the northern portion. This Preliminary Feasibility Study addresses the State Mineral rights only.

In practical terms, it is anticipated that mining operations will continue into the Federal Mineral (North) portion at some point during the operational life of the Cowboy State Mine. As such, full closure of the site would be deferred pending the outcome of permitting and development of the Federal portion of the deposit. For the purposes of this report, costs associated with care and maintenance of the site during any transitional period between State and Federal mining operations are included in the overall cost estimate. This scenario represents the most favorable outcome from both an operational continuity and closure cost perspective.

## 15.6.3 Intermediate Case-Pit Lake Closure

If northward expansion onto Federal lands proves uneconomical or if permitting cannot be secured, an intermediate case closure scenario would be implemented. This scenario involves the formation of a pit lake, achieved through regrading of the pit walls to a 3:1 slope to the water table line, approximately 30 meters below the final pit crest elevation. The north highwall would be left intact and is expected to provide beneficial wildlife habitat value as part of the post-mining land use.

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The estimated earthwork volume associated with this regrading effort is approximately 20,000,000 cubic meters of unconsolidated tailings material. Closure operations under this scenario would be conducted at one shift per day, five days per week, with blasting carried out as required throughout the regrading program. This scenario represents a balanced outcome, limiting closure costs while still achieving a stable and functional post-mining landform.

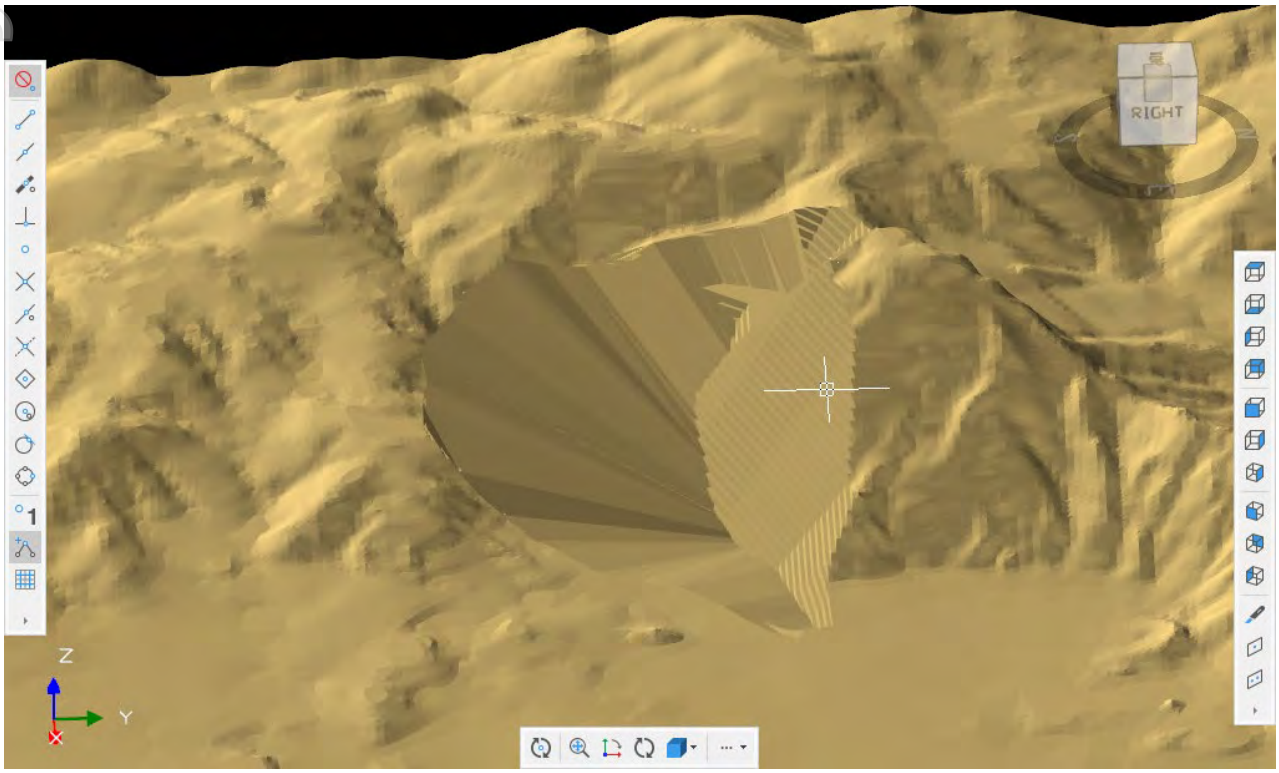


*Figure 15-6: Intermediate Case Pit Regrade Model*

### 15.6.4 Worst Case-Full Pit Regrading with TSF Rehandle

The worst-case closure scenario would be triggered if full pit regrading is required in conjunction with rehandling of the Tailings Storage Facility (TSF). This scenario requires regrading the entire pit to a 3:1 slope, along with the associated rehandle of TSF material. The total earthwork volume under this scenario is estimated at approximately 30 million cubic meters, representing a substantial increase in scope relative to the mid-case scenario.

Work would be conducted at one shift per day, five days per week for the full duration of the closure program. This scenario carries considerable rehandle costs and represents the most operationally intensive and financially burdensome closure pathway available. It is considered the least preferred outcome and would only be pursued if required by permit stipulations or if other closure options are deemed unviable.

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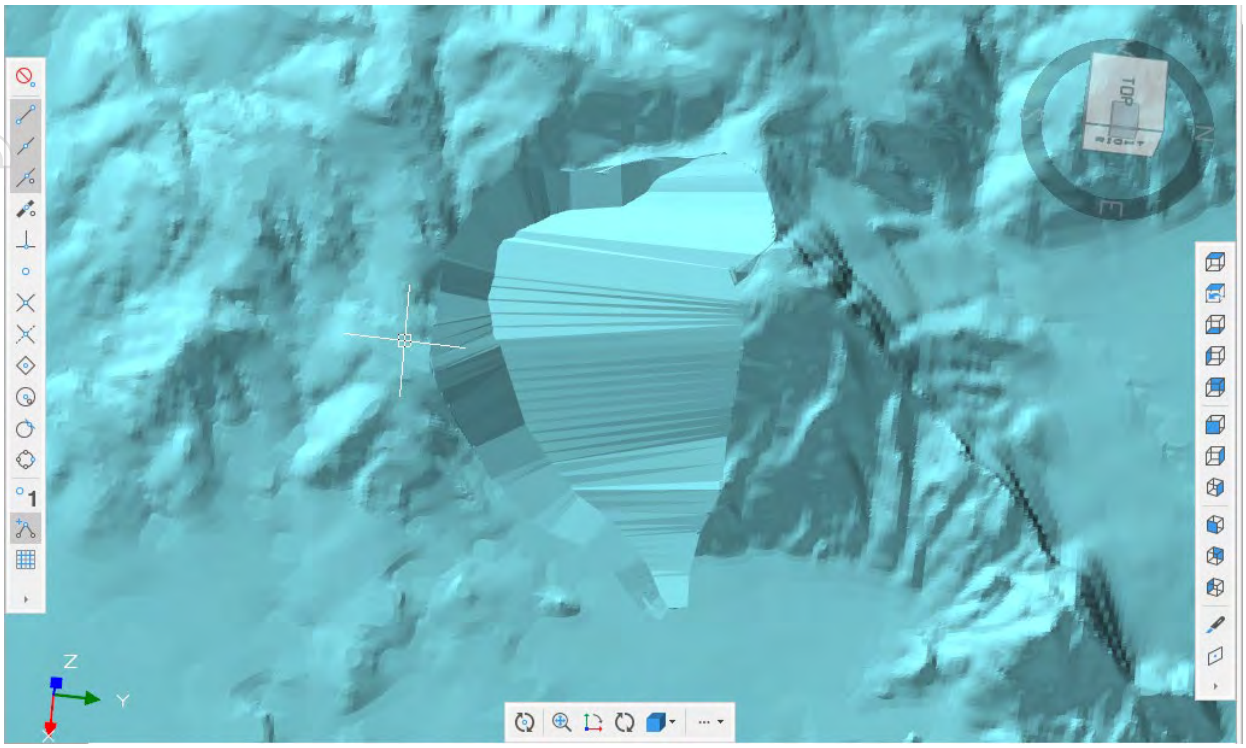


*Figure 15-7: Worst Case Pit Regrade Model*

# 16 Process and Recovery Methods

## 16.1 Process Summary

Comminution and concentration facilities will be located at the proposed mine site. The extraction, impurity removal, and separation and finishing will be located in the town of Wheatland WY at the Refinery Site. It is advantageous to locate the Refinery Site in Wheatland due to rail accessibility and existing infrastructure for natural gas, power and water. The concentrate would be trucked from the Mine Site to the Refinery Site. The proposed Cowboy State Mine rare earth processing components consists of the following components.

- Mine Site -
  - Comminution Circuit where run-of-mine ore is crushed to 100% passing 300 micron using a jaw crusher, cone crusher and a Vertical Roller Mill (VRM).
  - Concentration Circuit concentrates the TREO content of the ore approximately ten times (10X) using a combination of gravity separation such as a Reflux Concentrating Classifier (RCC) and a dry magnetic separation using Induced Roll Magnetic Separators (IRMS) and Wet High Intensity Magnetic Separation (WHIMS) for the fines stream, <50 micron. The gravity

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concentrate will be dried using a direct fired rotary dryer to create a dry feed necessary for the IRMS process.
    - Associated plant infrastructure (concentrate loading, tailings unloading, tailings storage facility, etc.)
- Refinery Site
    - Extraction Circuit where the REE is leached from the solid ore concentrate and placed into solution using a dilute sulfuric acid tank leaching circuit.
    - Impurity Removal Circuit removes Fe, Th, Al, and U, using two neutralization/precipitation steps and a Uranium Ion Exchange (IX) to remove any residual U and to protect against pH upsets in the neutralization steps.
    - A bulk solvent extraction circuit takes the uranium IX effluent and loads onto the organic in the extraction circuit, a scrub circuit uses a dilute sulfuric acid stream as the scrub solution while the strip circuit will use a dilute hydrochloric acid as the strip solution which will convert the matrix from sulfate to a chloride. A chloride matrix is favorable for the downstream solvent extraction circuits to produce the separated oxide products. The other purpose for the bulk extraction circuit is to reject cerium and lanthanum to the waste water treatment plant since the sales price is low and the markets are saturated.
    - Separation and Finishing Circuit where Solvent Extraction (SX) is used to separate the REE's into the following finished products:
- Neodymium (Nd)/Praseodymium (Pr) Oxide also referred to as Nd/Pr Oxide
        - Samarium (Sm)/Gadolinium (Gd)/Europium (Eu) mixed Oxide
        - Gadolinium Oxide (Gd)
        - Terbium Oxide (Tb)
        - Dysprosium Oxide (Dy)
    - Associated plant infrastructure (wastewater treatment plant, raw material railcar unloading and storage, concentrate unloading, tailings loading, steam boiler, cooling towers, tailings storage facility, etc.)

# 16.2 Preliminary Design Basis

## 16.2.1 Process Design Basis

The Process Design Basis presents key design parameters to be used for heat and material balances, equipment sizing, and as input for the next stages of project development.

### 16.2.1.1 Production Capacity

- Comminution – The Comminution circuit will process 4.5 million metric tonnes per annum (Mtpa), or 13,678 metric tonnes per day (mtpd) assuming a 90% uptime (329 days per year) of Run of Mine (ROM) ore on a dry basis. The TREO content of the ROM is 4,184 ppm TREO averaged over the first 5 years of production.
- Concentration – The Concentration circuit would be designed to match the Comminution rate of 4.5 Mtpa of ore on a dry basis, or 13,678 tpd assuming a 90% uptime (329 days per year) of crushed ore. The Concentration circuit will produce 287,222 tpa or 873 mtpd on a dry basis assuming a 90% uptime

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(329 days per year) of concentrate. This corresponds to an Overall Concentrate Recovery of 6.4% mass yield. The Overall TREO Concentrate Recovery Recovery is 65% for the combination of WHIMS fines treatment, gravity concentration, and IRMS magnetic concentration. The gravity concentrate dryer is designed for 1,600 mptd dry basis with the feed coming from a stacking cyclone with an assumed 25% moisture.

- Extraction (Leach) – The Extraction circuit would be designed to process 287,222 tpa or 873 mtpd on a dry basis assuming a 90% uptime (329 days per year) of concentrate. This corresponds to an Overall Concentrate Recovery of 6.4% mass yield. The Leach Residue Filter is designed for 1,024 mtpd of solids on a dry basis. Wash water flowrate for the filter is 624 gpm which will be recycled to the leach tanks along with 190 gpm of water contained in the 25% dilute sulfuric addition of 218 gpm. The percent solids of the leach reaction is 15% solids.
- Impurity Removal
    - Iron (Fe) Removal - The Iron Removal circuit is designed to match the output of the Extraction (Leach) Circuit, or 862 gpm of Pregnant Leach Solution (PLS). Mg(OH)2 15% slurry will be added at ~156 gpm to attain a pH target of 3.15. The Iron Removal Filter is designed for 60 mtpd of solids assuming 15% moisture in the cake, with 100 gpm of wash water.
    - Aluminum (Al) Removal - The Aluminum Removal circuit is designed to match the output of the Iron Removal Circuit, or 965 gpm of Iron Removal leachate. Mg(OH)2 10% slurry will be added at ~128 gpm to attain a pH target of 5.25. The Aluminum Removal Filter is designed for 33 mtpd of solids assuming 15% moisture in the cake, with 50 gpm of wash water.
    - Uranium (U) Removal – The Uranium Removal circuit is designed to match the output of Aluminum Removal, or 1,025 gpm of Aluminum Removal leachate. The Ion Exchange (IX) columns will be sized for a 3 mg/L uranium concentration in the feed.
    - Bulk Solvent Extraction – The Bulk Solvent Extraction circuit is sized for 1,025 gpm of Uranium Removal effluent liquor containing approximately 32 mtpd of TREO. The circuit will consume approximately 6.2 mtpd of caustic, 364.2 mtpd of concentrated sulfuric and 158.7 mtpd of concentrated hydrochloric acid.
- Separation and Finishing – The Separation and Finishing circuit would be designed to match the output of the Impurity Removal plant.
    - Solvent Extraction Bulk (SXB)
        - Heavies Precip and Finishing
    - Solvent Extraction Nd/Pr (SXNd/Pr)
        - Nd/Pr Precip and Finishing
    - Solvent Extraction La/Ce (SXLa/Ce)
        - La/Ce Precip
    - Solvent Extraction Dy (SXDy)
        - Dy Precip and Finishing
        - Heavies Precip and Finishing
    - Solvent Extraction Tb (SXTb)
        - Tb Precip and Finishing
        - SEG Precip and Finishing
    - (In Development) Solvent Extraction SEG (SXSEG)
        - (In Development) Sm Precip and Finishing

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### 16.2.1.2 Product Specifications

- Comminution – The Comminution circuit will produce a crushed ore product with 100% passing 0.3 mm (300 micron) and a $P_{80}$ 204 microns. Fines less than 50 microns should be minimized utilizing a screening or sizing circuit to prevent over grinding.
- Concentration – The concentrate product produced in the Concentration Plant will have an estimated average TREO concentration of 4.27% TREO (42,700 ppm TREO) with a production rate of 873 mtpd on a dry basis. The ground ore will be concentrated using gravity separation and magnetic separation techniques. The gravity separation equipment consists of RCC. The magnetic separation is performed by IRMS units which require a dry feedstock, therefore the gravity separation concentrate is dried in a direct fired rotary dryer prior to IRMS. The gravity and magnetic separation technologies are unable to process fines. Any fines generated (<50 microns) will be concentrated using WHIMS in a rougher/cleaner arrangement but the upgrade factor and TREO recovery of the WHIMS is lower than the gravity/magnetic concentration so therefore economically fines should be minimized in the comminution step.
- Extraction – The extraction circuit consists of a sulfuric acid tank leach followed by filtration to remove the leach residue silids. The PLS produced in the Extraction circuit will have an REO (Treo minus LA and Ce) concentration of at least 1 g/L at a free acidity of 32 g/L, with a production rate of 794 gpm.
- Impurity Removal – The Impurity Removal Circuit consists of an Iron Removal and Al Removal where $Mg(OH)_2$ is added to increase the pH to 3.15 and 5.25, respectively. The Uranium Removal Circuit consists of multiple ion exchange columns that bind the uranium to resin. Once loaded the uranium resin will be send off site for proper disposal. The final step the separation of REO's via a bulk solvent extraction. This step will transfer the remining REO's into an organic extractant phase, while leaving behind the remaining impurities where they will be send to water treatment.
- Separation and Finishing – Separation and Finishing will produce the following five finished products for sale. As well as a mixed heavy rare earth oxide byproduct.
- Neodymium / Praseodymium (Nd/Pr) Oxide (didy Oxide) – 2,498.2 tpa
    - SEG Oxide Concentrate – 253.2 tpa on a TREO basis
    - Terbium (Tb) Oxide – 12.7 tpa
    - Dysprosium (Dy) Oxide – 30.5 tpa

The product specifications will be developed in upcoming design work using computer simulations and laboratory testing.

### 16.2.1.3 Run of Mine Analysis

Comminution Feedstock or ROM Ore head analysis for Halleck Creek is shown below in Table 16-1.

*Table 16-1: Halleck Creek Composite Head Analysis*

| Rare Earth Oxide, ppm | Value | Gangue, % | Value |
|---|---|---|---|
| $Y_2O_3$ | 221 | $SiO_2$ | 61.8 |
| $La_2O_3$ | 751 | $Fe_{tot}$ | 5.11 |
| $CeO_2$ | 1583 | FeO | 5.20 |



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| Rare Earth Oxide, ppm | Value | Gangue, % | Value |
|---|---|---|---|
| $Pr_6O_{11}$ | 189 | $Al_2O_3$ | 15.9 |
| $Nd_2O_3$ | 644 | $P_2O_5$ | 0.072 |
| SEGs | 187 | CaO | 2.87 |
| HREOs | 105 | $K_2O$ | 6.03 |
| CREOs | 887 | $Na_2O$ | 4.24 |
| TREO+Y | 3668 | $TiO_2$ | 0.50 |

The TREO distribution in the ore of Halleck Creek is shown below in Table 16-2.

*Table 16-2: REE Distribution in Feed*

| TREO distribution | Feed +Y, % |
|---|---|
| La | 20.55% |
| Ce | 43.37% |
| Nd/Pr | 22.72% |
| SEG | 5.18% |
| Tb | 0.23% |
| Dy | 1.30% |
| Y | 6.64% |
| | 100% |

### 16.2.1.4 Operating Factor or Uptime

General operating factors are as follows.

- Operating Factor = Operating time x Capacity Utilization where:
  - Operating-time: number of operating hours per year.
  - Capacity Utilization: average annual percentage of design capacity achieved when operating.

Operating time incorporates both planned and unplanned maintenance and hours lost when the process chemistry deviates from its design.

Capacity utilization accounts for lower than nameplate production during ramp-up and ramp-down around shut-downs and limitations on one area caused by dependency on adjacent areas.

An Operating Factor of 90%, or the equivalent of 329 days of operation per year was assumed for all areas of the plant. Further refinement will occur in the next stages of design.

The Operating Factor is equivalent to the annual production of saleable product divided by the theoretical annual production of the plant operating at its design rate for 7,896 hours per annum.

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#### 16.2.1.5 Storage Capacities

- Comminution – ROM (ore) will be stockpiled in outdoor impoundments designed to de-couple mining operations from the Comminution circuit. These stockpiles will accommodate planned and unplanned downtime. The exact size and location of these stockpiles will be designed in upcoming engineering and design studies.
- Concentration, Extraction, Impurity Removal, Separation and Finishing – The balance of plant will contain numerous points of surge storage in the form of tankage and solid impoundments. The surge storage will serve to accommodate transportation delays, planned and unplanned downtime as well as batch operations within an otherwise continuous operation. The exact size and location of these items will be designed in upcoming engineering and design studies.

#### 16.2.1.6 Control and Automation

All areas of a conceptual processing plant will be semi-automated. Equipment and stream flows would be automated and primarily controlled from a control room. Local controls would also be installed where required. Laboratory technicians will manually perform chemical analyses such as rare earth product element distribution and tailings elemental distribution. The Process Flow Diagrams (PFD) and Piping and Instrumentation Drawings in particular will show the major control loops (Temp, Flow, pH, Pressure, etc.)

#### 16.2.1.7 Radionuclides

Two radionuclide elements, (thorium (Th) and uranium (U)) and associated daughter products are present in Halleck Creek mine mineralization at low levels. The combined concentration of these two radionuclides is approximately 68 ppm in ROM ore.

Further simulation and laboratory testing in future engineering studies is needed to determine the deportment and concentration of the radionuclides within the proposed process and products. The impurity removal plant is designed to remove both Th and U via a precipitation reaction followed by filtration and ion exchange to remove and precipitate, respectively.

The radionuclide content reporting to the rare earth carbonate concentrate is currently estimated at levels below 0.001%. Further testing will be required to evaluate the exact concentration in radionuclides. This concentration is not expected to exceed 0.001%. The current beneficiation methods will result in a low radionuclide level that meet the current regulatory guidelines. Additional test work is needed to determine radionuclide levels in tailings disposal material.

## 16.3 Process Description

A Block Flow Diagram (BFD) is provided in Figure 16-1 for the Cowboy State Mine.

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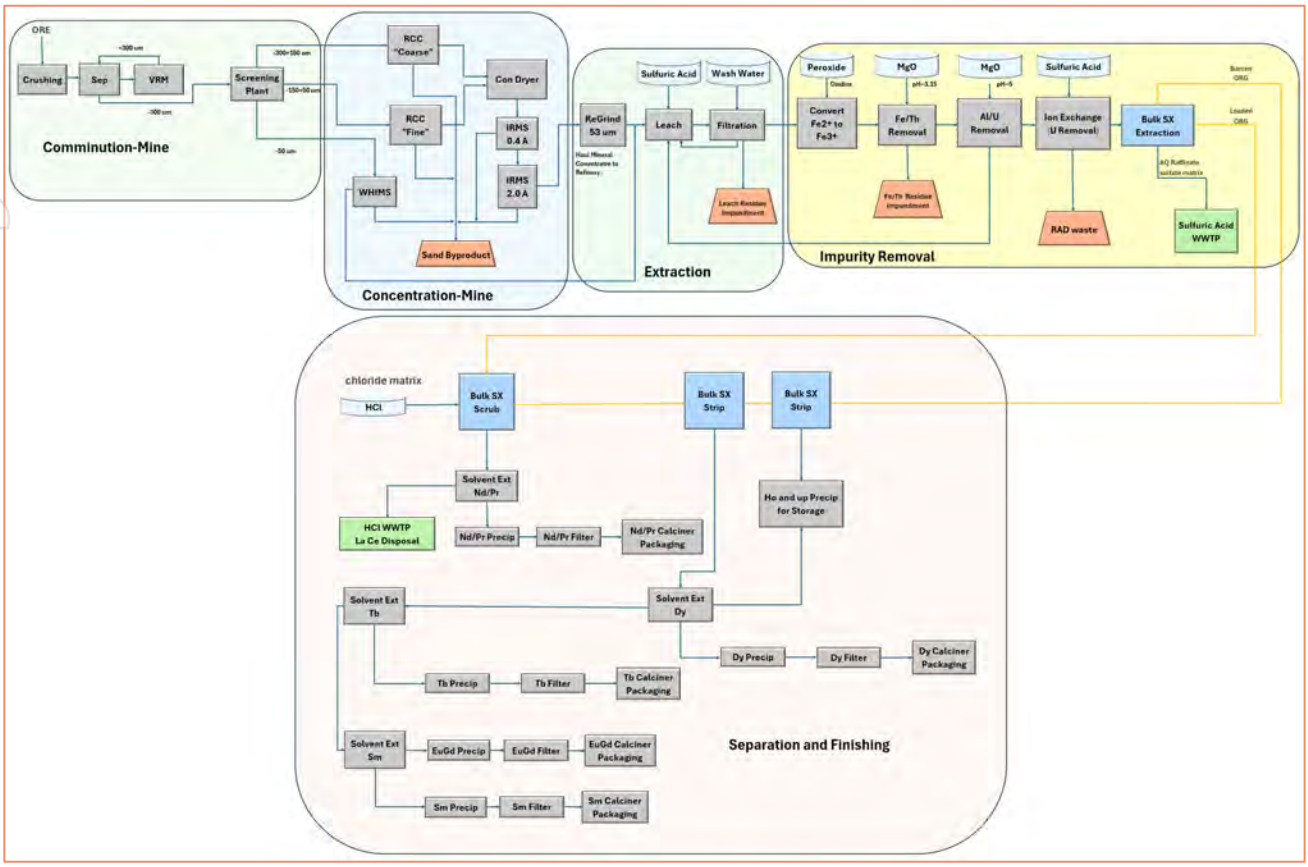


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*Figure 16-1: Preliminary Flowsheet*

## 16.3.1 Comminution

Initial crushing is provided by a Jaw Crusher and Cone Crusher. Grinding is provided by a Vertical Roller Mill (VRM) along with air classification to prevent overgrinding and generation of fines. Ore is ground to 100% passing 300 micron while separating material that is <50 micron which will require a different concentration method than the -300/+50 micron material.

## 16.3.2 Concentration

The concentration circuit is arguably the most important circuit in the flowsheet. In the concentration circuit the REE is retained in the concentrate while rejecting as much mass to tailings as possible. By concentrating before Extraction, the size of equipment and amount of acid added is minimized. The ratio of TREO in the concentrate divided by the TREO in the ore is referred to as the “Upgrade Factor”. The concentration circuit provides for a 10X Upgrade Factor, concentrating the REE by a factor of ten while retaining only 6.4% of the total mass.

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#### 16.3.2.1 Gravity and Magnetic Separation

Undersize material, referred to as “fines” (defined as less than 50 microns) will be sent through WHIMS (rougher/cleaner arrangement) to concentrate the REE and reject gangue. It is assumed that 20% of the ground ore will be <50 microns. The WHIMS separation delivers 16% mass yield and 58% TREO Recovery.

The light gangue material can be removed using a Reflux Concentrating Classifier (RCC). The gravity separation rejects roughly 75% of the ore with a 21% TREO yield loss (25% mass yield and 79% TREO Recovery).

The magnetic separators (IRMS) require a dry feed, so the gravity concentrate will be dewatered using a stacking cyclone to allow the wet solids to be fed to a direct fired rotary dryer. Feedrate to the dryer is 2,047 mtpd with an approximate 15% moisture.

The magnetic separators (IRMS) are very efficient at separating the allanite from the hastingsite while rejecting 72% of the gravity concentrate mass with a 15% TREO yield loss (28% mass yield and 85% TREO Recovery – Option 2 non-mag retreat using spirals).

The Concentration flowsheet shows that only 6.4% of the ore mass is sent forward for further processing with a TREO Recovery of 64.8%. The concentration of TREO is upgraded by a factor of 7.0 (4,200 ppm TREO in the ore, 42,700 ppm TREO in the Concentration product).

### 16.3.3 Extraction

The Extraction circuit takes the gravity/magnetic concentrate solids and solubilizes the REE into solution using sulfuric acid and heat. The acid dosage is measured as ‘kg of sulfuric (dry)/ton of concentrate’. Therefore, the amount of acid added to the Extraction circuit is based on total tonnage of concentrate and is independent of the TREO concentration in the concentrate.

#### 16.3.3.1 Leaching

The leaching step will solubilize the rare earth elements from the concentrate material using sulfuric acid. Leaching will be carried out in Continuously Stirred Tank Reactors (CSTR) in a gravity cascade arrangement with a scrubbing system to remove and neutralize any acid fumes from the tanks. Leach residue solids are filtered from the leachate using a Vacuum Belt Filter (VBF). The filtration will utilize counter-current water washing of the cake to prevent REE losses if the filter cake is left wetted with leachate. The wash water will be recycled to the leaching tanks since water is required to bring the leach slurry to 15% solids. Leach tank heating is applied through direct steam injection since additional water is to be added to bring the % solids to 15% in any event.

Leach testing performed by SGS showed that sulfuric acid tank leaching is the preferred option due to recovery, cost of reagents, ease of processing, limited corrosion, and material of construction simplicity. Sulfuric acid bake with a water leach was also evaluated but did not show a dramatic increase in recovery, and raw material usage was higher. The acid bake/water leach also requires more exotic metallurgy to prevent corrosion and wear. Counter current leaching was tested using a series of batch reactions but did not result in positive results to offset the additional equipment required for an extra filtration step.

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The sulfuric acid tank leach testing varied the acid dosage, temperature, % solids, temperature and residence time. The optimal operating conditions were found to be 15% solids, 400 kg of sulfuric acid per mt of solid concentrate, 90°C operating temperature, and 6 hr of residence time. With these operating parameters, the rare earth recovery and the extraction of the gangue materials data is provided in Table 16-3. The cake wash liquor will be recycled back to the leach tanks which will account for a portion of the necessary water in the leach.

*Table 16-3 Sulfuric Acid Leach Results*

| **Optimal Leach Conditions** | **AL23** |
|---|---|
| Feed | 100% Unaltered + WHIMS Concentrate |
| Regrind Particle Size | -53 µm |
| Acid Dosage | 400 kg/t |
| Retention Time | 6 hrs |
| Temperature | 90°C |
| % Solids | 15% |
| | |
| Leach Result | |
| La Extraction | 94% |
| Pr Extraction | 91% |
| Nd Extraction | 88% |
| Tb Extraction | 54% |
| Dy Extraction | 46% |
| Fe Extraction | 22% |
| Al Extraction | 25% |
| Mg Extraction | 35% |
| Ca Extraction | 12% |
| Th Extraction | 96% |
| U Extraction | 94% |
| Final Acidity | 35 g/L |

The general leaching reaction equations for primary components are:

- Rare Earth Oxides Reaction

$$REE_2O_3\ (s) + 3H_2SO_4\ (Aq) \rightarrow REE_2(SO_4)_3\ (Aq) + 3H_2O(l) \qquad \text{Eq. 1}$$

In Equation 1, REE is a rare earth element such as Yttrium present in the pre-concentrate. Cerium oxide is insoluble in the leach reaction thus rejecting cerium to the tailings.

- Iron and Aluminum Reactions, Iron (III) Oxide ($Fe_2O_3$), Aluminum Oxide ($Al_2O_3$)

$$M_2O_3\ (s) + 3H_2SO_4\ (l) \rightarrow 2M^{3+} + 3(SO_4^{-2}) \qquad \text{Eq. 2}$$



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In Equation 2, M represents both Fe and Al. Both of these metals will behave similarly in the sulfuric leach. Table 1-3 provides the leach recovery for Fe as 22% and for Al as 25% at 400 kg sulfuric/ton of ore, 90 °C and 6 hr of residence time.

- Uranium Oxide Reaction

  $U_3O_8 + 3H_2SO_4\ (l) \rightarrow 3UO_2^{2+} + 2H_2O$ Eq. 3

- Thorium Oxide Reaction

  $ThO_2 + 2H_2SO_4 \rightarrow Th(SO_4)^{2+}\ 2H_2O$ Eq. 4

The leaching recovery for uranium is ~94% and ~96% for thorium. The extraction of iron, thorium, aluminum and uranium are unintended, but the leaching step is indeterminate, and these elements will be removed in the Impurity Removal circuit.

## 16.3.4 Impurity Removal

The leaching process successfully solubilizes the REE's but also leaches other elements that are present in the ore such as iron, aluminum, thorium and uranium. These elements must be removed from the leachate stream to ensure they do not carry through and deport to the product streams. The leachate also contains excess sulfuric acid, known as free acidity or terminal acidity, due to excess sulfuric acid being added in the leaching operation which is necessary to maximize recovery and kinetics. The free acidity must be neutralized using a base. Increasing the pH also results in precipitation of the impurity elements.

### 16.3.4.1 Iron Removal (Primary Neutralization, Fe/Th Removal)

The Primary Neutralization (Fe/Th Removal) consists of adding neutralizing agents to bring the leachate from ~30 g/L free acid to a pH of 3.15. Neutralization of the leachate is required to remove free acidity left over from the leaching operation and to remove Fe/Th through a precipitation reaction at a higher pH. Hydrogen peroxide is added to increase the oxidation-reduction potential, known as theORP, value to ~600mV to oxidize iron from ferrous ($Fe^{2+}$) to ferric ($Fe^{3+}$) to drive precipitation of iron at a pH of 3.15. The 50% peroxide will be added as a volumetric ratio in cascade control from the ORP in the leachate. For the purposes of the mass balance and estimated peroxide usage a ratio of 0.53% v/v for 50% peroxide has been used based on laboratory testing.

Magnesium oxide (MgO) was selected as the neutralizing agent over other neutralizing agents due to low REE losses, impurity removal and cost. The pH adjustment and precipitation will be carried out in a cascade of stirred tank reactors with a combined residence time of 2 hrs. MgO will be purchased as a dry material and slaked onsite to form a 15% $Mg(OH)_2$ suspension which will be added to the tanks using a pH control loop. For the purposes of the mass balance and estimated MgO usage a ratio of 1.42% w/w for MgO (dry basis)/Leach PLS has been used based on laboratory testing. The solids generated by the iron removal step will be thickened in a cone bottom clarifier and filtered using a vacuum belt filter. The solids will be washed with water on the filter to minimize REE yield loss and disposed of in an impoundment or sent off as waste.

The Iron Removal step will operate at a pH of 3.15 and results in a near total removal of Fe, Th, Ti, and P along with partial removal of Al (approximately 50%) and U (approximately 20%). These results can be viewed in Figure 1-2 which provides curve data for pH vs precipitation and in Table 1-4 MgO Results at pH of 3.15. The

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partial removal of aluminum in the Iron Removal step is important since it will act as an outlet for aluminum to tailings as the Aluminum Removal (Al/U Removal) solids will be recycled back to leach in order to minimize REE loss.

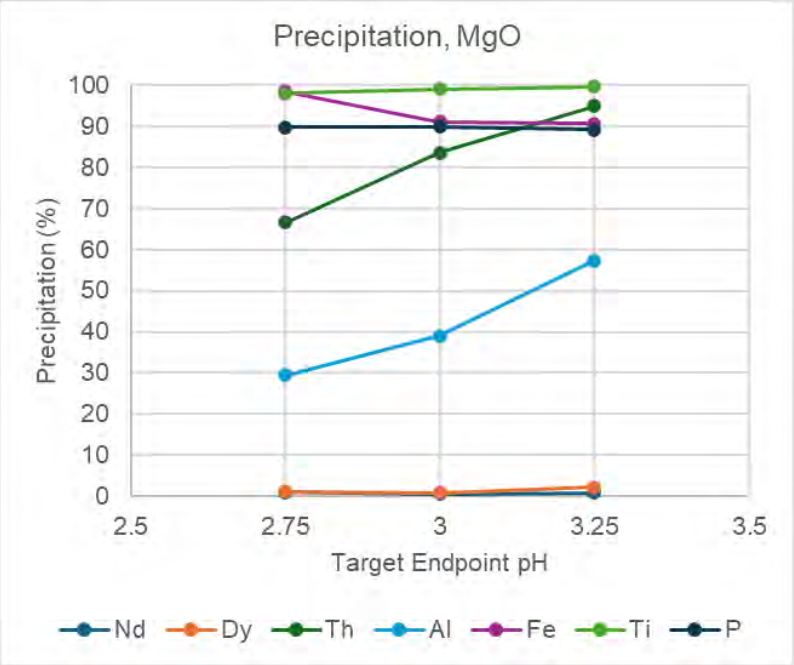


*Figure 16-2 Magnesium Oxide Curve Data: pH vs Precipitation*

*Table 16-4 Magnesium Oxide Results at pH of 3.15*

| **Iron Removal Conditions** | **PN14** |
|---|---|
| Feed | AL22 Filtrate |
| Reagent | MgO (OxipHix) |
| Reagent Strength (% w/w) | 15% |
| pH Target | 3.15 |
| Retention Time | 2 hrs |
| Temperature | 75°C |
| Reagent Addition (kg/m3) | 15 |
| | |
| Precipitation (%) | |
| La | 0.6% |
| Pr | 1.3% |
| Nd | 1.3% |
| Tb | 2.0% |
| Dy | 2.3% |
| Th | 93.3% |

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| Iron Removal Conditions | PN14 |
|---|---|
| U | 18.9% |
| Si | 92.0% |
| Al | 57.8% |
| Fe | 89.6% |
| Ti | 99.6% |
| P | 89.9% |

### 16.3.4.2 Aluminum Removal (Secondary Neutralization, Al/U Removal)

The Aluminum Removal consists of adding a neutralization agent (MgO) to increase the pH from 3.15, exiting the Iron Removal, to a pH of 5.0. The pH adjustment and resulting precipitation will be carried out in a cascade of stirred tank reactors with a combined residence time of 2 hrs and 75°C. MgO will be purchased as a dry material and slaked onsite to form a 10% Mg(OH)2 suspension which will be added to the tanks using a pH control loop. For the purposes of the mass balance and estimated MgO usage a ratio of 0.23% w/w for MgO (dry basis)/iron removal liquor has been used based on laboratory testing. The solids generated by the Secondary Neutralization will be thickened in a cone bottom clarifier and filtered using a vacuum belt filter. These solids will be recycled back to the leach circuit to reclaim any REE that co-precipitated. Rejection of aluminum and uranium will be in the iron removal solids.

*Table 16-5: Aluminum Removal Parameters and Results*

| Aluminum Removal Conditions | SN2 |
|---|---|
| Feed | PN11 Filtrate |
| Reagent | MgO |
| Reagent Strength (% w/w) | 10% |
| pH Target | 5.0 |
| Retention Time | 2 hrs |
| Temperature | 75°C |
| Reagent Addition (kg/m3) | 2.54 |
| | |
| Precipitation (%) | |
| La | 4.8% |
| Pr | 9.0% |
| Nd | 9.3% |
| Tb | 19.6% |
| Dy | 21.5% |
| Th | 98.9% |
| U | 19.8% |
| Si | 71.0% |
| Al | 96.3% |
| Fe | 99.4% |
| Ti | 95.6% |

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| Aluminum Removal Conditions | SN2 |
|---|---|
| P | 10.4% |

### 16.3.4.3 Ion Exchange (U Removal)

An Ion Exchange (IX) system for removal of the uranium will consist of resin packed columns. The rare earth containing solution from aluminum removal is pumped through columns packed with IX resins that have an affinity to uranium which retains these elements onto the chemically reactive site of the resin thus removing them from the solution. Once a resin bed is saturated and cannot remove any more uranium the solution will be switched to a new packed column and the first column is taken offline to ship the resin off site for disposal. The primary and secondary neutralization steps remove a great majority of the uranium, and the IX column would just be an insurance policy to any breakthrough. Due to the low U concentration, the on-stream time for the columns should be very long such that replacing media should not require a shutdown of any kind. There is a possibility that uranium mining companies in the area would take the resin once loaded and elute such that the U would be added to their production and ownership. Uranium companies are already positioned with satellite operations that use IX columns which are transported to a central processing plant to elute and further process. However, they operate with a different cation bond on the resin, so further investigation is required. This approach should allow for a lower-level radiological operating permit.

### 16.3.4.4 Bulk Solvent Extraction (SXB)

A bulk solvent extraction circuit takes the uranium IX effluent and loads onto the organic in the extraction circuit, a scrub circuit uses a dilute sulfuric acid stream as the scrub solution while the strip circuit will use a dilute hydrochloric acid as the strip solution which will convert the matrix from sulfate to a chloride. The purpose of the bulk solvent extraction circuit is as follows:

- Complete a “media exchange” - which is changing from a sulfate matrix to a chloride matrix. A chloride matrix is favorable for the downstream solvent extraction circuits to produce separated oxide products.
- Rejection of cerium and lanthanum to the wastewater treatment plant since the sales price is too low to support the cost of further processing and the markets are saturated such that you most likely would not find a customer for these products
- Concentration – by extracting the rare earths from the dilute sulfate stream onto the organic and then stripping with a smaller volume of dilute hydrochloric acid you will experience a concentrating effect which reduces the size of downstream solvent extraction circuits.

## 16.3.5 Separation (Solvent Extraction and Finishing)

A series of conceptual solvent extraction and finishing circuits have been outlined for inclusion in the Pre-Feasibility study. The following sections describe the general methods that might be used to isolate each rare earth product for Halleck Creek. It should be noted that no laboratory testwork for solvent extraction or finishing has been performed using Halleck Creek material. This testwork is currently being planned.

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The conceptual raffinate from bulk solvent extraction and the Dy secondary strip solution will be combined into a single heavies product. The stream is composed of Dy, Ho and larger rare earths as well as Ytrrium (Y) which behaves similarly throughout the solvent extraction circuit.

The most widely used extractant is Di-(2-ethylhexyl phosphoric acid) (DEHPA). A sister compound which has superior separation factors should be considered, 2-ethylhexyl phosphonic acid-mono-2-ethylhexyl ester (PC88A).

It is helpful to note that in solvent extraction “Heavies load first” with rare earths and phosphoric or phosphonic acid functional groups. In SXH the heavier element (by molecular weight) would load preferentially onto the organic phase which is made up of a mixture of the extractant (DEHPA or PC88A) and a diluent (kerosene). If a light REE loads onto the organic, a heavier REE can displace it from the organic.

The sketches below show the major sections of a conceptual solvent extraction circuit. The feed would be introduced to the extraction section, where the target elements are loaded (transferred from the aqueous phase to the organic phase). In the extraction section, the number of potentially loaded elements is controlled by the acidity of the feed. In an extraction section, it would be necessary to “over-extract,” meaning some of the target elements intended to go out in the raffinate (aqueous stream product) are temporarily loaded onto the organic. The over-extraction ensures that none of the heavier molecules intended to leave the strip (organic product) are lost to the raffinate. A conceptual scrubbing section takes the elements which are intended to be in the raffinate, removes them from the organic, and returns them to the aqueous. The scrub solution is usually an acid or salt solution, but it all depends on the system and the chosen extractant. The following conceptual section is the stripping section, where an acidic strip solution would be added to remove all the elements present on the organic into the aqueous. The flow of aqueous is from right to left, and the organic is from left to right, with the organic being recycled. In some cases, the organic will need to be washed or regenerated to reset the organic so it can be used again. The feed acidity has to be tightly controlled because the lower the acidity, the more REEs will load onto the organic. However, there is a limitation to the loading that the organic will accept, and above this level, the organic will “gel” or form fine particles that look like a gel

The separation factor is the ratio of organic to aqueous REE concentration after a simple shakeout of aqueous and organic is performed in a separatory funnel in the laboratory. The lower the separation factor the more difficult the separation. The separation factor measures the separation in only one stage and therefore to overcome a low separation factor is to add stages or how many times the separation has to be performed to get the results you want. The separation factor dictates how many stages are needed in each of the sections of a solvent extraction circuit.

Due to the push and pull of a solvent extraction circuit using acid / base relationship, one of the two product streams (strip or raffinate) has to be chosen as the primary product. For instance, to achieve high purity of the strip product, the circuit will operate so that a small percentage of the strip elements will be lost to the raffinate.

In the case of SXBulk, the preferred elements to load onto the organic will be samarium and larger (to the right on the periodic table), which will become the strip product. The raffinate, therefore, will be from neodymium and smaller (to the left on the periodic table).

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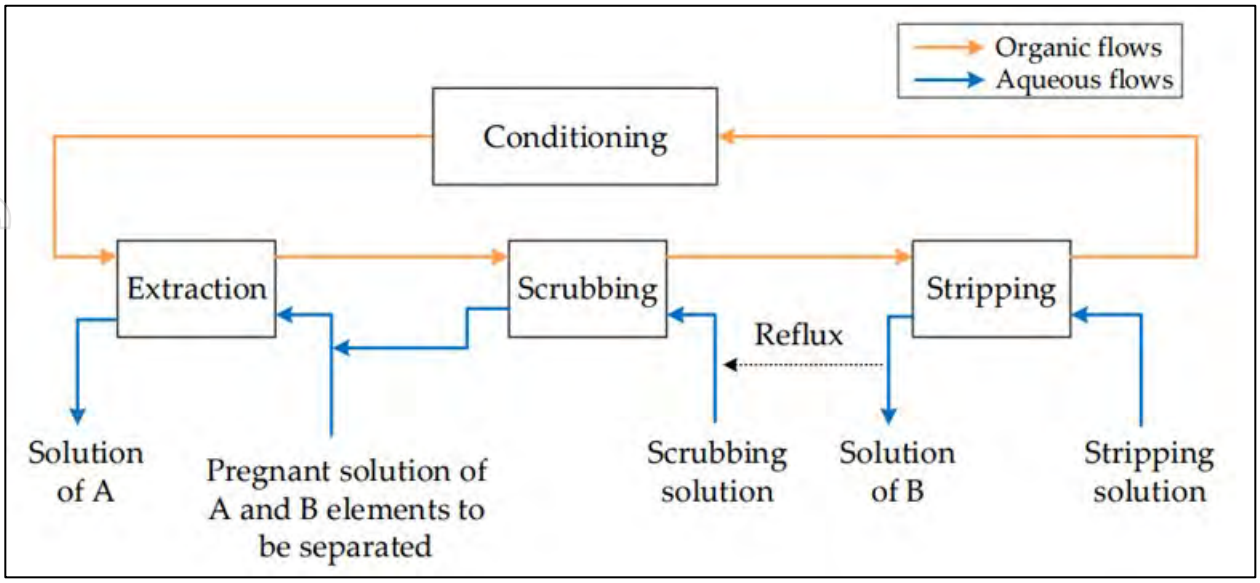


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*Figure 16-3: Schematic Example of SX Circuit 1*

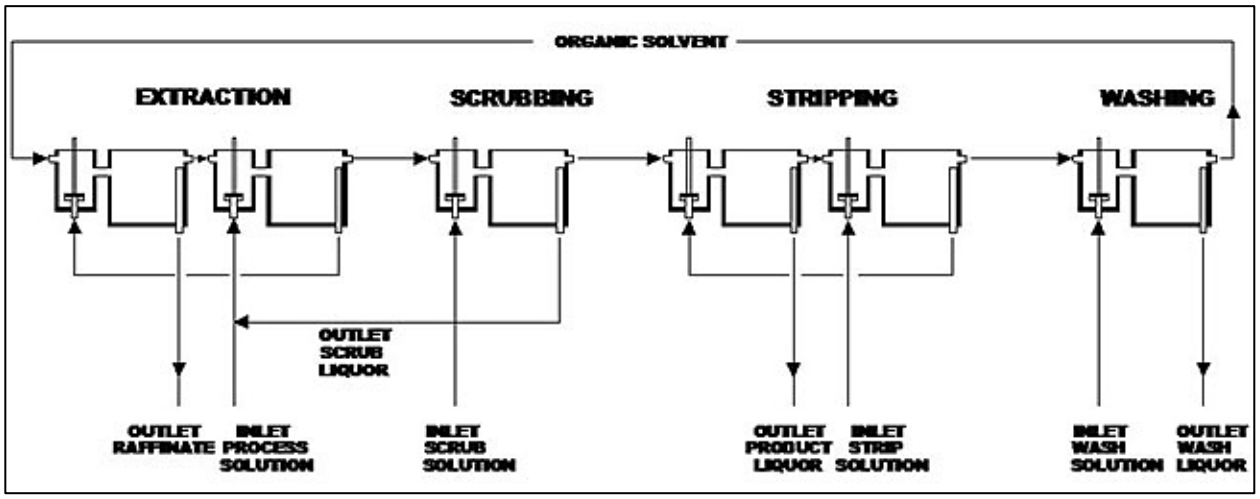


*Figure 16-4: Schematic Example of SX Circuit 2*

### 16.3.5.1 Nd/Pr Solvent Extraction

A conceptual solvent extraction circuit that produces La/Ce as the raffinate and Nd/Pr as the strip is referred to as SXNd/Pr. This is the second largest circuit (based on total stages) due to the low separation factor of Nd/Pr separation factor as well as the largest vessel size (volume) for HCl based PLS.

The strip product (Nd/Pr) has a much higher selling price and a higher purity requirement so Nd/Pr will be the preferred product and will lose ~0.2% of the Nd/Pr to the raffinate (aqueous stream La/Ce) to ensure there is no La in the Nd/Pr. In fact, the catalyst manufacturers have confirmed that any trivalent (rare earth element that has a 3+ cationic charge) acts the same in the catalyst.

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### 16.3.5.2 Nd/Pr Finishing

The conceptual strip product (Nd/Pr) is fed to a precipitation tank (two total) for oxalate precipitation on a batch-wise basis. Oxalic acid in powder form in 1-t super sacks is pneumatically fed to the precipitation tank. A batch recipe must be created based on test work to form large, easily filtered Nd/Pr oxalate particles. One method to improve solids' size and shape is the utilization of a seeding technique where the initial solids are formed quickly by a dose of oxalic, but then slowly add the remainder of the oxalic in order to grow larger crystals on top of the initial solids (seeds). A small thickener receives the solids slurry from the reactors. The thickened slurry is then fed to a plate and frame filter press, which is suited for freshwater washing to control impurity levels in the final product. The filter cake is then fed to a direct-fired rotary kiln to produce oxide. The oxide powder is fed into 1-t super sacks for shipment.

### 16.3.5.3 La/Ce Disposal

Lanthanum is used in oil refineries as a component in the fluid cracking catalyst. Conceptually, La is the raffinate product from SXD and is precipitated with either caustic to form a hydroxide or soda ash to form a carbonate, oxalic acid is not justified at this price point and the customers are accepting of the hydroxide or carbonate form and impurity levels. A continuous precipitation across two tanks with gentle agitation forms the La/Ce solid which is then pumped to the waste water treatment plant thickener where the underflow is then sent to a filter. A horizontal plate and frame filter press is best suited for this application to minimize the moisture content and minimize shipping costs since that will be sent offsite for solid waste disposal.

### 16.3.5.4 Dy Solvent Extraction

The conceptual feed to the dysprosium solvent extraction circuit (SXDy) is the strip solution from Bulk SX. The acidity of the feed stream will need to be adjusted using caustic. The conceptual raffinate stream is composed of SEG, and Tb. To create a high purity Dy product two strip stages will be used. The first strip will produce the high purity product, which will be further scrubber to ensure high purity. While the second Dy strip is needed to remove the remaining Dy and heavier elements. The second strip consists of Dy, Ho and larger as well as Ytrrium (Y) (which behaves similarly to heavy rare earths throughout the solvent extraction circuit), will be sent to mixed heavy rare earths oxide finishing.

### 16.3.5.5 Dy Finishing

The first SXDy scrubber stream will supply the Dy material. The SXDy scrubber solution will be sent to a batch precipitation, where oxalic acid is added to the tank via a pneumatic conveyance system. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank capacity. The Dy oxalate is sent to a small filter (vac belt filter to allow for washing) and the filter cake is fed to a direct-fired rotary calciner. The product from the calciner is then packaged into drums or pails and sold.

### 16.3.5.6 Mixed Heavy Rare Earth Oxide (Heavies) Finishing

The conceptual raffinate from bulk solvent extraction and the Dy secondary strip solution will be combined into a single heavies product, where sodium carbonate is added to the tank at a 10% concentrated solution. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank

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capacity. The heavies oxalate will be sent to a small filter (vac belt filter to allow for washing) and the filter cake is fed to a direct-fired rotary calciner. The stream is composed of Dy, Y, Ho and larger rare earths. The combined solution could be inventoried until there is a need to process further or sold as a concentrate to be further refined.

#### 16.3.5.7 Tb Solvent Extraction

The conceptual feed to the Tb Solvent Extraction (SXTb) is the raffinate solution from SXDy which contains SEG, and Tb. In this circuit the raffinate (aqueous) is the SEG and the strip is a high purity Tb stream. This circuit is very small due to the small amounts of materials.

#### 16.3.5.8 Tb Finishing

Like the other circuits, the conceptual raffinate from SXTb contains Tb which is sent to a batch precipitation tank where oxalic acid is added to the tank via a pneumatic conveyance system. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank capacity. The Tb oxalate is then sent to a small filter (vac belt filter to allow for washing) and the filter cake is fed to a direct-fired rotary calciner. The product from the calciner is then packaged into drums or pails and sold.

#### 16.3.5.9 SEG Finishing

The conceptual raffinate from SXTb is the SEG solution that is sent to a batch precipitation tank where sodium carbonate is added to the tank at a 10% concentrated solution. The volumes are small enough that only one reactor tank should be needed given that there is ample storage tank capacity. The SEG oxalate is then sent to a small thickener where the underflow is fed to a small filter (belt filter, or drum filter or filter press) and the filter cake is fed to a direct-fired rotary calciner. The product from the calciner is then packaged in super sacks or drums and sold.

#### 16.3.5.10 (In Development) SEG Solvent Extraction

The project will consider the potential for a SEG Solvent Extraction (SXSEG) that would take the raffinate solution from SXTb, and produce a high purity Sm product. The strip would be a SEG product with depleted Sm concentrations.

#### 16.3.5.11 (In Development) Sm Finishing

High purity Sm concentrate material would be possible with a SEG solvent extraction circuit. The conceptual raffinate would be sent to a batch precipitation tank, where the Sm oxalate would be filtered and calcined.

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# 17 Infrastructure

## 17.1 Power

### 17.1.1 Power Supply and Source

Power will be taken from the grid of Wheatland Rural Electric Association Grid (WREA). WREA distributes power from the Laramie River Station power plant operated by the Basin Electric Power Cooperative just northeast of Wheatland Wyoming. Figure 17-1 shows the estimated total power needs across the mine/mill (mine) site and the refinery. The mine site (T22N R70W, Section 30, SWSW) will have a substation fed by transmission lines due to the distance from existing infrastructure. This substation would be connected to an existing substation (upgrade required) along Wyoming Highway 34 that is approximately 6 miles from the mine site.

### 17.1.2 Transmission Line Route and Capacity

The powerline route would follow the road alignment south along Wyoming Highway 34 from the substation before turning west and following Halleck Creek Road to the turn off for the mine site. WREA has provided confirmation that this location will be suitable by the time power is needed at the mine. The power line will be a standard 110 V, 3-phase connection with a 69 KVA capacity. A substation will supply the project's peak process annual demand of 8 MVAh. In Figure 17-1, the electrical network in the project area and the nearest substation and the nearest electrical line are shown. Figure 17-2 shows the Wyoming Public Utilities map for approved electrical power providers. Table 17-1 shows the power required from WREA for the project.

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*Figure 17-1: Electrical Network in Project Area*

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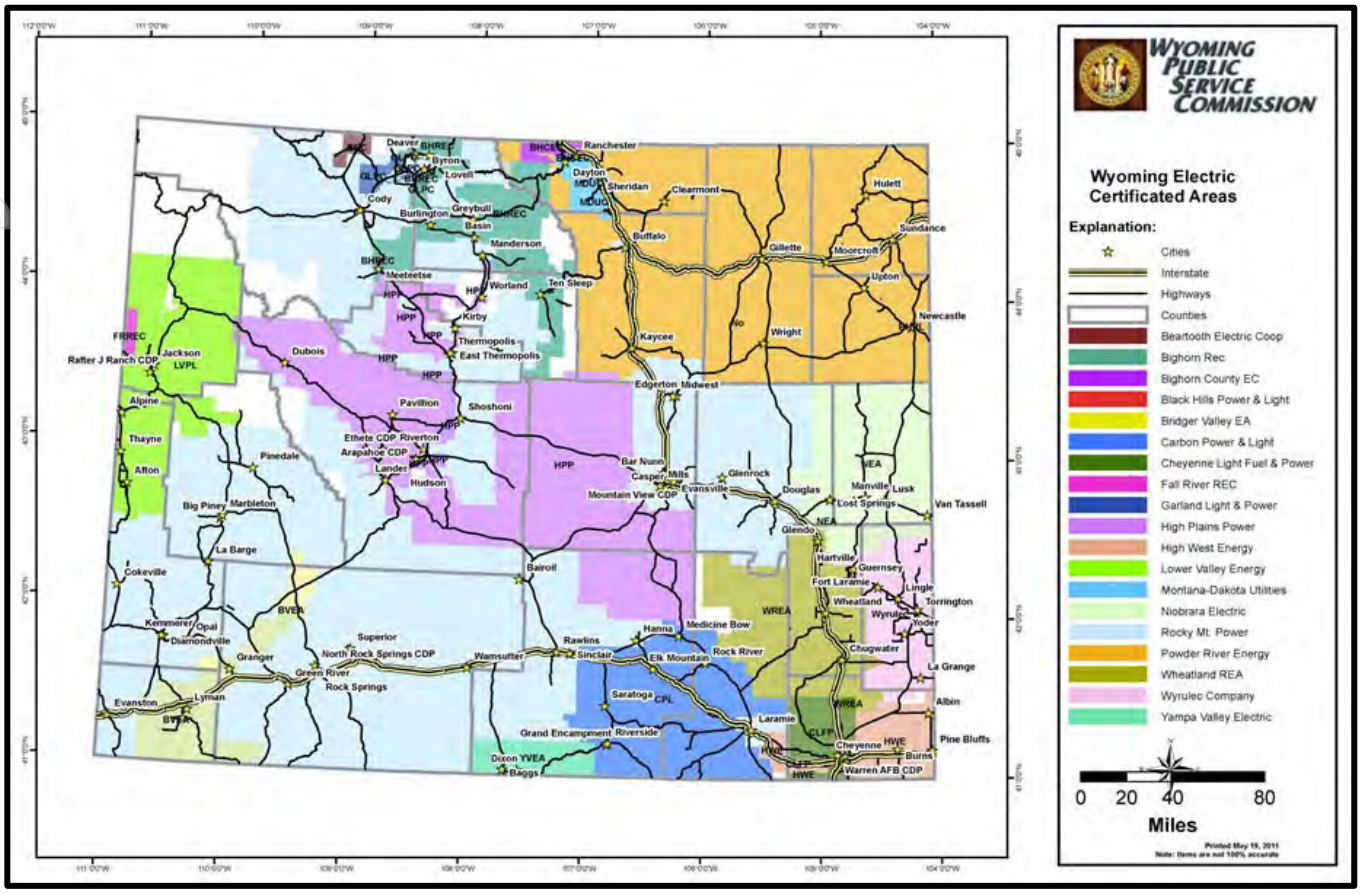


*Figure 17-2: Wyoming Public Utilities Map*

*Table 17-1: Power Requirements from WREA*

| **Areas** | **Connected** | **Estimated Running Load** | **Equipment Utilization** | **Subscribed Power** | **Annual Consumption** |
|---|---|---|---|---|---|
| **Mine and Mill** | (kVA) | (%) | (%) | (kVA) | (kVAh/y) |
| Total Crushing and Grinding Electrical Opex | 6,650 | 75 | 90 | 3,375 | 38,434,500 |
| Total Concentration Electrical Opex | 1,175 | 75 | 90 | 790 | 6,918,210 |

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| Areas | Connected | Estimated Running Load | Equipment Utilization | Subscribed Power | Annual Consumption |
|---|---|---|---|---|---|
| Total Infrastructure Electrical Opex | 4,740 | 75 | 90 | 3,200 | 28,032,000 |
| Total Mine and Mill | **12,565** | | | **7,365** | **73,384,710** |
| **Refinery** | (kVA) | (%) | (%) | (kVA) | (kVAh/y) |
| Total Extraction Electrical Opex | 1,000 | 75 | 90 | 675 | 5,913,000 |
| Total Impurity Removal Opex | 2,250 | 75 | 90 | 1,519 | 13,304,250 |
| Total Separation and Finishing Opex | 3,150 | 75 | 90 | 2,126 | 18,625,950 |
| Total Refinery | **6,400** | | | **4,320** | **37,843,200** |

## 17.2 Natural Gas

During the mill processing, the ore will need to be dried before Induced Roll Magnetic Separation (IRMS). This process requires a steady supply of natural gas. Previous estimates indicate an annual consumption of approximately 2.5 million therms for the life of mine. Using the assumption that one gallon of liquefied natural gas (LNG) contains approximately 82,000 BTUs and 100,000 BTUs is equivalent to one therm, the annual demand translates to roughly one fully loaded LNG tanker delivery per day. A standard cryogenic, double-wall, stainless steel vacuum tanker truck can transport approximately 10,000 gallons of LNG per delivery, which is sufficient to meet the estimated daily requirements.

Black Hills Energy has natural gas fueling locations throughout Wyoming. The nearest fueling station to the Cowboy State Mine development is in Cheyenne, Wyoming, approximately 80 miles south of the development site. As of April 2, 2026, Black Hills Energy has quoted a non-fixed price of US$0.3587 per therm. Historical pricing data provided by Black Hills Energy indicates that natural gas prices fluctuate on a quarterly basis, with adjustments typically occurring in March, June, September, and December. These price variations are influenced by broader national natural gas market conditions and may be higher or lower than prior rates. Historical cost data show a recent maximum price of US$0.84720 per therm during the summer of 2022, while the lowest recorded recent price was US$0.23450 per therm in the fall of 2020. Based on the most recent

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quoted cost, one delivery (assuming a 10,000-gallon capacity at 82,000 BTUs per gallon) would cost approximately US$2,941. These costs do not include transportation fees or required infrastructure of any kind and are subject to change.



*Figure 17-3: Example of Natural Gas Tanker Truck*

Liquid natural gas will be brought to site by LNG tanker trucks; the cryogenic liquid will then be run through the vaporizer for regassification before being consumed on site. To provide the required 800 MMBtu/day LNG, approximately 2-13,000-gallon LNG tanker trucks would be required.

An ambient vaporizer such as the Model HBVP-54K capable of 54,000 SCFH would be required to return the LNG to gas form on site. Ambient vaporizers can have issues running in low temperature environments and require ice removal. This may require switching between two units to deal with icing. One unit may be online while the other is defrosting. Requirements are dependent on how long the unit operates daily and are affected by the runtime curve specific to each unit.

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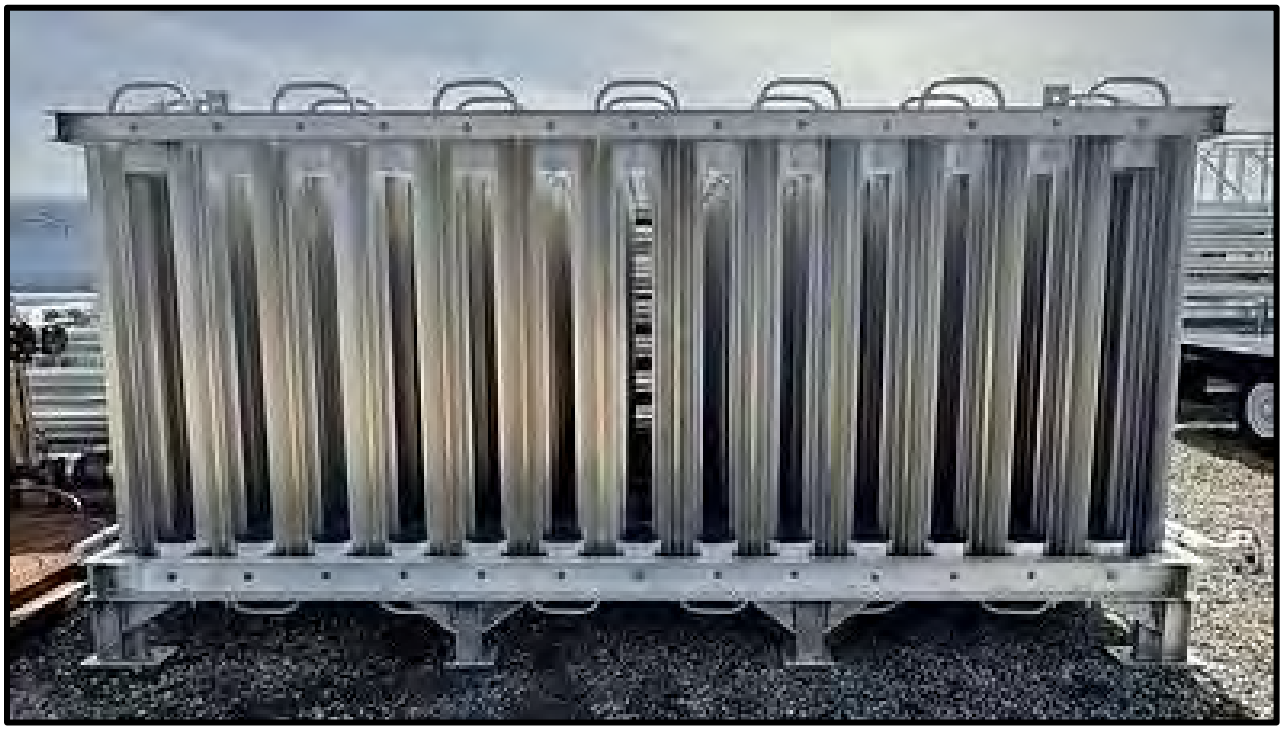

*Figure 17-4: Example of a New Ambient Natural Gas Vaporizer*

Figure 17-4 shows a different model, but the one in stock is a Class 300 RF flange, 15’ x 16’ x 8’, for US$32,000. It has a capacity of 100,000 SCFH LNG and 75,000 SCFH LNG after 8 hours of operation. Figure 17-4 shows a single unit but they can be arranged in a stackable design and ability to switch between units as the ice builds up. According to the vendor, a 12-week lead time may be required. If not in stock at the time of order, a 20% deposit is required.

## 17.3 Pipeline

A pipeline to sight was briefly investigated.  It was determined quickly that this would be cost prohibitive, with initial estimates being as high as US$40M.

## 17.4 Trucking

### 17.4.1 Trucking

Trucking is estimated at US$4.00 per mile by area vendors. Rawhide Leasing in Evanston, WY estimated US$4 / mile for the round-trip mileage on the LNG deliveries. This includes truck and driver but not the LNG itself. Their route does not use the Cheyenne fuel depot. They would truck it to site from the Exxon station near Green River, WY. With a 3–4-year contract, the price would come down further because they would dedicate an LNG-powered tanker truck to do the deliveries. Prices are greatly affected by current diesel prices.

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## 17.5 On-Site Mill

Mining infrastructure will be broken down into two sites, the mine site and the refinery. The mine will have a security gate to control access to the site, an administrative building, maintenance building, six process building with two separate control rooms, and a large storage building so that the site does not have to shut down if weather affects highway traffic. The rest of the equipment will be mounted on slabs outdoors, include the crusher, grinder, dryer, process tanks, water collection tank, recycle water thickener, and loadout scales.

## 17.6 Off-Site Refinery

The proposed refinery will also have a security gate to control access, an administrative building, maintenance building, warehouse, three sperate control rooms, and a large storage building to reduce bottlenecking caused by the shipping of concentrate. The rest of the equipment will be mounted on slabs outdoors, including the regrind mill, chemical supply tank, wastewater treatment plants, leaching tanks, scrubber, iron removal tank, aluminum removal tanks, and SX settlers and tank farms.

## 17.7 Dewatering

*Dewatering from the pit is achieved by Pump 6, which is installed within the pit and serves as the primary collection pump. From Pump 6, water is conveyed through a series of pipeline segments to Junctions 1 through 5, with individual line lengths ranging from 50 m to 154 m and elevation changes up to +100 m as the pipeline climbs toward the northeast high wall. From these junctions, the flow is distributed to Pumps 1 through 5, which further transfers water along discharge lines extending 132 m to 397 m in length. These downstream pipelines experience varying elevation changes, including both minor gains and losses (from +25 m to −40 m), reflecting the topography between the pit and the high wall discharge locations. Table 17-2 summarizes the lengths and elevation changes between pumps and piping junctions that join them together in the dewatering system.*

shows the proposed dewatering system in relation to the conceptual mine pit.

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*Table 17-2: Length and Elevation Differences between Dewatering Pumps and Junctions*

| Pump | Junction | L (m) | H (m) |
|---|---|---|---|
| 6 | 1 | 115 | 11 |
| | 2 | 109 | 64 |
| | 3 | 154 | 100 |
| | 4 | 50 | 0 |
| | 5 | 69 | 30 |
| 1 | 6 | 296 | -1.5 |
| 2 | 7 | 149 | -29 |
| | 8 | 163 | -2 |
| 3 | 9 | 202 | 4 |
| | 10 | 132 | -40 |
| 4 | 11 | 390 | 25 |
| 5 | 12 | 222 | -6 |
| | 13 | 397 | -11 |

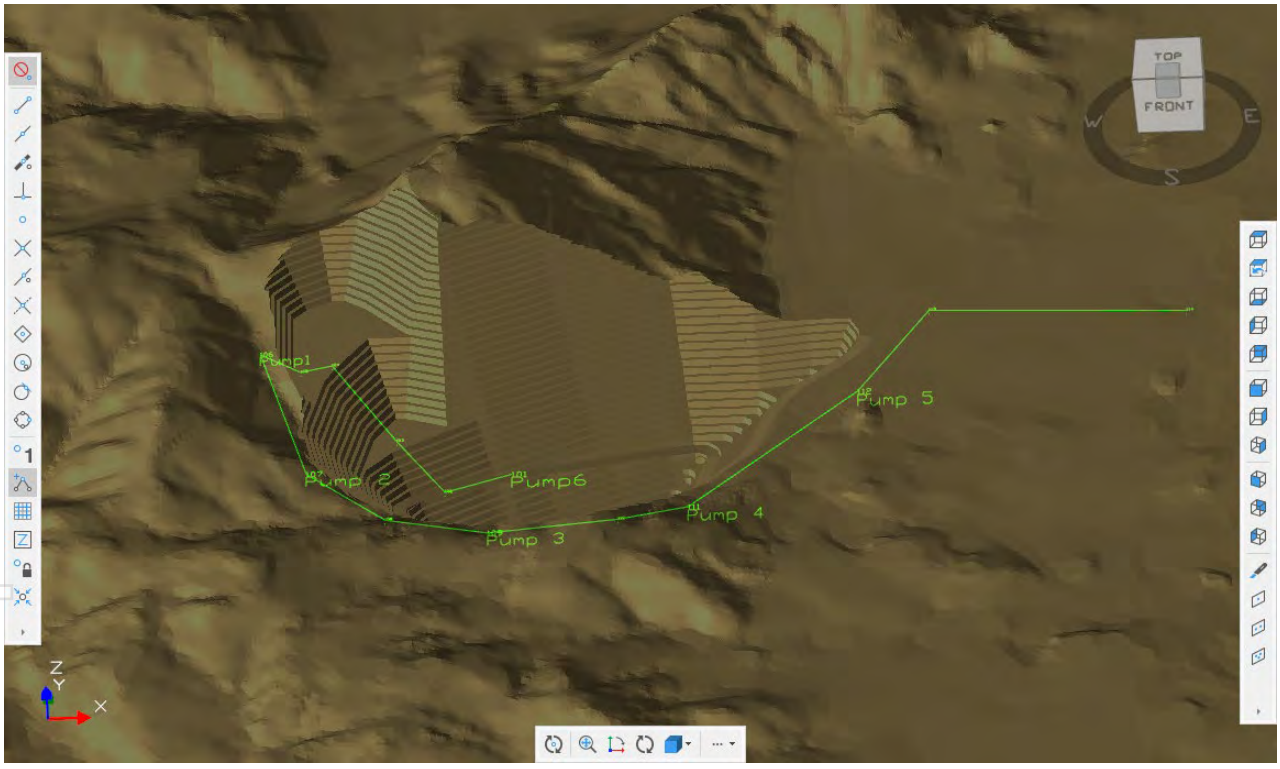


*Figure 17-5: Dewatering System in Relation to Mine Pit*

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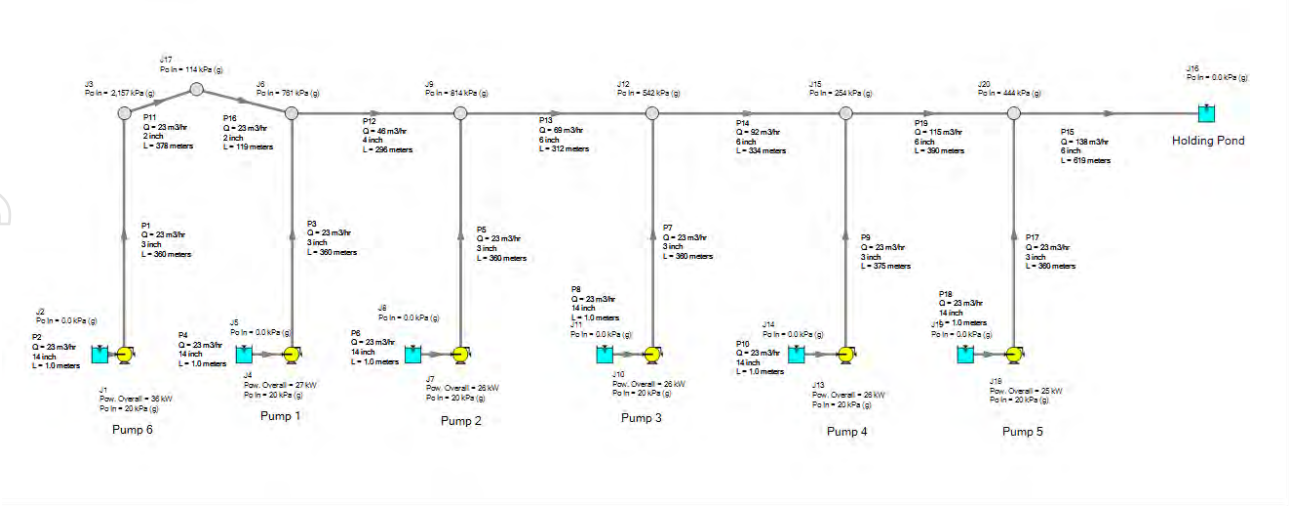


*Figure 17-6: Dewatering System Flow Diagram*

# 17.8 Manufactured Sand Byproduct Storage

## 17.8.1 Plant Sand Byproduct Dewatering, Handling, Temporary Storage, and Placement

Sand byproduct streams generated from the WHIMS, RCC coarse, RCC fine, and IRMS circuits will be combined in a common sump and pumped to a cyclone bank for initial classification. The cyclone circuit will separate the coarser solids from the finer solids and process water. Cyclone underflow will discharge to a mixing box and be combined with thickener underflow prior to dewatering on a horizontal belt filter. Cyclone overflow will report to the thickening circuit for solids recovery and water clarification, with clarified water returned to the plant water system.

The dewatering circuit will include a 194 m² Jord Viper horizontal belt filter, vacuum pumps, filtrate and effluent handling equipment, and associated tanks located within a dedicated filter building. The building will house the filter and vacuum equipment and include a 10-ton overhead crane for routine maintenance. The filter will dewater the combined sand byproduct stream to a target moisture content suitable for truck haulage and placement in the temporary stockpile.

Dewatered filter cake will discharge from the horizontal belt filter to a conveyor system feeding a 150-ft radial stacker. The stacker will build a temporary live-storage pile above a concrete reclaim tunnel. Tunnel feeders and a reclaim conveyor will transfer the material to two truck-loading hoppers for transport to the temporary sand byproduct stockpile. This arrangement will provide surge capacity between continuous plant operation and intermittent truck haulage.

When the upper surface of a placement lift is completed, or when an inactive surface requires stabilization, dry Portland cement will be metered into the damp sand byproduct on the reclaim conveyor prior to truck loading.

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Two 100-ton cement silos equipped with feeders are planned to supply cement at an assumed dosage of approximately 2% by mass. Cement addition is intended to improve near-surface stability, reduce infiltration, and minimize fugitive dust generation from exposed inactive placement areas.

### 17.8.2 Sand Byproduct Transport and Temporary Placement

Dewatered sand byproduct will be hauled by truck from the loading hoppers to the temporary stockpile. Placement will be managed to maintain the material at or below the target placement moisture and limit exposure to standing water. Trucks will generally end-dump the material, and low-ground-pressure dozers will spread the sand byproduct in approximately 10-m lifts. For PFS-level planning, compacted sand byproduct is assumed to have an average placed density of approximately 1.85 metric tonnes per cubic meter (approximately 115 lb/ft$^3$).

ROM waste rock will be placed concurrently with the dewatered sand byproduct, where required, to establish haul roads, buttress exterior slopes, and protect exposed slope faces from erosion and operational impacts. Waste-rock haul roads will be advanced ahead of sand byproduct placement within each lift to maintain access for trucks, dozers, and supporting mobile equipment

### 17.8.3 Stockpile Surface Stabilization and Water Management

Inactive placement areas will be graded and compacted to limit ponding, reduce infiltration, and minimize the potential for fugitive dust. Cement-treated upper lift surfaces will be compacted using a smooth-drum roller. The stockpile crest will be graded to direct runoff away from exterior slopes. Perimeter ditches will divert non-contact runoff around the facility and route contact water to temporary collection ponds. Standing water will not be allowed to remain on the stockpile surface during normal operations.

## 17.9 Refinery Tailings Management Facility (TMF)

A Tailings Management Facility (TMF) will be constructed within the proposed refinery site to provide long-term storage of refinery residues generated during rare earth processing. The facility is designed to accommodate approximately 890 metric tonnes per day of filtered material and provide an overall storage capacity of approximately 800,000 tonnes over the project life.

Materials placed within the TMF will consist primarily of leach residue, iron (Fe) precipitate, and mine waste sand transported from the mine site. Leach residue and Fe precipitate will be dewatered to approximately 15% moisture prior to placement, while mine waste sand will be dewatered to approximately 14% moisture. The refinery processing and dewatering circuits are outside Stantec's scope. Stantec's TMF scope begins with hauling, placement, and management of the dewatered materials.

The TMF is expected to occupy approximately 140 acres within the overall 400-acre refinery property. Approximately 40 acres will be used for excavated soil storage, with approximately 100 acres occupied by the tailings storage area and associated water management pond.

The facility will be developed as an engineered containment structure excavated to an average depth of approximately 3 m. Environmental protection measures will include a triple-lined containment system

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incorporating 60-mil HDPE geomembranes with intermediate clay and soil layers. An underdrain collection system will capture drainage or leachate generated within the facility and convey it to the associated water management pond.

Fe precipitate will be managed separately from the other refinery residues and placed within dedicated engineered cells within the lined TMF. Mine waste sand transported from the mine site will be placed around and over the Fe precipitate to provide physical isolation and encapsulation. The PFS assumes approximately two tonnes of mine waste sand per tonne of Fe precipitate for this purpose.

The requirement for separate Fe precipitate disposal cells was identified in the PFS development. Specific cell configuration and placement methodology have not yet been fully defined and will require further development during subsequent engineering.

The estimated capital cost for the triple-lined TMF is approximately $47.9 million, this includes $4. million allowance for construction of the dedicated Fe precipitate cells. The TMF will be developed in three construction stages, with a significant portion of the capital expenditure occurring in Years 3 and 13 as additional storage capacity is developed.

Operating costs include hauling, placement, and management of the dewatered residues and mine waste sand within the TMF, including transport of mine waste sand from the mine site for encapsulation of the Fe precipitate. These costs are included in the PFS operating cost estimate and should be refined as the Fe precipitate cell design and material-handling requirements are advanced.

The water management pond will be sized to contain facility drainage, collected leachate, and runoff associated with the design storm event. Recovered water will be returned to the refinery process-water circuit where practicable to reduce freshwater demand and support water reuse objectives.

Additional environmental monitoring and containment features will include leak detection systems, groundwater monitoring wells, and perimeter stormwater diversion ditches. Surface water controls will direct runoff away from the TMF and route stormwater to the sedimentation pond for management and recovery. These features are intended to support regulatory compliance, protect groundwater and surface water resources, and provide safe long-term storage of refinery tailings throughout the operating life of the facility and into closure.

## 17.10 Water

A conceptual water balance model has been developed for the site. The model was used to evaluate the ore-process performance, evaluate the water supply pond utilization, and estimate average make-up water flowrates and storage needed. The water balance simulation model is incremented monthly to reflect seasonal variations in precipitation and evaporation.

## 17.11 Climate Data

The water balance computations were performed using multiple precipitation datasets, including above-average (wet) and below-average (dry) precipitation conditions, to estimate the accumulation of process solution within the system and the associated makeup water requirements. Evaluating a range of climatic conditions allows the model to capture the variability in inflows and outflows that the system may experience over its operating life.

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The average-year scenario provides a baseline for typical operating conditions and supports the interpretation of the wet and dry results. The primary objectives of this study are to confirm that the proposed pond has sufficient capacity to contain process solution and to quantify the makeup water required to sustain operations. The results of these evaluations are intended to support the pond design and the planning of a reliable makeup water supply.

Daily rainfall for the site was estimated using precipitation data from the Dodge Creek, Wyoming station (482106), which is located approximately 14.4 miles northwest of the mine site. Because no long-term on-site precipitation record is available, data from this nearby station were used to represent site conditions. The Dodge Creek station was selected based on its proximity to the site and the availability of a continuous daily record for the period from 2001 to 2025. Daily precipitation values were aggregated into monthly totals, and the arithmetic average method was applied to develop the average monthly precipitation profile for the site. The daily estimated rainfall during the mine operating period resulting and average monthly precipitation values are presented in Figure 17-7 and Table 17-3, respectively. This precipitation profile serves as the primary climatic input to the water balance model and is used to estimate direct precipitation and runoff contributions to the process solution system. The same period of record was also used to identify the above-average (wet) and below-average (dry) precipitation conditions evaluated in the water balance scenarios.

*Table 17-3: Rainfall Data Estimated for the Site*

| Months | Rainfall (in) | Rainfall (mm) |
|---|---|---|
| 1 | 0.062 | 1.6 |
| 2 | 0.064 | 1.6 |
| 3 | 0.259 | 6.6 |
| 4 | 0.752 | 19.1 |
| 5 | 2.658 | 67.5 |
| 6 | 1.267 | 32.2 |
| 7 | 1.431 | 36.4 |
| 8 | 1.024 | 26.0 |
| 9 | 0.980 | 24.9 |
| 10 | 0.476 | 12.1 |
| 11 | 0.089 | 2.3 |
| 12 | 0.054 | 1.4 |
| Total | 9.116 | 231.5 |

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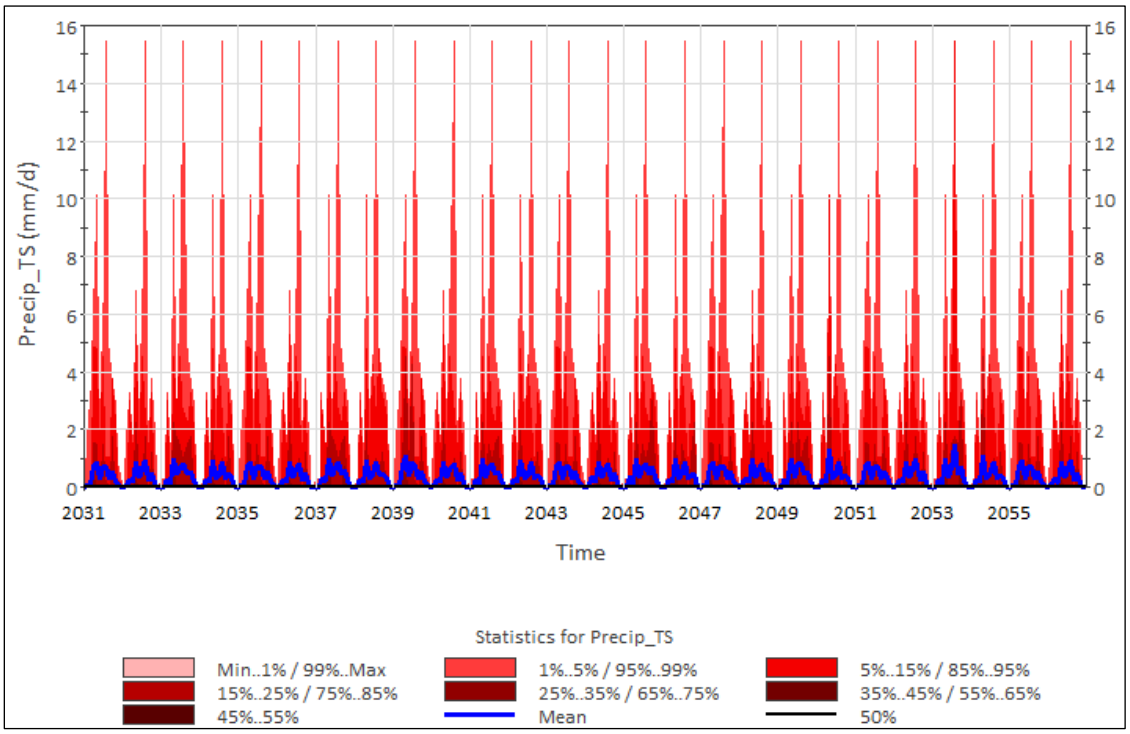


*Figure 17-7: Simulated Daily Precipitation on the Mining Site*

Monthly average pan evaporation for the site was estimated using the Penman-Monteith method. This method is physically based and accounts for the principal climatic parameters that govern the energy exchange at the water surface and the corresponding latent heat flux, including solar radiation, air temperature, humidity, and wind speed. Because it combines both energy balance and aerodynamic terms, the Penman-Monteith method is widely accepted for estimating evaporation where direct pan measurements are not available. The estimated monthly pan evaporation values are presented in Table 17-4. Pan evaporation represents the potential evaporation rate under the assumption that water is continuously available at the surface; therefore, it can be used to estimate evaporation from open water surfaces such as the pond. For surfaces without standing water, however, actual evaporation is limited by the amount of water available. During dry months, evaporation from these surfaces cannot exceed the precipitation received, and the water balance model therefore limits evaporation to the available precipitation. This approach prevents the overestimation of evaporative losses and provides a more realistic representation of site water losses throughout the year.

*Table 17-4: Pan Evaporation Estimated for the Site*

| Months | Pan Evaporation(mm) |
|---|---|
| 1 | 9.0 |
| 2 | 17.4 |
| 3 | 37.6 |
| 4 | 56.3 |
| 5 | 90.8 |
| 6 | 149.8 |

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| | |
|---|---|
| 7 | 197.6 |
| 8 | 181.0 |
| 9 | 154.2 |
| 10 | 73.8 |
| 11 | 29.3 |
| 12 | 13.1 |
| Total | 1009.9 |

# 17.12 Process Water

## 17.12.1 Water Balance

A water supply pond will be designed to collect and store water from several on-site sources, including recycled water from ore processing, surface runoff and seepage from the waste sand piles, and direct rainfall on the pond surface. The pond will serve as the central storage facility for the process water system and will supply water to the ore processing and other site operations. By capturing and reusing these on-site flows, the pond is intended to reduce the volume of makeup water required from external sources. The pond capacity will be established based on the results of the water balance analysis described in the following sections.

Surface runoff from the waste sand piles was estimated using the GR4J daily rainfall-runoff hydrologic model. GR4J is a conceptual, four-parameter model that simulates runoff on a daily time step and is well suited to long-term continuous simulation. For piles composed of sand/coarse waste material, runoff coefficients typically range from 0.05 to 0.20 because of the high infiltration capacity and storage within the pile. Because no on-site flow data are available to calibrate the model, the model parameters were adjusted to produce a long-term runoff coefficient of 0.1, which falls within the typical range for coarse waste piles. This value is considered a reasonable estimate for planning purposes and should be verified once site-specific flow monitoring data become available.

A conceptual water balance model was developed using GoldSim (Version 15). The model operates on a daily time step and simulates direct rainfall, surface runoff, and evaporation at the pond using the daily rainfall and evaporation data described above. The model was used to predict the site water balance over the mine operating period from 2031 to 2056. Inflows to the pond include recycled water from ore processing, seepage and runoff from the waste sand piles, and direct rainfall on the pond, while outflows include evaporation and site water demands. The average monthly water demands, on-site water sources, and required makeup water volumes are summarized in Table 17-5. Based on the model results, the average annual water deficit is approximately 820 ac-ft, which represents the volume of makeup water that must be supplied from external sources to sustain operations.

It should be noted that water use for road dust suppression and for miscellaneous buildings and infrastructure was estimated based on currently available information. These demands may change as the mine layout, haul road network, and facility requirements are further developed. The estimates will be updated, and the water balance model revised accordingly, once detailed design information becomes available.

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The results indicate that routing sand pile runoff and direct rainfall to the water supply pond generally reduces reliance on makeup water from the river. However, this runoff is not essential to meeting the site makeup water requirements. Because runoff volumes vary with seasonal and annual precipitation, these contributions are less reliable during dry periods, when water demand is typically highest. Therefore, the makeup water supply should be sized to meet site demands without relying on runoff, while the captured runoff provides an additional benefit by reducing the volume of makeup water required.

*Table 17-5: Water Demand and Makeups*

| Month | Water Demand(including loss) | | | | On-site Water Source | | | | Water Makeups (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| | Water for Ore Process (ac-ft) | Water Usage for Dust Control/Admin (ac-ft) | Evaporation from Water Pond (ac-ft) | Total Demand (ac-ft) | Runoff (Sand Pile, Direct rainfall to Pond, etc.) (ac-ft) | Seepage from Waste Sand / Dry Tailings (ac-ft) | Recycling from Ore process (ac-ft) | Total Reclaimed (ac-ft) | |
| Jan | 1074 | 2.7 | 0.3 | 1077.0 | 0.1 | 6.7 | 1001 | 1007.8 | 69.1 |
| Feb | 1074 | 2.7 | 0.5 | 1077.2 | 0.2 | 6.7 | 1001 | 1007.9 | 69.3 |
| Mar | 1074 | 2.7 | 0.8 | 1077.5 | 0.4 | 6.7 | 1001 | 1008.1 | 69.3 |
| Apr | 1074 | 2.7 | 0.9 | 1077.6 | 0.9 | 6.7 | 1001 | 1008.6 | 68.9 |
| May | 1074 | 2.7 | 0.8 | 1077.5 | 5.3 | 6.7 | 1001 | 1013.0 | 64.5 |
| Jun | 1074 | 2.7 | 0.7 | 1077.4 | 4.9 | 6.7 | 1001 | 1012.6 | 64.7 |
| Jul | 1074 | 2.7 | 2.7 | 1079.4 | 2.1 | 6.7 | 1001 | 1009.8 | 69.6 |
| Aug | 1074 | 2.7 | 3.7 | 1080.4 | 6.0 | 6.7 | 1001 | 1013.7 | 66.7 |
| Sep | 1074 | 2.7 | 6.5 | 1083.2 | 1.3 | 6.7 | 1001 | 1009.0 | 74.2 |
| Oct | 1074 | 2.7 | 3.3 | 1080.0 | 8.0 | 6.7 | 1001 | 1015.7 | 64.3 |
| Nov | 1074 | 2.7 | 1.2 | 1077.9 | 0.9 | 6.7 | 1001 | 1008.6 | 69.3 |
| Dec | 1074 | 2.7 | 0.5 | 1077.2 | 0.2 | 6.7 | 1001 | 1007.9 | 69.2 |
| Annual Total | 12888.0 | 32.4 | 21.7 | 12942.1 | 30.4 | 80.4 | 12012.0 | 12122.8 | 820 |

## 17.12.2 Water Source

Any water deficit that cannot be met by on-site water sources will be balanced by makeup raw water supplied from a nearby water reservoir. Withdrawals from the reservoir are permitted only from June 1 to September 15 each year, with a maximum pumped volume of 1,620 ac-ft/yr. Because makeup water can be obtained only during this limited window, sufficient water must be pumped and stored during the allowed period to meet site demands for the remainder of the year. This seasonal restriction is therefore a key constraint on the design of the pumping system and the on-site storage facilities.

Given the annual water deficit and the restricted pumping period, pump capacity and pumping schedule are the key factors in sizing any additional storage. As discussed above, a water supply pond with a capacity of approximately 550 ac-ft has been proposed. To make full use of this capacity and minimize the additional

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storage required, the pond should be filled before September 15 each year. If the pond is not full at the end of the pumping window, the shortfall must be made up by additional storage, which increases the overall storage requirement for the site.

Several combinations of pump capacity and pumping schedule were developed and simulated using the GoldSim water balance model. Each scenario was evaluated for its ability to meet site water demands, the volume of makeup water required from the reservoir, and the additional storage needed beyond the proposed water supply pond. The results of these simulations are presented in Table 17-6.

Based on the initial evaluation, the following observations were made:

- Pump capacity and pumping schedule are the key factors in sizing additional storage. Higher pumping rates allow more water to be delivered within the permitted pumping window and therefore reduce the storage required.
- The water supply pond should be maintained at, or brought to, a high water level or full capacity by September 15 each year. This ensures that the maximum volume of water is available to meet site demands until pumping can resume the following June.
- Scenario 1 has the lowest overall storage requirement among the scenarios evaluated.
- Scenario 3 has the lowest mean river makeup requirement because it uses up of the water stored in the pond before mining begins. However, it requires substantially more storage, with a maximum additional storage requirement of 330 ac-ft. The benefit of reduced makeup water under this scenario should therefore be weighed against the cost of constructing the additional storage.

It should be noted that these initial results are based on assumed pump capacities and pumping schedules. Actual pump capacity will depend on the selected pumping equipment, pipeline configuration, and reservoir operating constraints. Further detailed studies are required to confirm the pumping system design and to determine the additional storage requirement. The water balance model will be updated as additional design information becomes available.

*Table 17-6: Pump Capacity, Pump Schedule and Additional Storage*

| | **Date** | **Senario-1** | **Senario-2** | **Senario-3** |
|---|---|---|---|---|
| Pump Schedule/Rate (gpm) | Jun | 1000 | 2000 | 1000 |
| | Jul | 1000 | 2000 | 1000 |
| | Aug | 3000 | 2000 | 1000 |
| | Sep | 3000 | 2000 | 1000 |
| Water makeup From River (mean) (ac-ft) | | 827 | 852 | 773 |
| Water makeup From River (max) (ac-ft) | | 897 | 881 | 803 |
| Additional Storage Required (mean) (ac-ft) | | 71 | 85 | 299 |
| Additional Storage Required (max) (ac-ft) | | 89 | 129 | 330 |

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# 18 Market Studies

## 18.1 Critical Enablers of Electric Mobility, Automation and Energy Efficiency

Compared to similarly abundant elements in nature, such as copper, lead, and tin, global annual production of rare earth elements is notably low.

Nevertheless, rare earth elements have become critical enablers of technologies at the heart of clean energy initiatives worldwide, as well as ubiquitous gadgetry and electronics that have pervaded modern society.

Rare earth elements are used in small, but often necessary, amounts in hundreds of different technologies, materials, and chemicals worldwide for commercial, industrial, social, medical, and environmental applications.

**In just a period of decades, rare earth elements have seeped deeply into the fabric of modern technology and industry and have proven exceptionally challenging to duplicate or replace.**

## 18.2 Classification and Terminology

On the Periodic Table of Elements, rare earth elements include the lanthanide series, plus yttrium and sometimes scandium (see Figure 18-1).

Yttrium is classified as a rare earth element because of its similar ionic radius and chemical properties to the lanthanides, resulting in its strong affinity for concentrating with the REEs in the same minerals. Although similar in nature, scandium often concentrates in a wider array of minerals without the REEs and therefore is not as commonly associated.

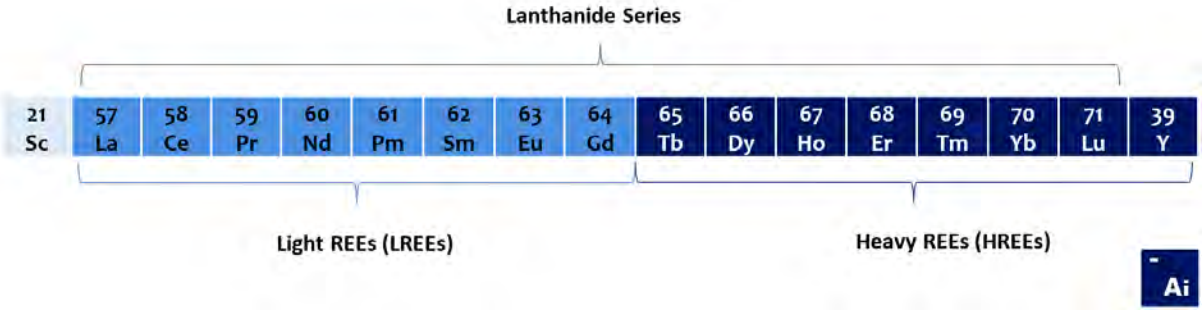


*Figure 18-1: Rare Earth Elements Include the Lanthanide Series Plus Yttrium and Sometimes Scandium*

Rare earth elements are arbitrarily classified as light rare earth elements or oxides (“LREEs” or “LREOs”) or heavy rare earth elements or oxides (“HREEs” or “HREOs”) based on their electron configurations.

By virtue of having a higher crustal abundance, LREOs collectively make up over 90% of the total rare earth oxide (“TREO”) content in a typical rare earth deposit and thereby also make up the vast majority of the world’s TREO output each year.

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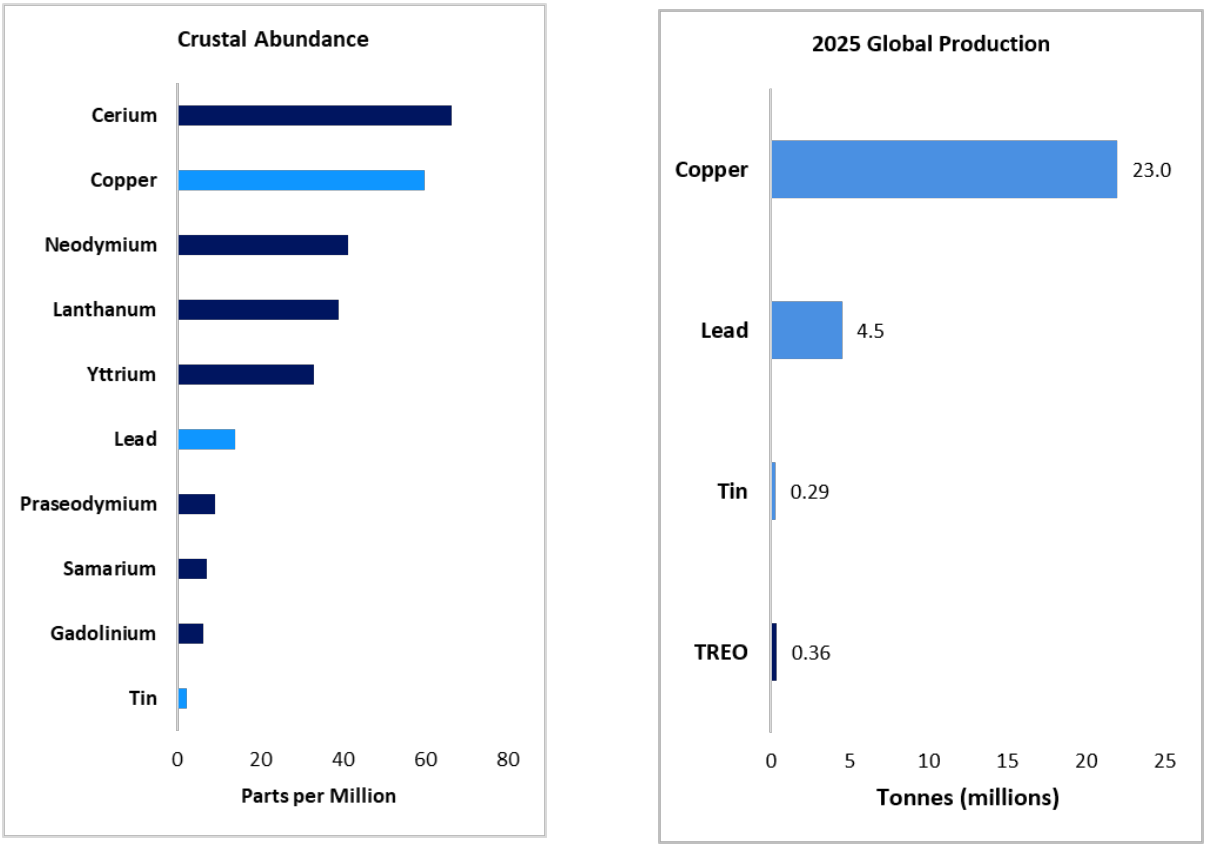
Heavy rare earth oxides, on the other hand, are present in the Earth's crust in substantially lower concentrations than LREOs and, as such, make up a relatively small portion of the world's TREO output each year.

## 18.3 Rarely Enriched in Nature

Despite the misleading moniker, rare earth elements are not remarkably rare in nature, but rather are rarely concentrated into economically significant amounts for extraction and processing owing to certain physical and chemical characteristics that promote their broad dispersion in most rock types.

In fact, cerium is more abundant in the Earth's crust than copper; neodymium, lanthanum and yttrium are more abundant than lead; and praseodymium, samarium and gadolinium are more abundant than tin (see Figure 2 – LHS).

Despite this fact, there were only 360,000 tonnes of all 16 REOs combined ("TREO") – lanthanides plus yttrium – produced globally in 2025 versus 23.0 million tonnes of copper, 4.5 million tonnes of lead and 290,000 tonnes of tin in the same year (see Figure 18-2).




**Source:** Adamas Intelligence research, USGS, Jefferson Lab

*Figure 18-2: Global Production of REEs Is Remarkably Low Compared to Similarly Abundant Elements*

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## 18.4 Historical Production

From 2020 through 2025, Adamas data indicates that global mine production of rare earth oxides (“TREO”) increased at a CAGR of 10.1%, from 223,000 tonnes to 360,000 tonnes, with China responsible for 63% to 74% of output each year (Figure 18-3).

Other notable mine producers in recent years have included Australia, the U.S. and Myanmar, albeit their combined share of global supply has fallen from 32% in 2020 to 15% in 2025, outpaced by China’s production growth.

Since the early 2000s, China has leveraged its dominance of upstream production to cement control over all downstream value adding steps along the mine-to-magnet supply chain.

As of 2025, China was responsible for 67% of global mine production of magnet rare earths and over 89% of each subsequent step, making it the world’s dominant producer of refined rare earth oxides, metals and alloys, magnetic alloys, and NdFeB permanent magnets (see Figure 18-4).

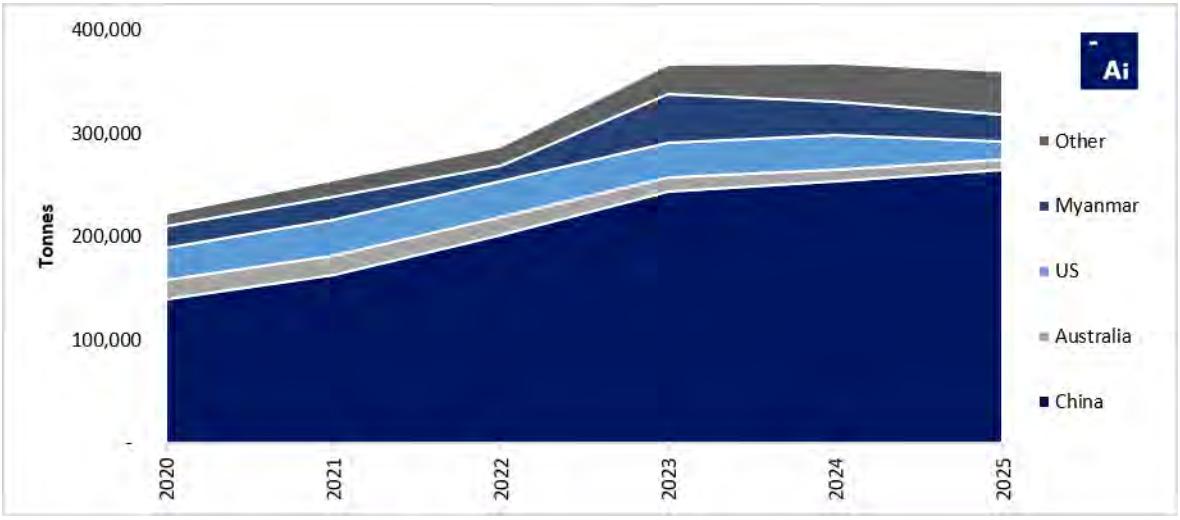


*Figure 18-3: Historical global TREO mine production by country*

| Regional Share | Mining | Oxides | Metals and Alloys | NdFeB Alloys and Powders | NdFeB Magnets |
|---|---|---|---|---|---|
| China | 67% | 89% | 92% | 91% | 90% |
| Other | 33% | 11% | 8% | 9% | 10% |

Figure 18-4: Overview of the Global Mine to Magnet Value Chain in 2025, Led by China at Every Step



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## 18.5 Eight End-Use Categories

Rare earth elements are used in hundreds of unique end-uses and applications that collectively fall into one of eight end-use categories: 1.) Battery Alloys, 2.) Catalysts, 3.) Ceramics, Pigments and Glazes, 4.) Glass Polishing Powders and Additives, 5.) Metallurgy and Alloys, 6.) Permanent Magnets, 7.) Phosphors, and 8.) Other End-Uses and Applications (Table 18-1).

*Table 18-1 Rare Earth Applications and End-Uses Fall into One of Eight End-Use Categories*

| End-Use Category | Description |
|---|---|
| **Battery Alloys**<br><br>(La, Ce, Pr, Nd) | Rare earth elements are used to produce anode materials for nickel-metal hydride ("NiMH") batteries. NiMH batteries are used in hybrid electric vehicles, consumer electronics, cordless shavers, cordless powertools, baby monitors and other applications of rechargeable batteries. |
| **Catalysts**<br><br>(La, Ce) | Rare earth elements, such as cerium and lanthanum, are used in catalytic converters of gasoline- and diesel-powered vehicles, as well as fuel cracking catalysts and additives used by oil refiners to break down crude oil into lighter distillates, such as gasoline, diesel, kerosene and more. |
| **Ceramics, Pigments and Glazes**<br><br>(La, Ce, Pr, Nd, Y) | Rare earth elements are used to produce decorative ceramics, functional ceramics, structural ceramics, bio ceramics and many other types of ceramics used in everything from jet engine coatings to ceramic cutting tools, dental crowns, ceramic capacitors, ceramic tiles, and more. |
| **Glass Polishing Powders and Additives**<br><br>(Ce, La, Er, Gd, Y) | Rare earth elements, such as cerium, are used to polish optical glass, hard disk drive platters, LCD display screens and gemstones, among a long list of applications. Cerium is also used as an additive in UV-filtering glass and container glass, whereas lanthanum, yttrium and gadolinium are used to produce high quality optical glass used in camera lenses, microscopes and telescopes. |
| **Metallurgy and Alloys**<br><br>(La, Ce, Ho, Gd, Y) | Rare earth mischmetal (a mixture of light REE metals) is used during production of some types of steel, as well as ductile iron making. Rare earth elements are also used to produce a variety of different alloys, such as ferro-cerium, ferro-holmium, ferro-gadolinium and a growing list of others. |

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| End-Use Category | Description |
|---|---|
| **Permanent Magnets** (Nd, Pr, Dy, Tb, Sm, minor Ho, Gd, Ce, La) | Rare earth elements are used to produce high-strength permanent magnets that have enabled the production of ubiquitous gadgets and electronics, such as mobile phones and laptops, as well as power dense energy-efficient electric motors and generators used in electric vehicles, wind turbines, energy efficient appliances and hundreds of other applications. |
| **Phosphors** (Ce, La, Y, Tb, Eu) | Rare earth elements are used in phosphors for energy efficient lamps, display screens and avionics, and are added to fiat currency in some nations as an anti-counterfeit measure. |
| **Other** (La, Ce, Nd, Dy, Tb, Gd, Lu, Tm) | Aside from the above-described end uses and categories, rare earth elements are used in a long list of other end uses and applications, including many in defense, medicine, health, wellness, aerospace, agriculture, high-tech and chemical industries. |

## 18.6 Global Rare Earth Consumption in 2025

By volume, permanent magnets and catalysts were collectively responsible for 71% of global TREO consumption in 2025 (see Figure 18-5). However, by value, permanent magnets alone were again responsible for over 95% of the total value of global TREO consumption last year (see Figure 18-5) and this share continues to expand further as demand for (and prices of) neodymium, praseodymium, didymium, dysprosium and terbium continue to outperform.

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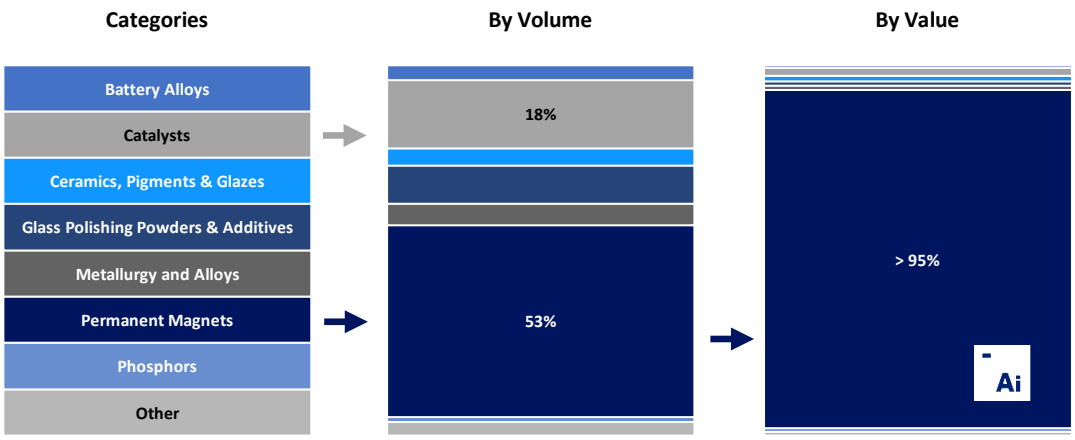
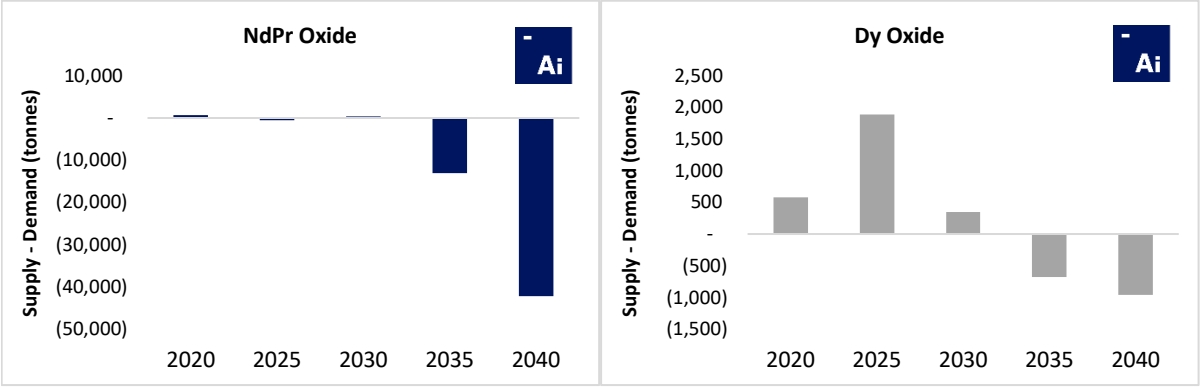



*Figure 18-5: Permanent Magnets and Catalysts are the Largest Rare Earth Demand Drivers*

Not only does demand for neodymium, praseodymium, didymium, dysprosium and terbium collectively make up the majority of global value today, but in the years ahead demand for these four rare earth elements will continue to grow faster than demand for all other rare earth elements, challenging the ability of the supply-side to keep up.

As shown in Figure 18-5, Adamas Intelligence forecasts that global annual demand for didymium ("NdPr") oxide and dysprosium ("Dy") oxide will increasingly exceed global annual production post-2030, leading to the depletion of historically accumulated inventories and, ultimately, shortages of these critical magnet materials if substantial additional sources of supply are not developed.




Note: Didymium Oxide = NdPr Oxide = Oxide compound of ~75% Nd2O3 and ~25% Pr6O11; NdPr is the main rare earth input material for NdFeB magnet production. Only minor quantities of individual Nd oxide and Pr oxide are produced and consumed globally each year.

*Figure 18-5: The Supply-Side Will Struggle to Keep Up with Rising Demand for Magnet Rare Earths*

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# 18.7 Rare Earth Balance Problem

Over the past decade, rare earth producers globally have sacrificially overproduced certain low value rare earth elements, such as cerium (see Figure 18-6 - LHS), to keep up with rapidly growing demand for other high value rare earth elements and compounds, such as didymium (see Figure18-7 – RHS).

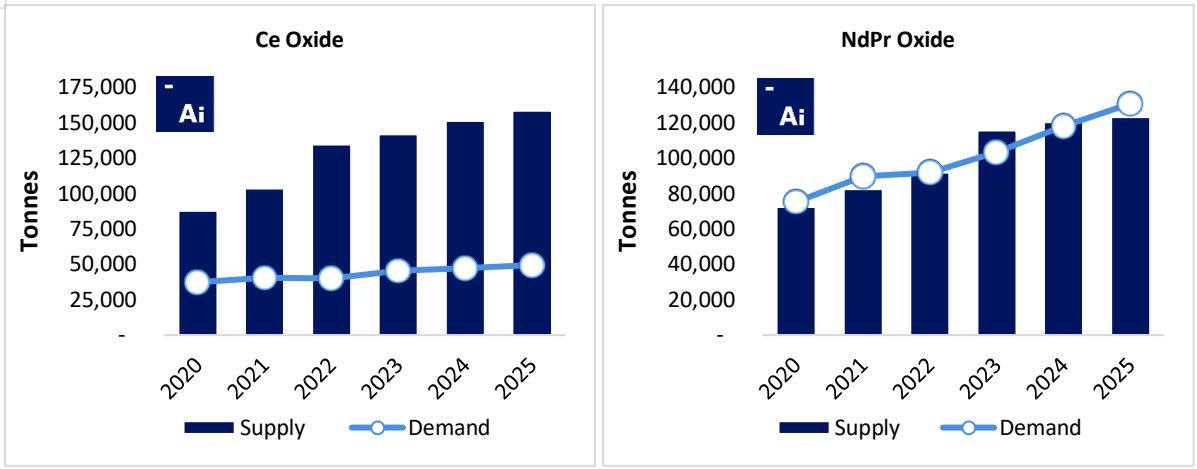


*Figure 18-6: Sacrificial over-production of cerium oxide to satisfy rapidly growing demand for didymium oxide*

Looking ahead, Adamas forecasts that steadily increasing demand for rare earth permanent magnets will drive global demand for didymium oxide (or oxide equivalent) to new heights (see Figure 18-7), exacerbating the imbalance between production and demand of other rare earth elements, such as cerium oxide (see Figure 18-8 – LHS) if the industry continues on a path of business-as-usual.

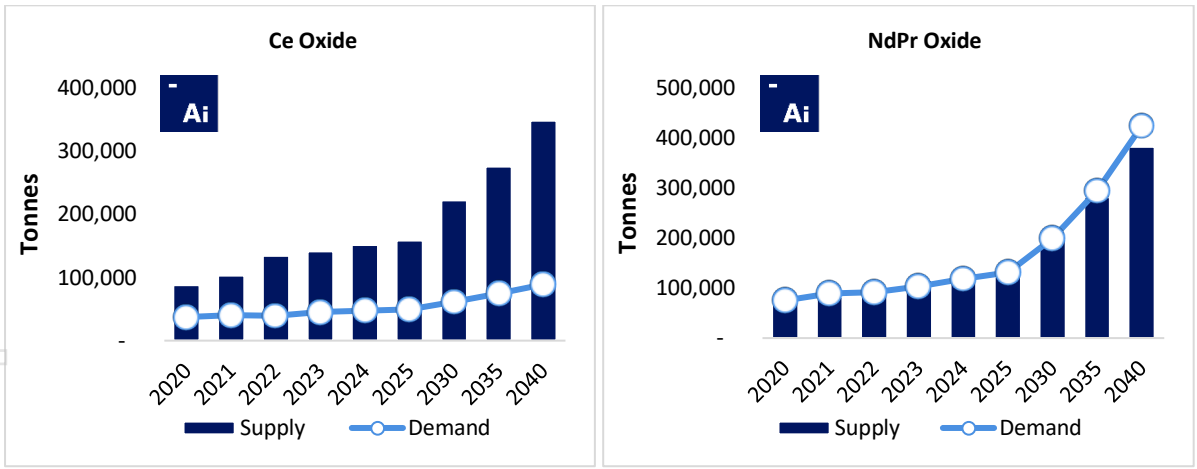


*Figure 18-7: Strong future demand growth for permanent magnets will exacerbate the balance problem*

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## 18.8 Implications of the Balance Problem

Unless new end-uses and applications are developed for lanthanum, yttrium, and other sacrificially-overproduced rare earth elements in the near-term (see

Figure 18-8), Adamas forecasts that prices of high-demand elements and compounds, like didymium, neodymium, praseodymium, dysprosium, and terbium will stay relatively strong and/or rise accordingly (see

Figure 18-8) to compensate for losses that producers are chronically incurring by necessarily over-producing the other unsaleable, surplus rare earths.

The industries that will feel these price increases the most in the coming years are those reliant on use of high-strength NdFeB permanent magnets, such as the automotive industry, the wind power sector, the robotics industry, the defense industry, and many others.

Ultimately, Adamas expects that price increases of magnet input materials may upend the economics of using rare earths in some end-use sectors – pushing some manufacturers to adopt alternatives to rare earth permanent magnets where possible.

However, for the most promising of end-use sectors – such as electric vehicles, robotics, advanced air mobility, defense, and others – the economics of using rare earth elements are robust, and Adamas expects these segments will continue to fuel strong rare earth demand growth into the foreseeable future.

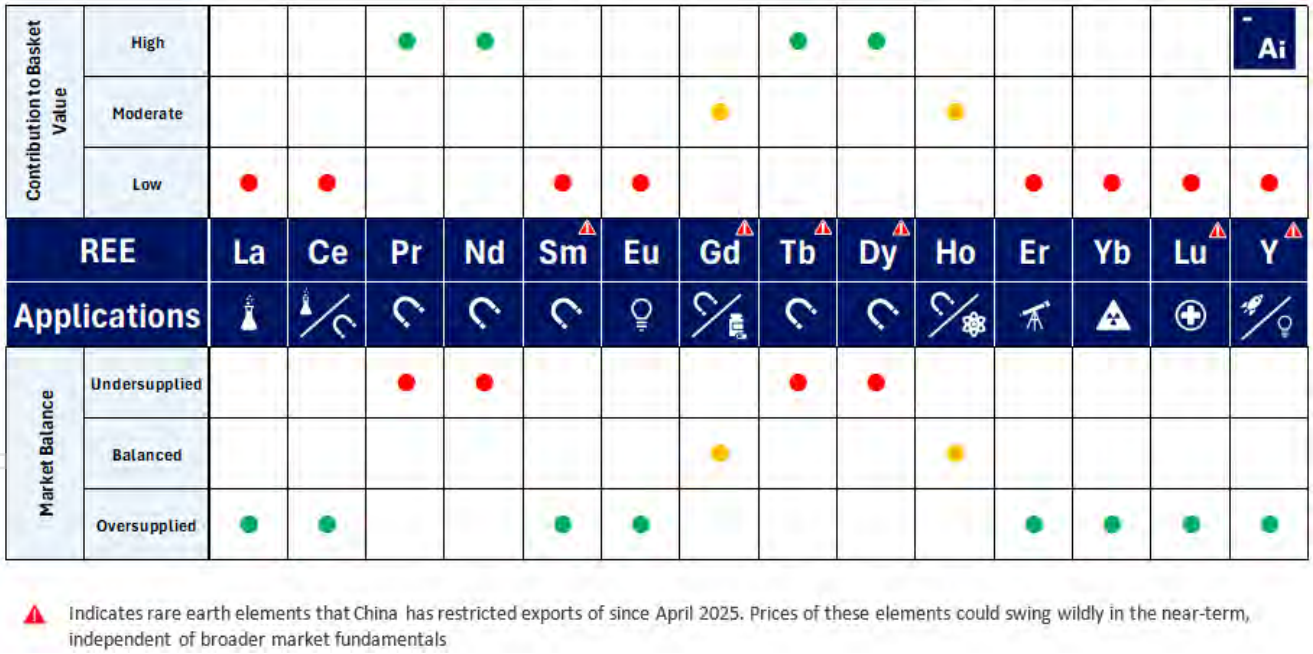


*Figure 18-8: Prices of Magnet Rare Earths Will Rise to Compensate for Losses Incurred on Other Rare Earths*



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# 18.9 Forecasted TREO Demand by End-Use Category

After rising at an estimated 7.7% last year, Adamas forecasts that global TREO demand will increase at a CAGR of 6.0% going forward, from 252,000 tonnes in 2025 to 607,000 tonnes in 2040, driven primarily by the permanent magnet sector (see Figure 18-9).

In the years ahead, global TREO demand for permanent magnets is projected to rise at a market-leading CAGR of 8.4%, driven by double-digit demand growth for applications involving electric mobility, robotics, advanced air mobility and more (see Figure 18-9).

Conversely, over the forecast period, global TREO demand for all other end-use categories, except for phosphors, are projected to grow at market-lagging CAGRs of 0% to 6%, while TREO demand for phosphors is projected to fall at a CAGR of -5.2% (see Figure 18-9).

Over the forecast period, the rapid TREO demand growth expected for permanent magnets will lead the end-use category to continuously absorb market share from incumbent categories.

By 2035, Adamas projects that permanent magnets will drive 66% of global TREO demand by volume and over 95% of the market's value each year.

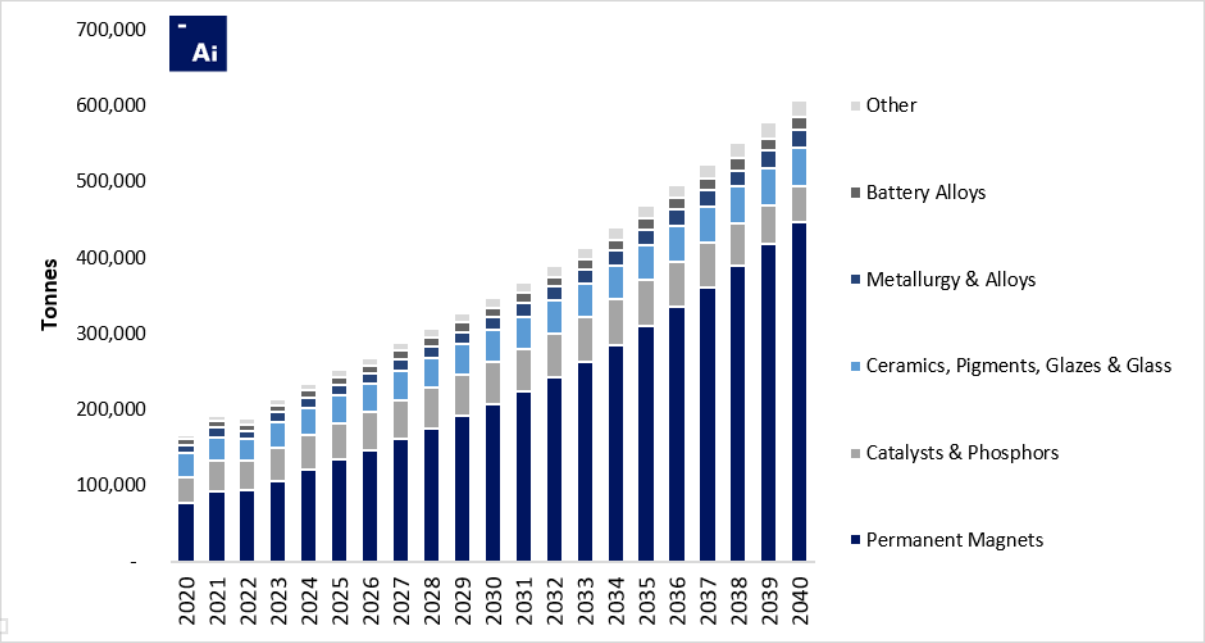


*Figure 18-9: Historical global consumption and forecasted demand for TREO by end-use category*

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# 18.10 NdFeB Permanent Magnets: Enablers of Modern Technology

## 18.10.1 What is NdFeB?

Neodymium-iron-boron (“NdFeB”) is a permanent magnet alloy that was developed and commercialized in the 1980s as an alternative to costly samarium-cobalt (“SmCo”) alloy that was developed and commercialized three decades earlier.

## 18.10.2 What is it made of?

As the name suggests, NdFeB alloy is comprised primarily of neodymium, iron, and boron in a $Nd_2Fe_{14}B$ tetragonal crystalline structure, and often contains lesser concentrations of praseodymium (combined with neodymium in the form of didymium), dysprosium, terbium, cerium, gadolinium, holmium, copper, cobalt, niobium, gallium and other metals to optimize the alloy’s properties for certain applications.

## 18.10.3 Why is it special?

NdFeB permanent magnet alloy is the strongest type of permanent magnet material commercially available today in terms of maximum energy product (i.e., magnetic flux output per unit volume, measured in megagauss-oersteds (MGOe) or Joules per cubic meter (J/m3)) (see Figure 18-10).

As such, NdFeB magnets have largely supplanted SmCo, AlNiCo, and ferrite magnets in many size- and weight-sensitive applications since the 1980s and simultaneously have enabled the conception and miniaturization of a wide array of ubiquitous gadgets and electronics that have pervaded modern society.

NdFeB permanent magnets are used in hundreds of different end-uses and applications – many of which we interact with daily, whether we realize it or not. From mobile phone loudspeakers and vibration motors, to hard disk drives, optical disc drives, electric vehicle traction motors, automotive micromotors, wind power generators, and beyond – NdFeB permanent magnets are literally all around us.

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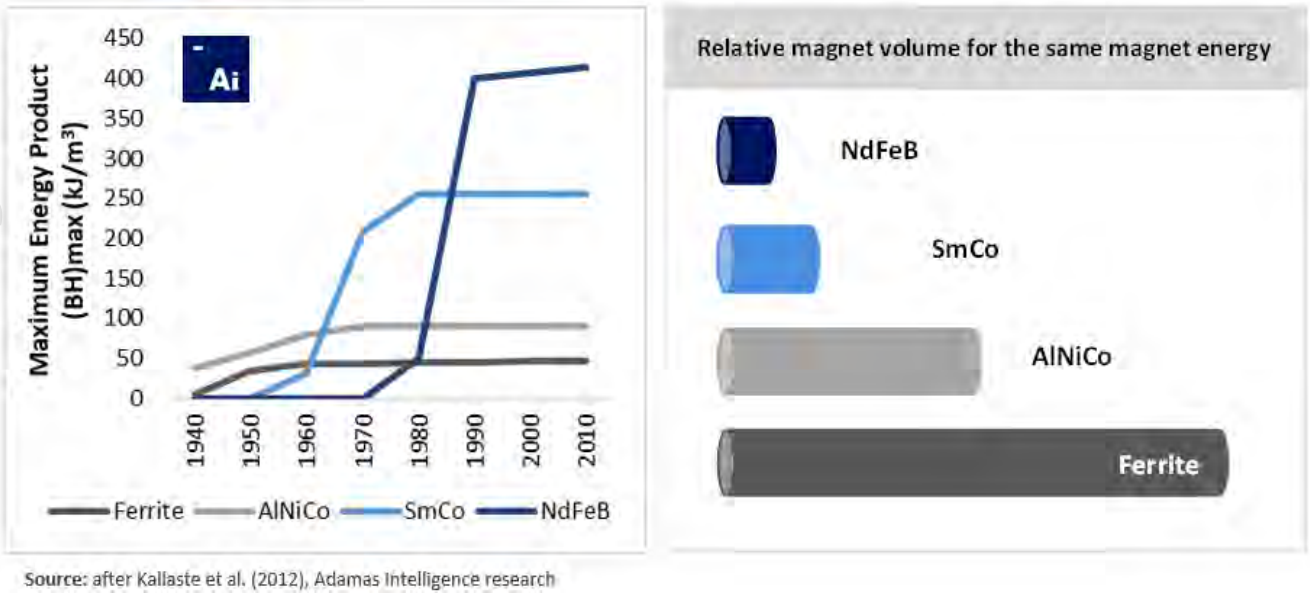


Source: after Kallaste et al. (2012), Adamas Intelligence research

Figure 18-10: NdFeB is the strongest permanent magnet material commercially available today

## 18.11 Heavy Rare Earths Are Used in High Strength and High Temperature Grades of NdFeB

NdFeB permanent magnet alloy - the bulk precursor material from which final sintered NdFeB magnets are manufactured - is available in over 80 different grades, each defined by its maximum energy product and intrinsic coercivity (i.e., resistance to demagnetization at temperature) (Figure 18-12).

Different grades of NdFeB alloy often have slightly different chemical compositions due to the addition of other metals or alloys to modify the magnet's properties.

Didymium is the main rare earth input for production of all grades, making up around 25% to 31% by weight. Low-strength and low-temperature magnet grades can contain upwards of 5% cerium in place of didymium. Conversely, some high-strength and high-temperature magnet grades can contain 0.5% to 5% dysprosium and/or 0.1% to 1.0% terbium in place of didymium in concentrations that increase with strength and/or temperature.

EVs, wind power generators, robotics, and advanced air mobility applications often use high-strength and high-temperature grades of NdFeB magnets (e.g., SH, UH, and EH grades), which can contain appreciable concentrations of the heavy rare earth elements dysprosium and terbium to protect against demagnetization.

In April 2025, China announced the implementation of export controls on a variety of rare earth materials, including several heavy rare earth elements (e.g., dysprosium and terbium), as well as NdFeB magnets containing dysprosium and/or terbium.

The export control measures are not an outright ban on exports. Rather, they require that suppliers in China first apply for an export license before fulfilling foreign purchase orders, allowing Beijing to halt supplies to specific companies, industries or regions with surgical precision.

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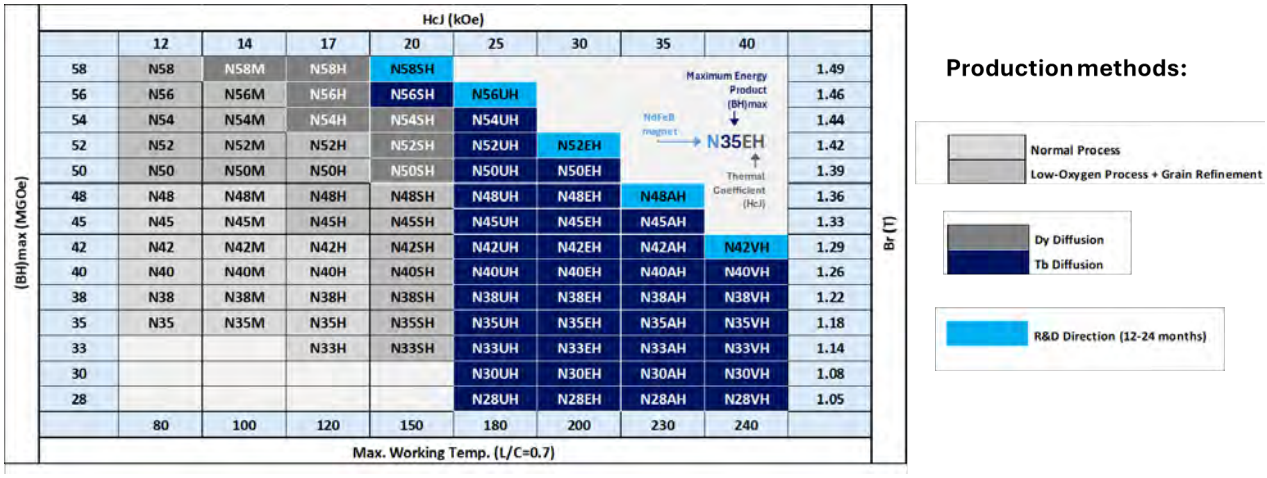
The measures are wreaking havoc on global supply chains with some major OEMs shutting down production lines, others delaying product ramp ups and virtually all scrambling to secure alternative sources of supply.

According to Adamas, Beijing's latest weaponization of rare earths will have long lasting impacts on the global industry through the galvanization and acceleration of efforts to develop alternative mine-to-magnet supply chains outside China.




| | 12 | 14 | 17 | 20 | 25 | 30 | 35 | 40 | |
|---|---|---|---|---|---|---|---|---|---|
| 58 | N58 | N58M | N58H | N58SH | | | | | 1.49 |
| 56 | N56 | N56M | N56H | N56SH | N56UH | | | | 1.46 |
| 54 | N54 | N54M | N54H | N54SH | N54UH | | | | 1.44 |
| 52 | N52 | N52M | N52H | N52SH | N52UH | N52EH | | | 1.42 |
| 50 | N50 | N50M | N50H | N50SH | N50UH | N50EH | | | 1.39 |
| 48 | N48 | N48M | N48H | N48SH | N48UH | N48EH | N48AH | | 1.36 |
| 45 | N45 | N45M | N45H | N45SH | N45UH | N45EH | N45AH | | 1.33 |
| 42 | N42 | N42M | N42H | N42SH | N42UH | N42EH | N42AH | N42VH | 1.29 |
| 40 | N40 | N40M | N40H | N40SH | N40UH | N40EH | N40AH | N40VH | 1.26 |
| 38 | N38 | N38M | N38H | N38SH | N38UH | N38EH | N38AH | N38VH | 1.22 |
| 35 | N35 | N35M | N35H | N35SH | N35UH | N35EH | N35AH | N35VH | 1.18 |
| 33 | | | N33H | N33SH | N33UH | N33EH | N33AH | N33VH | 1.14 |
| 30 | | | | | N30UH | N30EH | N30AH | N30VH | 1.08 |
| 28 | | | | | N28UH | N28EH | N28AH | N28VH | 1.05 |
| | 80 | 100 | 120 | 150 | 180 | 200 | 230 | 240 | |

**Note:** Production methods and grade compositions can vary from one producer to the next.

*Figure 18-11: High-temperature and high-strength grades of NdFeB often contain appreciable dysprosium and/or terbium*

## 18.12 Forecasted Rare Earth Demand for NdFeB Magnets by End-Use Category

After an estimated 11.0% increase in 2025, Adamas forecasts that global TREO demand for permanent magnets will rise at a CAGR of 8.4% going forward, from 134,000 tonnes to 447,000 tonnes in 2040, boosted by strong demand growth from electric vehicles, robotics, advanced air mobility, and other applications of NdFeB magnets (see Figure 18-12).

Specifically, from 2025 through 2040 Adamas forecasts that global TREO demand for passenger EV traction motors, commercial EV traction motors and "other e-mobility" applications will collectively increase at a CAGR of 8.5%, together representing the single largest demand driver by 2040 (see Figure 14).

Similarly, from 2025 through 2040 Adamas forecasts that global TREO demand for industrial robots, consumer service robots and professional service robots will collectively increase at a CAGR of 26.6%, poised to collectively overtake EV motors in the decade to follow (see Figure 18-12).

Moreover, from 2025 through 2040 Adamas projects that global TREO demand for applications involving advanced air mobility ("AAM"), including consumer drones, commercial drones, electric vertical takeoff and

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landing (“eVTOL”) aircraft, and more, will increase at a CAGR of 16.2% to become one of the largest end-use categories by the end of the forecast period (see Figure 14).

Additionally, from 2025 through 2040 Adamas projects that global TREO demand for direct drive and hybrid direct drive wind power generators for onshore and offshore applications will rise at a CAGR of 7.1% as the competitive economics of wind power generation (and low maintenance of hybrid and direct drive generators) continue to spur growing adoption (see Figure 18-12).

Lastly, from 2025 through 2040 Adamas forecasts that global TREO demand for all other end-uses and applications of NdFeB permanent magnets will increase at CAGRs of 3.4% to 7.4%, leading some sectors (e.g., industrial) to forgo market share to electric vehicles, robotics and other high-growth applications (see Figure 18-12).

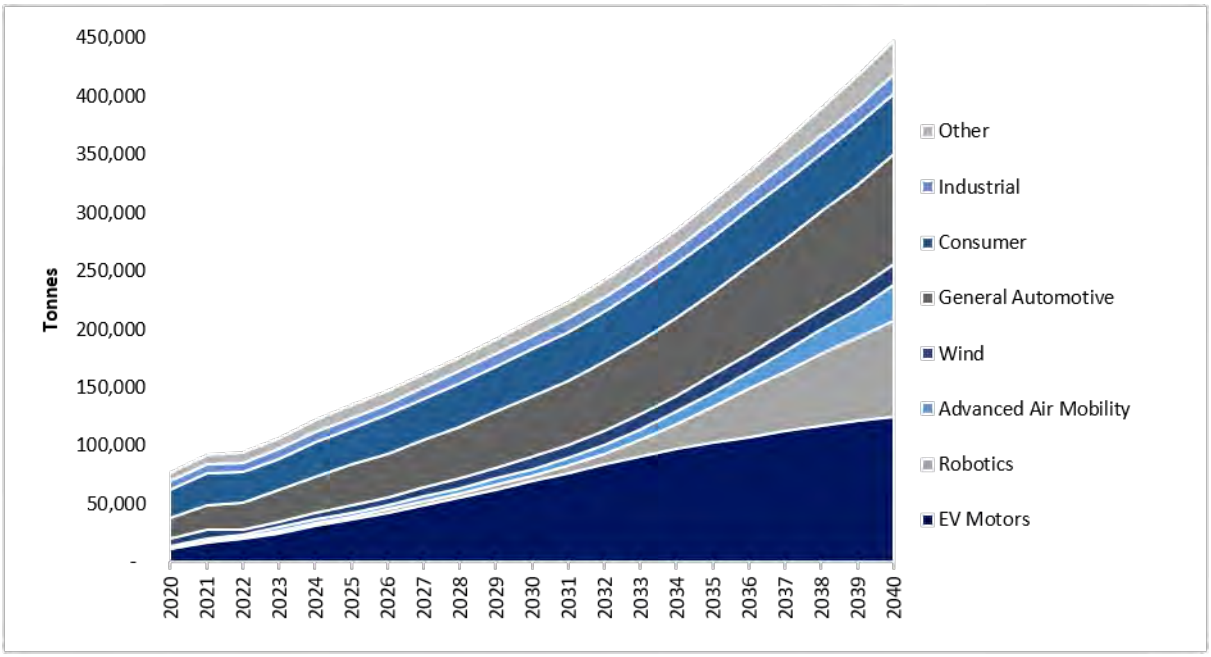


*Figure 18-12: Historical global consumption and forecasted demand for magnet rare earth oxides by end-use category*

## 18.13 EVs, Robotics, AAM and Energy Efficient Applications to Drive 76% of Demand by 2040

By 2040, Adamas forecasts that electric vehicles, wind power generators, robotics, advanced air mobility, and defense applications (see Figure 18-13) combined with automotive micromotors and sensors, industrial applications, consumer appliances, and magnetocaloric chillers (see Figure 18-13) will collectively be responsible for 76% of total global demand for NdFeB magnets and alloys, up from 61% last year and just 53% in 2020.

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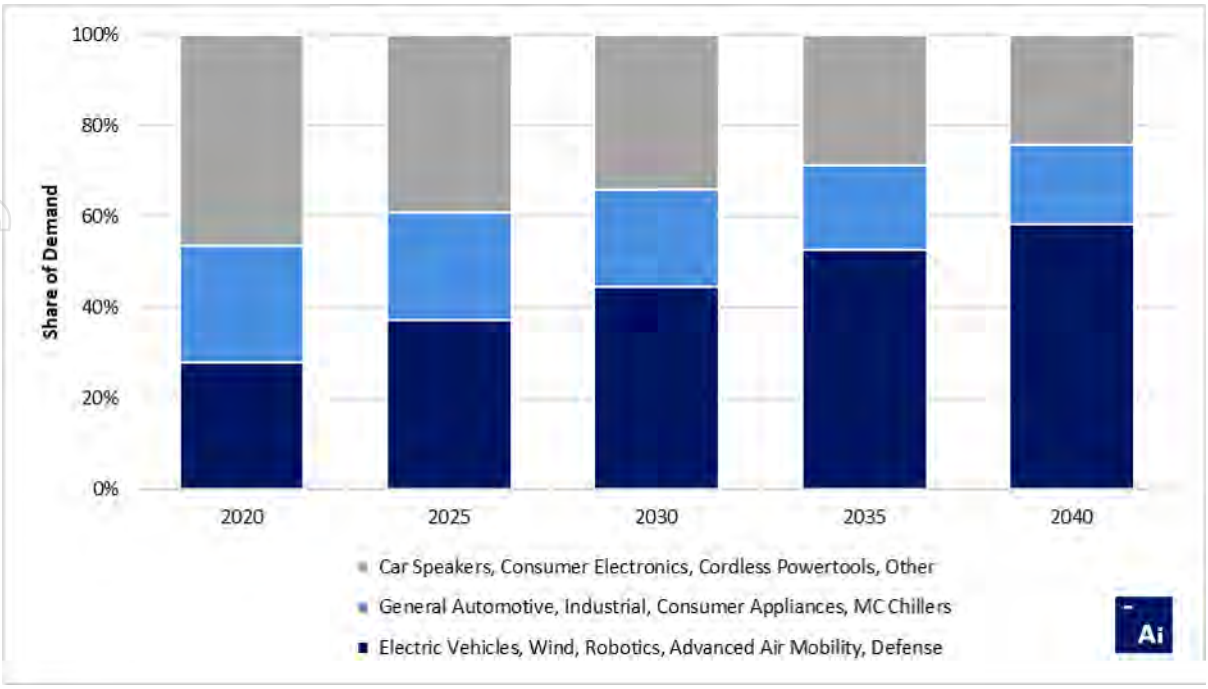


*Figure 18-13: Forecasted share of global NdFeB demand driven by less price sensitive applications*

Adamas believes this evolution is noteworthy as it implies that the future of magnet rare earths demand will be less sensitive to price than that of the past because future demand will be increasingly driven by the above-mentioned applications in which the use of rare earth permanent magnets imparts an economic benefit at the system level.

Be it through battery cost thrifting in an electric vehicle, maintenance cost savings in a wind farm or robot fleet, or electricity cost savings in an industrial facility, grocery store or hotel, the economic upsides enabled by using technologies based on rare earth permanent magnets often allow for a significant rise in magnet rare earth prices going forward before it would be economically justifiable to switch to a REE-free alternative.

As such – Adamas expects that the future of rare earths demand (at least in the case of didymium, dysprosium, and terbium) will be more robust, more resilient and less sensitive to price than demand of the past and present, which is still largely driven by price sensitive consumer and legacy automotive applications.

## 18.14 Forecasted Production – Demand Balance for NdPr Oxide to 2040

From 2025 through 2029, Adamas forecasts that didymium oxide will experience persistent structural deficits as the supply side of the industry struggles to keep up with rapidly growing demand for NdFeB magnets for EV traction motors, wind power generators, industrial applications, consumer applications, robotics, advanced air mobility applications, and more.

By the end of the decade, with today's existing producers increasing output and 22 "highly probable", "probable" and "possible" new producers potentially coming online, Adamas forecasts that global didymium oxide



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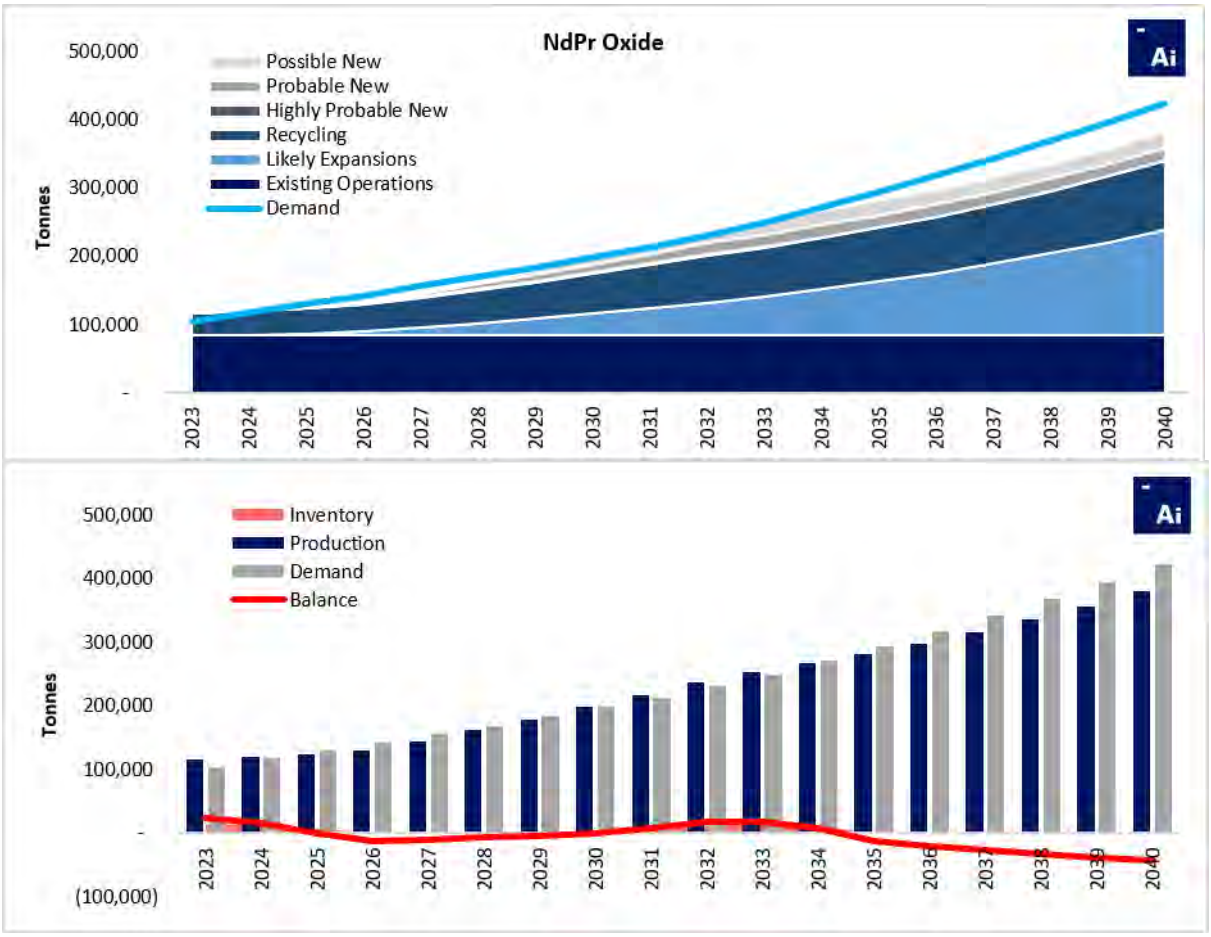
production will moderately exceed global demand from 2030 through 2034 before flipping back to a structural deficit and rising shortages from 2035 through 2040 (see Figure 18-14).

Overall, for the global market to effectively balance production and demand from 2035 through 2040 will require the gradual addition of another 200,000 to 300,000 tonnes-per-annum of LREO-rich production by the end of the forecast period, over-and-above the production growth Adamas is already forecasting.




* Production from highly probable, probable and possible producers is not probability weighted.

*Figure 18-14: Forecasted production – demand balance for NdPr oxide to 2040 (Base Case)*

## 18.15 Forecasted Production – Demand Balance for Dy and Tb Oxides to 2040

In 2025, Adamas estimates that global supply (i.e., production plus inventories) of dysprosium oxide exceeded global demand following a jump in production in Myanmar in 2023 and 2024 that propped up inventory levels in China. However, from 2027 on, Adamas forecasts that global demand for dysprosium oxide will exceed global



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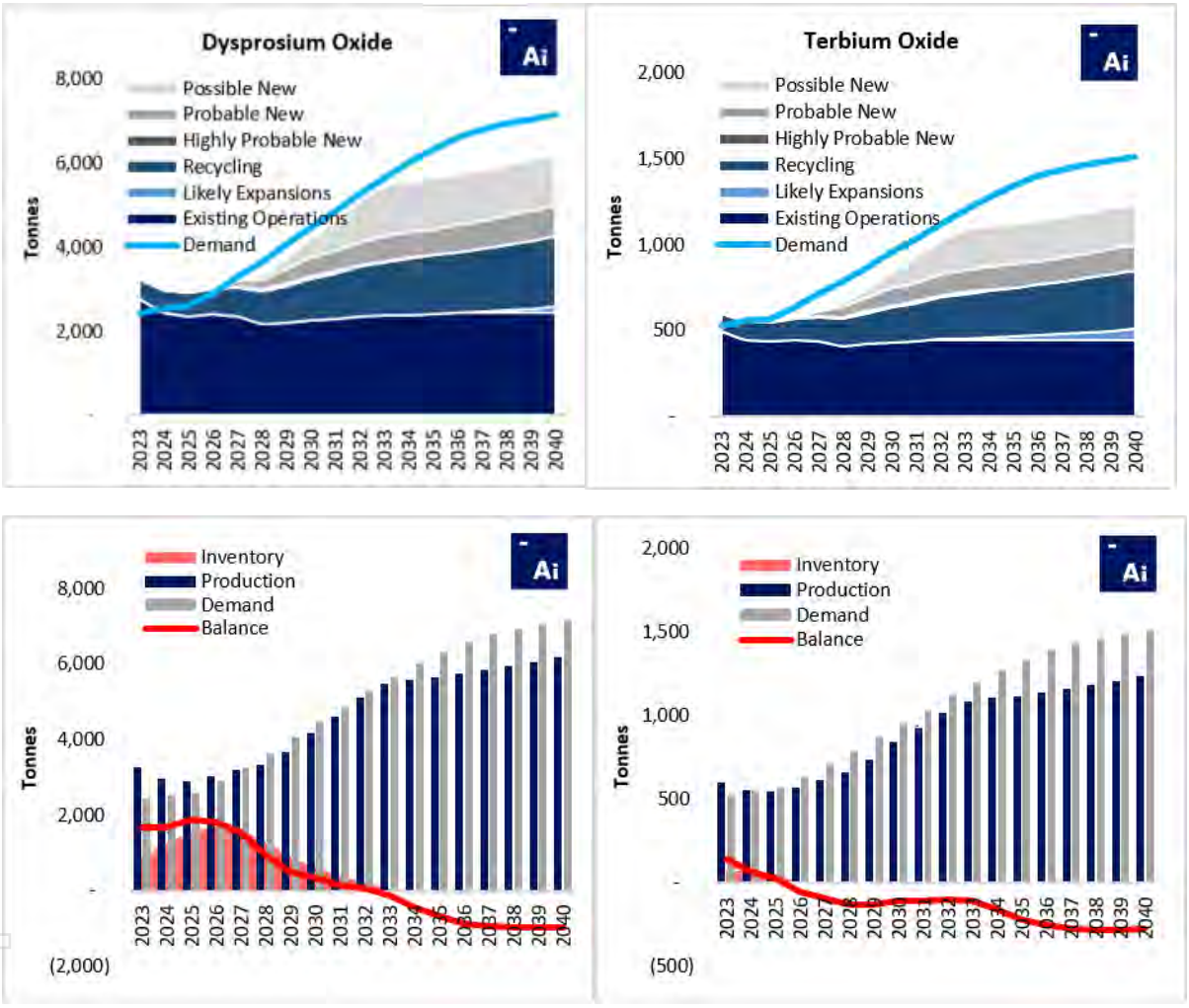
production each year resulting in a gradual drawdown of inventories and persistent deficits in the years to follow (Figure 18-16).

Conversely, in 2025 Adamas forecasts that global demand for terbium oxide exceeded global production resulting in the expedited drawdown of inventories and a growing structural deficit from 2026 on. In the early 2030s, with a wave of new supplies coming online, the market's deficit for both dysprosium and terbium oxides is expected to temporarily narrow, but from 2033 on, pervasive, rising deficits will return.

In the face of near-term terbium deficits, Adamas expects that magnet makers will increasingly look to use dysprosium as a supplement when possible.




* Production from highly probable, probable and possible producers is not probability weighted.
* Production from recycling to come primarily from magnet production swarf and increasingly from EOL magnet recycling over time.

*Figure 18-15: Forecasted production – demand balance for Dy and Tb oxide to 2040 (Base Case)*

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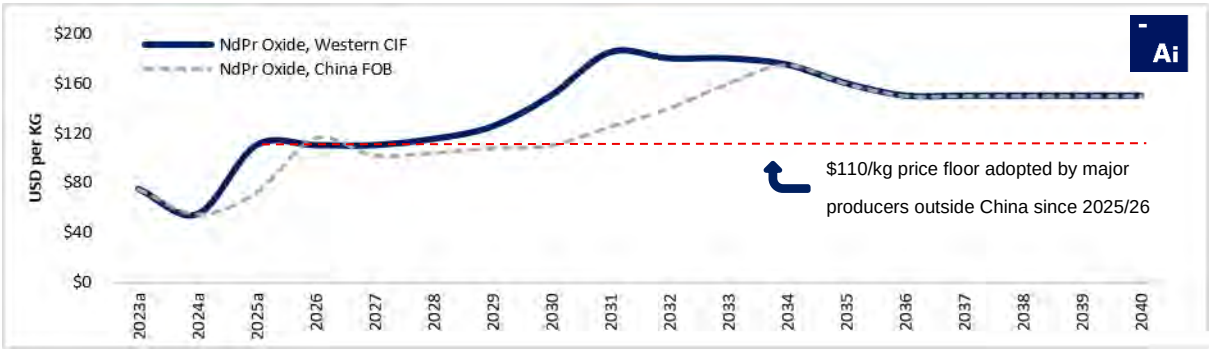
# 18.16 Forecasted REO Prices to 2040

As per its latest “Rare Earth Pricing Outlook” report (Q4 2026), Adamas Intelligence forecasted Western CIF (Cost, Insurance and Freight) rare earth oxide prices to 2040 under three scenarios.

## 18.16.1 NdPr oxide:

In its Base Case, Adamas forecasts that the benchmark China price of NdPr oxide will average below $110/kg each year of 2026 and 2027, resulting in a Western-origin equivalent price of $110/kg in both years (unchanged from 2025).

From 2028 through 2031, with demand from NdFeB magnet factories rising rapidly and supply struggling to keep up, Adamas forecasts the price of Western-origin NdPr oxide will increase from $115/kg to $185/kg before drifting lower and settling at $150/kg from 2035 through 2040.




* Forecasted prices are in Real 2026 U.S. dollars

Figure 18-16**:** Forecasted NdPr oxide price to 2040 (Base Case – Western CIF).

### 18.16.1.1 Dy and Tb oxide:

Similarly, in its Base Case Adamas expects Western CIF prices of Dy and Tb oxides to increase overall from an average of $365/kg and $1,644/kg last year, respectively, to $600/kg and $2,200/kg in 2028 on the back of strong demand growth and pervasive undersupply.

With multiple new suppliers by the end of the decade, Western CIF prices of Dy and Tb oxides are expected to be tempered lower before converging with China FOB in the early 2030s and thereafter averaging $550/kg and $2,000/kg, respectively, through the end of the forecast period (Figure 18-18).

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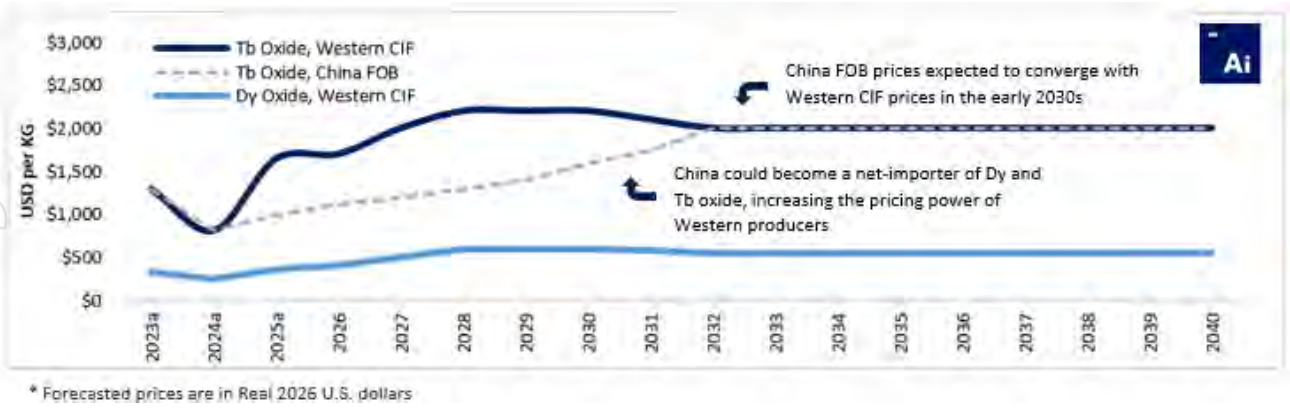


*Figure 18-17: Forecasted Dy oxide and Tb oxide price to 2040 (Base Case – Western CIF)*

## 18.16.2 Average Long-Term Prices

Owing to higher production costs than China, coupled with urgent demand for alternative sources of supply for rare earths like samarium and yttrium, Adamas Intelligence expects that near-term Western delivered (CIF) prices of most rare earth oxides will carry a significant premium over China domestic (EXW) and China export (FOB) price levels.

However, by the early 2030s, Adamas forecasts that China could become a net importer of some rare earths, such as dysprosium and terbium, transferring pricing influence to Western producers and driving convergence of Western CIF and Chinese FOB prices at Western levels.

American Rare Earths targets first production from Halleck Creek in 2031. Table 18-2 is a summary of the average price forecasted for each rare earth oxide from 2031 through 2040 in Adamas Intelligence's Base Case scenario (Q4 2026).

*Table 18-2: Forecasted long-term average rare earth oxide prices from 2031 through 2040*

| Oxide | USD/kg |
|---|---|
| La | $1.40 |
| Ce | $4.00 |
| NdPr | $163.00 |
| Sm | $23.20 |
| Eu | $34.70 |
| Gd | $85.00 |
| Tb | $2,010.00 |
| Dy | $552.50 |
| Ho | $213.50 |
| Er | $58.00 |
| Yb | $15.75 |
| Lu | $1,250.00 |
| Y | $63.00 |

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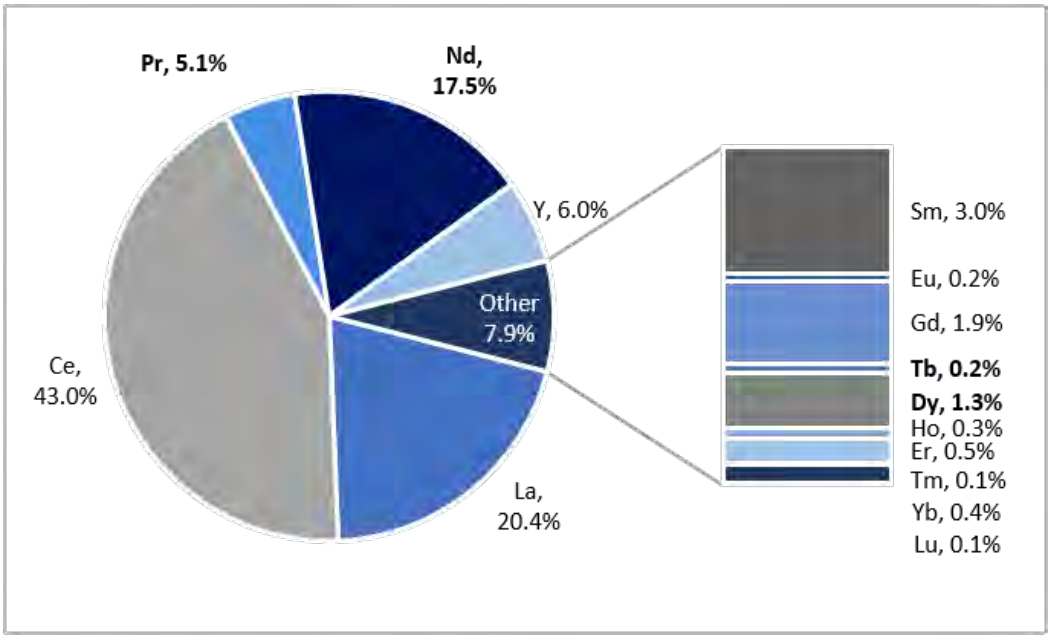
**Note:** Forecasted prices in Real 2026 USD. Prices highlighted in blue are forecasted Western CIF. Prices not highlighted are forecasted China FOB. If/when ex-China production capacity is developed for Ho, Er, Yb, etc. Adamas will develop Western CIF price forecasts accordingly. Until then, China FOB price levels remain the most accurate proxy.

## 18.17 Forecasted per-REO Contribution to Halleck Creek Project Basket Value

Table 18-3 shows the average relative distribution of rare earth oxides contained in run of mill feedstock from Halleck Creek. By volume, the four critical magnet rare earth oxides (neodymium, praseodymium, dysprosium and terbium) make up 24.2% of the TREO contained in the Halleck Creek basket, 1.5% in the form of dysprosium and terbium oxide alone.

*Table 18-3: Relative distribution of rare earth oxides in Halleck Creek project run of mill*

| Oxide | Relative |
|---|---|
| La | 20.4% |
| Ce | 43.0% |
| Pr | 5.1% |
| Nd | 17.5% |
| Sm | 3.0% |
| Eu | 0.2% |
| Gd | 1.9% |
| Tb | 0.2% |
| Dy | 1.3% |
| Ho | 0.3% |
| Er | 0.5% |
| Tm | 0.1% |
| Yb | 0.4% |
| Lu | 0.1% |
| Y | 6.0% |
| TREO | 100.0% |




**Source:** Adamas Intelligence from company-provided data

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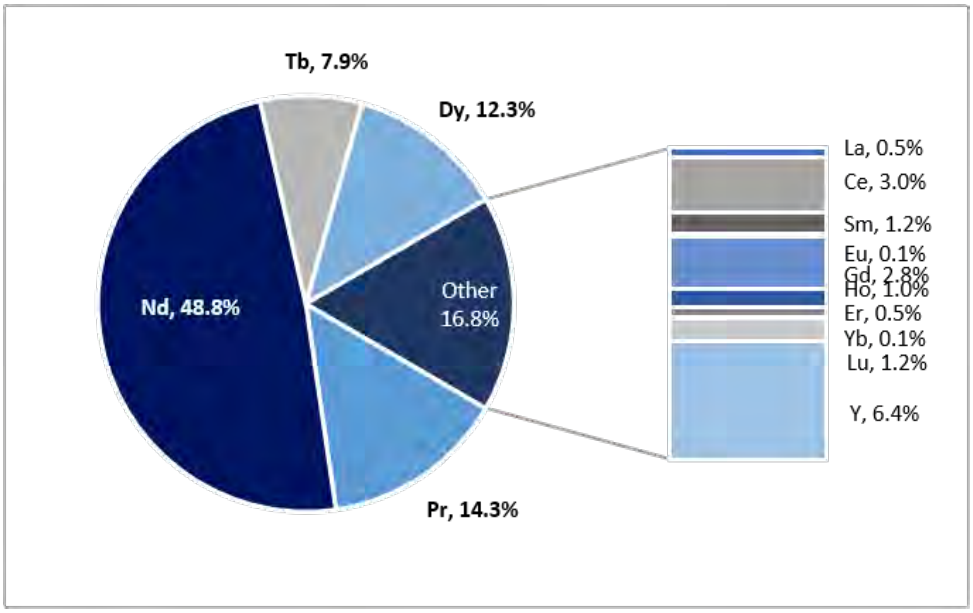
*Table 18-4: Average per-REO contribution to Halleck Creek project basket value from 2031 through 2040*

| Oxide | Relative% |
|---|---|
| **La** | 0.5% |
| **Ce** | 3.0% |
| **Pr** | **14.3%** |
| **Nd** | **48.8%** |
| **Sm** | 1.2% |
| **Eu** | 0.1% |
| **Gd** | 2.8% |
| **Tb** | **7.9%** |
| **Dy** | **12.3%** |
| **Ho** | 1.0% |
| **Er** | 0.5% |
| **Tm** | 0.0% |
| **Yb** | 0.1% |
| **Lu** | 1.2% |
| **Y** | 6.4% |
| **TREO** | **100.0%** |




**Source:** Adamas Intelligence from company-provided data

Table 18-4 shows the forecasted average per-REO contribution to the Halleck Creek project's TREO basket value from 2031 through 2040 based on Adamas Intelligence's Base Case scenario for Western CIF prices. By value, the four critical magnet rare earth oxides (Nd, Pr, Dy and Tb) are projected to drive 83.2% of the project's basket value between 2031 and 2040, one-quarter of which will be driven by the highly sought after heavy rare earths, dysprosium and terbium

## 18.18 Forecasted Basket Value and Implications for Project

Taking Adamas' Base Case Western CIF price forecasts from Q4 2026 into account, along with the relative distribution of rare earth oxides in Halleck Creek feedstock (see Table 18-4 and Figure 18-20), the project basket value (i.e., value of rare earth oxides contained in one kilogram of separated TREO produced from the project) was projected for each year from 2031 through 2040, as shown in Figure 18-18.

Across the Base Case, Upside and Downside scenarios, the Halleck Creek project basket value is projected to peak in 2031-2032. This peak is underpinned by Western CIF prices for NdPr, Dy, and Tb oxides reaching their highest levels in the forecast period, supported by strong demand growth and pervasive Western undersupply. However, with multiple new suppliers expected to come online at the end of the decade and early in the next, Western CIF REO prices are expected to temper lower before plateauing through the end of the forecasted period. Consequently, Halleck Creek project basket value will decrease overall from 2031 through 2040 at a CAGR of 2.2%, 2.1%, or 0.8%, respectively.

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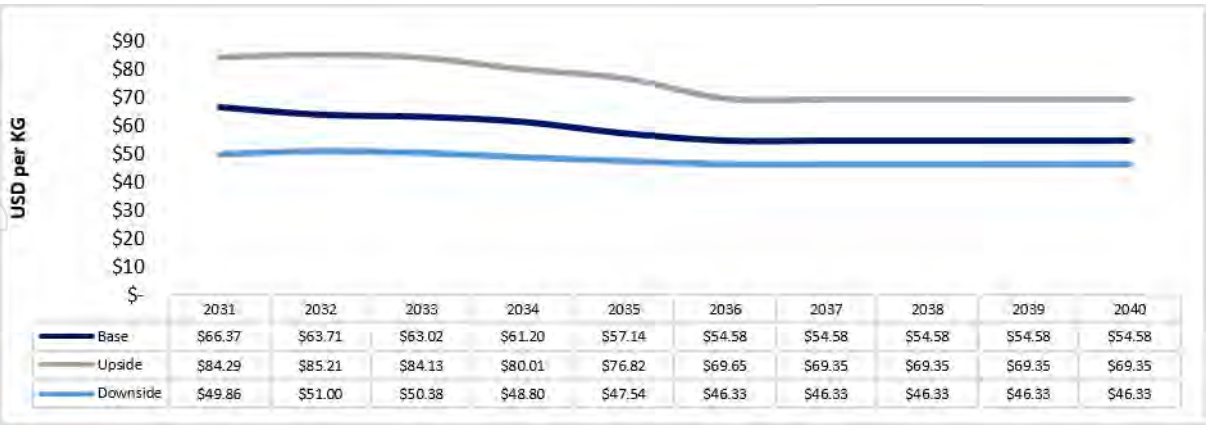



| | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 |
|---|---|---|---|---|---|---|---|---|---|---|
| Base | $66.37 | $63.71 | $63.02 | $61.20 | $57.14 | $54.58 | $54.58 | $54.58 | $54.58 | $54.58 |
| Upside | $84.29 | $85.21 | $84.13 | $80.01 | $76.82 | $69.65 | $69.35 | $69.35 | $69.35 | $69.35 |
| Downside | $49.86 | $51.00 | $50.38 | $48.80 | $47.54 | $46.33 | $46.33 | $46.33 | $46.33 | $46.33 |

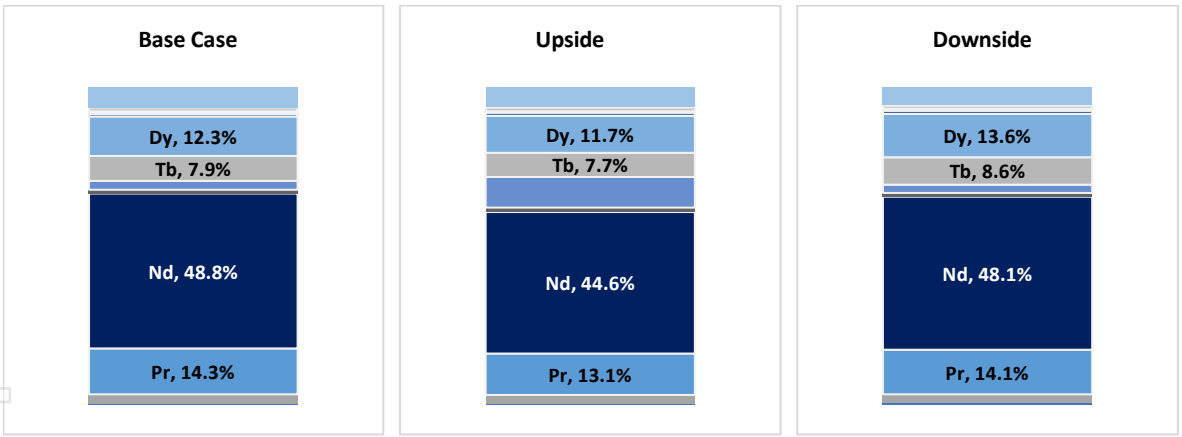
* Forecasted prices are in Real 2026 U.S. dollars

**Source:** Adamas Intelligence

*Figure 18-18: Forecasted Halleck Creek basket value from 2031 through 2040*

In all three scenarios examined, Adamas projects that critical magnet rare earth oxides (i.e., neodymium, praseodymium, dysprosium and terbium) will collectively drive over 77% of the Halleck Creek project basket value each year from 2031 through 2040 (see Figure 18-19).

Note: A basket value assumes the full value of each REE in the form of an individually separated oxide. If the final saleable products are not individually separated oxides, the actual realized value will depend on the form of the REE products ultimately produced for sale and may differ materially from the theoretical basket value. Additionally, although basket value depends on individual REO prices and their relative distribution, it is independent of the overall REO grade (i.e., grade agnostic).




**Source:** Adamas Intelligence

*Figure 18-19: Contribution of magnet rare earth oxides to the Halleck Creek basket value in each scenario*

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## 18.19 China's Export Restrictions Creating an Acute Need for Alternative Sources of Supply

China's export restrictions have revealed massive vulnerabilities not just in global NdFeB magnet supplies, but also in supplies for a host of rare earth elements used widely in high tech, aerospace, defense and other industries.

In addition to NdFeB, China's export controls also apply to oxides, compounds, metals, alloys and mixtures of **samarium, gadolinium, terbium, dysprosium, lutetium, yttrium and scandium**, as well as samarium-cobalt ("SmCo") magnets and alloys.

Some of these materials, such as yttrium, samarium and gadolinium, are available in abundance in China, however, access to those supplies for defense, aerospace and other dual-use industries has been cut off with these restrictions, exacerbating the acute need for alternative sources of supply.

Yttrium, for example, is used widely in phosphors for avionic display screens, in thermal barrier coatings for civilian and military aircraft and turbines, and in high performance ceramics for engine components, optics for laser targeting, and other communications and electronics systems.

Similarly, gadolinium is used in specialty alloys, optics, radiation shielding, electronics and phosphors, whereas samarium is mainly used to produce SmCo alloys and magnets used in a variety of defense-related applications.

The U.S. and other countries maintain strategic stockpiles of these rare earth materials as a hedge against market uncertainty, evincing the criticality of rare earths like yttrium, samarium and gadolinium to defense and civilian industries.

As such, Adamas sees strong demand for new sources of these rare earths in the U.S., Europe and elsewhere, and potential for emerging alternative suppliers of samarium, gadolinium, dysprosium, terbium, yttrium and lutetium to secure significantly higher prices than Chinese benchmark levels.

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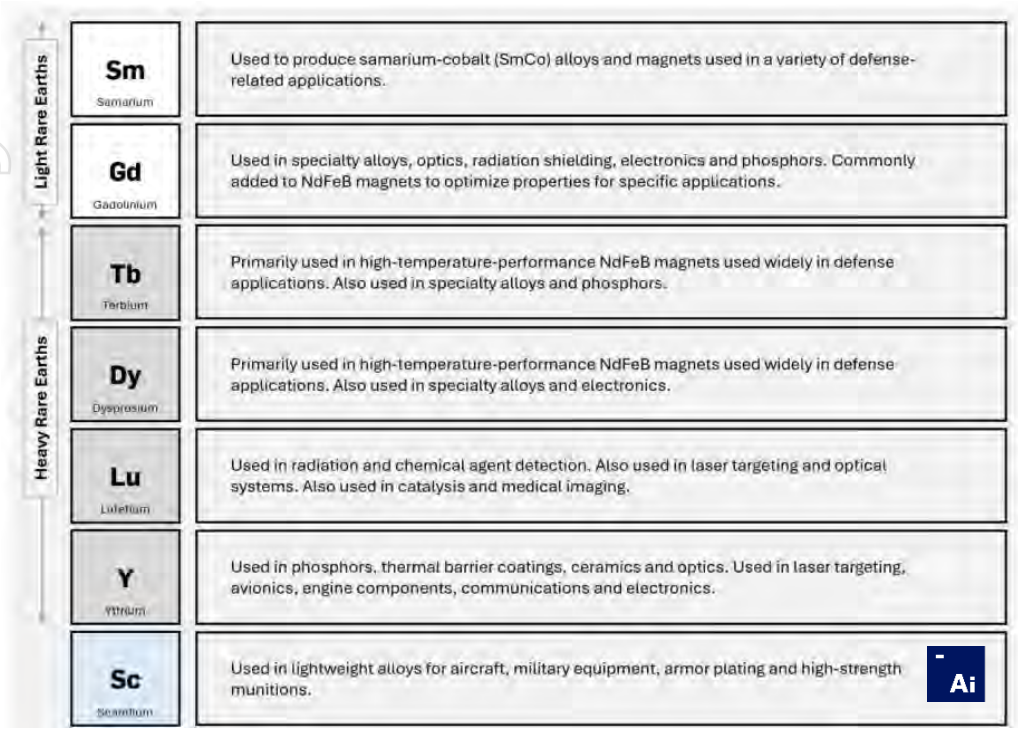


*Figure 18-20: Overview of dual-use rare earth elements subject to export controls*

## 18.20 International Supply Chain Development

**A rare earth renaissance is underway in the West:**

In recent years, strong rare earth magnet demand growth coupled with a wave of incoming rare earth oxide supply has helped de-risk the business case for downstream investments in metals, alloy and magnet production capacity, spurring public and private sectors into action.

More recently, China's implementation of export controls on a suite of rare earth elements, including high-performance rare earth magnets, in April 2025 has galvanized the resolve of governments and end users alike to support the expedited development of alternative supply chains connecting the Americas, Europe, Australia, Africa and beyond.

These developments, and others yet to come, are a testament to the upstream market's rising diversity and supply security, coupled with the downstream market's rapidly increasing demand for alternative supplies of NdFeB magnets.

According to Adamas Intelligence data, combined rare earth magnet production capacity in the U.S. and Europe is poised to increase more than 10-fold by 2030 as new factories are built and/or ramped up, necessitating comparable growth in rare earth oxide supplies.

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**A year of unprecedented action and investment from governments:**

China's export restrictions on rare earth elements and magnets have exacerbated the need for diversified sources of supply, triggering a wave of investments, policies and international initiatives around the globe.

Governments have responded with substantial funding, strategic reserves, price supports and bilateral/multilateral partnerships to build resilient supply chains.

In 2025, MP Materials and Vulcan Elements (with partner ReElement) received landmark investments from the U.S. government. In early 2026, that list grew to include USA Rare Earth.

Furthermore, in February 2026, the U.S. Strategic Critical Minerals Reserve ("Project Vault") was launched to establish a large-scale, decentralized domestic stockpile of critical minerals (including rare earths) to protect American manufacturers and industries from supply chain disruptions, price volatility and foreign dependencies.

In Europe, the European Union is advancing its Critical Raw Materials Act ("CRMA") with ambitious 2030 benchmarks for domestic extraction, processing and recycling, while accelerating implementation through the RESourceEU Action Plan. The plan introduces coordinated EU-level stockpiling, demand aggregation, joint purchasing and enhanced financing mechanisms that will mobilize around €3 billion in EU and EIB funding by December 2026.

In Canada, the government is accelerating its Critical Minerals Strategy through multibillion-dollar investments and alliances aimed at unlocking billions in project support. In Australia, a Critical Minerals Strategic Reserve plan was announced in April 2025 and confirmed in January 2026.

Full diversification from China may take years, but these coordinated actions position allied nations to rapidly reduce vulnerabilities and secure supplies for advanced technologies, renewable energy and national security.

## 18.21 Current State of the Market and Near-Term Outlook

### 18.21.1 The global market is bifurcating:

The global rare earths market today is at a historic pivot point whereby the market forces inside China and outside China are disconnecting and bifurcating.

Inside and outside China, Adamas is seeing distinct supply-demand balances emerge, distinct bottlenecks emerge, unique levels of government support, and most recently, the harmonized adoption of price floors or minimum price levels by the two ex-China volume leaders, MP Materials and Lynas Rare Earths.

## 18.22 Rare earth price floors are helping cement the shift:

In July 2025, the U.S. Department of Defense ("DoD") announced a landmark public private partnership with MP Materials, owner of the Mountain Pass rare earth mine and co-located processing facility in California.

Notably, the agreement includes a price floor of US $110/kg of NdPr oxide, applied proportionately to all products the company produces, from rare earth concentrate to oxides to metals to magnets.

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Similarly, in March 2025, Lynas Rare Earths announced an updated long-term offtake agreement with Japan Australia Rare Earths (JARE) that also includes a market-linked floor price of US $110/kg for NdPr oxide.

Adamas sees these price floors imminently becoming a de facto benchmark for price levels outside China, further minimizing China's influence on the global market.

## 18.23 U.S. to expand price support for additional projects, other regions likely to follow:

The U.S. administration has stated that it's pursuing a pandemic-like approach to rapidly build up critical minerals supply chains to minimize reliance on China. As part of this effort, U.S. officials have indicated that they will provide minimum price level guarantees for other rare earth projects and producers as well.

In January 2026, the White House issued a proclamation titled "Adjusting Imports of Processed Critical Minerals and Their Derivative Products into the United States" stating that "in negotiating, the Secretary and the Trade Representative should consider price floors for trade in critical minerals and other trade-restricting measures."

## 18.24 Availability of heavy rare earths a potential constraint to scaling Western magnet production:

With China restricting exports, availability of dysprosium and terbium could soon become a major constraint to scaling high performance NdFeB magnet production in the U.S., Europe and elsewhere unless multiple new sources of supply are developed by the end of the decade, and in the decade to follow.

## 18.25 Key Takeaways

- From 2025 through 2040, Adamas forecasts that global TREO demand for permanent magnets will rise at a CAGR of 8.4%, boosted by strong demand growth from electric vehicles, robotics, advanced air mobility and other applications of NdFeB magnets.
- Over the same period, Adamas forecasts that global production of neodymium, praseodymium, dysprosium and terbium (the so-called magnet rare earths) will collectively increase at a slower CAGR of 7.8% as the supply side of the market increasingly struggles to keep up with rapidly growing demand.
- Post-2026 Adamas forecasts that the global rare earth industry will consistently underproduce neodymium, praseodymium, dysprosium and terbium oxides (or oxide equivalents), resulting in the depletion of historically accumulated inventories and, ultimately, shortages of these critical magnet materials if supply is not increased beyond levels currently anticipated.
- The Halleck Creek project basket offers a high degree of economic exposure to the rare earth permanent magnet sector, which is the fastest-growing end-use category and most in need of additional rare earth supplies, according to Adamas Intelligence. In all scenarios examined, Adamas projects that magnet rare earths will collectively drive over 77% of the Halleck Creek project basket value each year from 2031 to 2040.

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- In its Base Case scenario, Adamas forecasts that the Halleck Creek TREO basket value will reach $66.37 per kilogram in 2031, before gradually declining to $54.58 per kilogram in 2036, then plateauing through 2040, in line with comparable movements in magnet rare earth prices.
- In the near-term, China's ongoing export restrictions are wreaking havoc on global supply chains and have galvanized efforts to develop alternative sources of supply, from mine to magnet.
- Adamas believes that availability of heavy rare earths could soon become a major constraint to scaling NdFeB production in the U.S., Europe and elsewhere unless multiple new sources of supply are developed by the end of the decade, and in the decade to follow.
- Greater availability of dysprosium and terbium outside China will unlock the business case for rapidly scaling NdFeB magnet production – essential for automotive, robotics, advanced air mobility, defense and other fast-growing industries.
- In addition to the four critical magnet rare earths, Adamas also sees growing demand for new sources of samarium, gadolinium, yttrium and lutetium oxide in the U.S., Europe and elsewhere, and potential for emerging alternative suppliers of to secure significantly higher prices than Chinese benchmark levels.

# 19 Environmental Studies, Permitting and Plans, Negotiations or Agreements with Local Individuals or Groups

Stantec, WRI, and ARR worked collaboratively to develop Environmental, Social, and Governance (ESG) reporting as a Modifying Factor(s) for consideration and disclosure. During development of the program reporting process, Stantec and WRI engaged in an initial materiality assessment, the first greenhouse gas (GHG) inventory (where development was possible), and an initial climate and biodiversity assessment. Stantec also collaborated with WWC Engineering for technical state-level permitting relative to ARR and CSM, and collated initial work performed by the University of Wyoming (UW) in some circumstances. Each subsection identified in the ESG section now has programmatic maturity concurrent and equivalent to the project's overall maturity. As the project matures further in the future, as updated SEC guidance relative to ESG expectations is published, and technical aspects of the ESG section advance, updates to the ESG section may be required.

## 19.1 Environmental Permitting and Baseline Studies

### 19.1.1 General Environmental Permitting Requirements

The Cowboy State Mine (CSM) Project is located entirely on Wyoming State Trust Lands, and WRI holds the associated mineral interests as described in Section 3.2. Accordingly, the Wyoming Department of Environmental Quality (WDEQ), through its Land Quality Division (LQD), serves as the primary regulatory and permitting authority for the Project. WRI is currently preparing a Permit to Mine application for submittal to WDEQ-LQD.

Although WDEQ-LQD is the lead agency responsible for review and approval of the mining operation, development of the Project will require coordination with numerous federal, state, and local agencies throughout the permitting process. The permits, approvals, and authorizations identified below represent the

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primary regulatory requirements currently anticipated for the Project; however, the list is not exhaustive, and additional permits, certifications, or approvals may be required prior to construction and commencement of operations.

**State Regulatory Agencies and Stakeholders**

- Wyoming Department of Environmental Quality (WDEQ)
    - Land Quality Division (LQD): Regulates mineral exploration, mine permitting, operation, reclamation, and bond release activities under the Wyoming Environmental Quality Act.
    - Industrial Siting Division (ISD): Administers Industrial Siting Permits for qualifying large industrial facilities and associated infrastructure.
    - Air Quality Division (AQD): Regulates stationary-source air emissions and issues air quality permits, monitoring requirements, and compliance approvals.
    - Water Quality Division (WQD): Regulates surface water and groundwater discharges, stormwater management, and water quality compliance.
    - Solid and Hazardous Waste Division (SHWD): Regulates the generation, storage, treatment, and disposal of solid and hazardous wastes associated with project activities.
- Wyoming State Engineer's Office (SEO): Administers water rights, groundwater development, well permitting, beneficial use requirements, and water appropriations within the State of Wyoming.
- Wyoming Game and Fish Department (WGFD): Provides technical review and recommendations regarding potential impacts to wildlife, fisheries, habitat, migration corridors, and species of management concern.
- Office of State Lands and Investments (OSLI): Administers Wyoming State Trust Lands and associated mineral leases, rights-of-way, easements, surface use authorizations, and land-use agreements required for project development.
- State Historic Preservation Office (SHPO): Reviews and maintains records of cultural, archaeological, and historic resources and provides consultation regarding compliance with state and federal cultural resource requirements.
- State Fire Marshal (SFM): Reviews and enforces applicable fire prevention, fire protection, life-safety, and hazardous materials storage requirements for industrial facilities.

**Federal Agencies**

- U.S. Army Corps of Engineers (USACE): Regulates activities affecting Waters of the United States (WOTUS), including the discharge of dredged or fill material under Section 404 of the Clean Water Act.
- U.S. Fish and Wildlife Service (USFWS): Provides consultation regarding federally listed threatened and endangered species, designated critical habitat, migratory birds, and other federally protected biological resources.

**Local Permitting**

- County planning and zoning
- Wheatland Irrigation District

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## 19.1.2 Baseline Environmental Studies

To support preparation of the Permit to Mine application, a series of baseline environmental studies have been conducted across the proposed CSM permit area since 2024. These studies are intended to characterize existing environmental conditions and provide the technical information necessary to support permit evaluations, impact assessments, and regulatory compliance requirements. The investigations encompass the full extent of the proposed permit area and are being completed by qualified technical specialists as summarized in Table 19-1.

*Table 19-1: Outline of Baseline Studies for CSM Permit to Mine Application*

| **Study** Discipline | **Contractor** | **Support** for Additional Permitting Requirements |
|---|---|---|
| Cultural Resources | Cultural Resource Analysts, Inc | NHPA Section 106 consultation; SHPO review; USACE Section 404 permits; federal NEPA reviews |
| Climatology | WWC Engineering | Air quality permitting; facility design and water management planning |
| Geology/Waste Characterization | WWC Engineering | Groundwater discharge permits; waste management planning; facility design approvals; |
| Groundwater Hydrology | WWC Engineering | WDEQ Water Quality Division permits; groundwater monitoring plans; dewatering permits; water rights applications; USACE Section 404 alternatives analyses; |
| Surface Water Hydrology | WWC Engineering | Clean Water Act Section 404 permitting; Section 401 certification; NPDES permitting; stormwater permitting; floodplain development permits; |
| Soils | Cedar Creek Associates, Inc. | Reclamation planning; stormwater permitting; erosion and sediment control plans; wetland mitigation planning |
| Vegetation | Cedar Creek Associates, Inc. | Reclamation and revegetation planning; wildlife habitat assessments; USACE Section 404 permitting; |
| Wildlife | Cedar Creek Associates, Inc. | ESA Section 7 consultation; Bald and Golden Eagle Protection Act compliance; Migratory Bird Treaty Act compliance; WGFD coordination; |
| Wetlands and Aquatic Resources | Cedar Creek Associates, Inc. | USACE Section 404 permit; WDEQ Section 401 certification; aquatic resource mitigation planning; stream alteration approvals; |
| Air Quality | Pace Analytics | WDEQ Air Quality Division construction permits; Title V applicability evaluations; greenhouse gas reporting assessments; |

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# 19.2 Baseline Information

## 19.2.1 Cultural Resources

A Class III Cultural Resource Inventory was completed for the proposed Cowboy State Mine and reviewed by the Wyoming State Historic Preservation Office (SHPO). In a concurrence letter dated July 31, 2025, SHPO determined that the survey documentation met applicable professional standards and concurred that ten identified cultural resource sites are not eligible for listing in the National Register of Historic Places (NRHP) and would experience no effect from the Project. SHPO also concurred that four prehistoric archaeological sites are eligible for NRHP listing and would be adversely affected by the Project as currently designed. To mitigate potential impacts, SHPO recommended avoidance of these sites by a minimum of 30 meters (100 feet); where avoidance is not feasible, archaeological data recovery and SHPO review and concurrence of a recovery plan would be required prior to disturbance. Subject to these stipulations, SHPO recommended that the undertaking be allowed to proceed in accordance with applicable state and federal cultural resource protection requirements. These findings identify manageable cultural resource constraints that can be addressed through avoidance, mitigation, and ongoing compliance measures during project development and construction.

## 19.2.2 Vegetation Baseline

The vegetation baseline investigation completed in 2024 for the Cowboy State Mine Project to characterize existing vegetation conditions and encompassed approximately 853 acres of private and state land in Albany County, Wyoming, and included desktop review, vegetation community mapping, field verification, sensitive-plant surveys, and quantitative sampling of vegetation cover, shrub density, and tree density. Three principal upland vegetation communities were identified within the Project Area: ponderosa mixed shrubland, mixed shrubland, and shortgrass prairie. Smaller occurrences of mountain mahogany and low sagebrush communities were also documented. Riparian areas, wetlands, seeps, and springs were evaluated separately as aquatic resources. The baseline investigation was conducted to support the vegetation information requirements applicable to a WDEQ-LQD mine permit application.

Quantitative vegetation sampling was completed at 15 locations within each of the three principal vegetation communities. Average perennial vegetation cover was 38.53 percent in ponderosa mixed shrubland, 51.33 percent in mixed shrubland, and 56.47 percent in shortgrass prairie. Perennial grasses constituted the dominant lifeform within each community. The ponderosa mixed shrubland exhibited relatively high rock cover because of its association with bedrock slopes, while the shortgrass prairie exhibited the highest perennial grass and litter cover. Ponderosa pine was the only tree species recorded at a measurable density, averaging 22.3 trees per acre and 9.1 inches in diameter at breast height. Growing-season precipitation during 2024 was approximately 80 percent of the long-term normal; consequently, the baseline data are considered representative of below-average vegetation vigor and production. This climatic context should be considered when establishing reference conditions and evaluating future revegetation performance.

Surveys of potentially suitable habitat did not identify Ute ladies'-tresses, western prairie fringed orchid, or other special-status plant species within the Project Area. Incidental observations included spider milkweed, green comet milkweed, and plains milkweed, with the largest observed population consisting of approximately 50 plains milkweed plants. Targeted surveys of likely weed dispersal corridors did not identify substantial noxious weed infestations. Isolated occurrences of houndstongue, perennial sowthistle, and common mullein were

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documented, but were not considered sufficiently extensive to warrant detailed population mapping. These findings do not indicate a significant constraint to Project development; however, final mine design and permitting should incorporate appropriate measures for pre-disturbance surveys, weed prevention, monitoring, and treatment throughout construction, operations, reclamation, and closure.

The vegetation baseline provides the technical basis for evaluating potential disturbance effects, developing revegetation prescriptions, establishing post-mining land-use and revegetation success criteria, and estimating reclamation quantities and costs. Undisturbed portions of the mapped vegetation communities may serve as extended reference areas for evaluating reclamation performance, subject to WDEQ-LQD review and approval. Subsequent feasibility-level design and permitting should verify that sufficiently representative portions of each vegetation community will remain undisturbed throughout the mine life. Where an entire community, or a substantial and potentially unrepresentative portion of a community, would be disturbed, limited extended reference areas or another WDEQ-LQD-approved reference approach may be necessary.

The baseline report should also be reconciled with the current mine disturbance footprint to confirm the suitability and long-term availability of proposed reference areas. These matters are not expected to represent material impediments to Project development but should be resolved during the feasibility and permitting phases to reduce the potential for supplemental field investigations, agency information requests, revisions to revegetation success criteria, or associated schedule impacts.

### 19.2.3 Wildlife

The wildlife baseline investigation for the Cowboy State Mine Project included agency coordination, habitat assessments, migratory bird surveys, raptor nest surveys, grouse lek surveys, herpetofauna surveys, and general wildlife observations conducted during 2024 and 2025. The surveys determined that no suitable habitat exists within the project area for federally listed species identified through the USFWS IPaC review, and therefore no project-specific threatened or endangered species surveys were required.

Wildlife surveys documented a diverse but typical assemblage of species for the area. Migratory bird surveys recorded 37 species and 1,012 individual bird observations across shortgrass prairie, shrubland, ponderosa pine, and riparian habitats. No upland sandpipers were observed during targeted surveys, and no grouse leks or displaying grouse were identified within the project area or the 2-mile survey buffer. Raptor surveys identified four inactive nest sites, including nests with characteristics consistent with potential historical raptor or golden eagle use, but no active nests or evidence of recent nesting activity were observed. Additional wildlife observations included northern leopard frogs, western tiger salamander larvae, pronghorn, mule deer, desert cottontail rabbit, and a golden eagle flyover.

The primary permitting implication of the wildlife baseline is that the surveys satisfy key LQD wildlife baseline data requirements and provide the information necessary for agency review of potential wildlife impacts. Because no federally listed species, active raptor nests, or active grouse leks were identified within the survey areas, the report indicates no immediate need for project-specific permitting or consultation under the Endangered Species Act. However, project construction and operations remain subject to compliance with the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and applicable Wyoming Game and Fish Department recommendations. If future site development could affect active raptor nests, migratory bird nesting habitat, or golden eagles, seasonal timing restrictions, nest avoidance buffers, or additional agency

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coordination may be required. The wildlife baseline therefore serves as the technical foundation for LQD permit review, wildlife impact assessment, and agency consultation associated with the Cowboy State Mine Project.

#### 19.2.3.1 Conservation Concerns

Under the 2020 Statewide Habitat Plan, the Wyoming Game and Fish Department (WGFD) identified priority areas across the state as either "crucial to conserving and maintaining populations of terrestrial and aquatic wildlife for the present and future" (i.e., Priority Habitat Area) and those that are "important aquatic and/or terrestrial wildlife habitats that can and should be actively restored to achieve greater wildlife value" (i.e., Priority Restoration Area) (WGFD, 2020). The Site falls within area designated by WGFD as both a Priority Habitat Area *and* Priority Restoration Area, indicating the Site has both a high ecological importance in its current (i.e., undeveloped) state and an identified potential to enhance critical biodiversity through restoration (e.g., invasive species management).

The Site is encompassed by an area designated as antelope crucial range (WGFD, 2020). Crucial range is described as an area necessary to maintain a wildlife population (at or above target level) and may encompass seasonal ranges and/or habitat components (e.g., winter forage, breeding grounds) critical to their survival. Wyoming is home to over half of the world's pronghorn antelope (*Antilocapra americana*) population (WGFD, 2024) and is renowned as one of the most desirable hunting destinations across North America (SA, 2017).

Big game hunting is critical to Wyoming's economy. As a prized big game species, antelope is an important driver of the recreational and tourism industries of Wyoming. In a study conducted on Wyoming's big game hunting economy, Southwick Associates (SA) (2017) found that big game hunting brought in over $300M USD to the state in 2015, across travel and equipment spending and tax revenue. Of the big game species targeted by big game hunters that year, antelope ranked as the most pursued across non-residents (40.6%) and 3$^{rd}$ most pursued by residents (26.3%) – just behind elk (75.9%) and deer (60.1%) (SA, 2017).

Antelope remains an abundant constituent of a historically diminished community of wild grazing ungulates across Wyoming. As a keystone ecological process, grazing maintains habitat diversity and structure. Although historic grazing levels across Wyoming may be maintained today, largely through displacement of a once abundant wild grazer community (e.g., American bison [*Bison bison*]) by livestock, the migratory patterns and (seasonally dependent) forage preferences of native grazing populations underpinned historic ecosystem community dynamics (e.g., composition, structure, function) (WGFD, 2017). Thus, a diminished antelope population, driven by mine development and fragmentation of its crucial range, may result in downstream impacts to both Wyoming's big game hunting economy and ecosystem integrity across the antelope population's range.

Aside from big game species, the proposed mine footprint overlaps with the ranges of various Species of Greatest Conservation Need (SGCN) (Table 19-2) (UWYO, 2025). SGCN designation is made by the WGFD for wildlife species with "low and declining populations" and that are "indicative of the diversity and health of the state's wildlife" (WGFD, 2017). According to the WGFD's 2017 State Wildlife Action Plan (WGFD, 2017), the designation is intended to "identify species whose conservation status warrants increased management attention, and funding, as well as consideration in conservation, land use, and development planning in Wyoming." Across the various SGCN, there is an associated ranking system developed by the University of Wyoming (UWYO) for the Wyoming Natural Diversity Database (WNDD), the Wyoming Contribution Rank (WCR), based on the Wyoming-specific populations contribution to the taxon's range-wide persistence. Species

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ranked as “High” or “Very High” rely substantially on their Wyoming populations for range-wide persistence and includes most local and regional endemics. Select examples of SGCN (WCR: High or Very High) whose ranges overlap with the Site are shown in Table 19-3.

*Table 19-2: SGCN Ranges Overlapping with Proposed Mining Site*

| **Taxonomic Group** | **SGCN (Total)** | **WCR** | | | |
|---|---|---|---|---|---|
| | | **Low** | **Medium** | **High** | **Very High** |
| Amphibians | 3 | 2 | - | - | - |
| Birds | 58 | 14 | 2 | 16 | 3 |
| Mammals | 25 | 11 | - | 2 | 4 |
| Reptiles | 9 | 2 | - | 2 | - |
| **Total** | **102** | **29** | **2** | **20** | **7** |

*SGCN = Species of Greatest Conservation Need (WGFD, 2017); WCR = Wyoming Contribution Rank (UWYO, 2025)*

*Table 19-3: Select SGCN (High / Very High WCR)*

| **Taxonomic Group** | **Comon Name** | **Scientific Name** |
|---|---|---|
| Birds | Greater Sage-Grouse | *Centrocercus urophasianus* |
| | Lewis’s Woodpecker | *Melanerpes lewis* |
| | Mountain Plover | *Anarhynchus montanus* |
| | Pygmy Nuthatch | *Sitta pygmaea* |
| Mammals | Prebel’s Meadow Jumping Mouse | *Zapus hudsonius preblei* |
| | Swift Fox | *Vulpes velox* |
| | Townsend’s Big-eared Bat | *Corynorhinus townsendii* |
| | White-tailed Prairie Dog | *Coccyzus americanus* |
| Reptiles | Prairie Lizard | *Sceloporus consobrinus* |

## 19.2.4 Aquatic Resources Impacts

The Aquatic Resource Report documented aquatic resources within the 852.6-acre Cowboy State Mine Project and identified only two jurisdictionally relevant wetland systems among five aquatic features evaluated during field investigations. The study delineated 0.70 acre of emergent wetlands, 0.77 acre of degraded transitional

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wetland, and 0.56 acres of riverine wetland associated with Trail Creek. Trail Creek was the only channel exhibiting an ordinary high-water mark and perennial flow characteristics, while the remaining drainages were determined to be ephemeral.

The primary permitting implication of the study is the identification and delineation of aquatic resources that must be considered during mine planning, impact analysis, and regulatory review. The report concludes that the emergent wetlands (Wetland-1 and Wetland-2) are isolated features with no identified connection to downstream Waters of the United States, while the riverine wetland associated with Trail Creek is hydrologically connected to the Laramie River watershed through Trail Creek, North Sybille Creek, and Sybille Creek. T

The delineation establishes the baseline aquatic resource inventory required to support the mine permitting process and future coordination with regulatory agencies. Any proposed disturbance to the delineated wetlands or Trail Creek corridor would require further impact evaluation during project design and permitting. Based on the report findings, impacts to the Trail Creek riverine wetland or associated jurisdictional channel may require authorization under Clean Water Act Section 404, likely through a U.S. Army Corps of Engineers Nationwide Permit if impacts are limited and meet applicable thresholds and conditions. If dredge or fill impacts to jurisdictional waters are unavoidable, the project would also need to obtain the corresponding state water quality certification under Clean Water Act Section 401. The isolated emergent wetlands identified in the report may not require federal Section 404 authorization if USACE confirms they are non-jurisdictional; however, impacts to these features should still be evaluated during agency coordination and mine permit review.

Mining operations at the Site may impact regional aquatic habitats. However, the type and magnitude of these impacts are not fully understood. Pit mining at the site will likely extend below the natural water table, requiring dewatering (i.e., pumping out groundwater) to maintain dry conditions and enable machinery access to ore deposits. Proposed outfalls for the dewatering infrastructure indicate that excess groundwater will be routed into a natural flowline running eastward into Sybille Creek, identified as a WGFD Green Ribbon (i.e., locally important) trout stream. The extent of aquatic habitat impacts from dewatering operations at the mine will depend on both the quantity and quality (e.g., toxic metal concentrations, acidity) of water entering these systems, as well as potential changes to groundwater hydrology that may influence springs, streams, and other surface-water bodies supported by the underlying aquifer. Given the complexities of hydrodynamics and potential cascading effects of altering groundwater hydrology, a more granular analysis of site and regional hydrology may be needed to adequately assess downstream impacts to aquatic habitats from mining operations at the Site.

### 19.2.5 Carbon Impacts

Semiarid shrublands dominated by big sagebrush (*Artemisia tridentata*) cover over 10% of North America (Frisina and Wambolt, 2004) and are a substantial constituent of continent-wide carbon storage (Jackson et al., 2002). The historically fire-dominated disturbance regimes of these ecosystems have resulted in perpetual successional cycles, in which carbon sequestration increases post-fire as woody biomass, roots, and soil organic matter accumulate (Knapp et al., 2008; Lorenz and Lal 2005). Although the woody biomass of these shrublands is typically in flux from semi-regular disturbance, the relatively substantial soil carbon content is indicative of grasslands. In a study on carbon dynamics of a foothill shrubland ecosystem in Wyoming, Cleary et al. (2010) found mature shrublands (i.e., approximately 40 years since fire) to contain an average of 1.10 metric tonnes (MT) of carbon (C) per hectare (ha) (0.46 MT C $acre^{-1}$) in biomass and 110.00 MT C $ha^{-1}$ (44.52



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MT C acre$^{-1}$) as soil organic carbon (SOC) . Given the proximity and similar environmental characteristics between the study site (Cleary et al., 2010) and the Site, it is assumed that the study's carbon stock density estimates are representative of the mining site and are used in estimating carbon impacts from land conversion below.

Construction of mining infrastructure and pit mining operations will require the clearing of habitat and the excavation of soils, resulting in the oxidation and release of carbon sequestered in biomass and soils into the atmosphere as greenhouse gases (GHG). Loss of carbon stocks from the removal/excavation of shrubland habitat and soils were estimated following IPCC guidelines for calculating changes in biomass and soil carbon stocks from land conversion (IPCC, 2006). Carbon stocks impacted by construction and mining operations were conservatively assumed to be immediately lost through oxidization and emitted into the atmosphere as carbon dioxide ($CO_2$).

Equation 2.16 from IPCC (2006) served as the basis for estimating the loss in biomass carbon stocks and subsequent GHG emissions from land conversion (i.e., land clearing and excavation activities) at the Site. Biomass carbon density was sourced from a regional study (Cleary et al., 2010), encompasses live above-ground biomass, live below-ground biomass, and dead organic matter (e.g., litter) and incorporates uncertainty provided therein as a 90% confidence interval (CI). The streamlined equation used in calculations is presented as:

$$\Delta B_{CONVERSION} = (B_{AFTER} - B_{BEFORE}) \times A_{CONVERTED}$$

Where:

$\Delta B_{CONVERSION}$ = Changes in biomass carbon stocks from land conversion

$B_{AFTER}$ = Carbon stock in biomass per unit of area immediately after land conversion; this value is conservatively set to 0 MT C ha$^{-1}$

$B_{BEFORE}$ = Carbon stock in biomass per unit of area immediately before conversion; 1.10 ± 0.87 MT C ha$^{-1}$ (Cleary et al., 2010)

$A_{CONVERTED}$ = Area of conversion; ha.

Equations 2.24 and 2.25 from IPCC (2006) served as the basis for calculating the loss in soil carbon stocks and subsequent GHG emissions from land conversion (i.e., excavation activities). Only areas Soil organic carbon density was sourced from a regional study (Cleary et al., 2010), assuming a depth of 1.8m, and incorporates uncertainty provided therein as a 90% CI. The streamlined equation used in calculations is presented as:

$$\Delta SOC_{CONVERSION} = (SOC_{AFTER} - SOC_{BEFORE}) \times A_{EXCAVATED}$$

Where:

$\Delta C_{CONVERSION}$ = Changes in biomass carbon stocks from land conversion

$SOC_{AFTER}$ = Soil organic carbon stock per unit of area immediately after land conversion; this value is conservatively set to 0 MT C ha$^{-1}$

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$SOC_{BEFORE}$ = Soil organic carbon stock per unit of area immediately before land conversion; 110.00 ± 37.84 MT C $ha^{-1}$ (Cleary et al., 2010)

$A_{EXCAVATED}$ = Area of excavation; ha.

Carbon impact estimates from mining infrastructure development and operations were converted into carbon dioxide equivalents ($CO2_e$) (using stoichiometry) and are summarized in Table 19-4.

*Table 19-4: Carbon Impact to Carbon Dioxide Conversion Equivalent Summary*

| **Infrastructure Type** | **Habitat (Biomass) Removal** | **Soil Excavation** | **Total** |
|---|---|---|---|
| | MT CO2e | MT CO2e | MT CO2e |
| Access Roads | 0.28 – 2.46 | 0* | 0.28 – 2.46 |
| Mining Pits | 33.05 – 285.66 | 10,454.54 – 21,416.86 | 10,487.60 – 21,702.52 |
| Tailings Ponds | 57.02 – 492.80 | 18,035.48 – 36,946.92 | 18,092.50 – 37,439.73 |
| *Total* | *90.36 – 780.92* | *28,490.02 – 58,363.78* | *28,580.38 – 59,144.70* |

## 19.3 Greenhouse gas emission sources

Stantec outlined the greenhouse gas emissions sources based on the ESG Guidance in the JORC Code, Appendix 1. The GHG equipment sources were determined from the mining operation estimates at Cowboy State Mine. The JORC guidance requires a quantitative analysis of Scope 1, 2 and 3 emissions. Scope 1 represents all direct greenhouse gas emissions from the project, such as the emissions from an engine or vehicle. Scope 2 emissions represent all indirect emissions, such as the purchase of electricity to warm or cool a building. Scope 3 emissions are calculated from the results of activities from assets not owned by the organization, such as the emissions associated with disposal of an end-of-life product. Scope 1 GHG emissions were estimated in the report; however, Scope 2 and 3 emissions were not yet calculated in the report due to the changing project design.

Scope 1 greenhouse gas emission sources at the site include port equipment, such as, blast hole drills, front end loader, track dozer, grader, compactor, backhoe, skidsteer, and mobile equipment, including, fuel/lube truck, water truck, off highway trucks (haulers), light vehicles, medium duty light vehicles. Explosives are another form of Scope 1 GHG sources at the Cowboy State Mine; however, the projected usage and associated emissions are to be determined. Additionally, Scope 2 and 3 GHG emission sources are not established yet but are expected to include the purchased electricity used to power the processing plant at the site and downstream emission sources, such as the emissions from disposal vehicles, not operated by WRI.

The magnitude of the greenhouse gas impact associated with the project emissions is represented by the total equivalent carbon dioxide ($CO_2e$). Total $CO_2e$ is calculated by multiplying a Global Warming Potential (GWP) for carbon dioxide ($CO_2$), nitrous oxide ($N_2O$) and methane ($CH_4$), and summing the total from each GHG. The GWP for $CO_2$ is 1, since $CO_2$ is the basis for $CO_2e$. The GWP for $CH_4$ is 28, and the GWP for $N_2O$ is 265.



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These GWP reflect the latest federal regulation, 89 Fed. Reg. 31,894, that was published on Apr. 25, 2024, and became effective on January 1, 2025. The total $CO_2e$ from the current design stage of the mining project is estimated to be 38,500 megatons (MT) of $CO_2e$. The associated gold product from the Cowboy State Mine is estimated to be 4.5 MT Au. Per the JORC guidance, the intensity of the project was calculated, taking the ratio of $CO_2e$ emitted to ore produced. The intensity of the mining operation is calculated to be 8,546.48 MT $CO_2e$/ MT Au.

Stantec drafted a Preliminary Inventory Management Plan for WRI. The Preliminary Inventory Management Plan summarizes the mining operation at Cowboy State Mine, describes the GHG emissions, and provides recommendations for inventory management. The scope of the Inventory Management Plan was limited by the incomplete design of the mining site. Once the design is finalized, the Preliminary Inventory Management Plan can be readdressed and enhanced.

As the design matures, WRI is continuously considering access to renewable energy sources and ways to implement decarbonization activities. WRI will develop a statement outlining the GHG emissions that includes discussion about access to renewable energy. Additionally, WRI will generate a carbon neutrality strategy outline that is inclusive of climate change vulnerability considerations. Once the design has matured, WRI will present their energy consumption profile, which will represent mining and processing methods through the life of the resource.

## 19.4 Potential effects on the project from climate change-related statutes and requirements

Consistent with the disclosure principles of SEC Regulation S-K 1300 and the JORC Code, the Project has been evaluated for environmental, regulatory, permitting, and other material factors that could affect Project development, operation, closure, mineral reserve estimation, or economic performance. As part of this evaluation, applicable climate change-related statutes, regulations, policies, and reporting requirements were reviewed to determine whether they represent material risks, constraints, or opportunities that could influence Project design, permitting, operating costs, closure obligations, or long-term economic viability.

At the time of this review, no state-level climate change statute was identified in Wyoming that would currently prohibit or constrain development of the Project. Wyoming regulates non-coal mining through the Wyoming Environmental Quality Act and the Wyoming Department of Environmental Quality Land Quality Division permitting framework, which focuses on mining operations, environmental protection mechanisms, reclamation, and closure requirements. Current permitting requirements for non-coal mining operations do not require a climate change assessment, climate adaptation plan, or comprehensive Scope 1, Scope 2, and Scope 3 GHG inventory as a condition of obtaining a mining permit. Wyoming's current regulatory framework remains generally supportive of critical mineral and rare earth development. The Project would, however, remain subject to applicable federal and state environmental permitting requirements, including air quality, water quality, reclamation, and land disturbance regulations, which might be indirectly influenced by future climate change-related policy developments.

A potentially applicable federal climate-related regulatory requirement is the U.S. EPA's GHGRP under 40 CFR Part 98. The GHGRP applies to specified source categories and, in certain cases, to facilities exceeding applicable greenhouse gas reporting thresholds, including facilities emitting 25,000 metric tons of carbon



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dioxide equivalent ($CO_2e$) or more annually. Applicability cannot be determined until the final mine, processing, refining, and power supply configurations are established; however, future mining, beneficiation, refining, or power generation facilities could become subject to reporting requirements depending on facility design, fuel usage, and resulting greenhouse gas emissions. The GHGRP does not establish greenhouse gas emission limits but may impose monitoring, recordkeeping, calculation, and annual reporting requirements that could result in additional administrative and operational costs over the life of the Project.

The Project may also be affected by climate-related regulatory considerations that arise through federal and state air permitting programs and associated greenhouse gas permitting requirements. Future processing, refining, and power generation facilities associated with the Project would be expected to require air quality permits addressing criteria pollutants, hazardous air pollutants, and emissions resulting from combustion and processing activities. Although Wyoming does not currently maintain a broad state-level greenhouse gas reduction program specifically applicable to mining projects, evolving federal air quality regulations, greenhouse gas reporting requirements, and climate-related policies could influence future facility design, equipment selection, electrification strategies, emissions control technologies, and operating costs. These considerations may become increasingly relevant if Project development includes energy-intensive mineral processing, refining, or power generation infrastructure.

Looking forward, the most significant climate-related regulatory risks to the Project are likely to arise from future federal policy developments. The Project remains in the permitting and development stage, and current planning contemplates future infrastructure development, mineral processing facilities, and potential expansion activities. Although future regulatory actions cannot be predicted with certainty, changes in climate-related laws, regulations, permitting requirements, reporting obligations, or federal policy could affect Project design, permitting, construction, operation, closure, and long-term economic performance. The extent of such impacts would depend on the nature and timing of future regulatory developments.

Conversely, future climate and energy-transition policies may create opportunities for the Project. Rare earth elements are important inputs to technologies commonly associated with electrification, renewable energy generation, advanced electronics, and other applications supporting the energy transition. Federal initiatives aimed at strengthening domestic critical mineral supply chains, improving mineral security, or supporting strategic mineral development could enhance market demand, financing opportunities, infrastructure investment, permitting support, or commercial opportunities for Project products. Accordingly, future climate-related policy developments may present both regulatory risks and strategic opportunities that should be monitored as federal and state regulatory frameworks continue to evolve.

## 19.5 Local economic and/or Social Contributions

The proposed development of the Cowboy State Mine, together with the anticipated associated downstream processing and refining facilities, has the potential to contribute to the regional economy through employment, contractor and supplier opportunities, infrastructure investment, and industrial development. The current plan supports an approximately 26-year operating life, providing the potential for sustained workforce participation, regional procurement, and economic activity throughout the development, construction, operation, and closure phases of the Project.

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As indicated in the Pre-Feasibility Study, ARR intends to engage local contractors and operators throughout permitting, construction and operations wherever practical. This approach is supported by the availability of an established regional workforce with experience in mining, oil and gas, and other industrial sectors, providing a skilled regional labor pool to support Project activities. Construction and operation of the project would also require supporting infrastructure such as access roads, water supply systems, power infrastructure, buildings, and transportation networks. Development of this infrastructure may create opportunities for construction contractors, equipment suppliers, transportation providers, and other service industries within the region.

The Project's downstream processing strategy may further support regional economic activity. Specifically, Wheatland is proposed to act as the primary regional service center supporting CSM development, with associated refining activities anticipated to be located nearby. This would likely allow portions of the value chain associated with processing and refining to remain in the region and could create an indirect inflow of economic benefit to local businesses.

The Project may also contribute to broader economic development objectives through the production of domestically sourced rare earth materials used in advanced manufacturing, electrification technologies, defense applications, and critical mineral supply chains within the United States. The economic analysis completed for the CSM also anticipates the payment of royalties, production taxes, ad valorem taxes, industrial property taxes, and federal income taxes over the life of the operation, contributing economic value at local, state, and federal levels.

### 19.5.1 Status of Key Stakeholder Identification

Stantec and WRI performed the initial impact-based materiality assessment (IMA). The IMA was conducted with key WRI internal stakeholders responsible for mitigating project- and ARR-level risks, along with relevant Stantec stakeholders responsible for addressing risks appropriate to the Project's current stage of maturity.. Stantec utilized widely recognized standards to guide the IMA including the Sustainability Accounting Standards Board (SASB) standards guidance for the Metals and Mining industry as well as the Global Reporting Initiative (GRI) as a guidance framework by which the internal stakeholder engagements were performed.

During the initial IMA, current internal and external stakeholder engagements were confirmed relative to the maturity of the project. Stantec and WRI concurred that initial external stakeholder engagements were too early in the process for full external stakeholder engagement common to full IMA's and in some cases Double Materiality Assessments (DMAs); however, Stantec and WRI discussed the maturity of external stakeholder identification, mapped importance relative to probably material risks to the project and discussed future engagements as part of the IMA. Key external stakeholders were identified including permitting engagement with state and federal agencies, indigenous relations and engagement process, community engagement and involvement processes, adjacent landowners and potential impacts to adjacent land, and any funding agencies or investor engagement plans.

External stakeholder outreach plans are currently in development associated with permitting and community engagement during the IMA and are anticipated to mature in need and scope as the project continues to mature.

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# 20 Capital and Operating Costs

## 20.1 Capital Cost Estimate

Total life-of-Project capital cost for the Cowboy State Mine is estimated at US$873.1 million and forms the primary capital cost input to the Project's Pre-Feasibility level economic evaluation. It comprises initial capital of US$840.0 million, expended during the three-year construction period (2028 to 2030), and expansion capital of US$33.0 million for the staged development of the refinery waste disposal facility, to be expended in Year 3 (2034) and Year 13 (2044). Total capital consists of direct capital of US$759.2 million and a 15% contingency of US$113.9 million.

Mining capital of US$55.0 million provides the owner-operated mobile equipment fleet and ancillary mining equipment. Infrastructure capital of US$704.2 million comprises the on-site and refinery processing facilities (US$590.1 million), the refinery waste disposal facility (US$47.9 million, including individual cells for Fe precipitate at US$4.0 million), the sand by-product stockpile facility (US$21.2 million), electric infrastructure (US$25.0 million) and water infrastructure (US$20.0 million).

## 20.2 Estimate Structure

The capital cost estimate is structured into two direct capital categories, mining and infrastructure, with contingency applied to both and closure capital carried separately. The mining capital estimate was prepared by Stantec to AACE International Class 4 standards. The processing and infrastructure capital estimates were prepared by Tetra Tech.

## 20.3 Basis of Estimate – Mining

### 20.3.1 General Estimating Criteria

The foregoing subsections describe the criteria, and general approach to the cost estimate and schedule.

#### 20.3.1.1 Base Year and Currency

The Stantec capital and operating cost estimates for mining, material movement, refinery waste disposal and closure have been prepared in fourth quarter (Q4) 2025 US dollars (USD). Costs obtained from similar Canadian-based estimates were escalated to Q4 2025 and converted to USD using an exchange rate of 1 USD to 1.38 CAD. The processing and refinery capital cost estimate prepared by Tetra Tech (Revision 3) is expressed in third quarter (Q3) 2026 USD. The component estimates have not been escalated or de-escalated to a common base date, as the difference is not considered material relative to the ±25% target accuracy of the estimate. The Financial Model combines them without adjustment, and all results are reported in constant Q1 2026 USD.

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#### 20.3.1.2 Estimate Accuracy

The capital and operating cost estimates have been prepared to a Pre-Feasibility Study (PFS) level of accuracy of approximately ±25%, consistent with the SME Guide. The estimates are based on the level of engineering and project definition available at the time of the Study, including historical factors, estimated quantities, vendor quotations, and other project-specific information, as applicable. A contingency allowance of 15% has been applied to all direct capital costs, consistent with the contingency range identified in the SME Guide for a PFS and with the Financial Model. No contingency has been added to operating costs or to the closure provision in the Financial Model.

#### 20.3.1.3 Units of Measure

Metric units of measure have been used in the capital cost estimates and schedules. The following units will be used for the estimates:

- meter (m) for linear distances (pipe runs, haulage roads, electrical cables, etc.)
- cu m (cubic meter) for volumes (concrete, excavations, etc.)
- sq m (square meter) for areas (wire mesh, clearing, etc.)
- Tonnes for ore/ waste rock haulage, fabricated steel, etc.

#### 20.3.1.4 Estimating Software

The cost estimate prepared by Stantec has been developed using InEight Estimate estimating software. Estimates were provided in MS Excel format for review purposes, and as final deliverables.

#### 20.3.1.5 Estimate Organization

Estimate organization has been achieved by employing various code-structures as meta-data within the InEight Estimate. These code-structures and their application are further described below.

##### *20.3.1.5.1 Estimate Breakdown Structure*

Stantec has structured the InEight cost estimate using a Cost Breakdown Structure (CBS) that facilitates Engineering, Procurement, Construction, Management (EPCM). The CBS is outlined in Figure 20-2.

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| | |
|---|---|
| 1 | **WRI Cowboy State Mine - Open Pit & Surface Mine Infrastructure** |
| 1.1 | <PROJECT CAPITAL> |
| 1.1.1 | <ENGINEERING> |
| 1.1.2 | <PROCUREMENT & CONSTRUCTION> |
| 1.1.2.1 | <PROCUREMENT> |
| 1.1.2.2 | <CONSTRUCTION> |
| 1.1.2.3 | <PROJECT & CONSTRUCTION INDIRECTS> |
| 1.1.3 | <CONTINGENCY> |
| 1.1.3.2 | <CONTINGENCY> |
| 1.2 | <OPERATING & SUSTAINING CAPITAL> |
| 1.2.2 | <PRODUCTION MINING> |
| 1.2.2.1 | <PRE-PRODUCTION MINING - YR 0> |
| 1.2.2.2 | <OPERATING PERIOD PRODUCTION MINING> |
| 1.2.3 | <MINE CLOSURE & REHABILITATION> |

*Figure 20-1: InEight Estimate CBS*

### *20.3.1.5.2 Work Breakdown Structure*

The Work Breakdown Structure (WBS) code structure used for the PFS Mining Estimate is similar to other recent Stantec Mining Estimates. The WBS Areas are outlined in Figure 20-3.

| | | |
|---|---|---|
| **0000** | **PRE-IMPLEMENTATION STUDIES & OVERALL PROJECT** | **H** |
| **0100** | **Strategy & Management** | H |
| **0200** | **Geology** | H |
| **0400** | **Hydrology and Hydrogeology** | H |
| **0500** | **Mining** | H |
| **0800** | **Engineering Studies** | H |
| **1000** | **MINE** | **D** |
| **1100** | **Surface Development** | D |
| **1500** | **Mine Dewatering** | D |
| **1700** | **Mobile Equipment** | D |
| **1800** | **Mine Area Services, Utilities and Infrastructure** | D |
| **1900** | **Mine Ancillary Facilities** | D |

*Figure 20-2: Work Breakdown Structure*

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#### *20.3.1.5.3 Other Code-Structures and Attributes*

In addition to the Cost Breakdown Structure, Work Breakdown Structure and Facility Breakdown Structure coding, additional tagging columns have been utilized in InEight Estimate to create further filtering and grouping capabilities. The following is a list of tagging columns utilized.

- Phase (Project / Operations).
- Cost Type (CapEx / OpEx / SusEx).
- Other tagging columns are as follows:
- Procurement and Contracts Packages
- Discipline
- Cost Source

## 20.3.2 Project/Operating Phases and Cost Types

The cost estimates and schedules have been grouped by Phase (Project / Operating) which has been determined by the project completion criteria above, and Cost Type.

The Cost Types are defined as follows:

- **CAPEX:** all direct and indirect labour, equipment and material costs incurred up to the completion of the project.
- **SUSEX:** all direct and indirect capital costs incurred post-commercial production
- **OPEX:** all direct and indirect operating costs incurred post-commercial production during steady-state mining operation. Ore production costs during the project period have been categorized as OPEX.

## 20.3.3 Energy Commodity Rates

Energy commodity rates employed in the cost estimates have been validated and/or benchmarked with onsite actuals and are summarized below.

- Electrical Power (Wyoming): US$0.17 per kWh.
- Diesel Fuel: US$0.91 per Liter.

## 20.3.4 Escalation

Forward escalation has been excluded from the PFS cost estimate.

## 20.3.5 Contingency

A contingency of 15% has been applied to the mining capital estimate, consistent with the contingency applied to all direct capital in the Financial Model (see Section 20.5). On mining direct capital of US$55,003,126, this equates to a contingency of US$8,250,469, for a total mining capital cost of US$63,253,595 including contingency. The mining contingency forms part of the total Project contingency of US$113.9 million summarized in Table 20-12.

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## 20.3.6 Taxes

Taxes are excluded from the PFS cost estimate. Royalties, Wyoming severance tax, Albany County ad valorem tax, Wyoming industrial property tax and federal corporate income tax are included in the Financial Model and are presented in Section 21 (Economic Analysis).

## 20.3.7 Estimate development

The following sections outline the general cost estimate and schedule methodology that was used to develop the corresponding deliverables.

### 20.3.7.1 Quantity Take-Offs

Quantity Take-Offs (QTOs) were created for the PFS based on the design, or in the absence of a design, from similar reference projects. Mine construction and production quantities were extrapolated from the Deswik mine plan. All quantities have been issued by Engineering to Estimating in Excel format.

### 20.3.7.2 Construction Quantity Allowances

Construction allowances have been added to neat quantities based on the QTOs to obtain final estimating quantities.

The calculated allowances outlined in this section are consistent with industry standards and have been built based upon information gathered from the following sources:

- AACE (Association for the Advancement of Cost Engineering).
- RSMeans.
- Costmine Mine and Mill Equipment Guide (MME)
- Communications with Industry Specialists.
- Historic Data.

#### *20.3.7.2.1 Concrete*

It has been assumed that all concrete will be delivered to site by local vendor(s) via concrete trucks.

The following allowances are added to the neat QTO quantities:

- An allowance for wastage of material and overpour. This allowance is based on the following:
    - Spillage, broken forms etc.
    - Overpours.
    - A design growth allowance for possible changes/modification of design.

#### *20.3.7.2.2 Bulk Materials (Steel, Cable, Piping, etc.) and Miscellaneous Items*

The following allowances are added to the neat QTO quantities for bulk materials miscellaneous items.

- An allowance to account for compaction.



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- An allowance for connectors.
- An allowance to account for waste.
- An allowance to account for design growth.
-

Quantity allowances factors are outlinedin Table 20-1.

*Table 20-1: Quantity Allowance Factors*

| **Material Description** | **Allowance Factor** |
|---|---|
| Small Concrete Pour ( < 8cum) | |
| Small Concrete Pour ( < 8cum) - Surface Floors | 1.22 |
| Small Concrete Pour ( < 8cum) - Surface Footing | 1.22 |
| Small Concrete Pour ( < 8cum) - Surface Walls | 1.22 |
| Small Concrete Pour ( < 8cum) - Surface Foundations | 1.22 |
| Small Concrete Pour ( < 8cum) - Surface Piers | 1.22 |
| **Large Concrete Pour ( > 8cum)** | |
| Large Concrete Pour ( > 8cum) - Surface Floors | 1.19 |
| Large Concrete Pour ( > 8cum) - Surface Footing | 1.19 |
| Large Concrete Pour ( > 8cum) - Surface Walls | 1.19 |
| Large Concrete Pour ( > 8cum) - Surface Foundations | 1.19 |
| Large Concrete Pour ( > 8cum) - Surface Piers | 1.19 |
| Structural Steel - light (less than 25kg/m) | 1.20 |
| Structural Steel - medium (between 25kg/m and 65kg/m) | 1.18 |
| Structural Steel - heavy (between 65kg/m and 110kg/m) | 1.16 |
| Structural Steel - extra heavy (greater than 110kg/m) | 1.16 |
| Structural Steel - plate | 1.16 |
| Reinforcing Rebar | 1.19 |
| Reinforcing Wire Mesh (8'x20') | 1.26 |
| Surface Excavation | 1.27 |
| Piping - Associated with Facility | 1.26 |
| Electrical/Instrumentation - Associated with Facility | 1.26 |
| HVAC/Vent - Associated with Facility | 1.11 |

-

#### *20.3.7.2.3 Cost Allowances*

Cost allowances for specification change allowances have been applied directly to the unit cost and not to the quantity. Table 20-2 lists the specification change cost allowances that have been applied in the estimate.

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*Table 20-2: Cost Allowances*

| Description | Cost Allowance |
|---|---|
| Mechanical and Electrical Equipment | 5% |
| Mobile Equipment | 5% |

## 20.3.8 Shift Schedule and Rotations

Shift schedules and rotations are outlined in Table 20-3 below.

*Table 20-3: Shift Schedule and Rotations*

| Work Type | Hours/Shift | Shifts/Day | Days/Week | Rotation |
|---|---|---|---|---|
| Construction (Project Period) | 12 | 1 | 7 | N/A |
| Mining (Pre-Production Period) | 12 | 2 | 7 | 7 on / 7 off |
| Mining (Operating Period) | 12 | 2 | 7 | 7 on / 7 off |

## 20.3.9 Effective Work Time and Productivities

Effective work time calculations were developed to support downstream performance and cycle time calculations. During both the pre-production and operating period, 2 x 12-hour shifts per day were utilized for construction and direct mining activities. See Appendix C Detailed Effective Utilization for further information.

### 20.3.9.1 Fixed Times

Fixed times represent delays and/or stoppages of work for legislated breaks, and typical mine-related delays specific to the mine site. The fixed time estimates are based on the site conditions, as well as experience of the Stantec team.

The fixed time includes:

- Lunch and rest breaks.
- Start of shift line ups.
- Fueling
- Blast delays
- Weekly safety meetings.
- Delays caused by visits to the workplace by supervisors, engineering/geology and/or management/other visits.

## 20.3.10 Construction and Operating Performances

Construction and operating performances are estimated on a first principles basis, based on historical data, recent project experience and input from contractors specializing in surface construction work. It should be noted that the surface construction performances are used for the purpose of calculating direct labour hours

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and overall durations of surface construction activities. Surface construction costs were from Stantec database, Costmine MME (2024) and RSMeans on a unit of measure basis for all discipline activities.

Operating performances (drilling m/day, blasting and haulage tonnes/day) were derived from the tonnage forecast/ schedule provided by Stantec Engineering. See Figure 20-3 for mining tonnage forecast by year.

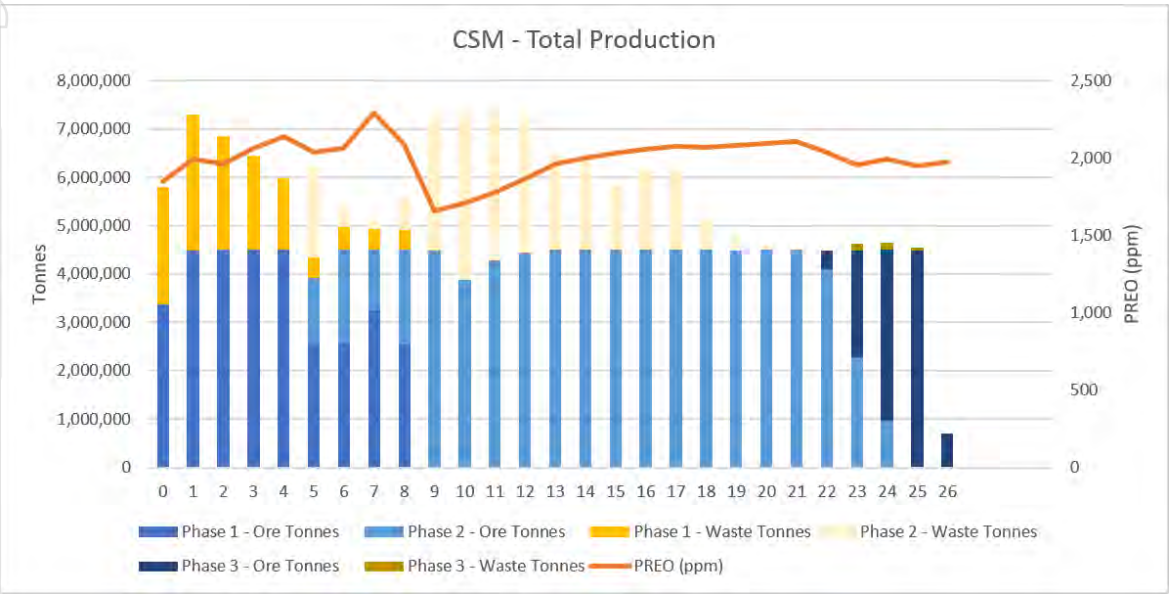


*Figure 20-3: Mining Production Profile*

## 20.3.11 Labor Rates

Labor rates were provided by Stantec based on current average contractor quotes from the Stantec database and Costmine MME (2024). All labour rates presented below in Table 20-4 include the base rate, bonus, burdens, allowances, overtime.

*Table 20-4: Labor Rates*

| | Description | Cost per Hour (USD) |
|---|---|---|
| **Indirect Labor** | CSM - General Manager | $ 168.27 |
| | CSM - Mine/Engineer Superintendent | $ 127.40 |
| | CSM - Admin | $ 64.24 |
| | CSM - Engineer 1 | $ 98.56 |
| | CSM - Geologist | $ 92.56 |



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| | Description | Cost per Hour (USD) |
|---|---|---|
| | CSM - Surveyor | $ 50.39 |
| | CSM - Office Staff | $43.69 |
| | CSM - HR Manager | $9.71 |
| | CSM - HSE Supervisor | $79.66 |
| Direct Labor | CSM - Haul Truck Driver | $ 66.30 |
| | CSM - Excavator Operator | $ 84.39 |
| | CSM - Driller | $ 84.39 |
| | CSM - Heavy Equipment Operator | $ 61.40 |
| | CSM - Laborer | $ 54.10 |
| | CSM - Mine Supervisor | $88.41 |
| | CSM - Maintenance Supervisor | $83.36 |
| | CSM - Maintenance Planner | $83.36 |
| | CSM - Mechanic | $63.98 |
| | CSM - Electrician | $89.09 |

**Corporate overhead rates are excluded from the PFS cost estimate.

### 20.3.12 Equipment Rates

Mining and construction equipment hourly operating rates were developed from first principles and account for parts, fuel, lubrication, ground engagement components (where applicable) and tires. Table 20-5 provides detailed diesel equipment rates and cost estimates in USD.

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*Table 20-5: Equipment Hourly Operating Rates*

| Description | Cost per Hour |
|---|---|
| Excavator - CAT 6015 | $248.23 |
| Haulage Truck - Komatsu HD605-10 | $79.57 |
| FEL - CAT 988 - 6.2 m3 | $113.62 |
| Blast Hole Drill - Epiroc PowerROC T50 | $122.15 |
| Track Dozer - Cat D6 | $60.88 |
| Wheel Dozer - Cat 824 | $110.06 |
| Grader - CAT 16 | $66.73 |
| Water Truck - CAT 745 (34,000 Liter) | $58.12 |
| Fuel/Lube Truck - 20,000L | $56.66 |
| Service Truck - Summit 8 Series (Hydraulic Telescopic Crane) | $54.52 |
| Telescopic Handler - 16 Tonne | $33.74 |
| Backhoe - 1.3m3 | $45.00 |
| Skid Steer - CAT 272D3 XE | $9.53 |
| Crew Cab Pickup - 1 T | $28.30 |
| Crew Bus - 13 Passenger | $29.42 |
| Lighting Plant - Bobcat PL80 | $7.24 |
| Pump - Clear Water | $42.20 |
| Pump - Diesel - Skid Mounted - Centrifugal Pit | $89.53 |
| Two Deck Screen-Scalper - Rubble Master HS7500 | $57.19 |

### 20.3.13 Procurement and Bulk Materials Pricing

Stantec worked with local and regional vendors to provide budgetary pricing and lead times for site delivery of equipment and bulk materials.

A target of 40% of total estimated costs for mobile fleet, mechanical and electrical equipment supply should be provided by vendor quotation for each category grouping listed.

Equipment Package pricing followed a general process as described below:

- Vendor pricing request based on available information/specifications generated during the study;
- Recent quotations and historical data from Stantec databases.

All bulk material pricing is included using the following general process:

- Vendor pricing request based on available information/specifications generated during the study;

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- Recent quotations and historical data from Stantec databases.
- Allowances.

See Figure 20-4 for an illustration of the cost estimate of the overall project equipment pricing.

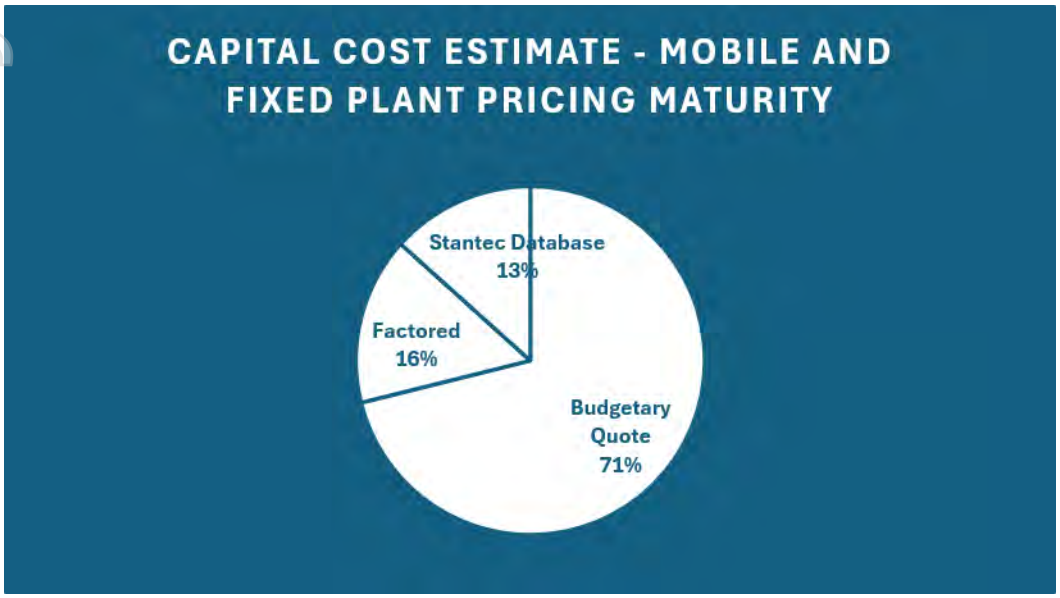


*Figure 20-4: Capital Cost Estimate Equipment Pricing Maturity*

## 20.3.14 Major Fixed Equipment

Examples of major fixed plant equipment utilized for this project and costs in USD are shown below in Table 20-6:

*Table 20-6: Major Mech/ Elect. Equipment Procurement*

| Major Mech/ Elect. Equipment | Units | Unit Cost | Source |
|---|---|---|---|
| Lighting Plant - Bobcat PL80 | 8 | $16,575 | Budgetary Quote |
| Pump - Clear Water | 3 | $99,654 | Factored |
| Pump - Diesel - Skid Mounted - Centrifugal Pit | 4 | $134,946 | Factored |
| Wash Plant | 2 | $22,837 | Budgetary Quote |
| MCC (Mtce Shop) 480V, 600A, 42kA- 6 sections, NEMA 12 Enclosure | 2 | $43,720 | Stantec Database |
| Dry Type Transformer, Outdoor, 3 MVA, 13.8 kV/600 V | 2 | $5,000 | Stantec Database |
| Neutral Ground Resistor, 15 A, 347 V, 23 OHMS, NEMA 3R | 2 | $5,000 | Stantec Database |
| 15T Bridge Crane (Wazee Crane) - Supply | 1 | $178,410 | Budgetary Quote |

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| Major Mech/ Elect. Equipment | Units | Unit Cost | Source |
|---|---|---|---|
| Two Deck Screen-Scalper - Rubble Master HS7500 | 1 | $395,000 | Budgetary Quote |
| Explosive Magazine - Type 2 Outdoor Magazine | 3 | $39,630 | Budgetary Quote |

### 20.3.15 Mobile Equipment

Mobile equipment fleet quantities were calculated by Stantec Mining Engineering and then issued to Stantec Estimating. The fleet quantities are based on the mine plan requirements and are itemized by each individual unit required.

Table 20-7 illustrates the mobile fleet count and procurement unit cost.

Table 20-7: Mobile Fleet Procurement Costs (in USD) and Qty's

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| Diesel Equipment | Units | Unit Cost | Source |
|---|---|---|---|
| Excavator - CAT 6015 | 1 | $1,854,000 | Budgetary Quote |
| Haulage Truck - Komatsu HD605-10 | 2 | $1,296,511 | Budgetary Quote |
| FEL - CAT 988 - 6.2 m3 | 1 | $1,181,600 | Budgetary Quote |
| Blast Hole Drill - Epiroc PowerROC T50 | 5 | $876,000 | Budgetary Quote |
| Track Dozer - Cat D6 | 1 | $605,550 | Budgetary Quote |
| Wheel Dozer - Cat 824 | 1 | $1,188,334 | Budgetary Quote |
| Grader - CAT 16 | 2 | $1,285,250 | Budgetary Quote |
| Water Truck - CAT 745 (34,000 Litre) | 1 | $469,000 | Budgetary Quote |
| Fuel/Lube Truck - 20,000L | 1 | $395,649 | Budgetary Quote |
| Service Truck - Summit 8 Series (Hydraulic Telescopic Crane) | 1 | $469,054 | Budgetary Quote |
| Telescopic Handler - 16 Tonne | 1 | $365,000 | Budgetary Quote |
| Backhoe - 1.3m3 | 1 | $528,676 | Budgetary Quote |
| Skid Steer - CAT 272D3 XE | 4 | $117,686 | Budgetary Quote |
| Crew Cab Pickup - 1 T | 1 | $88,395 | Budgetary Quote |
| Crew Bus - 13 Passenger | 8 | $110,000 | Budgetary Quote |

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**Mobile equipment rebuilds and replacement costs were incorporated into the equipment hourly operating costs (MME 2024).

### 20.3.16 Contractor Scopes of Work

The contract packaging strategy can be described as follows:

- **Open Pit Mine Blasting** – Open pit mine blasting for the life of mine.
- **Specialist Surface Construction** – Maintenance Shop, Mining Office, Dewatering Line(s), OH Power Transmission Lines, etc.

### 20.3.17 Unit Costs

Unit costs for project and production activities, were calculated from first principles and include labor, materials/consumables and mobile equipment operating. The operating unit cost calculations are provided for direct costs only, and contractor indirect costs are factored at 15% of Labor and Equipment Costs. Varying unit costs are calculated for both the project and operating periods.

The labor component is based upon the crew size and the calculated performance per day to determine the total hours per unit of measure, which are then applied to the crew labour rates. Materials costs are based on the quantity take-offs per unit, derived from the mine design criteria. Equipment operating is based on the calculated performance per day to determine the total hours per unit of measure, which are then applied to the equipment operating costs per hour.

See Table 20-8 and Table 20-9 for contractor/ facility construction unit costs in USD, and Table 20-10 for production/ operating unit costs in USD.

*Table 20-8: Construction and Contractor Unit Costs*

| Description | Quantity | Unit of Measure | Unit Cost |
|---|---|---|---|
| BLASTING (CONTRACTOR – Labor, Equipment and Materials) | 1.00 | Tonne | $0.67 |
| EXCAVATION/ BACK-FILL | 1.00 | Cubic Meter | $52.38 |
| CONCRETE - Forming | 1.00 | Square Meter | $212.17 |
| CONCRETE - Rebar | 1.00 | Kilogram | $3.81 |
| CONCRETE – Large Pours | 1.00 | Cubic Meter | $334.25 |

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| Description | Quantity | Unit of Measure | Unit Cost |
|---|---|---|---|
| CLEARING and GRUBBING | 1.00 | Hectare | $12,588.15 |
| MINE ELECTRICAL DISTRIBUTION | 1.00 | Meter | $463.41 |
| DEWATERING SYSTEM – Well Drilling | 1.00 | Each | $853,105.29 |
| DEWATERING SYSTEM – Pump Installation | 1.00 | Each | $463.41 |
| DEWATERING SYSTEM – Piping | 1.00 | Meter | $446.44 |

*Table 20-9: Facility Construction Costs*

| Description | Unit Cost |
|---|---|
| Office Complex | $275,596.12 |
| Maintenance Shop (Including OH Crane and Wash Plant) | $2,216,034.17 |
| Fuel Storage | $142,499.50 |
| Primary Haulage Road | $7,033,646.49 |
| Clearing and Grubbing | $56,995.85 |
| Mine Electrical Distribution (From Sub-Station) | $463,868.71 |
| Explosive Magazines and Emulsion Storage | $155,732.98 |
| Dewatering System | $4,040,591.44 |

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*Table 20-10: Production Unit Costs*

| Description | Quantity | Unit of Measure | Unit Cost |
|---|---|---|---|
| PRE-PRODUCTION CAPITALIZED WASTE STRIPPING | 1.00 | Tonne | $3.52 |
| PRE-PRODUCTION ORE MINING | 1.00 | Tonne | $3.33 |
| OPERATING WASTE MINING | 1.00 | Tonne | $2.60 |
| PRODUCTION ORE MINING | 1.00 | Tonne | $2.65 |
| MINE CLOSURE and REHABILITATION | 1.00 | Tonne | $1.13 |

## 20.3.18 Detailed Engineering (Mine Infrastructure Only)

Detailed Engineering costs were calculated based on 4% of the Project Capital, excluding Procurement. Detailed engineering costs are based only on the anticipated Mine Infrastructure/ Facilities found on preliminary GA's received.

## 20.3.19 Capital and Operating Spares

Spare parts costs are included for both start-up/commissioning spares and critical operating spares. The costs were calculated based on 2% of the direct equipment supply costs for start-up/commissioning spares.

## 20.3.20 Commissioning and Vendor Support

Direct facility unit costs include scopes of work up-to mechanical completion. Commissioning activities following mechanical completion, and up-to facility handover, were assessed for each facility individually. Estimator judgement and subject matter expert experience was applied to determine the duration for each commissioning activity. Direct trade labour hours were calculated based on the durations.

On-site vendor commissioning support costs were calculated based on 2% of the direct fixed-equipment supply costs.

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## 20.3.21 Indirect Costs

### 20.3.21.1 Contractor Indirects

Contractor indirect support costs were calculated by using a 15% factor applied to contractor labor and equipment costs. Contractor indirect labour positions were identified for each construction contract, along with allowances for indirect mobile equipment rental and operating requirements and any additional expenses (training, site orientation, etc.).

### 20.3.21.2 Project Staffing

The project staffing plan was developed using a first principles buildup of the project execution team resources and the ramp up of personnel associated with major project activities and milestones.

The time phasing of the project staff was developed in alignment with the mine plan and represented as full-time equivalents (FTEs) identified by position for the duration of the project.

### 20.3.21.3 Mine Staffing

Mine Staffing for pre-production and operating phases include both Direct and Indirect (Admin and Support) Labor. The mine staffing profile is provided in below Table 20-11.

*Table 20-11: Mine Staffing Profile*

| | Description | Qty |
|---|---|---|
| **Indirect Labor** | CSM - General Manager | **1** |
| | CSM - Mine/Engineer Superintendent | **1** |
| | CSM - Admin | **2** |
| | CSM - Engineer 1 | **1** |
| | CSM - Geologist | **1** |
| | CSM - Surveyor | **2** |
| | CSM - Office Staff | **2** |
| | CSM - HR Manager | **1** |
| | CSM - HSE Supervisor | **1** |
| | CSM - Mine Supervisor | **2** |
| | CSM - Maintenance Supervisor | **1** |
| | CSM - Maintenance Planner | **1** |
| | CSM - Mechanic | **6** |
| | CSM - Electrician | **1** |
| | CSM - Heavy Equipment Operator | **5** |
| | CSM - Laborer | **2** |

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| | Description | Qty |
|---|---|---|
| | | |
| **Direct Labor** | CSM - Haul Truck Driver | **4** |
| | CSM - Excavator Operator | **2** |
| | CSM - Driller | **8** |

## 20.3.22 Operating Cost Basis of Estimate

### 20.3.22.1 General Operating Cost

Operating Cost estimates have been built up from first principles where possible. The following operating costs have been calculated as part of this PFS study.

- Direct Mining.
- Direct Ore and Waste Handling.
- Indirect Mine Overhead.
- Fixed Plant Maintenance.
- Operating Utilities Consumption.

### 20.3.22.2 Direct Operating Cost

Direct operating costs have been developed from first principles for all ore and waste

production and material haulage related activities, per the methodologies described in the previous sections of this basis.

### 20.3.22.3 Indirect Operating Cost

### 20.3.22.4 Labor, Equipment, Plant Maintenance, Services, and Supplies

Indirect Labor, Equipment and Fixed plant maintenance (FPM) costs have been estimated based on Stantec's internal benchmarking and project experience, along with mining industry published standards aligned with the scope of work.

### 20.3.22.5 Power Consumption

The power consumption operating costs are calculated from first principles based on equipment specifications with the application of demand and utilization built-up using anticipated operating requirements. Power supply costs are estimated at US$0.17/kWh.

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#### 20.3.22.6 Process Water Consumption

Process water consumption costs are excluded from the estimate.

### 20.3.23 Production Schedule

The production schedule was developed with the mine development schedule in Deswik. Mine construction sequence was developed to support the mining production schedule, the procurement items with “long lead times” was developed primarily to support the construction activities, and the engineering activities was developed to primarily support the procurement schedule.

The assumption has been made that all other preceding activities (Detailed Engineering, Procurement and Project Construction) would be sequenced to support commencement of mine production.

### 20.3.24 Assumptions, Allowances and exclusions

Listed below are the assumptions, allowances and/or exclusions pertaining to the final estimate.

- Escalation is excluded from the cost estimate.
- American Rare Earths corporate overheads are excluded from the estimate.
- No allowances have been made in the cost estimates and/or schedules for the following:
    - Federal, state and other taxes and royalties. These are excluded from the cost estimates but are included in the Financial Model and presented in Section 21 (Economic Analysis).
    - Delays including, but not limited to, work stoppages, labor strikes, weather, poor ground conditions, supply-chain shortages, or force majeure.
- A detailed project and production schedule is not included in the estimate.

## 20.4 Exchange Rates

Canadian-based cost data used in the Stantec mining estimate is converted to USD at a rate of 1 USD to 1.38 CAD; this conversion applies only to that input data and carries no ongoing currency exposure, as all revenues, capital costs, operating costs, royalties and taxes are denominated in US dollars, and all equipment, materials and services are assumed to be procured on a US dollar basis. No foreign exchange assumptions are required, and no exchange rate risk is carried in the estimate.

## 20.5 Estimation Methodology

The capital cost estimate for the Cowboy State Mine Project was developed to a Prefeasibility Study level and is consistent with an AACE International Class 4 estimate. The estimate combines Stantec’s mining estimate with Tetra Tech’s processing estimate and is based on budgetary vendor quotations, historical cost data from comparable mining and mineral processing projects, benchmarked industry data, and factored estimating techniques. Major equipment costs were developed from supplier budget pricing where available, while installation, bulk materials, and infrastructure costs were estimated using preliminary engineering quantities and appropriate installation factors. Costs are reported in constant Q1 2026 US dollars; the base dates of the component estimates are set out in Section 20.3.1.

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For the mining scope, Stantec developed the capital estimate from the owner mobile fleet requirements defined by the mine plan, with fleet quantities calculated by Stantec Mining Engineering, priced using mine cost handbook data and benchmarked against comparable operations, consistent with AACE International Class 4 methodology. Major equipment pricing combined vendor budgetary quotations – targeted at approximately 40% of mobile fleet, mechanical and electrical equipment cost – with Stantec's historical project database for the remainder.

Labor rates were developed from Stantec's project database and the Costmine Mine and Mill Equipment Guide (2024), inclusive of base rate, bonus, burdens, allowances, and overtime, with corporate overhead excluded. Equipment operating rates were developed from first principles, including parts, fuel, lubrication, ground-engaging components and tires, with rebuild and replacement costs built into the hourly rate.

Mining operating costs were estimated as a single all-in owner-operated rate of US$5.47 per tonne of total material mined, inclusive of labor, equipment operation, maintenance, mining consumables and mobile equipment rebuild and replacement costs (mining sustaining capital), blended from phase-specific unit costs for pre-production stripping, pre-production and operating ore/waste mining, and closure. For the processing scope, Tetra Tech prepared a Class 4 capital estimate (Revision 3) comprising direct costs of US$536.5 million (major equipment US$220.1 million, bulk materials US$146.1 million and field labor US$170.3 million) and indirect costs of 10% (US$53.6 million) for detailed engineering, construction management and third-party QA/QC, for a base estimate of US$590.1 million. Tetra Tech's own contingency allowance is not carried in the Financial Model; the Project contingency of 15% is applied instead. Tetra Tech estimated operating costs on a unit cost per ROM tonne basis for each functional area of the flowsheet. A contingency of 15% was applied to all direct capital, including the refinery waste disposal expansion capital; no contingency was applied to the closure provision.

## 20.6 Qualifications and Clarifications

- The estimate carries a target accuracy of ±25%, consistent with a Pre-Feasibility level of study.
- Sustaining capital for the mining fleet (mobile equipment rebuilds and replacements) is included in the mining operating cost of US$5.47 per tonne. No sustaining capital has been estimated for the processing and refinery facilities or site infrastructure beyond the staged refinery waste disposal expansion capital of US$33.0 million.
- No contingency has been applied to the closure provision of US$55.9 million.
- Closure costs are carried in operating costs and are incurred as a lump sum in the final year of the mine plan (2056), comprising mine closure of US$30.9 million and refinery waste disposal closure of US$25.0 million.
- No escalation or inflation has been applied to any cost over the life of the Project.
- Owner's costs beyond pre-production engineering and administration are excluded; corporate overhead is also excluded from the estimate.
- Working capital movements are not modelled.
- The estimate makes no allowance for delays arising from work stoppages, labor strikes, adverse weather, poor ground conditions or supply-chain disruption.
- Royalties and taxes are excluded from the capital and operating cost estimate; these are addressed in the Economic Analysis section.
- A detailed project schedule is excluded from the estimate deliverables; the mine production schedule follows the Deswik mine plan, sequenced to first ore.

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## 20.7 Capital Cost Summary

*Table 20-12: Capital Cost Summary (Q1 2026 USD)*

| Capital Cost Category | USD (M) | % of Initial | Notes |
|---|---|---|---|
| Mining Capital | 55.0 | 6.3% | Owner mobile fleet and ancillary equipment |
| On-Site and Refinery Processing | 590.1 | 67.6% | Comminution, WHIMS, leach, SX, purification, finishing |
| Refinery Waste Disposal | 47.9 | 5.5% | Phased 40% Year −2, 30% Year 3, 30% Year 13; includes individual cells for Fe precipitate. |
| Sand By-Product Stockpile | 21.2 | 2.4% | |
| Electric Infrastructure | 25.0 | 2.9% | |
| Water Infrastructure | 20.0 | 2.3% | |
| **Sub-Total Direct Capital** | **759.2** | **87.0%** | **Contingency-bearing items** |
| Contingency (15%) | 113.9 | 13.0% | Applied to direct capital only |
| **Total Capital** | **873.1** | **100.0%** | **Initial capital US$840.0 M (2028–2030) plus expansion capital US$33.0 M (2034 and 2044).** |

Notes: Capital is drawn down at US$122.7 million in 2028 (14.6% of construction capital), US$308.3 million in 2029 (36.7%) and US$409.0 million in 2030 (48.7%), with first ore in 2031. Direct capital is phased 15% / 35% / 50% over the three construction years. The exception is the refinery waste disposal facility, which is phased 40% in 2029 (US$19.1 million before contingency), 30% in 2034 and 30% in 2044. Expansion capital of US$16.5 million, inclusive of contingency, is expended in each of 2034 and 2044. Closure costs of US$55.9 million, incurred in 2056, are included in operating costs. Percentages may not sum precisely due to rounding.

## 20.8 Operating Cost Estimate

Life-of-Project operating cost is estimated at US$4,726.4 million, equivalent to US$40.62 per tonne of ROM ore processed over 116.4 Mt. Operating costs were developed from first principles by three parties. Tetra Tech prepared the processing and refining estimates, US$3,611.1 million (76.4% of total operating cost), all of which are driven by ROM tonnes processed. Stantec prepared the mining, material movement, closure costs, and refinery waste disposal estimates, US$1,069.0 million (22.6%), each driven by its own physical quantity and built up from crew labor, equipment hours and consumable quantities, with contractor indirect costs (blasting, specialist surface construction) factored at 15% of contractor labor and equipment cost. ARR provided the water supply estimates, US$46.3 million (1.0%), modelled as fixed annual costs adjusted for utilization. Reagents are the largest cost element, representing 45.6% of life-of-Project operating cost across all functional areas.

Power consumption within the mining estimate is calculated from first principles at an electricity rate of US$0.17 per kWh (Wyoming); process water costs are excluded from the mining estimate, as water supply is estimated separately by ARR.

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The unit operating costs presented in **Error! Reference source not found.** are driven exclusively by ROM tonnes processed and total US$31.03 per tonne of ROM. The cost streams in Table 20-14 are driven by physical quantities other than ROM tonnes, or are fixed or lump-sum costs, and are stated with their respective drivers. Table 20-15 reconciles the two to total life-of-Project operating cost.

*Table 20-13: ROM-Driven Operating Costs*

| Cost Category | Unit | Unit Cost | Life-of-Project Total (USD M) | % of OpEx |
|---|---|---|---|---|
| Grinding | USD/t ROM | 1.54 | 178.9 | 3.8% |
| Concentration | USD/t ROM | 2.62 | 304.8 | 6.4% |
| Extraction | USD/t ROM | 7.51 | 874.0 | 18.5% |
| Impurity Removal | USD/t ROM | 6.37 | 741.7 | 15.7% |
| Separation and Finishing | USD/t ROM | 6.90 | 802.8 | 17.0% |
| Infrastructure | USD/t ROM | 3.90 | 454.2 | 9.6% |
| Product Packaging | USD/t ROM | 0.04 | 4.4 | 0.1% |
| Other | USD/t ROM | 2.15 | 250.3 | 5.3% |
| **Total ROM-Driven Operating Costs** | **USD/t ROM** | **31.03** | **3,611.1** | **76.4%** |

Notes: Unit operating costs are expressed on a ROM tonne basis over 116.4 Mt processed. Costs exclude royalties and production levies, which are reported in the Economic Analysis section. Processing costs encompass both on-site (grinding, concentration, and leaching) and off-site refinery (solvent extraction, separation, and finishing) components. All costs in this table were estimated by Tetra Tech. Tetra Tech's estimate includes disposal of process residues within the Impurity Removal (US$1.16/t ROM) and Infrastructure (US$0.64/t ROM) areas.

*Table 20-14: Operating Costs Not Driven by ROM Tonnes*

| Cost Category | Cost Driver | Unit | Unit Cost | Total (USD M) |
|---|---|---|---|---|
| Mining | Ore + waste tonnes mined | USD/t mined | 5.47 | 738.6 |
| Material Movement – Sand By-Product | Processed by-product tonnes (94% of ROM) | USD/t by-product | 2.00 | 218.8 |
| Refinery Waste Disposal – Disposal | Refinery waste tonnes (890 t/day) | USD/t waste | 3.60 | 30.4 |
| Refinery Waste Disposal – Thorium Dilution | Mine tailings tonnes (123.13 t/day) | USD/t tailings | 21.60 | 25.3 |
| Water – Mine Site | Fixed annual, adjusted for utilization | USD/year | 1,340,000 | 34.6 |
| Water – Hydrometallurgical Facility | Fixed annual, adjusted for utilization | USD/year | 500,000 | 11.7 |
| Closure – Mine | Lump sum, final year of mine plan | USD | 30,891,191 | 30.9 |
| Closure – Refinery Waste Disposal | Lump sum, final year of mine plan | USD | 25,000,000 | 25.0 |
| **Total Non-ROM-Driven Operating Costs** | | | | **1,115.3** |

Notes: Mining cost is applied to total material mined of 135.0 Mt (116.4 Mt of ore and 18.7 Mt of waste at a strip ratio of 0.16:1) and was estimated by Stantec as an all-in owner-operated rate built up from first-principles labor and equipment costs, including mobile equipment rebuild and replacement costs. Sand by-product tonnage is modelled at 94% of ROM tonnes processed. Refinery waste tonnage is modelled at a fixed rate of 890 tonnes per day, comprising leach residue (707.07 t/day), iron precipitate (59.8 t/day) and mine tailings (sand) (123.13 t/day). The mine tailings are used for dilution of thorium in the refinery waste and carry an additional cost of US$21.60 per tonne. Fixed annual costs are shown at their full annual rate and scaled by annual utilization. The life-of-



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Project average utilization is 89.9% for the hydrometallurgical facility and 99.5% for the mine site. This gives average annual costs of US$0.45 million for Hydromet water and US$1.33 million for mine site water. Closure costs are incurred as a lump sum in 2056 and carry no contingency. USD/t ROM figures are expressed on a common basis of 116.4 Mt for comparison only.

*Table 20-15: Reconciliation of Total Life-of-Project Operating Costs*

| Component | Total (USD M) | USD/t ROM |
|---|---|---|
| ROM-driven operating costs (Table 20-13) | 3,611.1 | 31.03 |
| Operating costs not driven by ROM tonnes (Table 20-4) | 1,115.3 | 9.59 |
| **Total Life-of-Project Operating Costs** | **4,726.4** | **40.62** |

Notes: Totals may not sum precisely due to rounding. Total life-of-Project operating cost includes closure costs of US$55.9 million, incurred as a lump sum in 2056.

## 20.9 Capital and Operating Cost Schedules

This section presents the annual phasing of the capital cost estimate and the annual profile of operating costs over the life of the Project, as scheduled in the Financial Model. All values are in constant Q1 2026 US dollars.

Capital expenditure by category and year is presented in Table 20-16. Of the total capital cost of US$873.1 million, US$840.0 million (96.2%) is incurred during the three-year construction period from 2028 to 2030, and the remaining US$33.0 million (3.8%) is incurred in 2034 and 2044 for the staged expansion of the refinery waste disposal facility. Contingency is phased with the direct capital to which it applies. The capital cost estimate has a target accuracy of ±25%; applied to the total capital cost, this corresponds to a range of approximately US$655 million to US$1,091 million.

*Table 20-16: Capital Cost Schedule by Category (USD M)*

| Capital Cost Category | 2028 | 2029 | 2030 | 2034 | 2044 | Total |
|---|---|---|---|---|---|---|
| Mining Capital | 8.3 | 19.3 | 27.5 | – | – | 55.0 |
| On-Site and Refinery Processing | 88.5 | 206.5 | 295.1 | – | – | 590.1 |
| Refinery Waste Disposal | – | 19.1 | – | 14.4 | 14.4 | 47.9 |
| Sand By-Product Stockpile | 3.2 | 7.4 | 10.6 | – | – | 21.2 |
| Electric Infrastructure | 3.8 | 8.8 | 12.5 | – | – | 25.0 |
| Water Infrastructure | 3.0 | 7.0 | 10.0 | – | – | 20.0 |
| Sub-Total Direct Capital | 106.7 | 268.1 | 355.7 | 14.4 | 14.4 | 759.2 |
| Contingency (15%) | 16.0 | 40.2 | 53.3 | 2.2 | 2.2 | 113.9 |
| Total Capital | 122.7 | 308.3 | 409.0 | 16.5 | 16.5 | 873.1 |

Notes: Direct capital is shown before contingency; the 15% contingency is applied to direct capital in the year in which it is incurred. No capital is incurred in years not shown. Totals may not sum precisely due to rounding.

Annual operating costs by cost area are presented in Table 20-17. Operating costs are incurred from first production in 2031 and total US$4,726.4 million over the 26 production years, an average of US$181.8 million per year. At the full throughput of 4.5 Mtpa, processing and refining, material movement, refinery waste disposal and water costs are essentially constant at approximately US$152.1 million per year, and the year-to-year variation in total operating cost is driven by mining cost, which follows the waste stripping schedule. Excluding the 2031 ramp-up year and the 2056 closure year, annual operating costs range from US$176.7 million (2053) to US$188.7 million (2035), equivalent to US$39.26 to US$41.94 per tonne of ROM ore processed; the highest-

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cost year coincides with the peak waste movement in 2035. The 2056 unit cost of US$50.46 per tonne includes closure costs of US$55.9 million. Over the life of the Project, operating cost is equivalent to US$40.62 per tonne of ROM ore processed and US$64.72 per kilogram of payable rare earth oxide.

*Table 20-17: Annual Operating Cost Profile (USD M unless stated)*

| Year | Ore Processed (Mt) | Mining | Processing and Refining | Material Movement | Refinery Waste Disposal | Water | Closure | Total | USD/t ROM |
|---|---|---|---|---|---|---|---|---|---|
| 2031 | 3.38 | 21.9 | 104.8 | 6.3 | 2.1 | 1.3 | – | 136.5 | 40.45 |
| 2032 | 4.50 | 25.7 | 139.7 | 8.5 | 2.1 | 1.8 | – | 177.8 | 39.50 |
| 2033 | 4.50 | 29.1 | 139.7 | 8.5 | 2.1 | 1.8 | – | 181.1 | 40.25 |
| 2034 | 4.50 | 32.8 | 139.7 | 8.5 | 2.1 | 1.8 | – | 184.8 | 41.07 |
| 2035 | 4.50 | 36.7 | 139.7 | 8.5 | 2.1 | 1.8 | – | 188.7 | 41.94 |
| 2036 | 4.50 | 34.5 | 139.7 | 8.5 | 2.1 | 1.8 | – | 186.5 | 41.45 |
| 2037 | 4.50 | 32.1 | 139.7 | 8.5 | 2.1 | 1.8 | – | 184.2 | 40.92 |
| 2038 | 4.50 | 26.9 | 139.7 | 8.5 | 2.1 | 1.8 | – | 179.0 | 39.77 |
| 2039 | 4.50 | 25.6 | 139.7 | 8.5 | 2.1 | 1.8 | – | 177.7 | 39.48 |
| 2040 | 4.50 | 24.8 | 139.7 | 8.5 | 2.1 | 1.8 | – | 176.9 | 39.31 |
| 2041 | 4.50 | 27.8 | 139.7 | 8.5 | 2.1 | 1.8 | – | 179.9 | 39.97 |
| 2042 | 4.50 | 29.5 | 139.7 | 8.5 | 2.1 | 1.8 | – | 181.6 | 40.35 |
| 2043 | 4.50 | 29.5 | 139.7 | 8.5 | 2.1 | 1.8 | – | 181.5 | 40.33 |
| 2044 | 4.50 | 30.1 | 139.7 | 8.5 | 2.1 | 1.8 | – | 182.2 | 40.49 |
| 2045 | 4.50 | 29.7 | 139.7 | 8.5 | 2.1 | 1.8 | – | 181.8 | 40.40 |
| 2046 | 4.50 | 28.6 | 139.7 | 8.5 | 2.1 | 1.8 | – | 180.6 | 40.14 |
| 2047 | 4.50 | 28.5 | 139.7 | 8.5 | 2.1 | 1.8 | – | 180.5 | 40.11 |
| 2048 | 4.50 | 28.8 | 139.7 | 8.5 | 2.1 | 1.8 | – | 180.8 | 40.18 |
| 2049 | 4.50 | 28.9 | 139.7 | 8.5 | 2.1 | 1.8 | – | 180.9 | 40.21 |
| 2050 | 4.50 | 31.4 | 139.7 | 8.5 | 2.1 | 1.8 | – | 183.4 | 40.76 |
| 2051 | 4.50 | 28.3 | 139.7 | 8.5 | 2.1 | 1.8 | – | 180.4 | 40.08 |
| 2052 | 4.50 | 25.3 | 139.7 | 8.5 | 2.1 | 1.8 | – | 177.3 | 39.41 |
| 2053 | 4.50 | 24.6 | 139.7 | 8.5 | 2.1 | 1.8 | – | 176.7 | 39.26 |
| 2054 | 4.50 | 25.0 | 139.7 | 8.5 | 2.1 | 1.8 | – | 177.1 | 39.35 |
| 2055 | 4.50 | 25.2 | 139.7 | 8.5 | 2.1 | 1.8 | – | 177.3 | 39.39 |
| 2056 | 4.98 | 27.3 | 154.4 | 9.4 | 2.1 | 2.0 | 55.9 | 251.1 | 50.46 |
| Total | 116.36 | 738.6 | 3,611.1 | 218.8 | 55.7 | 46.3 | 55.9 | 4,726.4 | 40.62 |

Notes: Processing and Refining comprises the ROM-driven cost areas in Table 20-17 (grinding, concentration, extraction, impurity removal, separation and finishing, infrastructure, product packaging and other). Mining cost is applied to total material mined. Closure costs are incurred as a lump sum in 2056. Totals may not sum precisely due to rounding.

# 21 Economic Analysis

## 21.1 Principal Assumptions

An economic analysis of the Cowboy State Mine was prepared by Stantec on behalf of WRI. The financial model was prepared to a Pre-Feasibility level of accuracy, with a target accuracy of ±25%, and is expressed in constant Q1 2026 United States Dollars (USD) unless stated otherwise. No escalation has been applied to costs or revenues over the Life of Mine (LOM).

The economic evaluation is based on an owner-operated open pit mining operation and a two-stage processing configuration, with comminution and mineral concentration occurring at the mine site in the Laramie Mountains

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and downstream solvent extraction and rare earth separation located near Wheatland, Wyoming. The base case production rate is 4.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) ore.

### 21.1.1 General Assumptions

The principal assumptions used in the financial model are summarized below:

- All currency values are in USD unless otherwise specified. No foreign exchange assumptions are required, as all revenues, costs and taxes are denominated in USD.
- The model operates on an annual basis. The construction period spans three years (Year −3 to Year −1, calendar years 2028 to 2030). Mining and first ore production commence in Year 0 (calendar year 2031), which is modelled as a ramp-up year at 3.4 Mt of ROM ore, with full-rate production from Year 1 (calendar year 2032). The LOM model covers 26 years of active mining and production through calendar year 2056.
- The mine plan schedules 116.4 Mt of ore at an average grade of 1,257 ppm PREO26 and 18.7 Mt of waste, for total material movement of 135.0 Mt at a life-of-Project strip ratio of 0.16:1.
- Capital costs have been estimated to a Pre-Feasibility level of accuracy, with a target accuracy of ±25%. A 15% contingency of US$113.9 million has been applied to direct capital of US$759.2 million, giving total life-of-Project capital of US$873.1 million. This comprises initial capital of US$840.0 million expended during the three-year construction period and expansion capital of US$33.0 million for staged development of the refinery waste disposal facility in Years 3 and 13. No contingency has been applied to the closure provision of US$55.9 million, which is carried in operating costs in the final year of the mine plan.
- Operating costs have been developed by three parties. Stantec prepared the mining, material movement, refinery waste disposal and closure cost estimates, representing 22.6% of life-of-Project operating cost, with mining estimated as an all-in owner-operated cost of US$5.47 per tonne of total material mined, including mobile equipment rebuild and replacement costs. Tetra Tech prepared the processing and refining cost estimates, representing 76.4%. ARR provided the water supply cost estimates, representing 1.0%. Life-of-Project operating cost totals US$4,726.4 million, equivalent to US$40.62 per tonne of ROM ore processed.
- Product revenues are calculated as the product of annual saleable mass (kg) and realized product price (USD/kg). Base case prices are US$163.00/kg NdPr oxide, US$34.58/kg SEG, US$2,010.00/kg terbium oxide ($Tb_4O_7$) and US$552.50/kg dysprosium oxide ($Dy_2O_3$), held constant across the LOM. Metallurgical recoveries applied are 58.2% for NdPr, 25.8% for SEG, 28.7% for terbium and 12.4% for dysprosium, giving an overall recovery of 49.9% of contained payable rare earth oxides. No offtake discounts have been modeled; actual realized prices will be subject to commercial negotiation.
- No inflation or escalation has been applied to prices, costs, or royalties across the LOM.
- The discount rate applied to calculate Net Present Value (NPV) is 8% per annum (real, after-tax). NPV at a 10% discount rate is also reported for reference, and the discount rate is flexed from 5% to 11% in the sensitivity analysis.
- Mineral production is subject to a Wyoming State royalty, calculated as the greater of a sliding-scale percentage of extracted mineral revenue or a minimum of US$0.50 per saleable short ton. The scale is applied by product against factored revenue per short ton processed, at 5% below US$50/ton, 7% from US$50/ton to US$100/ton, 9% from US$100/ton to US$150/ton and 10% above US$150/ton. Under base case assumptions the NdPr royalty is levied at 7% in all production years, and the SEG, terbium

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and dysprosium royalties are levied at 5% in all production years, giving life-of-Project royalties of US$816.7 million.

- Wyoming severance tax at 2%, Albany County ad valorem tax at 7%, and Wyoming industrial property tax at 0.875% of the net book value of infrastructure capital, including contingency, in production years are also applied. Severance and ad valorem taxes are levied on a netback basis under the Wyoming direct cost ratio method, in which adjusted revenue is derived by applying the ratio of direct mining cost to total operating cost to revenue net of the State royalty, and direct mining cost is then deducted. Levies total US$111.2 million over the life of the Project, giving total royalties and levies of US$927.9 million.
- Wyoming imposes no state income tax. Federal corporate income tax is applied at the statutory rate of 21% on net taxable income after permissible deductions including depreciation, amortization, and depletion allowances.
- A percentage depletion allowance of 14% is applied under Section 613 of the US Internal Revenue Code, capped at 50% of net taxable income in any given year.
- The Section 45X Advanced Manufacturing Production Credit (10% of eligible production costs) is not included in the Financial Model, and no 45X sensitivity case has been run. Under current legislation, the credit for applicable critical minerals is reduced to 75%, 50% and 25% of its full value for production in 2031, 2032 and 2033 respectively, and is not available for production after 2033. With first production in 2031, any benefit would be limited to the first three production years and is subject to confirmation of eligibility and eligible costs.
- The economic model is limited to material within the Cowboy State Mine boundary. All material scheduled for processing is classified as Indicated Mineral Resource and has been converted to Probable Mineral Reserve through the application of modifying factors as described in the Mineral Reserve Estimates section. No Measured Mineral Resources have been estimated at CSM, and accordingly no Proven Mineral (Ore) Reserves are declared. Material classified as Inferred within the designed pits, together with material of undefined classification, is scheduled as waste, generates no revenue, and is included in the economic model only as a mining cost. No Inferred Mineral Resources are included in the production schedule.

### 21.1.2 Recoveries and Product Specifications

Four rare earth oxide (REO) products are modeled for revenue generation in the base case. Recovery assumptions are based on the metallurgical test work program and are consistent with a two-stage processing configuration comprising on-site WHIMS and acid leach concentration, followed by off-site solvent extraction and separation. Recoveries are applied to contained payable rare earth oxide (PREO26) in ore, 146,303 tonnes over the life of the Project, and give an overall recovery of 49.9% of contained PREO26. Recoveries and resulting production are presented in Table 21-1.

*Table 21-1: Product Recovery and Production Summary*

| Product | Formula | Recovery (%) | LOM Production (tonnes) | Annual Production (LOM Avg.) |
|---|---|---|---|---|
| Neodymium-Praseodymium Oxide | NdPr Oxide | 58.2% | 64,893 | 2,496 t/yr |



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| | | | | |
|---|---|---|---|---|
| Samarium-Europium-Gadolinium Oxide | SEG Oxide | 25.8% | 6,893 | 250 t/yr |
| Terbium Oxide | $Tb_4O_7$ | 28.7% | 414 | 16 t/yr |
| Dysprosium Oxide | $Dy_2O_3$ | 12.4% | 824 | 32 t/yr |
| **Total** | | **49.9%** | **73,024** | **2,809 t/yr** |

Notes: Recoveries are applied to contained payable rare earth oxide (PREO26) in ore and are held constant over the LOM. Annual averages are stated over the 26 production years. Ongoing test work may result in updated recovery assumptions at the feasibility stage. Recovery of lanthanum is excluded from the base case revenue model due to current market conditions.

### 21.1.3 Taxation and Royalty Framework

The Project is subject to a Wyoming State royalty, Wyoming and county production levies, and US federal corporate income tax. Total royalties, levies and taxes payable over the LOM are estimated at US$1,785.1 million, of which US$816.7 million relates to the Wyoming State royalty. The framework applied in the base case is summarized in Table 21-2.

*Table 21-2: Royalty and Tax Framework*

| Levy / Tax | Rate | Basis | LOM Total (USD M) | Notes |
|---|---|---|---|---|
| Wyoming State Royalty | 7.00% NdPr / 5.00% SEG, Tb, Dy | Factored gross revenue | 816.7 | Min. basis: US$0.50/ton saleable |
| Severance Tax | 2.00% | Adjusted revenue less direct mining cost | 20.7 | Wyoming state levy |
| Albany County Ad Valorem Tax | 7.00% | Adjusted revenue less direct mining cost | 72.4 | County levy |
| Industrial Property Tax | 0.875% | Net book value of infrastructure capital | 18.0 | Production years, until fully depreciated |
| Sub-Total Royalties and Levies | | | 927.9 | |
| Federal Corporate Income Tax | 21.00% | Net taxable income after depletion | 857.3 | |
| Sub-Total Taxes | | | 857.3 | |
| Total Taxes and Royalties | | | 1,785.1 | |

Notes: The Wyoming State royalty is applied on a sliding scale by product against factored revenue per short ton processed — 5% below US$50/ton, 7% from US$50/ton to US$100/ton, 9% from US$100/ton to US$150/ton and 10% above US$150/ton — or US$0.50 per saleable short ton processed, whichever is greater, applied on a year-by-year basis. Under base case assumptions NdPr is levied at 7% and SEG, terbium and dysprosium at 5% in all production years. The royalty basis applies a price index factor to gross revenue that varies annually on a ten-year cycle between 1.000 and 0.764. Severance and ad valorem taxes are levied on a netback basis using the Wyoming direct cost ratio method. Totals may not sum precisely due to rounding. The point of valuation for the royalty is under review with the Wyoming Office of State Lands and Investments. The base case royalty is equivalent to 6.75% of life-of-Project revenue.

## 21.2 Production Schedule

The production schedule incorporated into the financial model is based on a phased open pit mining operation with three years of pre-production construction followed by 26 years of active mining and processing. The model

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period extends from 2028 through 2056, with construction from 2028 to 2030, mining and first ore production commencing in 2031, and full-rate commercial production from 2032.

Over the LOM the operation is scheduled to mine 116.4 Mt of ore and 18.7 Mt of waste, giving total material movement of 135.0 Mt and an overall strip ratio of 0.16 waste tonnes per ore tonne. The low strip ratio reflects shallow, favorable orebody geometry and contributes positively to mining economics. Although the LOM average is low, annual stripping requirements vary materially through the schedule, ranging from effectively nil to 0.49, reflecting pit development sequencing and localized waste stripping campaigns.

The mine plan maintains a stable ore mining and processing rate throughout the operating life. Following the 3.4 Mt ramp-up year in 2031, the operation processes 4.5 Mtpa through the schedule, with an increase to 4.98 Mt in the final year of operation. No stockpile strategy is currently modeled, and processed tonnes are therefore equivalent to mined ore tonnes over the LOM.

The production schedule is divided into three mining phases:

- CSM-West Phase 1: 32.6 Mt mined from 2031 to 2038.
- CSM-West Phase 2: 72.2 Mt mined from 2038 to 2054.
- CSM-West Phase 3: 11.5 Mt mined from 2054 to 2056.

The transition between phases materially influences the grade profile over the mine life. The average PREO26 feed grade over the LOM is 1,257 ppm, but annual grades vary significantly with mining sequence and ore source. Grades rise through the Phase 1 years and peak at 1,652 ppm in 2037, corresponding to higher-grade material within Phase 1. The transition into Phase 2 produces an abrupt decline, from 1,458 ppm in 2038 to 1,091 ppm in 2039, and grades remain in a trough between 1,029 ppm and 1,098 ppm from 2039 through 2042, reaching a minimum of 1,029 ppm in 2041. Grades then recover progressively through the Phase 2 years, stabilizing between 1,240 ppm and 1,300 ppm from 2046 to 2053, before easing to between 1,164 ppm and 1,187 ppm as mining transitions into Phase 3 over the final three years.

The combination of stable throughput and variable grade indicates that annual production value is driven primarily by feed grade variability rather than by changes in mining or processing capacity. The scheduling of higher-grade material during the earlier years of operation enhances early project cash flows and improves discounted economic returns.

Waste stripping is concentrated in the early Phase 1 years, associated with pit development and access to higher-grade ore zones. Annual waste mining peaks at 2.21 Mt in 2035 before declining and stabilizing at lower levels over the remainder of the mine life.

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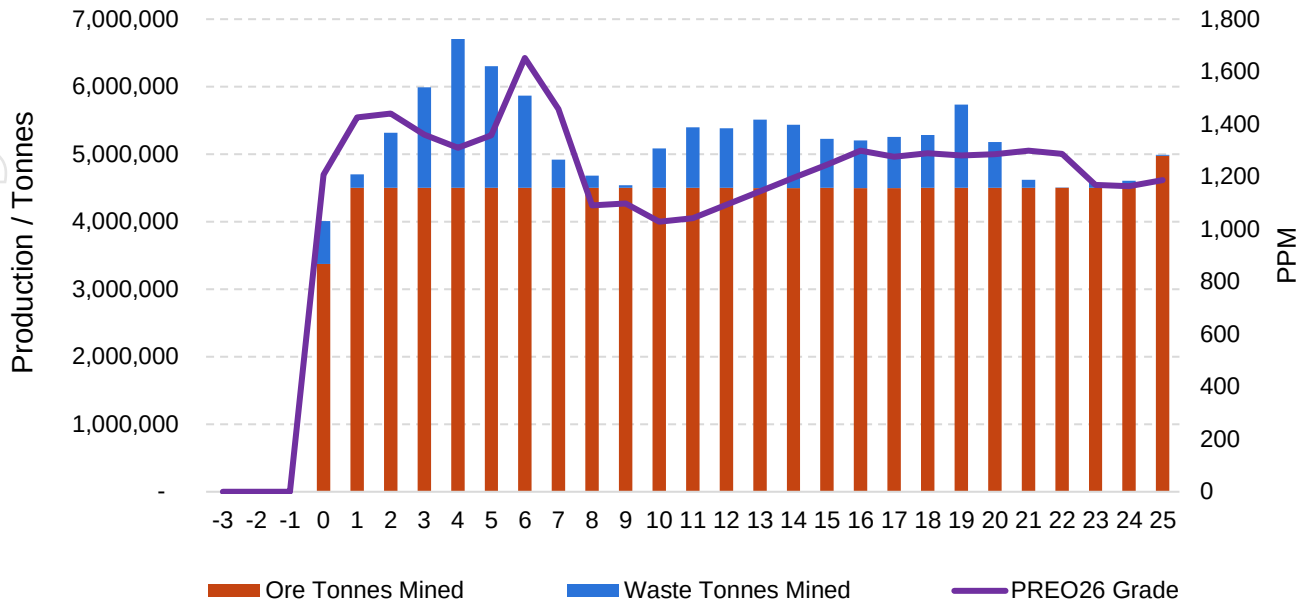


*Figure 21-1: Production Profile*

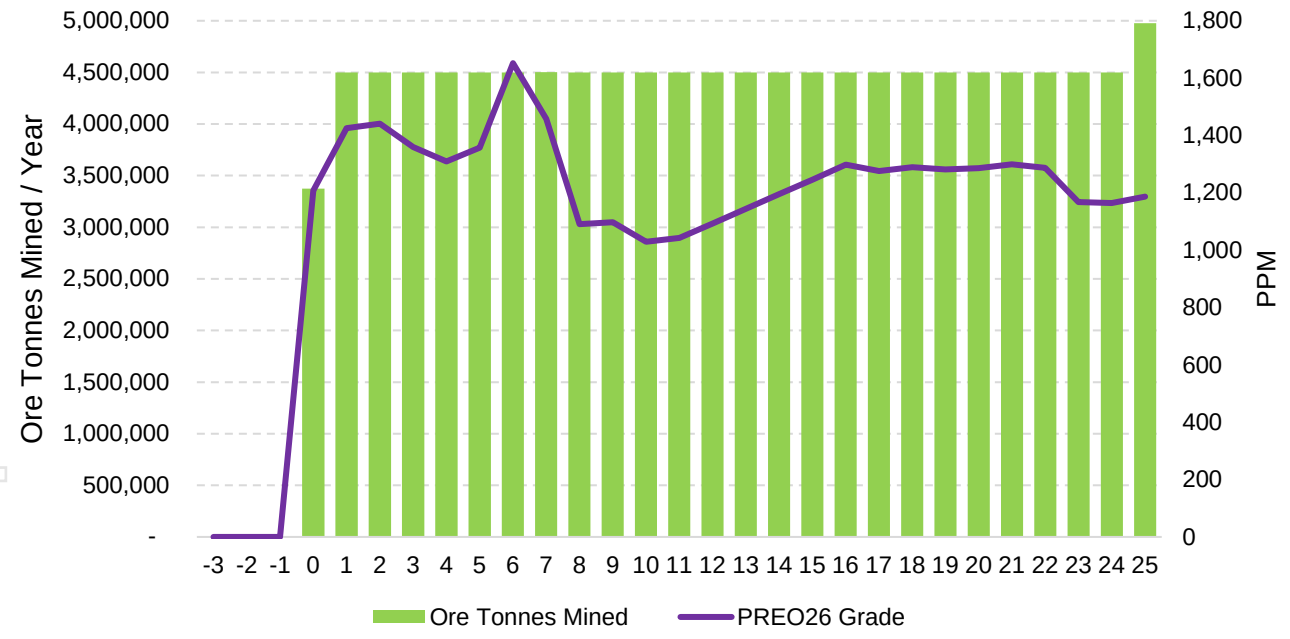


*Figure 21-2: Production Schedule (Ore vs. Grade)*

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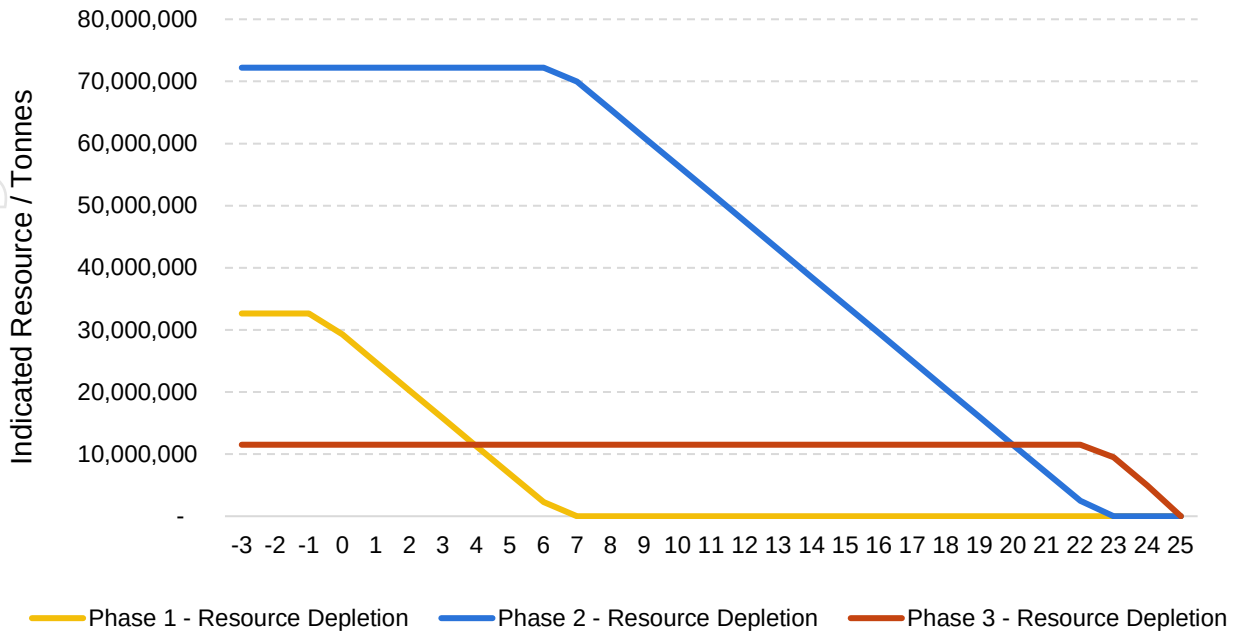


*Figure 21-3: Resource Depletion by Phase Mined*

## 21.3 Economic Model

The economic model was constructed by Stantec in Microsoft Excel (the "Financial Model") and comprises a fully integrated cash flow model encompassing revenue, operating costs, capital costs, royalties, taxes, depreciation, amortization, and depletion. The model was prepared on an annual basis, and all results are reported in real, constant Q1 2026 USD. Net present value is calculated on a beginning-of-period convention, in which the first period is undiscounted. Federal income tax is calculated on net taxable income after depreciation, amortization and percentage depletion, with losses carried forward and applied against taxable income in subsequent years.

### 21.3.1 Revenue and Pricing

Revenues are derived exclusively from the sale of four separate rare earth oxide products: NdPr Oxide, SEG Oxide, Terbium Oxide ($Tb_4O_7$), and Dysprosium Oxide ($Dy_2O_3$). Lanthanum carbonate is excluded from the base case revenue model given current market pricing conditions. Total LOM revenue is estimated at US$12,103.0 million.

The base case pricing assumptions and the resulting revenue composition are presented in Table 21-3: Base Case Product Pricing and Revenue Mix. Base case prices for NdPr, terbium and dysprosium oxides are the 2031 to 2040 average Western CIF prices forecast by Adamas Intelligence under its Base Case scenario (Rare Earth Pricing Outlook, Q4 2026, real 2026 USD; Section 18.16). The SEG oxide price was determined by ARR from Adamas Intelligence's forecasts, assuming SEG oxide is sold at 73% of its separated-oxide basket value (Section 3.4). In the Financial Model these prices are applied as realized prices with no deduction for freight, insurance,



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marketing costs or offtake discounts, and are held constant in real terms from 2031 to 2056. Prices from 2041 to 2056, beyond the Adamas forecast period, are assumed to remain at the 2031 to 2040 average. Because NdPr oxide accounts for 87.4% of revenue, the NdPr price sensitivity in Section 21.4 also indicates the effect of a discount to realized prices; a 10% reduction in the NdPr price reduces after-tax NPV to approximately US$1,027 million.

*Table 21-3: Base Case Product Pricing and Revenue Mix*

| Product | Unit | Base Case Price | LOM Revenue (USD M) | % of Revenue | Source |
|---|---|---|---|---|---|
| NdPr Oxide | USD/kg | 163.00 | 10,577.5 | 87.4% | Adamas (Q4 2026), 2031–40 avg. |
| Terbium Oxide ($Tb_4O_7$) | USD/kg | 2,010.00 | 832.1 | 6.9% | Adamas (Q4 2026), 2031–40 avg. |
| Dysprosium Oxide ($Dy_2O_3$) | USD/kg | 552.50 | 455.1 | 3.8% | Adamas (Q4 2026), 2031–40 avg. |
| SEG Oxide | USD/kg | 34.58 | 238.4 | 2.0% | ARR, from Adamas |
| Total Revenue | | | 12,103.0 | 100.0% | |

Notes: All prices in USD/kg (real 2026), applied without deduction for freight, insurance, marketing costs or offtake discounts. NdPr, terbium and dysprosium prices are Adamas Intelligence Base Case Western CIF forecasts averaged over 2031–2040; the SEG price was determined by ARR from Adamas Intelligence forecasts. NdPr Oxide accounts for 87.4% of total LOM revenue and is the dominant value driver for the Project. Percentages may not sum precisely due to rounding.

Four pricing scenarios are defined in the Financial Model to capture a range of market outcomes. The Base Case reflects Adamas Intelligence's Base Case forecasts. The Upside scenario incorporates stronger NdPr demand driven by accelerated EV and permanent magnet adoption. The Downside scenario reflects a moderate price environment consistent with near-term market softness. The Floor scenario applies minimum price assumptions stress-tested against project viability. All scenarios use the same product mix and recovery assumptions; only realized prices change. The four scenarios are summarized in Table 21-4.

*Table 21-4: Product Pricing Scenarios*

| Product | Floor (USD/kg) | Downside (USD/kg) | Base Case (USD/kg) | Upside (USD/kg) |
|---|---|---|---|---|
| NdPr Oxide | 110.00 | 131.80 | 163.00 | 193.50 |
| SEG Oxide | 21.95 | 27.48 | 34.58 | 118.54 |
| Terbium Oxide ($Tb_4O_7$) | 1,680.00 | 1,810.00 | 2,010.00 | 2,520.00 |
| Dysprosium Oxide ($Dy_2O_3$) | 453.69 | 502.50 | 552.50 | 680.00 |

Notes: The Base Case is the selected scenario for all financial results reported in this section. The SEG Upside price reflects a significant upside in the gadolinium price, which raises the averaged SEG basket price disproportionately relative to the Base Case. All prices in USD/kg (real 2026), applied on the same basis as the Base Case. Under the Upside and Downside price scenarios, after-tax NPV at 8% is US$2,081.1 million (IRR 31.27%) and US$713.3 million (IRR 17.45%) respectively. Under the Floor price scenario, after-tax NPV at 8% is US$294.8 million (IRR 12.20%).

### 21.3.2 Operating Expenditure

LOM total operating costs are estimated at US$4,726.4 million, equivalent to US$40.62 per tonne of ROM ore processed. The cost structure is dominated by downstream hydrometallurgical processing — extraction, impurity

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removal, and separation and finishing — which accounts for 51.2% of total operating cost, reflecting the reagent-intensive nature of rare earth separation and refining; reagents represent 45.6% of life-of-Project operating cost across all functional areas. Mining accounts for 15.6% and benefits from the Project's low strip ratio and near-surface mineralization. The full operating cost estimate, including the split between ROM-driven processing costs and costs driven by other physical quantities, is presented in Table 21-5, Table 21-6, and Table 21-7. Operating costs exclude royalties and production levies, which are presented in Table 21-2.

*Table 21-5: ROM-Driven Operating Costs*

| Cost Category | Unit | Unit Cost | Life-of-Project Total (USD M) | % of OpEx |
|---|---|---|---|---|
| Grinding | USD/t ROM | 1.54 | 178.9 | 3.8% |
| Concentration | USD/t ROM | 2.62 | 304.8 | 6.4% |
| Extraction | USD/t ROM | 7.51 | 874.0 | 18.5% |
| Impurity Removal | USD/t ROM | 6.37 | 741.7 | 15.7% |
| Separation and Finishing | USD/t ROM | 6.90 | 802.8 | 17.0% |
| Infrastructure | USD/t ROM | 3.90 | 454.2 | 9.6% |
| Product Packaging | USD/t ROM | 0.04 | 4.4 | 0.1% |
| Other | USD/t ROM | 2.15 | 250.3 | 5.3% |
| **Total ROM-Driven Operating Costs** | **USD/t ROM** | **31.03** | **3,611.1** | **76.4%** |

Notes: Unit operating costs are expressed on a ROM tonne basis over 116.4 Mt processed. Costs exclude royalties and production levies, which are reported in the Economic Analysis section. Processing costs encompass both on-site (grinding, concentration, and leaching) and off-site refinery (solvent extraction, separation, and finishing) components. All costs in this table were estimated by Tetra Tech. Tetra Tech's estimate includes disposal of process residues within the Impurity Removal (US$1.16/t ROM) and Infrastructure (US$0.64/t ROM) areas.

*Table 21-6: Operating Costs Not Driven by ROM Tonnes*

| Cost Category | Cost Driver | Unit | Unit Cost (USD) | Total (USD M) |
|---|---|---|---|---|
| Mining | Ore + waste tonnes mined | USD/t mined | 5.47 | 738.6 |
| Material Movement – Sand By-Product | Processed by-product tonnes (94% of ROM) | USD/t by-product | 2.00 | 218.8 |
| Refinery Waste Disposal – Disposal | Refinery waste tonnes (890 t/day) | USD/t waste | 3.60 | 30.4 |
| Refinery Waste Disposal – Thorium Dilution | Mine tailings tonnes (123.13 t/day) | USD/t tailings | 21.60 | 25.3 |
| Water – Mine Site | Fixed annual, adjusted for utilization | USD/year | 1,340,000 | 34.6 |
| Water – Hydrometallurgical Facility | Fixed annual, adjusted for utilization | USD/year | 500,000 | 11.7 |
| Closure – Mine | Lump sum, final year of mine plan | USD | 30,891,191 | 30.9 |
| Closure – Refinery Waste Disposal | Lump sum, final year of mine plan | USD | 25,000,000 | 25.0 |
| **Total Non-ROM-Driven Operating Costs** | | | | **1,115.3** |

Notes: Mining cost is applied to total material mined of 135.0 Mt (116.4 Mt of ore and 18.7 Mt of waste at a strip ratio of 0.16:1) and was estimated by Stantec as an all-in owner-operated rate built up from first-principles labor and equipment costs, including mobile equipment rebuild and replacement costs. Sand by-product tonnage is modelled at 94% of ROM tonnes processed. Refinery waste

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tonnage is modelled at a fixed rate of 890 tonnes per day, comprising leach residue (707.07 t/day), iron precipitate (59.8 t/day) and mine tailings (sand) (123.13 t/day). The mine tailings are used for dilution of thorium in the refinery waste and carry an additional cost of US$21.60 per tonne. Fixed annual costs are shown at their full annual rate and scaled by annual utilization. The life-of-Project average utilization is 89.9% for the hydrometallurgical facility and 99.5% for the mine site. This gives average annual costs of US$0.45 million for Hydromet water and US$1.33 million for mine site water. Closure costs are incurred as a lump sum in 2056 and carry no contingency. USD/t ROM figures are expressed on a common basis of 116.4 Mt for comparison only.

*Table 21-7: Reconciliation of Total Life-of-Project Operating Costs*

| Component | Total (USD M) | USD/t ROM |
|---|---|---|
| ROM-driven operating costs (Table 20-13) | 3,611.1 | 31.03 |
| Operating costs not driven by ROM tonnes (Table 20-4) | 1,115.3 | 9.59 |
| **Total Life-of-Project Operating Costs** | **4,726.4** | **40.62** |

Notes: Totals may not sum precisely due to rounding. Total life-of-Project operating cost includes closure costs of US$55.9 million, incurred as a lump sum in 2056.

### 21.3.3 Capital Expenditure

Total life-of-Project capital cost is estimated at US$873.1 million, inclusive of a 15% contingency of US$113.9 million applied to direct capital of US$759.2 million. It comprises initial capital of US$840.0 million, expended over the three-year construction period at 14.6% in 2028, 36.7% in 2029 and 48.7% in 2030, and expansion capital of US$33.0 million for staged development of the refinery waste disposal facility in 2034 and 2044. Closure costs of US$55.9 million, to which no contingency has been applied, are carried in operating costs in the final year of the mine plan. The estimate reflects the expanded design basis relative to earlier scoping-study work, including the 4.5 Mtpa design throughput, the two-location processing configuration, and more detailed engineering of the refinery circuit. The full capital cost estimate is presented in Table 21-8. Sustaining capital for the mining fleet, including equipment rebuilds and replacements, is carried in the mining operating cost. No sustaining capital has been estimated for the processing and refinery facilities or site infrastructure beyond the staged refinery waste disposal development; this will be developed at the feasibility stage.

*Table 21-8: Capital Cost Summary (Q1 2026 USD)*

| Capital Cost Category | USD (M) | % of Initial | Notes |
|---|---|---|---|
| Mining Capital | 55.0 | 6.3% | Owner mobile fleet and ancillary equipment |
| On-Site and Refinery Processing | 590.1 | 67.6% | Comminution, WHIMS, leach, SX, purification, finishing |
| Refinery Waste Disposal | 47.9 | 5.5% | Phased 40% Year −2, 30% Year 3, 30% Year 13; includes individual cells for Fe precipitate. |
| Sand By-Product Stockpile | 21.2 | 2.4% | |
| Electric Infrastructure | 25.0 | 2.9% | |
| Water Infrastructure | 20.0 | 2.3% | |
| **Sub-Total Direct Capital** | **759.2** | **87.0%** | **Contingency-bearing items** |

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| | | | |
|---|---|---|---|
| Contingency (15%) | 113.9 | 13.0% | Applied to direct capital only |
| **Total Capital** | **873.1** | **100.0%** | **Initial capital US$840.0 M (2028–2030) plus expansion capital US$33.0 M (2034 and 2044)** |

Notes: Capital is drawn down at US$122.7 million in 2028 (14.6% of construction capital), US$308.3 million in 2029 (36.7%) and US$409.0 million in 2030 (48.7%), with first ore in 2031. Direct capital is phased 15% / 35% / 50% over the three construction years. The exception is the refinery waste disposal facility, which is phased 40% in 2029 (US$19.1 million before contingency), 30% in 2034 and 30% in 2044. Expansion capital of US$16.5 million, inclusive of contingency, is expended in each of 2034 and 2044. Closure costs of US$55.9 million, incurred in 2056, are included in operating costs. Percentages may not sum precisely due to rounding.

### 21.3.4 Financial Summary

The Financial Model generates the pre-tax and after-tax cash flows, net present values, internal rates of return and payback periods presented in Table 21-9 and Table 21-10. At base case commodity prices and cost assumptions, the Project generates an after-tax NPV of **US$1,309.8 million** at an 8% discount rate, an after-tax IRR of **23.94%**, and an after-tax payback period of **6.38 years** from first capital expenditure.

*Table 21-9: Before-Tax Project Economics (Base Case)*

| Metric | Unit | Value |
|---|---|---|
| Total Revenue (LOM) | USD (M) | 12,103.0 |
| Total Operating Costs (LOM) | USD (M) | 4,726.4 |
| Total Royalties and Levies (LOM) | USD (M) | 927.9 |
| EBITDA (LOM) | USD (M) | 6,448.7 |
| Total Capital Costs (LOM) | USD (M) | 873.1 |
| Free Cash Flow (LOM, Before Tax) | USD (M) | 5,575.7 |
| NPV @ 8% | USD (M) | 1,579.5 |
| NPV @ 10% | USD (M) | 1,178.7 |
| Internal Rate of Return | % | 25.93% |
| Payback Period | years | 6.19 |

*Table 21-10: After-Tax Project Economics (Base Case)*

| Metric | Unit | Value |
|---|---|---|
| Federal Income Tax Paid (LOM) | USD (M) | 857.3 |
| Free Cash Flow (LOM, After Tax) | USD (M) | 4,718.4 |
| NPV @ 8% | USD (M) | 1,309.8 |
| NPV @ 10% | USD (M) | 965.6 |
| NPV per kg Payable Oxide @ 8% | USD/kg | 17.94 |
| Internal Rate of Return | % | 23.94% |
| Payback Period | years | 6.38 |
| Total Taxes and Royalties (LOM) | USD (M) | 1,785.1 |

Notes: EBITDA is stated after deduction of royalties and production levies, and of operating costs including closure costs of US$55.9 million. Payback period is measured from first capital expenditure in 2028. Net present value is calculated on a beginning-of-period convention with the first period undiscounted. Totals may not sum precisely due to rounding.

The annual cash flow forecast over the life of the Project is presented in Table 21-11 and Table 21-12. The Project generates positive annual after-tax free cash flow in 2031, the first year of production, and in every subsequent year of the mine plan.

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*Table 21-11: Annual Cash Flow Forecast, 2028 to 2042 (USD M unless stated)*

| Year | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ore Processed (Mt) | – | – | – | 3.38 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 |
| Feed Grade (ppm) | – | – | – | 1,207 | 1,426 | 1,441 | 1,360 | 1,310 | 1,358 | 1,652 | 1,458 | 1,091 | 1,098 | 1,029 | 1,042 |
| Payable Oxide (t) | – | – | – | 2,004 | 3,171 | 3,209 | 3,026 | 2,916 | 3,039 | 3,718 | 3,289 | 2,413 | 2,433 | 2,285 | 2,328 |
| Revenue | – | – | – | 335.5 | 530.6 | 536.2 | 505.4 | 486.0 | 504.4 | 614.9 | 545.2 | 403.2 | 405.9 | 380.3 | 386.2 |
| Royalties and Levies | – | – | – | -29.3 | -43.2 | -43.4 | -40.9 | -39.1 | -40.1 | -48.5 | -41.7 | -29.8 | -29.9 | -28.0 | -28.7 |
| Operating Costs | – | – | – | -136.5 | -177.8 | -181.1 | -184.8 | -188.7 | -186.5 | -184.2 | -179.0 | -177.7 | -176.9 | -179.9 | -181.6 |
| **EBITDA** | **–** | **–** | **–** | **169.7** | **309.6** | **311.7** | **279.8** | **258.1** | **277.8** | **382.3** | **324.4** | **195.8** | **199.1** | **172.4** | **175.9** |
| Federal Income Tax | – | – | – | – | -5.6 | -32.9 | -30.1 | -27.8 | -32.5 | -52.0 | -43.0 | -22.6 | -27.9 | -25.5 | -26.1 |
| Capital Costs | -122.7 | -308.3 | -409.0 | – | – | – | -16.5 | – | – | – | – | – | – | – | – |
| **After-Tax Free Cash Flow** | **-122.7** | **-308.3** | **-409.0** | **169.7** | **304.0** | **278.8** | **233.2** | **230.3** | **245.3** | **330.2** | **281.5** | **173.1** | **171.3** | **146.8** | **149.8** |

Notes: All values in USD millions unless otherwise stated. Feed grade is PREO26 in ppm. Payable oxide is the sum of NdPr, SEG, terbium and dysprosium oxide production. EBITDA is stated after royalties and production levies. Totals may not sum precisely due to rounding.

*Table 21-12: Annual Cash Flow Forecast, 2043 to 2056 (USD M unless stated)*

| Year | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ore Processed (Mt) | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.98 |
| Feed Grade (ppm) | 1,093 | 1,144 | 1,196 | 1,246 | 1,299 | 1,276 | 1,290 | 1,281 | 1,286 | 1,299 | 1,287 | 1,168 | 1,164 | 1,187 |
| Payable Oxide (t) | 2,456 | 2,585 | 2,708 | 2,822 | 2,943 | 2,890 | 2,920 | 2,901 | 2,909 | 2,934 | 2,902 | 2,632 | 2,629 | 2,960 |
| Revenue | 406.1 | 426.3 | 445.8 | 464.6 | 484.7 | 476.0 | 481.3 | 478.6 | 480.4 | 485.0 | 480.0 | 435.8 | 434.7 | 489.7 |
| Royalties and Levies | -30.3 | -32.2 | -33.7 | -35.1 | -36.7 | -36.0 | -36.5 | -36.5 | -36.3 | -36.3 | -35.8 | -32.4 | -32.3 | -35.1 |
| Operating Costs | -181.5 | -182.2 | -181.8 | -180.6 | -180.5 | -180.8 | -180.9 | -183.4 | -180.4 | -177.3 | -176.7 | -177.1 | -177.3 | -251.1 |
| **EBITDA** | **194.3** | **211.9** | **230.3** | **248.8** | **267.4** | **259.2** | **263.9** | **258.7** | **263.7** | **271.3** | **267.5** | **226.4** | **225.2** | **203.5** |
| Federal Income Tax | -29.4 | -32.4 | -35.5 | -39.0 | -42.5 | -41.1 | -42.0 | -41.0 | -42.0 | -43.5 | -42.8 | -35.5 | -35.4 | -29.3 |
| Capital Costs | – | -16.5 | – | – | – | – | – | – | – | – | – | – | – | – |
| **After-Tax Free Cash Flow** | **164.8** | **163.1** | **194.8** | **209.8** | **225.0** | **218.1** | **221.9** | **217.7** | **221.7** | **227.9** | **224.7** | **190.9** | **189.8** | **174.2** |

Notes: All values in USD millions unless otherwise stated. Operating costs in 2056 include closure costs of US$55.9 million. Totals may not sum precisely due to rounding.

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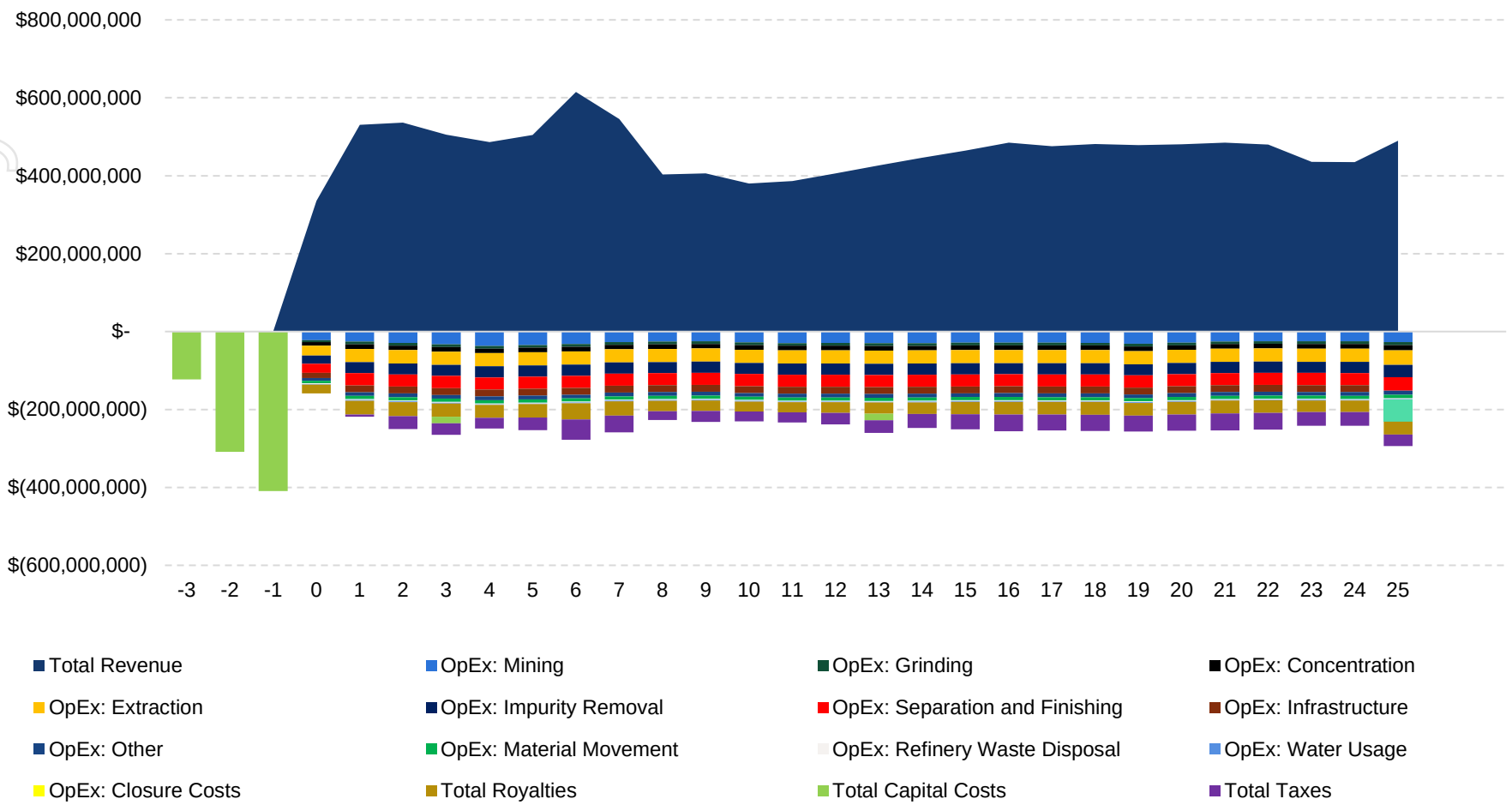


*Figure 21-4: Project Cashflow (USD)*



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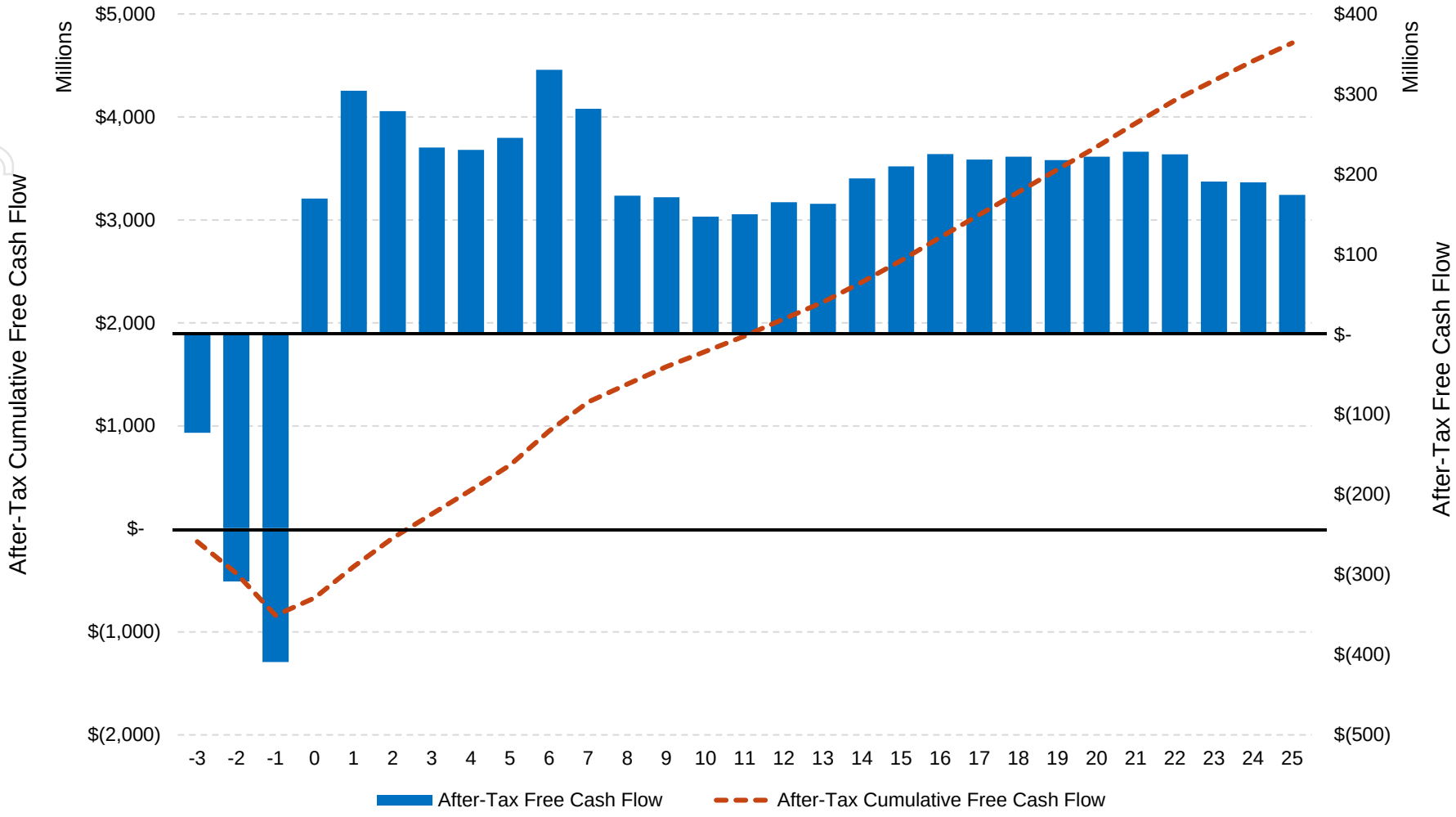


Figure -: LOM Cashflow Forecast



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### 21.3.5 Key Economic Metrics

Table 21-13 summarizes unit cost, funding and average annual metrics derived from the base case results of the Financial Model. Unit costs are expressed per kilogram of payable rare earth oxide, and annual averages are taken over the 26 production years from 2031 to 2056.

*Table 21-13: Key Economic Metrics (Base Case)*

| Metric | Unit | Value |
|---|---|---|
| Operating cost per kg payable oxide | USD/kg | 64.72 |
| Operating cost, royalties and levies per kg payable oxide | USD/kg | 77.43 |
| Operating cost, royalties, levies and capital per kg payable oxide | USD/kg | 89.39 |
| NdPr oxide cost net of by-product credits | USD/kg | 63.62 |
| Base case NdPr oxide price | USD/kg | 163.00 |
| Peak funding requirement | USD (M) | 840.0 |
| After-tax NPV @ 8% to total capital cost | ratio | 1.50 |
| Discounted payback period (after tax, 8%) | years | 7.48 |
| EBITDA margin | % | 53.3% |
| Average annual ore processed | Mt | 4.48 |
| Average annual payable oxide production | t | 2,809 |
| Average annual revenue | USD (M) | 465.5 |
| Average annual operating costs | USD (M) | 181.8 |
| Average annual EBITDA | USD (M) | 248.0 |
| Average annual after-tax free cash flow | USD (M) | 213.8 |

Notes: The NdPr oxide cost net of by-product credits is life-of-Project operating costs plus royalties and levies, less revenue from SEG, terbium and dysprosium oxides of US$1,525.5 million, divided by NdPr oxide production of 64,893 t. Peak funding requirement is the maximum cumulative negative after-tax free cash flow, reached at the end of 2030. The discounted payback period is measured from first capital expenditure in 2028 on the same beginning-of-period convention used for net present value. Unit costs exclude federal income tax. Annual averages are over the 26 production years; average after-tax free cash flow is stated after expansion capital.

The NdPr oxide cost net of by-product credits of US$63.62/kg is 39.0% of the base case NdPr oxide price of US$163.00/kg, leaving a margin of US$99.38/kg before capital and income tax. The peak funding requirement is equal to construction capital, as no revenue is generated before first production in 2031 and after-tax free cash flow is positive in every production year thereafter.



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## 21.3.6 Taxation and Depreciation

Capital costs are depreciated for tax purposes using the Modified Accelerated Cost Recovery System (MACRS), as summarized in Table 21-14. Mining equipment capital is depreciated over a 7-year recovery period and infrastructure capital over a 10-year recovery period, in each case including the contingency applied to that capital. Depreciation of each year's capital commences in the year in which it is incurred, so depreciation begins during construction in 2028. Total depreciation of US$873.1 million is equal to total capital cost; no amortization of intangible capital is modelled.

*Table 21-14: Tax Depreciation Basis*

| Asset Class | Recovery Method | Depreciable Base (USD M) | Depreciation Period |
|---|---|---|---|
| Mining equipment (including contingency) | 7-year MACRS | 63.3 | 2028–2037 |
| Infrastructure (including contingency) | 10-year MACRS | 809.8 | 2028–2054 |
| **Total** | | **873.1** | **2028–2054** |

Notes: Infrastructure capital comprises on-site and refinery processing, refinery waste disposal, sand by-product stockpile, electric infrastructure and water infrastructure capital. Totals may not sum precisely due to rounding.

Depreciation during construction, before revenue is generated, results in tax losses that accumulate to US$184.3 million at the end of 2030. These losses are carried forward and fully utilized against taxable income from 2031 to 2032, and federal income tax is first payable in 2032. Percentage depletion is calculated at 14% of gross income from the property, taken as revenue net of the Wyoming State royalty, and is limited in each year to 50% of taxable income before depletion. The limit restricts the allowance only in 2031 and 2032, when taxable income is wholly or largely offset by tax losses carried forward; depletion deductions total US$1,493.5 million over the life of the Project, compared with an unrestricted allowance of US$1,580.1 million. The federal income tax calculation is summarized in Table 21-15.

*Table 21-15: Federal Income Tax Summary (Life of Project)*

| Metric | Unit | Value |
|---|---|---|
| EBIT | USD (M) | 5,575.7 |
| Percentage depletion deducted | USD (M) | 1,493.5 |
| Net taxable income | USD (M) | 4,082.2 |
| Federal income tax (21%) | USD (M) | 857.3 |
| Effective federal tax rate on EBIT | % | 15.4% |
| Total royalties, levies and federal income tax | USD (M) | 1,785.1 |
| Government take | % | 27.4% |



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Notes: EBIT is stated after depreciation. Net taxable income is stated after percentage depletion and after utilization of tax losses carried forward, which are fully utilized by 2032. Government take is total royalties, production levies and federal income tax as a share of life-of-Project free cash flow before royalties, levies and income tax of US$6,503.6 million. Totals may not sum precisely due to rounding.

The effective federal tax rate of 15.4% of EBIT, below the statutory rate of 21%, reflects the percentage depletion allowance.

### 21.3.7 Exclusions and Limitations

The base case economic analysis excludes the following items, which should be considered when interpreting the results:

- Working capital: no allowance is made for working capital, including reagent and product inventories, receivables and payables; revenues and costs are recognized in the year in which they arise.
- Salvage and residual value: no salvage value is attributed to plant and equipment at the end of the mine life, and no terminal value is included.
- Sustaining capital: mining fleet sustaining capital (equipment rebuilds and replacements) is included in the mining operating cost; no sustaining capital is included for the processing and refinery facilities or site infrastructure beyond the staged refinery waste disposal expansion capital of US$33.0 million over the 26-year mine life.
- Financing: the analysis is prepared on an unlevered, 100% equity basis; no debt, interest or other financing costs are included. Funding for the initial capital of US$840.0 million, which is also the peak funding requirement, has not been secured.
- Section 45X credit: the IRA Section 45X Advanced Manufacturing Production Tax Credit is not included in the Financial Model.
- Escalation: all values are in constant Q1 2026 US dollars; no escalation of prices or costs is applied.
- Closure contingency: no contingency is applied to the closure provision of US$55.9 million.
- Corporate overhead: no allowance is made for ARR corporate overhead or for owner's costs beyond pre-production engineering and administration (Section 20.6).
- Price realization: product prices are applied without deduction for freight, insurance, marketing costs or offtake discounts (Section 21.3.1).

  In addition, the sensitivity analysis that follows evaluates single-variable changes only; variations in grade and combined adverse scenarios have not been evaluated.



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## 21.4 Sensitivity Analysis

A sensitivity analysis was completed to assess the impact of changes in key economic and operating assumptions on the Project's after-tax net present value. Each selected input was varied independently over a range of −30% to +30% from the base case while all other assumptions were held constant. The discount rate was flexed separately from 5.0% to 11.0% in 1.0% increments, with the base case at 8.0%. The base case after-tax NPV is US$1,309.8 million.

The Project is most sensitive to NdPr price and NdPr recovery, each producing an NPV spread of US$1,669.7 million across the tested range, from US$459.0 million at −30% to US$2,128.7 million at +30%. At the −30% case the after-tax IRR is 14.33% and continues to exceed the 8.0% discount rate applied. Because revenue is the linear product of price and recovery, these two variables produce identical results. This concentration of sensitivity reflects the dominant contribution of NdPr revenue, 87.4% of total product revenue.

The Project is next most sensitive to the discount rate, with after-tax NPV ranging from US$2,077.0 million at 5.0% to US$827.7 million at 11.0%, an NPV spread of US$1,249.2 million. Processing operating cost and processing capital cost are the fourth and fifth most sensitive variables, with NPV spreads of US$669.3 million and US$382.7 million respectively, indicating that processing plant capital intensity and the ongoing processing cost structure are material value drivers and should remain a focus of future engineering, procurement and optimization work.

The Project shows moderate sensitivity to terbium price and recovery (US$146.5 million each) and mining operating cost (US$116.9 million), and lower sensitivity to dysprosium price and recovery (US$78.5 million each). It is least sensitive to SEG price and recovery (US$40.8 million each) and mining capital cost (US$29.8 million). The full sensitivity results are presented in Table 21-16.

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*Table 21-16: After-Tax NPV Sensitivity at an 8.0% Discount Rate (USD M)*

| Rank | Variable | −30% | −20% | −10% | Base Case | +10% | +20% | +30% | NPV Spread |
|---|---|---|---|---|---|---|---|---|---|
| 1 | NdPr Price | 459 | 739 | 1,027 | 1,310 | 1,598 | 1,864 | 2,129 | 1,670 |
| 1 | NdPr Recovery | 459 | 739 | 1,027 | 1,310 | 1,598 | 1,864 | 2,129 | 1,670 |
| 3 | Discount Rate [1] | 2,077 | 1,778 | 1,525 | 1,310 | 1,125 | 966 | 828 | 1,249 |
| 4 | Processing OpEx | 1,645 | 1,533 | 1,422 | 1,310 | 1,198 | 1,086 | 976 | 669 |
| 5 | Processing CapEx | 1,502 | 1,440 | 1,375 | 1,310 | 1,245 | 1,182 | 1,119 | 383 |
| 6 | Tb Price | 1,237 | 1,261 | 1,285 | 1,310 | 1,334 | 1,359 | 1,383 | 147 |
| 6 | Tb Recovery | 1,237 | 1,261 | 1,285 | 1,310 | 1,334 | 1,359 | 1,383 | 147 |
| 8 | Mining OpEx | 1,368 | 1,349 | 1,329 | 1,310 | 1,290 | 1,271 | 1,251 | 117 |
| 9 | Dy Price | 1,271 | 1,284 | 1,297 | 1,310 | 1,323 | 1,336 | 1,349 | 78 |
| 9 | Dy Recovery | 1,271 | 1,284 | 1,297 | 1,310 | 1,323 | 1,336 | 1,349 | 78 |
| 11 | SEG Price | 1,289 | 1,296 | 1,303 | 1,310 | 1,317 | 1,323 | 1,330 | 41 |
| 11 | SEG Recovery | 1,289 | 1,296 | 1,303 | 1,310 | 1,317 | 1,323 | 1,330 | 41 |
| 13 | Mining CapEx | 1,325 | 1,320 | 1,315 | 1,310 | 1,305 | 1,300 | 1,295 | 30 |

Notes: Each variable was flexed independently over −30% to +30% from the base case while all other assumptions were held constant. NPV spread is the difference between the −30% and +30% cases. Tied ranks share a position. Price and recovery pair identically for each element because revenue is the linear product of the two. The NdPr sensitivity is not fully linear: at NdPr +20%, factored NdPr revenue per short ton processed exceeds US$100/ton in four production years (2032, 2033, 2037 and 2051), and at +30% in nine production years (2031 to 2034, 2037, 2038 and 2051 to 2053); the Wyoming State royalty on NdPr steps from 7% to 9% in those years, dampening the incremental NPV response. Conversely, the NdPr royalty rate falls from 7% to 5% in two production years (2039 and 2040) at −10% and −20%, and in 15 production years at −30%, compared with none in the base case, partially offsetting the NPV decline. Totals may not sum precisely due to rounding. [1] The discount rate was flexed from 5.0% to 11.0% in 1.0% increments rather than on a percentage-of-base-case basis; columns correspond to 5.0%, 6.0%, 7.0%, 8.0% (base case), 9.0%, 10.0% and 11.0% respectively.

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The sensitivity analysis presented above is a single-variable analysis. It does not test combinations of adverse outcomes, and a combined downside scenario would return results below any individual case presented here. Grade, tonnage, project schedule and capital timing were not flexed. These limitations should be considered alongside the results. Overall, the sensitivity analysis demonstrates that Project value is driven principally by NdPr price and NdPr recovery, followed by the discount rate and the operating and capital intensity of the downstream processing plant. These variables represent the key economic risks and opportunities for the Project and should be prioritized in future metallurgical test work, engineering refinement, market analysis and cost estimation. The Project returns a positive after-tax NPV in every single-variable downside case tested, the lowest being US$459.0 million at a 30% reduction in either NdPr price or NdPr recovery.

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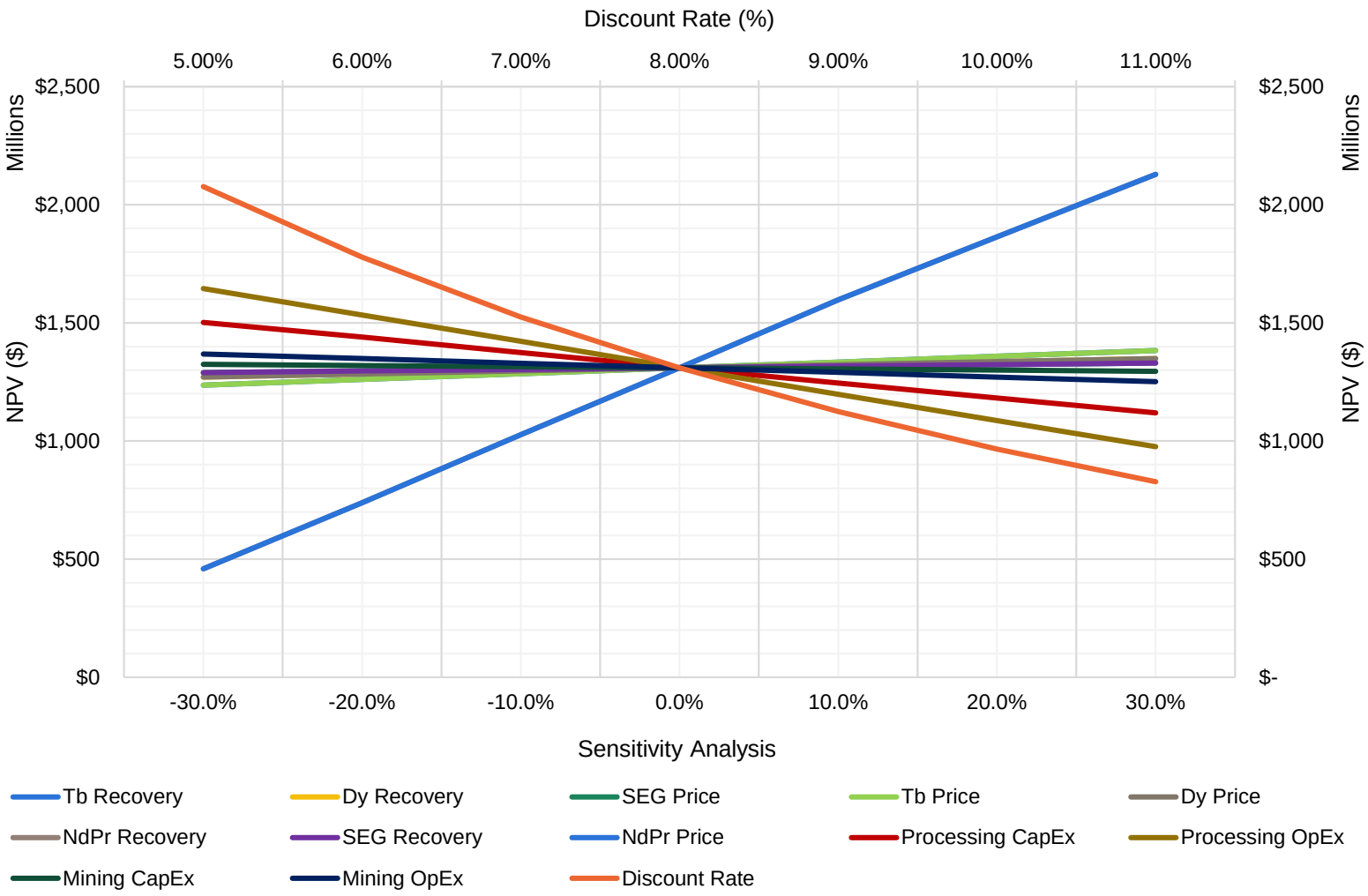


Figure 21-5: Spider Graph



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Notes: First, price and recovery lines are coincident for each element, as revenue is the linear product of the two and a given percentage change in either produces an identical result. Second, the NdPr line is not perfectly straight: from a variation of +20%, factored NdPr revenue per short ton processed exceeds US$100 in four production years (nine at +30%) and the Wyoming State royalty on NdPr steps from 7% to 9% in those years, reducing the NPV increment to US$266.7 million between +10% and +20% and US$264.2 million between +20% and +30%, compared with US$288.0 million between the base case and +10%. At −30%, the NdPr royalty falls to 5% in 15 production years, reducing the change between −30% and −20% to US$279.9 million. These effects are not visually apparent at the scale of the diagram.

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The sensitivity results are presented graphically in Figure 19-6. The spider diagram plots after-tax NPV on the vertical axis against the percentage variation applied to each input on the horizontal axis, with all lines converging on the base case NPV of US$1,309.8 million at the zero-variation point. The gradient of each line is a direct measure of the Project's exposure to that variable: steeper lines indicate greater sensitivity, and the sign of the gradient indicates whether an increase in the variable raises or reduces Project value.

Revenue-side variables — product prices and metallurgical recoveries — slope upward, as an increase in either raises revenue. Cost-side variables and the discount rate slope downward. The NdPr price and NdPr recovery lines are materially steeper than all others, changing after-tax NPV by US$278.3 million for each 10% variation, 2.5 times the gradient of the next steepest variable. This visual dominance reflects NdPr's 87.4% share of life-of-Project revenue and is the single clearest conclusion to be drawn from the diagram.

The discount rate line, plotted against its own axis of 5.0% to 11.0%, changes after-tax NPV by US$208.2 million for each one percentage point applied. Processing operating cost and processing capital cost follow, at US$111.5 million and US$63.8 million per 10% variation respectively. The remaining variables form a tightly clustered band close to the horizontal: terbium price and recovery at US$24.4 million per 10%, mining operating cost at US$19.5 million, dysprosium price and recovery at US$13.1 million, and SEG price and recovery and mining capital cost at US$6.8 million and US$5.0 million respectively. The near-flat gradient of these lines indicates that variation in these inputs, within the tested range, has limited influence on Project value.

### 21.4.1 Incremental NdPr Recovery (%) Sensitivity

The sensitivity analysis in Table 21-16 applies relative variations to each input. For example, a +10% variation in NdPr recovery corresponds to a recovery of 64.0% (58.2% × 1.10). NdPr recovery is the principal metallurgical value driver, so its effect on Project economics was also assessed in absolute terms. The base case NdPr recovery of 58.2% was increased in increments of one percentage point, with all other assumptions held constant. The results are presented in Table 21-17.

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*Table 21-17: After-Tax NPV Sensitivity to Absolute Increases in NdPr Recovery (8.0% Discount Rate)*

| NdPr Recovery | NdPr Revenue, LoM (USD M) | After-Tax NPV (USD M) | Change in NPV (USD M) | After-Tax IRR |
|---|---|---|---|---|
| 58.2% | 10,577.5 | 1,309.8 | – | 23.9% |
| 59.2% | 10,759.2 | 1,359.3 | 49.5 | 24.4% |
| 60.2% | 10,941.0 | 1,408.8 | 49.5 | 24.9% |
| 61.2% | 11,122.7 | 1,458.2 | 49.5 | 25.4% |
| 62.2% | 11,304.5 | 1,507.7 | 49.5 | 25.9% |
| 63.2% | 11,486.2 | 1,557.2 | 49.5 | 26.4% |
| 64.2% | 11,667.9 | 1,606.7 | 49.5 | 26.9% |
| 65.2% | 11,849.7 | 1,651.3 | 44.6 | 27.3% |
| 66.2% | 12,031.4 | 1,694.0 | 42.7 | 27.7% |
| 67.2% | 12,213.2 | 1,737.4 | 43.5 | 28.0% |
| 68.2% | 12,394.9 | 1,785.0 | 47.6 | 28.5% |

Notes: Change in NPV is relative to the preceding row. Totals and differences may not reconcile exactly due to rounding.

Each one-percentage-point increase in NdPr recovery adds approximately US$181.7 million to LOM NdPr revenue, approximately US$49.5 million to after-tax NPV and approximately 0.5 percentage points to after-tax IRR, up to a recovery of 64.2%. Above 64.2%, the NPV gain per percentage point is smaller, at between US$42.7 million and US$47.6 million.

The smaller increments above 64.2% result from the stepped structure of the Wyoming State royalty. The royalty rate applied to NdPr revenue in each year is determined by factored NdPr revenue per short ton processed: 5% at or below US$50 per ton, 7% above US$50 per ton, 9% above US$100 per ton and 10% above US$150 per ton. The applicable rate is charged on the full year's NdPr revenue.

In the base case, factored NdPr revenue ranges from US$53.74 per short ton (2040) to US$89.69 per short ton (2037), and the NdPr royalty is levied at 7% in every production year. At an NdPr recovery of approximately 64.9%, factored NdPr revenue in 2037 exceeds US$100 per short ton and the royalty rate in that year increases from 7% to 9% on all 2037 NdPr revenue; 2032, 2033 and 2051 follow at recoveries of approximately 65.6%, 67.0% and 68.1% respectively. Each crossing reduces the NPV gain in the increment in which it occurs, to US$44.6 million (64.2% to 65.2%), US$42.7 million (65.2% to 66.2%), US$43.5 million (66.2% to 67.2%) and US$47.6 million (67.2% to 68.2%). The reduction is smallest for 2051, which occurs late in the mine life and is more heavily discounted.

The base case is not close to a royalty threshold. NdPr recovery would need to fall to approximately 54.2%, or NdPr price by approximately 7%, before any production year moves to the 5% band, and would need to increase to approximately 64.9%, or NdPr price by approximately 11.5%, before any year moves to the 9% band. This behavior reflects the royalty structure as modeled and is captured in the sensitivity results presented in Table 21-17.

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## 21.5 Risks and Opportunities

A workshop-level assessment of the principal risks and opportunities relevant to Project economics was undertaken as part of the PFS process. The register presented in Table 21-18 captures the key items identified across geology, mining, processing, metallurgy, marketing, ESG and cost domains. This assessment is not a full quantitative risk analysis; a probabilistic risk assessment is recommended at the feasibility study stage.

*Table 21-18: Risk and Opportunity Register (Workshop-Level Assessment)*

| Category | Risk / Opportunity | Potential Impact | Direction |
|---|---|---|---|
| Geology | Upgrade of Inferred to Indicated or Measured Resources through infill drilling | Increased reserve tonnage and mine life extension | ↑ Opportunity |
| Geology | Grade variability or dilution exceeding modelled assumptions | Reduced PREO26 head grade and lower recoveries | ↓ Risk |
| Mining | Geotechnical conditions permit steeper pit slopes than modelled | Reduced strip ratio and mining costs; increased ore access | ↑ Opportunity |
| Mining | Adverse geotechnical outcomes requiring flatter slopes or additional dewatering | Increased strip ratio, higher mining OPEX and CAPEX | ↓ Risk |
| Processing | Improved REE recoveries through ongoing test work | Higher product yield per tonne processed; improved economics | ↑ Opportunity |
| Processing | Lower-than-modelled recoveries from mineralogical complexity or impurity challenges | Reduced revenue; potential CAPEX and OPEX increases for additional circuits | ↓ Risk |
| Marketing | NdPr price recovery driven by EV and wind turbine demand exceeding base case forecasts | Significant NPV and IRR upside; price is the leading sensitivity driver | ↑ Opportunity |
| Marketing | Sustained low REE prices or changes to Chinese export policy | Material reduction in project returns; potential project deferral | ↓ Risk |
| ESG | Streamlined Wyoming DEQ permitting and favorable community relations | Faster path to construction; lower permitting cost and schedule risk | ↑ Opportunity |
| ESG | Tailings characterization or water management issues identified during permitting | Additional CAPEX for storage facility design or water treatment; schedule delays | ↓ Risk |
| Costs | Owner-operated mining model reducing contractor margins | Reduction in unit mining OPEX versus contract mining baseline | ↑ Opportunity |
| Costs | Inflationary pressure on reagent, energy and labor costs | Higher-than-modelled OPEX; margin compression in early project years | ↓ Risk |
| Costs | No sustaining capital estimated for the processing and refinery facilities or site infrastructure over the 26-year mine life (mining fleet sustaining capital is included in the mining operating cost) | Understatement of life-of-Project capital and overstatement of after-tax returns | ↓ Risk |

Notes: Risks and opportunities have not been probability-weighted or quantified in terms of cash flow impact. A quantitative risk assessment is recommended at the feasibility study stage.

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### 21.5.1 Key Observations from Risk Workshop

- Commodity price risk is the dominant economic risk, given that NdPr Oxide accounts for 87.4% of LOM revenue. The Project is exposed to rare earth price cycles historically driven by Chinese export policy. The strategic importance of rare earths to United States technology and defense supply chains provides a structural buffer against prolonged price weakness.
- Metallurgical recovery risk is the primary technical risk. The base case recovery assumptions of 58.2% for NdPr, 25.8% for SEG, 28.7% for terbium, and 12.4% for dysprosium are derived from the PFS metallurgical test work program. Recovery improvement through ongoing test work represents the single largest source of technical upside: the sensitivity analysis shows that a 10% relative improvement in NdPr recovery alone increases after-tax NPV by US$288.0 million.
- Capital execution risk is elevated given the split-site processing configuration and the scale of the refinery investment of US$590.1 million. Detailed engineering at the feasibility stage should focus on optimizing the refinery circuit and confirming offtake-linked product specifications.
- Sustaining capital for the mining fleet, including equipment rebuilds and replacements, is included in the mining operating cost of US$5.47 per tonne of total material mined. No sustaining capital has been estimated for the processing and refinery facilities or site infrastructure beyond the US$33.0 million staged refinery waste disposal expansion.
- Wyoming is a mining-friendly jurisdiction with an established permitting pathway through the Wyoming Department of Environmental Quality. Engagement with federal agencies regarding lode mining claims is proceeding concurrently with the PFS. Permitting risk is considered manageable given the Project's location and WRI's existing stakeholder relationships.
- Geotechnical uncertainty remains elevated pending completion of the geotechnical drilling program and formal slope stability analysis. Results will directly inform pit design parameters for the feasibility study, with potential to reduce the LOM strip ratio below the 0.16:1 base case assumption.

# 22 Mineral (Ore) Reserve Estimates

## 22.1 Introduction

This section describes the Mineral Reserve estimation methodology, summarizes the key assumptions used, and presents the Mineral Reserve estimates for CSM.

The Qualified Person (QP) for the estimation of the Mineral Reserve is Patrick Sobecke, of Stantec. The Mineral Reserve estimates reported herein are a reasonable representation of the

Mineral (Ore) Reserves within the Project at the current level of analysis. Mr. Sobecke has reviewed the risks, opportunities, conclusions, and recommendations summarized in Sections 25 – Interpretation and Conclusions, and 26 – Recommendations, and he is not aware of any unique conditions that would put the Project Mineral Reserve at a higher level of risk than any other developing project.

The Mineral (Ore) Reserves were estimated in conformity with the US Securities and Exchange Commission S-K Subpart 1300 (17 CFR §229.1300) regulations. The Mineral Reserve estimates are

based on a mine plan and pit design developed using modifying parameters including metal price, metal recovery based on the forecast performance of the processing plant, and operating cost estimates."

The Project Mineral (Ore) Reserves Estimate equates to the mill feed schedule, as presented in Section 16 – Mining Methods. The general mine planning sequence to produce the mill feed schedule consisted of a Reserve pit limit analysis, pit shell selection, Reserve pit design, and mining sequence schedule. Section 15 – Mineral Reserve Estimates includes a description of the reserve estimation process through Reserve pit design. Section 16 includes the remaining processes requisite to schedule mill feed and estimate Mineral (Ore) Reserves.

## 22.2 Pit Limit Analysis

### 22.2.1 Approach

Guidance for ultimate pit and phase design used industry accepted open pit optimization software, GEOVIA Whittle 2022 Refresh 2 (version 4.8.5300.2). To help improve computational run time, Whittle's Pseudoflow algorithm was used in the evaluation of the optimal pit shell limits. Whittle produces nested pit shells evaluating the revenue of each shell by varying the price, known as revenue factors (RF). Nested pit shells and associated resource quantities were generated at various RFs ranging from 0.1 to 2.0 to understand the potential for pit and phase limit sensitivities with respect to price. The Payable Rare Earth Oxide Elements (PREO) considered the recovery and price for each payable element and include the following:

- Dysprosium = $Dy_2O_3$ → Dy
- Europium = $Eu_2O_3$ → Eu
- Gadolinium = $Gd_2O_3$ → Gd
- Neodymium = $Nd_2O_3$ → Nd
- Praseodymium = $Pr_6O_{11}$ → Pr
- Samarium = $Sm_2O_3$ → Sm
- Terbium = $Tb_4O_7$ → Tb

Final pit shell selection was driven by desired LOM production targets of around 4.5 Mtpa of ore for 26 years.

### 22.2.2 Geologic Resource Block Model

An updated resource block model (bm_rm_oct25_stn) was provided to Stantec in October of 2025, updated from the 2023 PEA and 2024 Update Studies, and modified by Stantec to incorporate additional mining considerations and value calculations.

Stantec normalized the Odessa block model to contain equal blocks with dimensions of 10 m x 10 m x 10 m, representing the selective mining unit (SMU) for the anticipated equipment and importation into Geovia's Whittle software for pit shell generation. Variables were added with the following criteria:

- tons = 10 * 10 * 10 * (sg) * (fillpc)/100
    - sg = Specific Gravity = 2.7



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    - fillpc = Fill % = % of material falling below the topography
- PREO_i = Dy2O3 + Eu2O3 + Gd2O3 + Nd2O3 + Pr6O11 + Sm2O3 +Tb4O7 = PREO grade (ppm) indicated
- SEG_i = Sm2O3 + Eu2O3 + Gd2O3 = SEG grade (ppm) indicated
- NdPr_i = Nd2O3 + Pr6O11 = NdPr grade (ppm) indicated
- PREO_ii = Dy2O3 + Eu2O3 + Gd2O3 + Nd2O3 + Pr6O11 + Sm2O3 +Tb4O7 = PREO grade (ppm) indicated and inferred
- SEG_ii = Sm2O3 + Eu2O3 + Gd2O3 = SEG grade (ppm) indicated and inferred
- NdPr_ii = Nd2O3 + Pr6O11 = NdPr grade (ppm) indicated and inferred

The regularized block model, csm_RB_10-2025.bmf, includes indicated and inferred material, but pit sensitivities and mine production only consider indicated material.

### 22.2.3 Ore Dilution and Mining Losses

Dilution is defined as “material that is below the cut-off grade or value but is intentionally or inadvertently mined and must be considered in Mineral Reserve estimates because it dilutes the average grade estimate and increases the volume mined”. Dilution can be classified as either internal or external. Internal dilution occurs within a mining block where pockets of material below the cut-off grade cannot be removed selectively during the digging operation. External dilution typically occurs because of blasting, which causes material movement and mixing of ore and waste along mining block boundaries.

Internal dilution in the reserve block model is negligible. The impact of external dilution is also negligible, as the waste rock adjacent to the reserve is above cut-off grade Inferred Resources.

Mining losses are defined as “the percentage of ore grade material within the mine designs that will not be extracted for various reasons”. Mining losses are typically more significant in underground operations where material may need to be left in place for safety and geotechnical considerations. Mining losses are not expected for the Project due to the geologic characteristics.

### 22.2.4 Overall Pit Slope Angles

Overall Slope Angle (OSA) guidance and pit wall configurations were based on geotechnical information obtained from drilling campaigns and various laboratory tests. Geotechnical analysis evaluated results from geotechnical borehole logs, UCS triaxial testing, direct shear, and televiewer surveys. Groundwater data, however, was not incorporated due to the absence of data available during the analysis. Recommendations also assumed pit walls fall within the RMP formation and good blasting control incorporating trim shots, pre-shear, no large production blasts against final pit walls etc.

Final OSA guidance considers the full height of the slope, decreasing as the height increases. Table 22-1 below summarizes the various slope angles given a set of slope heights.

*Table 22-1: Geotechnical Parameters*

| Slope Height (m) | Max OSA (°) |
|---|---|

| | |
|---|---|
| 700 | 45 |
| 600 | 47 |
| 500 | 49 |
| 400 | 51 |
| 300 | 54 |

### 22.2.5 Input Parameters

Model attributes, mine design, and economic criteria used for the pit optimization for CSM are summarized below in Table 22-2.

*Table 22-2: Pit Optimization Inputs*

| **Costs** | **Unit** | **Value** |
|---|---|---|
| Mining Cost | US$/t | 5.38 |
| Process Cost | US$/t | 28.28 |
| G&A | US$/t | 1.10 |
| Incremental Mining Cost | US$/t | 0.006 |
| **Mining** | | |
| Mining Recovery | % | 100 |
| Mining Dilution | % | 0 |
| Processing | | |
| Recovery: Pr | % | 54.0 |
| Recovery: Nd | % | 54.0 |
| Recovery: Sm | % | 24.0 |
| Recovery: Eu | % | 24.0 |
| Recovery: Gd | % | 24.0 |
| Recovery: Tb | % | 24.0 |
| Recovery: Dy | % | 18.0 |
| **Selling** | | |
| Price: Pr | US$/kg | 85.89 |
| Price: Nd | US$/kg | 85.89 |
| Price: Sm | US$/kg | 13.59 |
| Price: Eu | US$/kg | 13.59 |
| Price: Gd | US$/kg | 13.59 |
| Price: Tb | US$/kg | 1,375.66 |
| Price: Dy | US$/kg | 356.43 |
| Wyoming State Royalty | % | **2.50** |
| Inter-ramp | degrees | **50** |

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The geological interpretation considers nearly all the material mined to be mineralized and, therefore, does not anticipate material dilution on the resource and waste contact. This results in 100% mine recovery of ore. Shipping costs are zero, as metal is payable as Freight on Demand (FOB).

### 22.2.6 Cut-Off Calculation

Mineral Reserve Estimation calculated a PREO cut-off grade of approximately 875 ppm based on the input parameters above and considers the following equation.

*Cut-Off Grade = (Mc + Pc + G&A) / ((PREO Price – Roy) * Rec*

The following bullets provide the equation definitions:

- Mc = Mining Cost
- Pc = Process Cost
- G&A = General and Administrative Cost
- PREO Price = PREO Price ($/kg)
- Royz = Royalty
- Rec = Recovery

## 22.3 Reserve Pit Limit Shell Selection

The RF 1 pit is defined as the undiscounted pit shell that extracts the most value given the associated inputs i.e. price, cost, recovery etc. Variations of the RF are generated by factoring the element price to identify sensitivities to the pit shell / mining volumes (costs, recoveries and other inputs are kept constant). While RF values greater than 1 may generate more revenue, the ultimate value of the associated pits diminishes. To better understand how the value of the deposit is impacted by production constraints and delivery, additional production scenarios were evaluated to aid in shell selection and design. Using the defined Whittle input parameters, three cases were compared, assuming a 10% discount rate and a total annual production of 4.5 M tonnes for 26 years.

- • The “Worst Case” – resultant cash flow model derived by mining the entire selected pit shell from the top down, bench by bench as per the assigned annual mining rate.
- • The “Best Case” (onion peel mining) – resultant cash flow model derived by mining successive pit shell from smallest to largest using an assigned annual mining rate.
- • The “Specified Case” – resultant cash flow model derived by mining selected pit shells, representing pushbacks to represent a more realistic mining schedule.

Results from the open pit optimization are shown in Figure  and Table 22-3: Pit Optimization Results – CSM.

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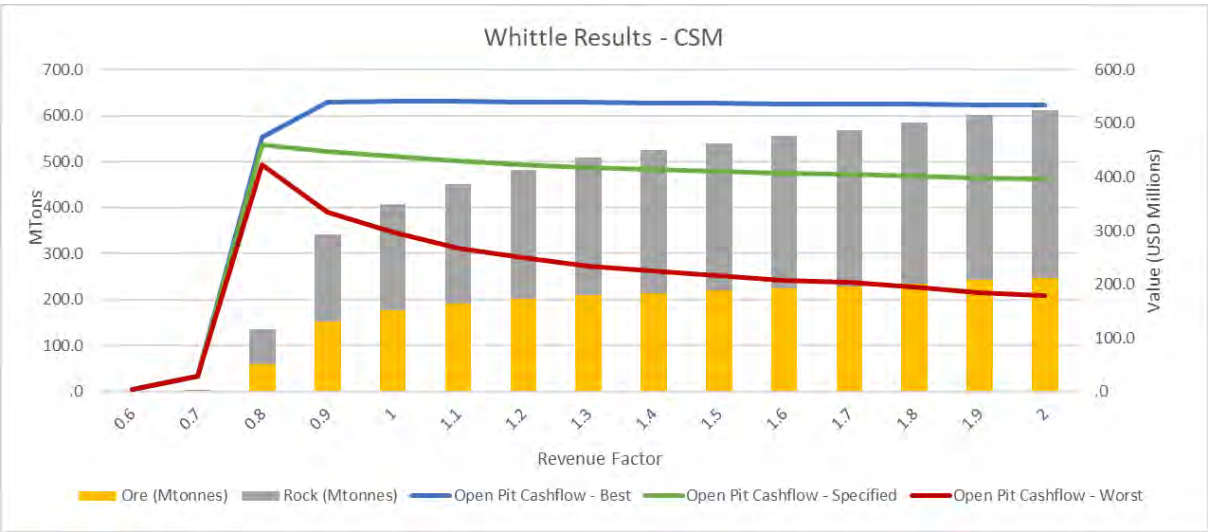


*Figure 22-1: Pit Optimization Results – CSM*

*Table 22-3: Pit Optimization Results – CSM*

| Pit | Rev Factor | Total Tonnes (Mt) | Ore Tonnes (Mt) | Strip | Max Bench | Min Bench | PREO Grade (ppm) |
|---|---|---|---|---|---|---|---|
| 1 | 0.6 | 0.1 | 0.1 | 0.04 | 46 | 34 | 2,631 |
| 2 | 0.7 | 1.4 | 1.2 | 0.09 | 48 | 25 | 2,314 |
| 3 | 0.8 | 77.6 | 58.4 | 0.33 | 51 | 10 | 2,106 |
| 4 | 0.9 | 190.7 | 150.9 | 0.26 | 51 | 3 | 1,959 |
| 5 | 1 | 230.5 | 176.6 | 0.31 | 51 | 3 | 1,924 |
| 6 | 1.1 | 259.8 | 192.2 | 0.35 | 51 | 3 | 1,899 |
| 7 | 1.2 | 280.4 | 201.4 | 0.39 | 51 | 3 | 1,882 |
| 8 | 1.3 | 299.4 | 209.2 | 0.43 | 51 | 3 | 1,866 |
| 9 | 1.4 | 310.5 | 214.6 | 0.45 | 51 | 3 | 1,851 |
| 10 | 1.5 | 321.1 | 219.3 | 0.46 | 51 | 3 | 1,837 |
| 11 | 1.6 | 332.0 | 224.6 | 0.48 | 51 | 3 | 1,820 |
| 12 | 1.7 | 339.3 | 228.7 | 0.48 | 51 | 3 | 1,805 |
| 13 | 1.8 | 349.6 | 235.3 | 0.49 | 51 | 3 | 1,781 |
| 14 | 1.9 | 358.5 | 243.6 | 0.47 | 51 | 3 | 1,748 |
| 15 | 2 | 365.0 | 247.4 | 0.48 | 51 | 3 | 1,735 |

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### 22.3.1 Shell Selection

Initial pit optimization analysis evaluated RFs from 0.1 to 2.0 to obtain a general understanding of the value and tonnage dynamic. The RF 1 pit for CSM generates resource volumes that exceed the production quantities for a 26-year LOM at 4.5 Mtpa for the Best-Case scenario. To ensure the value of the deposit is maximized, RFs less than 1 were evaluated targeting ultimate LOM resource tonnages and an initial phase to provide sufficient production for the first 5 years of production and a ramp up period. The Specified case incorporated and supported selecting RFs equal to 0.6 and 0.732 to guide Phase 1 and Phase 2 / the ultimate pit designs.

Results from the open pit optimization are shown in Table 22-4.

*Table 22-4: Pit Optimization Results – CSM*

| Pit | Rev Factor | Rock (ktonnes) | Ore (ktonnes) | Strip | Waste (ktonnes) |
|---|---|---|---|---|---|
| 1 | 0.4 | 53 | 52 | 0.03 | 2 |
| 2 | 0.5 | 2,060 | 1,820 | 0.13 | 239 |
| **3** | **0.6** | **34,733** | **25,171** | **0.38** | **9,563** |
| 4 | 0.7 | 89,673 | 74,411 | 0.21 | 15,262 |
| **5** | **0.732** | **134,489** | **116,277** | **0.16** | **18,212** |
| 6 | 0.77 | 176,398 | 154,022 | 0.15 | 22,377 |
| 7 | 0.8 | 194,101 | 168,715 | 0.15 | 25,386 |
| 8 | 0.9 | 234,861 | 194,158 | 0.21 | 40,703 |
| 9 | 1 | 260,345 | 208,284 | 0.25 | 52,061 |
| 10 | 1.1 | 281,436 | 218,606 | 0.29 | 62,830 |
| 11 | 1.2 | 300,352 | 226,810 | 0.32 | 73,542 |
| 12 | 1.3 | 314,263 | 234,038 | 0.34 | 80,225 |
| 13 | 1.4 | 325,837 | 244,319 | 0.33 | 81,518 |
| 14 | 1.5 | 338,071 | 251,915 | 0.34 | 86,156 |
| 15 | 1.6 | 348,722 | 257,791 | 0.35 | 90,931 |
| 16 | 1.7 | 356,651 | 263,007 | 0.36 | 93,644 |
| 17 | 1.8 | 366,207 | 267,493 | 0.37 | 98,714 |
| 18 | 1.9 | 372,779 | 271,098 | 0.38 | 101,681 |
| 19 | 2 | 375,555 | 275,156 | 0.36 | 100,398 |

## 22.4 Reserve Pit Designs

The following sections define the methodology used for CSM pit design.

Pit designs incorporate toe, crest, and ramps strings for every 10 m bench. The design targeted modeled ore while using Whittle outputs as a guide. Whittle pit shells were initially used as a limit for highwall

designs, with an allowance for haul roads to be designed beyond the shell up until the haul road mid-point. Inter-ramp slope angles were not initially adjusted to generate overall pit slope angles, as the location of haulage ramps was unknown. Once the final ramp configuration was determined, catch bench widths were adjusted to follow geotechnical OSA and IRA ramp guidance. Ramps were designed to maximize ore extraction while considering haulage access. Where possible, material will be mined “on contour”, utilizing the existing topography to create ex-pit haulage access minimizing the loss of resources due to the placement of haulage ramps.

## 22.4.1 Haul Ramp Design Criteria

### 22.4.1.1 Maximum Width

Maximum haul ramp design considered using a Komatsu 605 with an overall width of 4.595 m. Using a haul ramp rule of 3.5 x’s Truck Width + Berm + Ditch + Offset a total width of 19.6 m is required. A haul ramp design of 20 m was used for pit design. A typical haul road cross section is shown below in Figure 22-2: Typical Haul Road Cross Section.

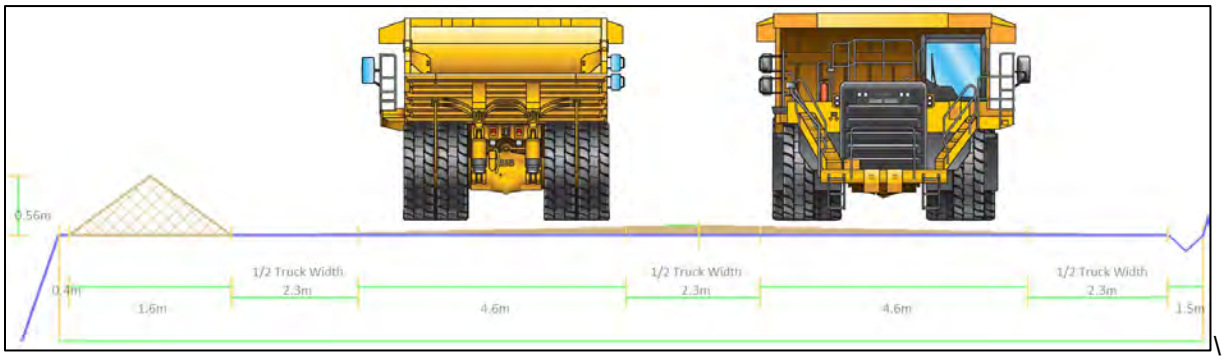


*Figure 22-2: Typical Haul Road Cross Section*

### 22.4.1.2 Maximum Grade

A ramp grade of 10% was used on all standard pit roads. An allotment to use a maximum grade of 12 % on the last three benches, was not implemented; however, a single lane ramp was also considered on the last two benches.

## 22.4.2 Geotechnical Constraints

Final OSA guidance was based on the full height of the slope as shown in Table 22-5.

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*Table 22-5: Geotechnical Parameters*

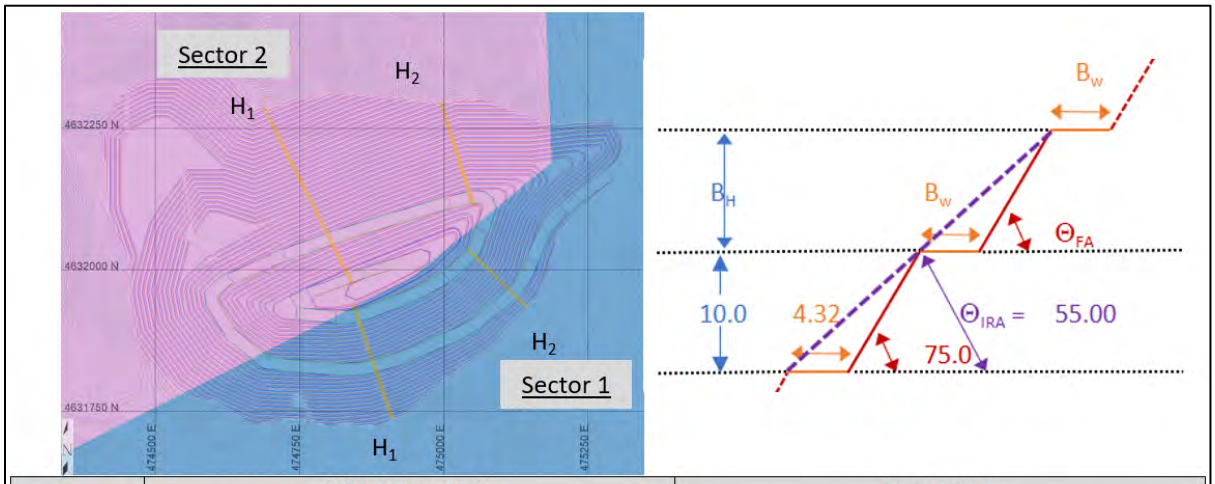
| Slope Height (m) | Max OSA (°) |
|---|---|
| 700 | 45 |
| 600 | 47 |
| 500 | 49 |
| 400 | 51 |
| 300 | 54 |

### 22.4.2.1 Slope Sectors

Mineral extraction is constrained by the property boundary to the North, with ultimate pit and phase designs descending to the extent of modeled mineralization. These limits set the wall to the North, while the southern wall straddles the modeled mineralization boundary between ore and waste. This general configuration results in slope heights that vary between 450 m and 240 m, resulting in the generation of two separate slope sectors.

### 22.4.2.2 Berm and Batter Criteria

To achieve the OSA slope sector guidance, berm widths were adjusted, maintaining a constant face angle of 75° for each 10 m bench. Given the configuration of the pit, ramp placement, and slope heights, the final pit design incorporated two geotechnical sectors. Because the topography is variable, each sector contains a range of slope heights. Figure 22-3: Geotechnical Slope Sectors and IRA Criteria below shows the OSA and IRA configurations given the maximum slope height for each sector.




| Sector | Inter-Ramp Angle | | | | Overall Slope | | | |
|---|---|---|---|---|---|---|---|---|
| | IRA | Face Angle | Height | Berm | Max Height | Slope Angle | Min Height | Slope Angle |
| | $\Theta_{IRA}$ (°) | $\Theta_{FA}$ (°) | $B_H$ (m) | $B_W$ (m) | $H_1$ (m) | $OSA_1$ (°) | $H_2$ (m) | $OSA_2$ (°) |
| 1 | 55.00 | 75.0 | 10.0 | 4.32 | <300 | 51.4 | 166 | 48.5 |
| 2 | 50.93 | 75.0 | 10.0 | 5.44 | <400 | 48.8 | 225 | 49.3 |

*Figure 22-3: Geotechnical Slope Sectors and IRA Criteria*

### 22.4.3 Ultimate Pit Designs

The ultimate pit design for Cowboy State Mine is achieved by mining two independent pits, East and West. The West pit contains two phases, with maximum elevations just below 1,988 masl and a final pit depth of 1,565 masl. Upper benches are mined using contour roads, established before mining commences, retreating access to upper benches as subsequent benches are mined and the access removed. The final pit ramp for the West Pit is established on the northeast corner, at approximately the 1,765 masl elevation, descending clockwise at 10%, with a double-lane design haul road width of 20 m, and a single-lane design haul road width of 10 m, used on the last three benches. The East pit is approximately 360 m northeast of the West pit entrance and does not require haulage access to be constructed before establishing a pit ramp at the 1,754 masl elevation, descending clockwise at 10%, 20 m wide establishing a final pit bottom at the 1,640 masl elevation.

Multiple ramp placements and configurations were considered, but the selected design(s) successfully achieve planning targets, minimize mining operational complications, and reduce waste quantities while adhering to Whittle guidance.

The ultimate pit configuration is shown below in Figure 22-4: CSM Ultimate Pit Configuration with the associated mine physicals in Table 22-6.

*Table 22-6: Cowboy State Mine Mined Quantities*

| Classification | Total Tonnes (Mt) | Ore Tonnes (Mt) | PREO (ppm) | PREO (Mkg) | Waste Tonnes (Mt) | Strip Ratio |
|---|---|---|---|---|---|---|
| Measured | - | - | - | - | - | 0.00 |
| Indicated | 132.1 | 116.4 | 1,257 | 146.3 | 15.7 | 0.14 |
| Inferred | 2.8 | - | - | - | 2.8 | 0.00 |
| Undefined | 0.1 | - | - | - | 0.1 | 0.00 |
| Total | 135.0 | 116.4 | 1,257 | 146.3 | 18.7 | 0.16 |

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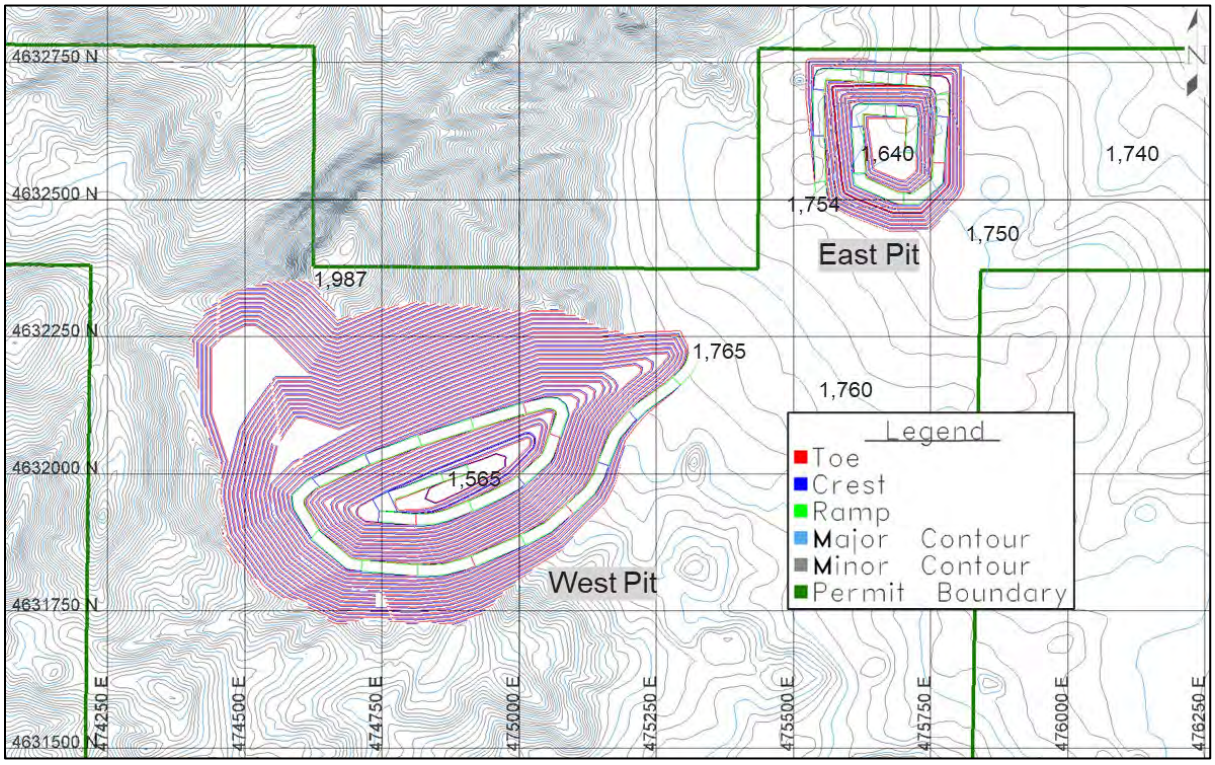


*Figure 22-4: CSM Ultimate Pit Configuration*

## 22.4.4 Pit Phase Designs

The West pit is mined in two separate phases, with Phase 1 designed to access higher grades during the first 5 years of production. The West pit borders the property boundary to the North and extracts mineralization contained within Red Mountain. Access to the upper / initial benches of each phase require contour roads to be established before being able to mine the upper benches of each phase. Access to each bench above will be retreated as the subsequent bench below is mined. Phases 1 and 2 with conceptualized contour roads are shown below in an isometric view in Figure .

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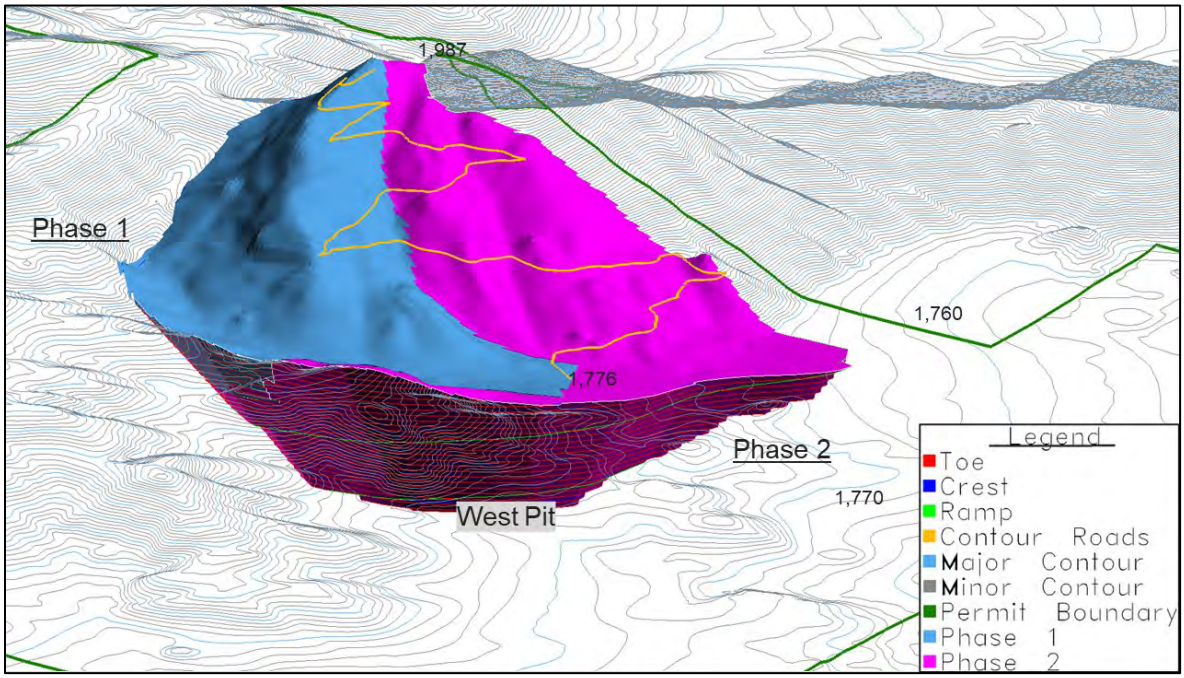


*Figure 22-5: West Pit Phases 1 and 2 with Conceptual Contour Road Configuration*

Phase 1 of the West Pit has a maximum height just below the 2,000 masl elevation and descends to the 1,780 masl elevation using contour roads before inverting the haulage profile and establishing a pit ramp. The pit ramp descends at 10%, accommodating double lane haulage until reaching the 1,680 masl elevation.

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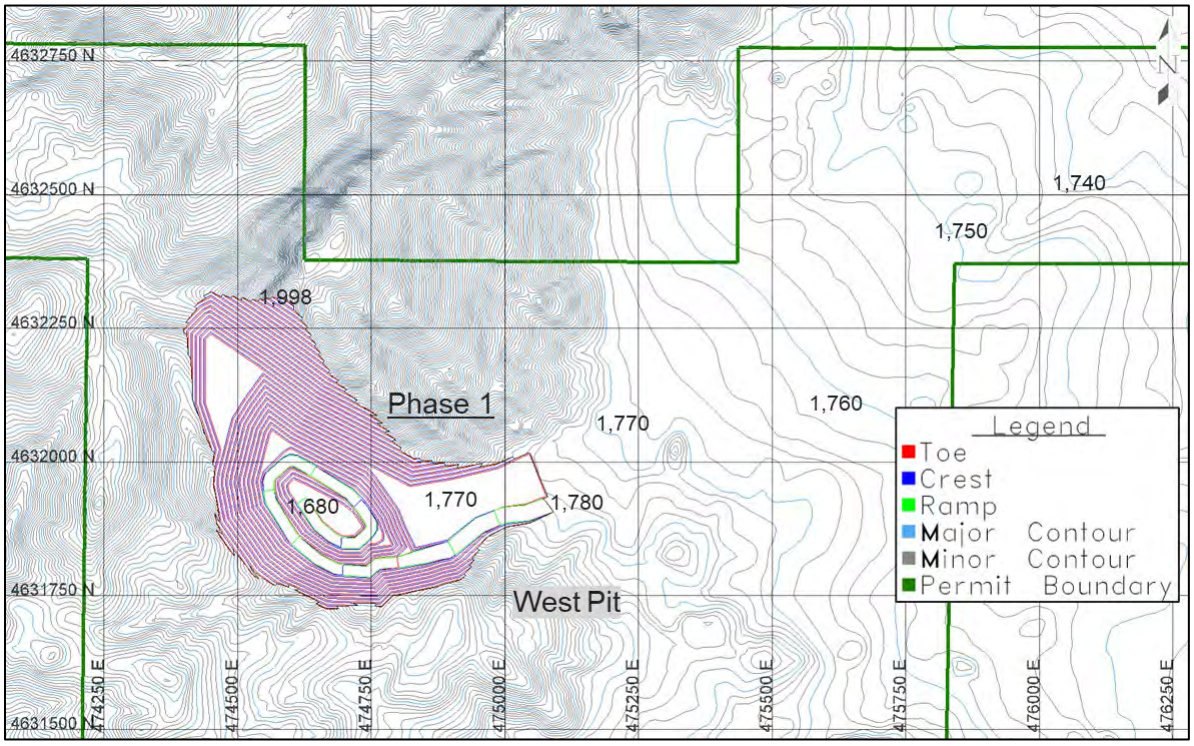


*Figure 22-6: West Pit Phase 1*

Phase 2 leaves behind a maximum crest elevation of 1,987 masl (although benches above the 1,980 will likely be incorporated within Phase 1), descending to the 1,765 masl elevation with the use of contour roads. If any section(s) of contour roads are placed within the pit limits of Phase 1, they will need to be reestablished within Phase 2 limits before they are mined out in Phase 1. Conceptual contour roads shown above in Figure 22-6 reduces the number of switchbacks required for Phase 1 but may require additional segments to be established for Phase 2. The haulage profile is inverted below the 1,765 masl elevation with a pit ramp that descends clockwise at 10%, accommodating double lane haulage until reaching the last two benches where the haul road is reduced to single lane traffic. Phase 2 of the West pit reaches an ultimate depth of 1,565 masl and is shown below in Figure 22-7.

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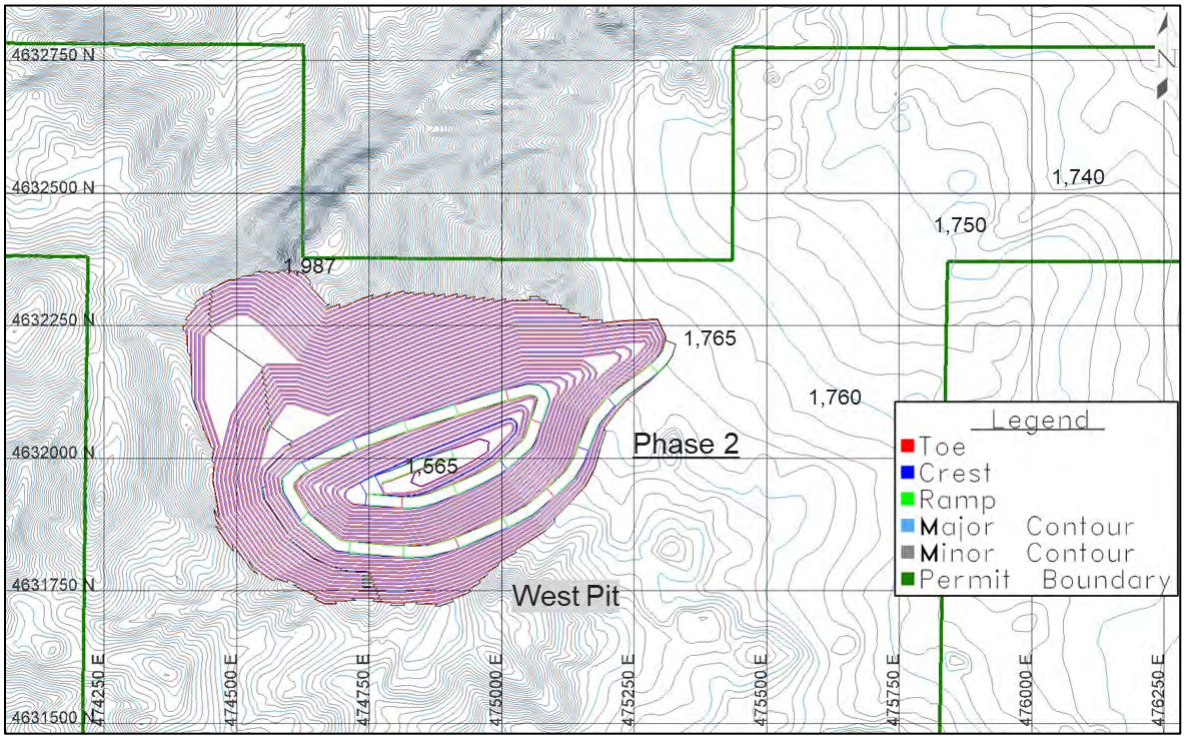


*Figure 22-7: West Pit Phase 2*

The East pit, while scheduled to be mined after Phase 2 as “Phase 3” due to comparatively lower grades, is not a true sequential phase and can be mined at any time. Due to being situated on relatively flat ground, logistics associated with phase development are simpler when compared to Phases 1 and 2 of the West pit. The East pit is shown below in Figure 22-8.

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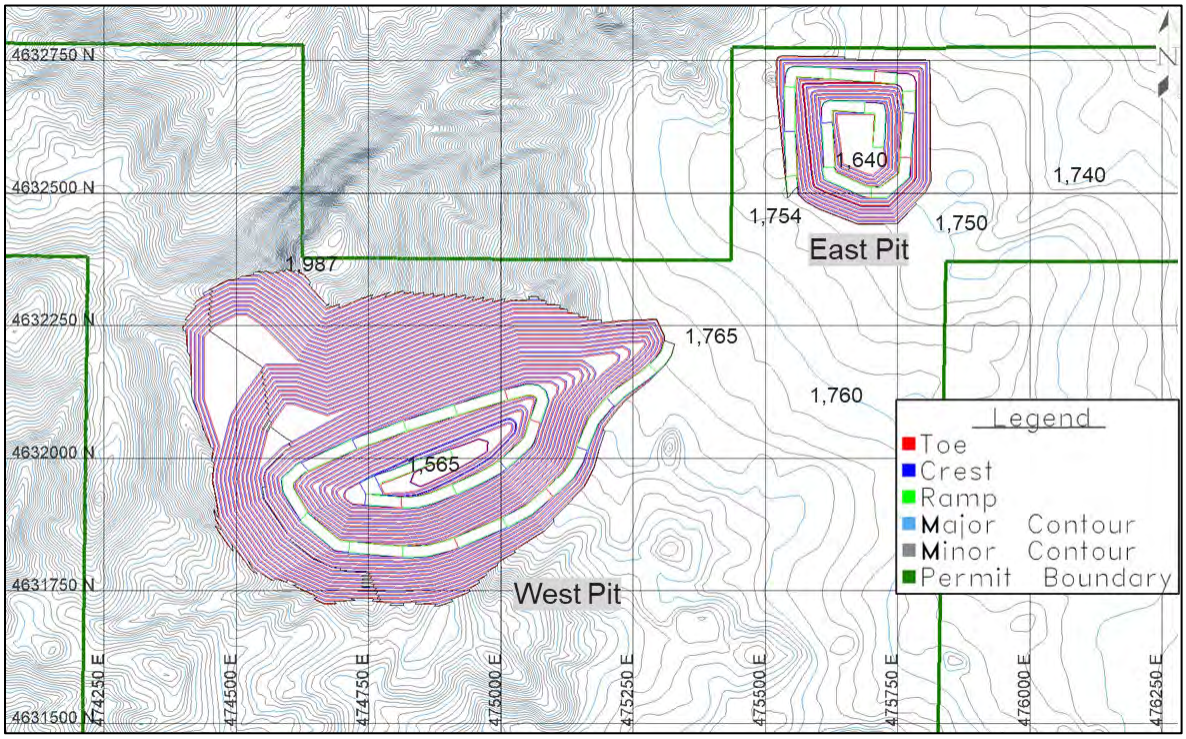


*Figure 22-8: East Pit*

Associated mining quantities and ore distribution results in low stripping requirements making ore readily available. Prioritization and determination of mining phases was based on the PREO grade, mining higher grade areas first to bring value forward in the schedule. Mine physicals by phase / pit are shown below in Table 22-7.

*Table 22-7: Pit and Phase Quantities*

| Pit | Total Tonnes (Mt) | Ore Tonnes (Mt) | PREO (ppm) | PREO (Mkg) | Waste Tonnes (Mt) | Strip Ratio |
|---|---|---|---|---|---|---|
| CSM-PH1-West | 41.5 | 32.6 | 1,433 | 46.8 | 8.9 | 0.27 |
| CSM-PH2-West | 81.8 | 72.2 | 1,193 | 86.1 | 9.6 | 0.13 |
| CSM-East | 11.7 | 11.5 | 1,163 | 13.4 | 0.2 | 0.02 |
| Total | 135.0 | 116.4 | 1,257 | 146.3 | 18.7 | 0.16 |

#### 22.4.4.1 Minimum Mining Widths

Pit designs evaluated operating widths ensuring each bench could be accessed and mined, considering phase-to-phase interactions and equipment capabilities. Minimum mining widths for each bench (32.5 m) were determined by the swing radius of the shovel, truck turning circle and safety berm, while minimum operating widths for the pit bottom truck turning circle and berm requirements (28 m).



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## 22.5 Mineral Reserve Statement

The Mineral Reserve Estimate incorporating the mill feed schedule as presented in Section 16 – Mining Methods considers the pit limit analysis, pit shell selection, Reserve pit design, and mining sequence is shown below in Table 22-8.

*Table 22-8: Mining Reserve Estimate Summary*

| Probable | PREO | NdPr | SEG | TB4O7 | DY2O3 |
|---|---|---|---|---|---|
| Total Tonnes (Mt) | 135.0 | | | | |
| Ore Tonnes (Mt) | 116.4 | | | | |
| Grade (ppm) | 1,257 | 958 | 230 | 12 | 57 |
| Contained (Mkg) | 146.3 | 111.5 | 26.7 | 1.4 | 6.6 |
| Proven Tonnes (Mt) | - | | | | |
| Probable Tonnes (Mt) | 116.4 | | | | |
| Total Waste Tonnes (Mt) | 18.7 | | | | |
| Waste Tonnes (Mt) | 15.8 | | | | |
| Mineralized Inferred Tonnes (Mt) | 2.8 | | | | |

The Reserve pit design requires a total material movement of 135 Mt to provide 116.4 Mt of mill feed, sustaining a 26-year mine life at 4.5 Mtpa. Within the Reserve pit, there are 18.7 Mt of waste material, 2.8 Mt of which is Inferred material above the cut-off grade. For the Reserves, Inferred material is considered waste; however, this material represents a potential upside if further geological testwork and information results in the conversion from inferred to indicated.

### 22.5.1 Comparison of Reserve Pit Design to Pit Shell

Compared to the selected RF 0.839 shell, there is a 14% increase in waste material (4.8 Mt). This is due to the selective nature of Whittle and inability to model all design and operational constraints. To ensure ore delivery for the LOM, additional material was mined to achieve production targets. The comparisons of the pit designs and shells are shown in Table 22-9.

*Table 22-9: Comparison of Pit Designs and Whittle Shell*

| Pit | Total Tonnes (Mt) | Ore Tonnes (Mt) | Waste Tonnes (Mt) | Strip Ratio |
|---|---|---|---|---|
| CSM Reserve Pits | 135.0 | 116.4 | 18.7 | 0.16 |
| Whittle Pits | 134.5 | 119.4 | 15.1 | 0.13 |
| % Difference | 0.4% | -2.5% | 23.6% | 26.8% |

## 22.6 Factors That May Affect the Mineral Reserve Estimate

The following risks were identified that may impact the MRE that can be mitigated or reduced with further study:

- Unexpected variations in quantity of mineralized material, grade, or recovery rates.
- Geotechnical considerations during mining are different from what was assumed.
- Failure of plant, equipment, or processes to operate as anticipated
- Variations in project costs or metal prices

# 23 Adjacent Properties

The Cowboy State Mine area is part of the Halleck Creek Rare Earth Project. The Cowboy State Mine is being developed independently from the other resource areas at Halleck Creek. The other resource area at Halleck Creek is the Overton Mountain resource area which is approximately 2.5 km north of the Cowboy State Mine area.

There are no other active mineral prospects or mining operations within 5 km of the Cowboy State Mine area.

# 24 Other Relevant Data and Information

## 24.1 Radiometric (Gamma) Core Scanning Pilot Study

Arkenstone Exploration (Mark W. Travis, CPG-12090) has proposed a pilot core-table gamma scanning program using a Ludlum Model 3 survey meter with a Ludlum Model 44-2 sodium-iodide (NaI) scintillation detector and a 7002-107 lead collimator. The proposed pilot would scan archived HQ drill core at approximately 0.5-foot intervals on selected holes for which assay data, geological logs, and (where available) downhole gamma logs already exist, to evaluate whether core-table gamma response correlates with TREO grade distribution and could supplement, or in some cases reduce reliance on, downhole gamma logging in future drilling.

As of the effective date of this Technical Report Summary, this program has been proposed but not yet executed. It is not relied upon for the Mineral Resource Estimate (Section 14) or for any other disclosure in this report. See Section 26.10(Recommendations — Future Work).

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## 24.2 Radionuclide Content

Thorium and Uranium occur in Halleck Creek mineralization at low concentrations (approximately 68 ppm combined, run-of-mine basis; see Section 13.12). ARR is working with the WDEQ and the Nuclear Regulatory Commission to evaluate requirements and proper processing and handling permits for source material (Thorium and Uranium) occurring as impurities of processing (Section 19.2.2). No radiological studies beyond those described in Sections 13, 14, and 19 have been identified.

## 24.3 No Other Material Information

Other than the items identified above and the matters already discussed in Sections 4 through 24, the Qualified Persons contributing to this Report are not aware of other material information concerning the Halleck Creek Rare Earth Project that would be required for a complete understanding of this Pre-Feasibility Study as of its effective date.

# 25 Interpretation and Conclusions

This Section presents the Qualified Persons' interpretation and conclusions regarding the geological, metallurgical, mining, infrastructure, and economic aspects of the Project summarized in Sections 4 through 24, followed in Sections 25.6 through 25.10 by an integrated assessment of data quality, resource confidence, process and engineering maturity, and overall technical readiness. Wyoming offers an established regional mining workforce and regulatory framework relevant to the Project's development, and the CSM area lies wholly within State mineral leases controlled by WRI, simplifying land-tenure considerations relative to a mixed-ownership property.

## 25.1 Geology and Mineralization

The geologic homogeneity of the deposit observed to date is expected to support a relatively consistent feedstock over the life of the Project, subject to confirmation through continued grade control and metallurgical work. The current Halleck Creek estimated Measured and Indicated mineral resource is 1.48 Gt with an average TREO grade of 3,334 ppm.

Allanite is the primary rare earth-bearing mineral at Halleck Creek, comprising approximately 1.28% of all minerals and 72% of all REE-bearing minerals. Zircon is a secondary REE-bearing mineral at approximately 0.42% of all minerals (23% of REE-bearing minerals). Minor occurrences of other REE-bearing minerals account for approximately 5%. Mineralogical characterization shows that allanite liberates well from gangue during crushing; approximately 87.5% of allanite can be liberated into pure, free, and liberated classes. The relatively large phenocrysts observed in the rock are interpreted to contribute to high allanite liberation. High liberation generally increases the ability to reject gangue through physical separation and increases overall allanite recovery. Metamictization of allanite over an estimated 1.4 billion years is interpreted to contribute to the leachability of REEs from allanite. Naturally occurring Thorium and Uranium have decayed over time, causing allanite crystals to become amorphous. The in-situ Halleck

Creek deposit is naturally low in Thorium and Uranium, with an average concentration of approximately 68 ppm.

## 25.2 Metallurgical Test Work

### 25.2.1 Comminution

Halleck Creek material has been shown to have approximately average hardness compared to other granitic rock types. The material has been shown to be less abrasive than other granitic rocks due to the lack of quartz in the host rocks. A less abrasive feedstock would be expected to reduce wear on grinding equipment and lower operating costs over time, though this has not been confirmed through extended operation.

### 25.2.2 Separation

Allanite and other higher-density minerals can be separated from lower-density gangue minerals using gravity separation methods such as reflux classifier concentrators, spirals, gravity concentrators, or dense media. Allanite has a specific gravity (SG) of 3.6 to 4.0; primary gangue minerals (feldspar, syenite, minor quartz) have SG of 2.65 to 2.75. Preliminary gravity separation test work has shown that up to 77% of gangue material can be rejected from feed, TREO concentrations can be increased by 10 times, and allanite recovery can exceed a TREO grade of 4% (40,000 ppm). Allanite and the iron-rich amphibole hastingsite are paramagnetic; approximately 4% to 5% additional gangue can be separated using Wet High-Intensity Magnetic Separation (WHIMS). Bench-scale test work indicates that up to approximately 93% of feed mass may be rejected from ROM feed using combined gravity separation, IRMS and WHIMS, with a TREO recovery of approximately 65% and a TREO concentration factor of approximately 10x; these figures have not been confirmed at pilot scale. Using this factor, the ROM grade of 3,805 ppm increases to approximately 41,855 ppm (4.2% TREO). This large gangue rejection reduces downstream equipment size and reagent consumption, lowering capital and operating costs respectively.

### 25.2.3 Leaching

Testing by Wood PLC and Virginia Tech shows that REEs can be readily leached from allanite using sulfuric acid at approximately 90 deg C and residence times of 2 to 6 hours. Leach testing indicates approximately 85% TREO extraction under these parameters. The lower temperatures and shorter residence times reduce the formation of silica gels associated with leaching silicate minerals.

Metamictization of allanite over an estimated 1.4 billion years is interpreted to enhance leachability; on this basis, high-temperature caustic or acid cracking is not considered necessary and may interfere with rare earth extraction.

### 25.2.4 Rare Earth Recovery Products

ARR and Tetra Tech concluded that producing a mixed rare earth concentrate or mixed rare earth oxide would not result in commercially viable saleable products. As a result, the Pre-Feasibility Study identified

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four marketable products: NdPr oxide, Dy oxide, Tb oxide, and an SEG concentrate containing Samarium (Sm), Europium (Eu), and Gadolinium (Gd).

Subsequent testing completed after the Pre-Feasibility Study indicated that Lanthanum carbonate (La carbonate) is not economically attractive as a saleable product. The additional test work also demonstrated that production of Samarium oxide and an EG (Europium-Gadolinium) mixed concentrate may be commercially favorable under current market conditions, largely due to China's restrictive export quotas on rare earth products.

Based on these findings, Stantec developed Net Smelter Return (NSR) calculations using five saleable products as inputs: NdPr oxide, Dy oxide, Tb oxide, Sm oxide, and the EG mixed concentrate.

## 25.3 Mining Methods

Rare earth-bearing rock at the Halleck Creek Project occurs at or near surface across extensive portions of the Wyoming State mineral leases comprising the CSM development area. The geometry, continuity, and relatively homogeneous distribution of mineralization support the application of conventional open pit mining methods with a low waste-to-ore stripping requirement.

The current Pre-Feasibility Study contemplates a conventional truck-and-shovel open pit operation employing drill-and-blast methods where required, with mining conducted in phased pit developments designed to provide consistent feed to the processing facility. The conceptual mine plan incorporates conventional waste rock storage facilities, dry-stacked tailings, and associated mine infrastructure located within the State lease area under the control of American Rare Earths.

Mine planning, pit optimization, production scheduling, and equipment selection have been developed at the Pre-Feasibility Study level using the current engineering design basis. Accordingly, production inventories, throughput rates, and mine life presented elsewhere in this report reflect the current mine planning assumptions and supersede those associated with earlier Pre-Feasibility Study design iterations. Detailed mining parameters, production schedules, and mined inventories are presented in Section 15 and the associated mine planning sections of this Pre-Feasibility Study.

The near-surface nature and lateral continuity of mineralization provide flexibility for future pit optimization and phased expansion as additional engineering, geotechnical, and economic studies are completed. While the current mine plan represents the basis for this Pre-Feasibility Study, future engineering studies may further refine pit geometry, production scheduling, and sequencing as the Project advances toward subsequent stages of technical evaluation.

## 25.4 Recovery Methods

The Pre-Feasibility Study provides for comminution and mineral separation at the CSM, with leaching and final processing at facilities adjacent to interstate and rail infrastructure. Comminution focuses on the use of a Vertical Roller Mill (VRM) to minimize fines in ROM material. Separation focuses on gravity concentrators (RCC), and dry magnetic separation (IRMS) followed by WHIMS for separation of the fines fraction. Rare earth extraction begins with leaching REEs into solution using sulfuric acid. Major impurities — Iron and

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Thorium — are removed via partial neutralization by increasing pH and precipitating these elements as hydroxides. After filtration, Aluminum and Uranium are removed using precipitation filtration and ion exchange columns (for Uranium). ARR is working with the WDEQ and the Nuclear Regulatory Commission to acquire proper processing and handling permits for source material (Thorium and Uranium) occurring as by-products of processing. Each product — NdPr, SEG, Dy, and Tb, mixed concentrate — is then refined using iterative solvent extraction and precipitation circuits specific to each product.

## 25.5 Infrastructure

Infrastructure planned for the mine site reflects the simplicity and modest scale of the mining operation. Road access and buildings for a modest workforce of hourly and salary personnel can be satisfied by prefabricated buildings or trailers. Preliminary hydrological estimates indicate sufficient water can be obtained from several wells outside the pit limits. Drilling, pumping, and piping costs are based on Stantec's mining experience. Construction of road access, line power, and natural gas supply are not expected to be difficult or expensive, as existing infrastructure is in proximity.

## 25.6 Geological Model, Data Quality, and Drilling Density

The geological model for the Halleck Creek Project is supported by a surface sample database of approximately 950 rock chip samples, a 2025 channel sampling program), and 98 drill holes (28 HQ diamond core, 70 reverse circulation) totaling 12,490 m across the Red Mountain and Overton Mountain resource areas. Core recovery for diamond drilling is reported at approximately 96%; no quantitative reverse-circulation recovery figure has been established (Section 10.5). Quality assurance and quality control performance (Section 11.4) is generally acceptable, with two CDN-RE-1201 certified reference material exceedances (Nd and Pr) and one OREAS-101b external standard anomaly identified and evaluated as part of the QA/QC review.

Taken together, the surface, channel, and drill-hole datasets provide a reasonably dense, multi-method basis for the geological and grade model at Red Mountain. Confidence in the Overton Mountain portion of the deposit is comparatively lower: it has not been the subject of infill drilling or resource update since the 2024 Odessa estimate, and its Measured resource classification was established at a coarser (90 m) drill spacing than the current Red Mountain model.

## 25.7 Mineral Resource Estimate Confidence

The Mineral Resource Estimate (Section 14) was prepared by Alfred Gillman (FAusIMM CP Geol) of Odessa Resources using ordinary kriging within a geologically constrained domain model, with model validation performed against inverse-distance and nearest-neighbor estimates (Section 14.1.2). The estimate reflects an iteratively updated modeling effort (January 2024, November 2024, and November 2025 updates for Red Mountain), each incorporating additional drilling or channel-sampling data.

The Project-wide Mineral Resource adopted for this Report is the 1,000-ppm TREO cut-off grade estimate presented in Section 14.2. Subsequent resource-estimation work for the CSM/Red Mountain area,

discussed in Section 14.17, is retained as supporting technical information and does not replace the Project-wide Mineral Resource adopted for this Report.

## 25.8 Metallurgical and Process Engineering Maturity

Metallurgical test work (Section 12) has progressed through bench-scale comminution, gravity/magnetic concentration, leaching, and impurity-removal testing across multiple independent laboratories (SGS Lakefield, Nagrom, University of Kentucky, ALS Global, Mineral Technologies, and others). Pilot-plant and continuous demonstration-scale testing will commence shortly but has not been completed.

## 25.9 Mining and Engineering Assumptions

The conceptual open-pit mine plan (Section 15) reflects preliminary pit-shell optimization applied to the Indicated Mineral Resource, using geotechnical parameters -- including an assumed 55-degree inter- ramp angle -- that have not yet been confirmed by detailed geotechnical study. Infrastructure concepts (Section 17) are at a similarly preliminary, scoping-level stage and should not be read as feasibility-level design.

## 25.10 Overall Technical Readiness

Considered as a whole, the Halleck Creek Project is supported by a geologically coherent, multi- campaign exploration and drilling database and an iteratively refined Mineral Resource Estimate, together with scoping-level mining and processing concepts consistent with an early-stage technical study. The principal factors currently limiting the maturity of this Report are: (i) incomplete hydrology/hydrogeology characterization; and (iv) the absence, as of the effective date of this Report, of pilot-scale metallurgical confirmation testing. None of these items are believed to invalidate the underlying technical work; each is a defined, practical next-stage item described in the Recommendations that follow (Section 25).

# 26 Recommendations

## 26.1 Overall Recommendation

This Section presents a sequenced work program toward a Feasibility Study, organized by workstream. Order-of-magnitude budgets are noted where a discipline-specific figure is already available from the responsible consultant; where no confirmed budget basis exists, the workstream is identified for development by the responsible discipline rather than assigned an invented figure. ARR should pursue the workstreams below in a coordinated program, with particular emphasis on continued Mineral Resource refinement and pilot-scale metallurgy, while advancing environmental, permitting, geotechnical, and engineering workstreams in parallel.

- Budget for Next Phase (USD)
- Mineral Resource update/refinement — $ 250,000
- Permitting — $2,400,000
- Environmental and social programs — $500,000

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- Hydrology — $1,000,000
- Engineering and infrastructure — $1,750,000
- Mining and Geotechnical Engineering -- $1,500,000
- Metallurgy and process recovery — $1,500,000
- Process flowsheet reconciliation — $350,000
- Feasibility Study integration and preparation — $750,000
- Total- $10,000,000

## 26.2 Mineral Resource

ARR should continue to refine and integrate the Halleck Creek Mineral Resource as additional drilling, geological interpretation, and technical data become available. Future resource updates should incorporate both the Red Mountain and Overton Mountain areas on a consistent basis, using common estimation parameters, cut-off grade assumptions, and data vintages appropriate to the applicable study stage. Any future Mineral Resource update prepared to support the Feasibility Study should also incorporate relevant results from the ongoing 2026 drilling program and other material geological or sampling data available at the time of estimation.

As the Project advances, Mineral Resource reporting should remain coordinated with evolving mine planning, metallurgical, geotechnical, and economic assumptions so that the resource model and downstream engineering studies are developed from a consistent technical basis.

## 26.3 Permitting

ARR should continue advancing the WDEQ-LQD permit-to-mine application with WWC Engineering, complete the ongoing hydrology and hydrogeology characterization described in Sections 12 and 19t. ARR should also continue coordination with the Nuclear Regulatory Commission regarding applicable requirements for thorium- and uranium-bearing by-products and maintain ongoing USACE coordination regarding Waters of the United States.

The TMF design and proposed management of Fe precipitate within dedicated, encapsulated cells should be advanced during the next phase of engineering. This work should confirm the regulatory requirements applicable to the refinery residues and further define the Fe precipitate cell configuration, encapsulation requirements, material handling, water management, monitoring, closure, and associated capital and operating costs.

## 26.4 Environmental and Social Governance

Environmental baseline studies and permitting activities have progressed substantially and provide a sound foundation for continued project advancement. As the Project advances toward a Feasibility Study, completion of ongoing baseline environmental programs, refinement of water management planning, continued stakeholder engagement, and advancement of state and federal permitting activities will support engineering studies and future project development. These activities represent the normal progression of the Project toward the next stage of technical and engineering evaluation.

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## 26.5 Geology and Exploration

The Halleck Creek Project provides opportunities for continued geological refinement and resource expansion. Future geological work may include continued mapping, surface sampling, and targeted drilling to improve geological confidence, expand the defined Mineral Resource footprint where warranted, and further evaluate prospective areas within the broader Red Mountain Pluton, including the Bluegrass and County Line areas. Additional infill drilling in selected portions of the existing Mineral Resource may also support future refinement of Mineral Resource classifications as geological understanding continues to evolve.

## 26.6 Engineering and Infrastructure

Infrastructure concepts described in this Report (Section 17) are at a Pre-Feasibility level stage of definition. As the Project advances, engineering studies should further evaluate process-site configuration, including mine-site concentration and centralized processing alternatives, and refine infrastructure requirements associated with the proposed Wheatland-area refinery, including site selection, land control, utilities, access, and supporting infrastructure. These studies should be integrated with the evolving process flowsheet and mine plan to support the Project's next stage of engineering definition.

## 26.7 Mining and Geotechnical Engineering

Mining and geotechnical engineering evaluations completed to date are appropriate for the current Pre-Feasibility Study level of study. Additional geotechnical investigations, pit slope characterization, foundation studies, and refinement of mine design parameters are expected to support subsequent engineering studies and continued optimization of the proposed open-pit operation. These activities represent the normal progression of engineering definition as the Project advances toward a Pre-Feasibility Study.

## 26.8 Metallurgy and Process Recovery

Continued metallurgical development should focus on confirming and optimizing the proposed processing flowsheet in preparation for the next phase of engineering. Completion of ARR's pilot and demonstration plant program, currently targeted for completion by the end of 2026, should remain the highest priority. Results from the pilot program should be integrated with vendor-scale HPGR test work to support selection of the final comminution circuit.

Subsequent test work should refine the mine-site beneficiation process, including gravity and WHIMS concentration, to validate mass balances, establish optimum particle-size cut-offs, and further evaluate the recovery potential of zircon as a by-product. Additional thermal testing should optimize calcination conditions through evaluation of temperature, residence time, and roasting with sulfuric acid and/or caustic reagents.

Hydrometallurgical test work should continue to optimize sulfuric acid tank leaching of calcined concentrate by evaluating the effects of solids concentration, grind size, temperature, acid concentration, and oxidation

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conditions. Downstream impurity removal should further assess neutralization conditions, ion-exchange resin selection for Uranium and Iron removal, and precipitation performance.

Solvent extraction studies should continue to refine separation of the principal rare earth products, including La, NdPr, Sm, Dy, Tb, and the EG concentrate, through additional batch and continuous testing to optimize circuit configuration and product quality.

Wastewater treatment studies should further characterize process streams and confirm pH adjustment and precipitation requirements.

Finally, additional mineralogical and metallurgical investigations should be undertaken to better understand the apparent suppression of heavy rare earth recovery, including evaluation of zircon-hosted rare earths and characterization of leach residues where appropriate.

## 26.9 Process Flowsheet Reconciliation

As metallurgical test work advances, the evolving process flowsheet should be consolidated into a single integrated basis for subsequent engineering studies. Results from ongoing pilot-scale, comminution, beneficiation, thermal treatment, leaching, impurity-removal, and solvent-extraction programs should be incorporated into the flowsheet as they become available. Attention should be given to confirming key process conditions, mass balances, recovery assumptions, reagent requirements, and interfaces between mine-site concentration and downstream hydrometallurgical processing. A progressively refined and integrated process basis will support subsequent engineering design, cost estimation, and Feasibility Study evaluation.

## 26.10 Future Work and Path to a Feasibility Study

The Halleck Creek Project has advanced significantly since completion of the February 2025 Scoping Study through additional drilling, geological refinement, updated Mineral Resource estimation, and continued metallurgical development. The next phase of work should focus on converting this technical foundation into the engineering confidence required to support a Feasibility Study.

Metallurgical work currently underway provides an important step toward that objective. ARR is conducting large-scale bench testing at Nagrom Laboratories in Perth, Western Australia, and at the Saskatchewan Research Council (SRC) in Saskatoon to validate and refine the proposed process flowsheet and establish process traceability. In parallel, ARR is developing pilot-scale work in Wyoming to evaluate mine-site comminution and mineral concentration using bulk mineralized material. Concentrate produced through this program is expected to support downstream hydrometallurgical testing and further process optimization.

In parallel with metallurgical advancement, the geological, Mineral Resource, geotechnical, infrastructure, environmental, permitting, and engineering workstreams described in this Section should continue in a coordinated manner. Results from these programs should progressively inform updated geological and resource models, mine planning, process design, infrastructure requirements, cost estimation, and other technical inputs required for the next stage of study.

A pilot core-table gamma scanning program should also be evaluated to determine whether systematic radiometric measurements can provide a cost-effective supplementary dataset for geological logging and resource evaluation. If demonstrated to be effective, this approach may improve geological interpretation and support future drilling programs.

Collectively, these activities are expected to reduce technical uncertainty, improve engineering confidence, and provide the information necessary to support completion of a Feasibility Study and subsequent advancement of the Halleck Creek Project.

# 27 References

Chapman SS, Bryce SA, Omernik JM, Despain DG, ZumBerge J, Conrad M. (2004). Ecoregions of Wyoming (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Cleary MB, Pendall E, Ewers BE. (2010). Aboveground and belowground carbon pools after fire in mountain big sagebrush steppe. *Rangeland Ecology & Management* **63**(2): 187-196. DOI: 10.2111/REM-D-09-00117.1

IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K (eds). Published: IGES, Japan.

Jackson RB, Banner JL, Jobbagy EG, Pockman WT, Wall DH. (2002). Ecosystem carbon loss with woody plant invasion of grasslands. *Nature* **418**: 623-326.

Knapp AK, *et al*. (2008). Shrub encroachment in North American grasslands: shifts in growth form dominance rapidly alters control of ecosystem carbon inputs. *Global Change Biology* **14**: 615-623.

Lorenz K, Lal R. (2005). The depth distribution of soil organic carbon in relation to land use and management and the potential of carbon sequestration in subsoil horizons. *Advances in Agronomy* **88**: 35-66.

Southwick Associates (SA). (2017). *Economic Contributions of Big Game Hunting in Wyoming.* Southwick Associates, Inc. Fernandina Beach, FL.

Wyoming Game and Fish Department (WGFD). (2017). *Wyoming State Wildlife Action Plan*. Wyoming Game and Fish Department, Cheyenne, WY.

WGFD. (2020). *Statewide Habitat Plan*. Wyoming Game and Fish Department, Cheyenne, WY.

WGFD. (2024). *American Pronghorn – A Species Profile*. Wyoming Game and Fish Department, Cheyenne, WY.

For personal use only

University of Wyoming (UWYO). (2025). *Wyoming Natural Diversity Database – Data Explorer*. University of Wyoming. https://wyndd.org/portal/apps/data_explorer/pro/map (Accessed 1 September 2025)

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# Appendix A Halleck Creek JORC Table

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The conclusions in the Report titled Halleck Creek JORC Table  are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from Wyoming Rare - Cowboy State Mine (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

| **Section 1 Sampling Techniques and Data** | | |
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| (Criteria in this section apply to all succeeding sections.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Sampling techniques* | *Nature and quality of sampling (e.g. cut channels, random chips, or specific specialized industry standard measurement tools appropriate to the minerals under investigation, such as downhole gamma sondes, handheld XRF instruments, etc.). These examples should not be taken as limiting the broad meaning of sampling.* | Sample material from the CSM Project includes rock chip outcrop samples, channel samples, RC drill samples, and diamond drill core. Wyoming Rare maintains SOPs for sample collection, logging, security, and transport. |
| | *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* | Rock chip samples are split in the office. One part is ground to P100-P180 mesh (0.08 mm) and analyzed in triplicate on an Olympus Vanta handheld XRF analyzer. Odessa Resources' 2024 statistical evaluation confirmed that increasing the core sample interval from 1.5 m to 3.0 m has no significant influence on resource estimates. |
| | *Aspects of the determination of mineralization that are Material to the Public Report.* | Rare earth mineralization at Halleck Creek is disseminated, allanite-hosted and is not visually distinguishable in core or chips. Determination of mineralization therefore rests entirely on laboratory assay rather than on visual logging or estimation. |

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| | | The determinations that are Material to the Report are: total rare earth oxide (TREO) grade; the split of TREO into light, medium and heavy fractions (LREO, MREO, HREO); and the proportion of magnet rare earth oxides, principally neodymium-praseodymium (NdPr), which accounts for approximately 87% of life-of-Project revenue in the economic analysis. TREO, LREO, MREO and HREO are reported as sum calculations of the individually assayed rare earth element grades. Thorium, uranium, zirconium and iron were also estimated. (Sections 6, 8.4 and 11.2.2.) |
| | *In cases where 'industry standard' work has been done, this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverized to produce a 30 g charge for fire assay'). In other cases, more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralization types (e.g. submarine nodules) may warrant disclosure of detailed information.* | Rock chip, channel, RC, and diamond core sampling methods used at Halleck Creek are consistent with industry standards for this deposit type. |
| *Drilling techniques* | *Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or another type, whether the core is oriented and if so, by what method, etc.).* | Drilling used two methods across four campaigns from 2022 to 2024: HQ diamond core drilling (28 holes, 3,362 m, 63.5 mm core) and reverse circulation drilling (70 holes, 9,128 m). Core was sampled at 1.5 m intervals prior to 2024 except at lithological breaks; 2024 core holes were sampled at 3.0 m intervals. RC drilling produced three chip samples per 1.5 m interval using a rotary sample splitter. |
| *Drill sample recovery* | *Method of recording and assessing core and chip sample recoveries and results assessed.* | Core recovery at Halleck Creek is approximately 96% for diamond core holes. No quantitative recovery figure was calculated for RC drilling; no zones of loss or zero-sample recovery were recorded in any RC program. |
| | *Measures are taken to maximize sample recovery and ensure the representative nature of the samples.* | Recovery of core and RC chips to surface has been consistently high. The rotary sample splitter used in RC drilling provides representative samples. |
| | *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.* | No relationship between sample recovery and grade has been assessed or reported in the Pre-feasibility Study.<br>Diamond core recovery averages approximately 96%, and no zones of core loss or zero-sample recovery were recorded in any of the four drilling campaigns. The |

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| | | dataset therefore contains little recovery variation against which grade could be tested. On that basis sample bias arising from preferential loss or gain of fine or coarse material is not considered likely, but this has not been quantitatively demonstrated and remains an item for the next study stage. (Section 7.4.4.) |
| *Logging* | *Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.* | All core and RC chip cuttings were logged in detail by Wyoming Rare geologists, including RQD, lithology, and alteration. WSP-trained geologists have completed geotechnical logging since 2023. |
| | *Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc.) photography.* | Logging includes quantitative RQD measurement and qualitative description of lithology and alteration. All core is photographed. RC cuttings are logged under 10x binocular microscope and photographed for each hole. |
| | *The total length and percentage of the relevant intersections logged.* | All 98 drill holes completed to date have been geologically logged in full, comprising 28 HQ diamond core holes (3,362 m) and 70 reverse circulation holes (9,128 m) for a total of 12,490 m (40,979 ft). Logging coverage is therefore 100% of drilled meters, and all 98 holes are included in the resource models.<br>Geotechnical logging is not continuous across the full dataset. Geotechnical logging by WSP-trained geologists has been undertaken since 2023, and 48 geotechnical core samples from 11 drill holes were collected during the Fall 2024 program. (Sections 7.4 and 11.1.1.) |
| *Sub-sampling techniques and sample preparation* | *If core, whether cut or sawn and whether quarter, half or all core taken.* | Diamond core was cut longitudinally in half using a core saw. Core sample intervals were selected at lithological breaks, measured with a tape measure, marked on the core and core box with a paint pen, and tagged with ALS sample tags and barcodes. One half of the cut core was submitted for assay, with the remaining half retained in the core box for reference. |
| | *If non-core, whether riffled, tube sampled, rotary split, etc. and whether sampled wet or dry.* | RC drilling uses a rotary sample splitter, producing three samples (plus a fourth reserve split) per 1.5 m interval: one for chip trays, one for in-house XRF analysis, and one for external assay. |
| | *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* | Diamond core sample intervals are set by lithologic breaks and never cross lithology boundaries. Intervals are measured with a tape measure and marked on the core with a paint pen. ALS sample tags and barcodes are affixed to the core box, with entries recorded in the sample booklet. RC sampling uses a rotary splitter producing separate chip-tray, XRF, and assay splits for each interval. |

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| | *Quality control procedures adopted for all sub-sampling stages to maximize the representivity of samples.* | CRMs were inserted at a rate of approximately 1 per 19 samples for both RC and diamond core drilling. Total QA/QC insertion rates for the 2024 programs were 6.84% for diamond core (35 samples) and 4.51% for RC drilling (60 samples), including CRMs, blanks, and duplicates. |
| | *Measures are taken to ensure that the sampling is representative of the in situ material collected, including, for instance, results for field duplicate/second-half sampling.* | Company duplicate samples (riffle splits of coarse rejects) returned a regression $R^2$ greater than 0.99 for all elements against TREE content. |
| | *Whether sample sizes are appropriate to the grain size of the material being sampled.* | Sample support is 1.5 m (approximately 5 ft) for rock chip, channel, reverse circulation and pre-2024 diamond core sampling. For the 2024 core program, Odessa Resources carried out a statistical evaluation demonstrating that 3.0 m sample lengths have no statistically significant influence on resource estimates, provided lithological contacts are sampled discretely; 2024 core holes accordingly used 3.0 m intervals in homogeneous lithology with shorter intervals at contacts. Mineralogical characterization by SGS Lakefield established P80 and median grain sizes by mineral phase for the REE-bearing minerals. The Pre-feasibility Study does not contain an explicit assessment of sample mass against grain size. The mineralization is fine grained, disseminated and evenly distributed, and variography of TREO returned a near-zero nugget with long ranges, which is consistent with sample sizes being adequate for the material being sampled. (Sections 8.1, 10.3.5 and 11.2.4.) |
| *Quality of assay data and laboratory tests* | *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* | ALS analyzes samples by ICP-MS using the ME-MS81d package (including ME-ICP06 for whole rock analysis), providing quantitative results for all rare earth elements, major oxides, and selected trace elements. |
| | *For geophysical tools, spectrometers, handheld XRF instruments, etc., the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* | Surface rock chip samples are analyzed in triplicate using an Olympus Vanta handheld XRF analyzer as an initial screening tool ahead of external laboratory assay. |
| | *Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks)* | QA/QC included company and laboratory blanks, company and laboratory duplicates ($R^2$ > 0.99 for TREE), and CRMs (CDN-RE-1201 and CDN-RE-1202 internally; AMIS0304, OREAS 146, OREAS-101b, and SY-5 at ALS). Two CDN-RE- |

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| | *and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.* | 1201 results (Nd and Pr) and one ALS OREAS-101b result fell outside acceptable tolerance and require further investigation. |
| *Verification of sampling and assaying* | *The verification of significant intersections by either independent or alternative company personnel.* | The Competent Person routinely verified geological data collection and analysis throughout the drilling and analytical programs, reviewed geological descriptions against core and RC cutting photographs, monitored analytical progress through ALS's online laboratory information management system, and prepared and reviewed strip logs of assay and geological data for each drill hole. The Competent Person concluded that the data collected and maintained by ARR is comprehensive and adequate for geological modeling and resource estimation. No significant intersections are reported as Exploration Results, so no separate verification of individual intersections arises. (Section 9.) |
| | *The use of twinned holes.* | No twinned holes have been drilled at Halleck Creek, and none are reported in the Pre-feasibility Study. |
| | *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* | All drill hole collar information, surveys, lithology, alteration, assays, and geotechnical data are entered into the DHDB, which provides secure user access and audit tracking. Assay and QA/QC data are imported directly from certified laboratory data, which minimizes data entry error. Validation queries check for gaps and overlaps in lithology, alteration and assay data, cross-reference total depths of collar and lithologic data, and cross-reference entries to data dictionaries to restrict data entry to approved values. Original field logs, core and chip photographs and certified assay certificates are stored within the DHDB and cross-referenced to each drill hole. (Sections 8.9.2 and 8.9.4.) |
| | *Discuss any adjustment to assay data.* | No adjustment, factoring or recalculation of assay data is reported.<br>Grades were not capped and no outlier restrictions were applied at any estimation pass. TREO, LREO, MREO and HREO are reported as sums of the individually assayed rare earth element grades rather than as adjusted or derived values. Handheld XRF readings are used as a field screening tool only and do not substitute for, or adjust, the ALS laboratory assays used in the resource estimate. (Sections 8.4 and 11.2.2.) |
| *Location of data points* | *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* | Drill hole collars were surveyed by Laramie Land Surveying, registered professional land surveyors, using the NAD 1983 UTM Zone 13 North projection. Downhole |

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| | | deviation surveys were collected for all holes except the 2022 maiden program, which was drilled vertically. |
| | *Specification of the grid system used.* | Drill hole, trench, and surface sample locations are stored using the NAD 1983 UTM Zone 13 coordinate system. WGS 1984 latitude/longitude coordinates are retained as secondary coordinates. |
| | *Quality and adequacy of topographic control.* | Topographic control is provided by LiDAR data acquired from the United States Geological Survey, released publicly in August 2022 under the USGS Earth MRI project. Wyoming Rare personnel processed the LiDAR imagery into high-resolution topographic surfaces for use in ArcGIS and Leapfrog, and these surfaces were used to constrain the geological model and the block model. Topographic control is considered adequate for a resource estimate at this stage. (Sections 7.8 and 11.3.) |
| *Data spacing and distribution* | *Data spacing for reporting of Exploration Results.* | The drill pattern at Red Mountain is mostly irregular, with drill spacing of approximately 200 m. Fifty drill holes provide the data points for the Cowboy State Mine resource estimate, supported by 112 channel samples and a surface database of approximately 950 rock chip samples. No Exploration Results are reported, so no data spacing is quoted for that purpose. (Section 11.2.7.) |
| | *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* | Empirical observations and statistical analysis, supported by variography, confirm a high degree of geological and grade continuity within the Red Mountain rock masses. |
| | *Whether sample compositing has been applied.* | Grades were composited to 1.5 m (5 ft), the dominant sampling interval. |
| *Orientation of data in relation to geological structure* | *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* | Mineralization at Halleck Creek is controlled by batholith-scale fractionation, not by structural (fracture or vein) control. |
| | *If the relationship between the drilling orientation and the orientation of key mineralized structures is considered to have introduced a sampling bias, this should be assessed and reported if material.* | As mineralization is not structurally controlled, drilling orientation relative to any mineralized structure is not considered to have introduced a sampling bias. |
| *Sample security* | *The measures are taken to ensure sample security.* | Wyoming Rare geologists collect and log drilling samples daily, and surface geochemical and channel samples stay in the possession of Wyoming Rare |

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| | | geologists while in the field. Prior to shipping, drill core is held in a storage yard that is locked whenever no Wyoming Rare employees are on site, and RC chips are held in a locked shipping container. All samples are transported to Wyoming Rare's secure storage facilities in Laramie, Wyoming, and are cataloged with sample manifests prepared before shipment. Shipments are boxed or bagged, wrapped and sent by bonded carrier, with Wyoming Rare personnel preparing each shipment and supervising loading. ALS has carried out analytical services for Wyoming Rare since 2022 and maintains its own internal chains of custody. Split core not consumed in analysis and all sample pulps are returned to Wyoming Rare and stored in locked cabinets at the Laramie warehouse, and Wyoming Rare intends to retain them indefinitely. (Section 8.6.) |
| *Audits or reviews* | *The results of any audits or reviews of sampling techniques and data.* | Mr. Paul Dockwiler, CPG, CEM, audited the Halleck Creek core material in June 2025 and also reviewed Wyoming Rare's standard operating procedures and field procedures in the same month. No formal audit of the drill hole database has been carried out, and no bias analysis, check-and-balance review or dedicated sampling audit has been performed. Wyoming Rare personnel have not carried out in-person laboratory checks at ALS or SGS. Two CDN-RE-1201 certified reference material results (Nd and Pr) and one OREAS-101b external standard result fell outside acceptable tolerance and remain subject to further investigation. (Sections 8.5.3, 8.9.5 and 8.10.) |

| **Section 2 Reporting of Exploration Results** | | |
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| (Criteria listed in the preceding section also apply to this section.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Mineral tenement and land tenure status* | *Type, reference name/number, location and ownership, including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* | Wyoming Rare controls mineral rights through 365 unpatented federal lode mining claims administered by the BLM (approximately 7,831 acres, 3,169 ha) and four Wyoming State Mineral Leases administered by WOSLI (approximately 1,560 acres, 631 ha), together totaling approximately 9,391 acres (3,800 ha). The Wyoming State Mineral Leases, assigned to Wyoming Rare in June 2021, constitute the core of the CSM project area addressed in this Pre-feasibility Study. A sliding-scale royalty of 5% to 10% on revenue is payable to the State of Wyoming on production from the State Mineral Leases; no other royalties are known to apply. |

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| | *The security of the tenure held at the time of reporting and any known impediments to obtaining a license to operate in the area.* | Wyoming Rare has not received any violations or fines from the State of Wyoming or federal government in connection with Halleck Creek. Wyoming Rare holds a License to Explore by Dozer permit and an active exploration drilling permit (DN-0511) from WDEQ-LQD, and has not yet filed a mine permitting application. The point of valuation for the State of Wyoming royalty is currently under review with WOSLI. Water rights have not been adjudicated for the Project. |
| *Exploration done by other parties* | *Acknowledgment and appraisal of exploration by other parties.* | Anderson (1995) documented anomalous REE values at Red Mountain in a PhD thesis, providing the basis for later exploration interest. Blackfire Minerals acquired the Wyoming State Mineral Leases in 2010 and conducted preliminary research before dropping the leases in 2011 due to low REE prices; no drilling or resource estimation was completed. Zenith Mineral Ltd. reactivated the Project in 2018, staked five federal lode claims, and collected 87 surface samples in 2019 showing broad REE mineralization exceeding 2,000 ppm TREO; no Mineral Resources were compiled or reported by Zenith. |
| *Geology* | *Deposit type, geological setting and style of mineralization.* | The CSM Project is hosted within the Red Mountain Pluton (RMP), a magmatic allanite-hosted REE deposit composed primarily of monzonitic to syenitic rocks, classified as an A-type granite. REE mineralization is attributed to fractional crystallization during the final stages of magma evolution, concentrating allanite and other REE-bearing phases. Hydrothermal alteration in the RMP is minimal and does not appear to have significantly affected REE mineralization. |
| *Drill hole Information* | *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:* | Wyoming Rare completed four exploration drilling campaigns between March 2022 and October 2024, totaling 98 holes for 12,490 m (40,979 ft): 28 HQ diamond core holes for 3,362 m and 70 reverse circulation holes for 9,128 m. By area, Red Mountain accounts for 50 holes and 6,565 m and Overton Mountain for 48 holes and 5,925 m. All holes are included in the resource models. The 2022 maiden core program was drilled vertically and no downhole surveys were collected; downhole surveys were collected for all subsequent holes. Maiden core samples were assayed at American Assay Laboratories in Sparks, Nevada. Rock chip, RC and core samples from fall 2022 onward were prepared by ALS Global in Twin Falls, Idaho and assayed at ALS Global in Vancouver, British Columbia, with 2023 and 2024 core prepared at ALS Global in Reno, Nevada. In 2024 Wyoming Rare drilled 17 RC holes and 11 diamond core holes in the Cowboy State Mine area, and SGS in Lakefield, Ontario updated the mineralogical characterization using TIMA-X |

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| | | analysis. All collar information, surveys, lithology, alteration, assay and geotechnical data were entered into the DHDB. (Sections 7.4, 8.4.1 and 11.1.2.) |
| | *easting and northing of the drill hole collar* | Drill hole data from the 2022-2024 exploration campaigns is published in the "Technical Report of Exploration and Maiden Resource Estimates, Halleck Creek Rare Earths Project" (March 2023), the "Technical Report of Exploration and Updated Resource Estimates, Halleck Creek Rare Earths Project" (January 2024), the "Halleck Creek Updated Scoping Study Technical Report (Revision 3)" (28 February 2025), and the "Halleck Creek REE Project, Red Mountain Update Report" (Odessa Resources, 1 November 2025). |
| | *elevation or RL (Reduced Level – elevation above sea level in meters) of the drill hole collar* | Collar elevations were captured in the same registered survey and are held in the DHDB. Elevations are consistent with the LiDAR topographic surface used for the geological and block models. Individual collar RLs are not tabulated in the Pre-feasibility Study. (Sections 7.4.5 and 11.3.) |
| | *dip and azimuth of the hole* | Downhole deviation surveys were collected for all drill holes other than those of the 2022 maiden program, which were drilled vertically. Survey data are stored in the DHDB and were used in the resource models. Individual hole dips and azimuths are not tabulated in the Pre-feasibility Study. (Section 7.4.6.) |
| | *downhole length and interception depth* | No intercepts are reported as Exploration Results, so interception depths are not tabulated. Mineralization has been observed to a depth of 298 m at Red Mountain and 302 m at Overton Mountain, and both areas remain open at depth. Downhole lengths for every hole are held in the DHDB. (Sections 6 and 7.4.) |
| | *Hole length.* | Individual hole lengths are not tabulated. Aggregate lengths are reported by area and hole type: Red Mountain 6,565 m from 50 holes, Overton Mountain 5,925 m from 48 holes, for a Project total of 12,490 m from 98 holes. (Section 7.4.) |
| | *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.* | The Pre-feasibility Study reports Mineral Resource and Ore Reserve estimates; it does not report Exploration Results, and no individual intercepts are quoted. Hole-by-hole collar, survey and intercept tabulations are therefore not considered Material to an understanding of the Report, and their omission does not detract from it.<br>The underlying data for all 98 holes is held in the DHDB, was validated for gaps and overlaps, for consistency between collar and lithologic depths and against data dictionaries, and was reviewed by the Competent Person, who concluded it is |

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| | | adequate for geological modeling and resource estimation. Should Exploration Results be reported in a future public report, a full drill hole tabulation should be appended. (Sections 8.9 and 9.) |
| *Data aggregation methods* | *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually Material and should be stated.* | No Exploration Result intercepts are aggregated or reported in the Pre-feasibility Study.<br>For resource estimation, assay grades were composited to 1.5 m (5 ft), the dominant sampling interval. No weighting, maximum or minimum grade truncation, top-cutting or capping was applied, and no outlier restrictions were used at either estimation pass. The Mineral Resource is reported above a cut-off grade of 1,000 ppm TREO. (Sections 11.1.2, 11.2.3 and 11.5.) |
| | *Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low-grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.* | Not applicable. No aggregated intercepts are reported, and therefore no aggregation of short high-grade lengths with longer low-grade lengths arises. Mineralization at Halleck Creek is bulk-hosted and disseminated rather than occurring as discrete high-grade intervals. |
| | *The assumptions used for any reporting of metal equivalent values should be clearly stated.* | No metal equivalent values are reported. Grades are reported as TREO and as its LREO, MREO and HREO components, and as individual rare earth oxides, each derived as a sum of individually assayed element grades.<br>The economic analysis models revenue from four separately priced products, namely NdPr oxide, SEG (samarium, europium and gadolinium) oxide, terbium oxide and dysprosium oxide, rather than from a metal-equivalent grade. (Section 19.) |
| *Relationship between mineralization widths and intercept lengths* | *These relationships are particularly important in the reporting of Exploration Results. If the geometry of the mineralization with respect to the drill hole angle is known, its nature should be reported. If it is unknown and only the downhole lengths are reported, there should be a clear statement to this effect (e.g. 'down hole length, true width not known').* | Mineralization is a large, near-surface, disseminated body controlled by batholith-scale fractionation rather than by discrete mineralized structures. The Pre-feasibility Study states that, because mineralization is not structurally controlled, drilling orientation relative to any mineralized structure is not considered to have introduced a sampling bias.<br>No intercepts are reported as Exploration Results and no true-width corrections have been applied or required. Any downhole lengths held in the database are downhole lengths; true widths are not separately reported. (Sections 6 and 8.2.3.) |

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| *Diagrams* | *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported. These should include, but not be limited to, a plan view of drill hole collar locations and appropriate sectional views.* | Maps and cross sections are included in this Report, including a mineral tenure map, a surface control map, and a simplified geologic map of the Laramie Anorthosite Complex showing the location of the Red Mountain Pluton. |
| *Balanced reporting* | *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.* | The Pre-feasibility Study reports a Mineral Resource estimate for the whole modeled deposit above a 1,000 ppm TREO cut-off rather than selected intercepts, so reporting is inherently balanced. Grades were not capped or truncated and no outlier restrictions were applied, so high and low grades are represented as assayed.<br>Resource statements are presented both by classification category and by mineral owner, covering the Cowboy State Mine, Red Mountain Federal and Trail Creek areas, with the respective areas and the cut-off grade stated. The Pre-feasibility Study also discloses unfavorable information, including two certified reference material exceedances (Nd and Pr) and one external standard anomaly that remain subject to further investigation, and the comparatively lower confidence of the Overton Mountain portion of the deposit, which is not included in the current Mineral Resource estimate. (Sections 8.5.3, 11.6 and 22.) |
| *Other substantive exploration data* | *Other exploration data, if meaningful and material, should be reported, including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.* | Ground geophysical surveys have not been employed at Halleck Creek. The homogeneous nature of the host lithology and the low levels of radionuclides, metallic oxide minerals, and sulfide minerals do not lend themselves to conventional geophysical exploration methods. Wyoming Rare geologists were evaluating the use of handheld gamma spectrometers during the 2025 field season. |
| *Further work* | *The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out drilling).* | ARR/Wyoming Rare plans continued geological mapping, surface sampling, and targeted drilling to improve geological confidence and evaluate prospective areas within the broader Red Mountain Pluton, including the Bluegrass and County Line areas. Additional infill drilling in selected portions of the existing Mineral Resource is also planned to support future refinement of Mineral Resource classifications. |

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| | *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.* | The Pre-feasibility Study sets out a sequenced work program toward a Feasibility Study, with an order-of-magnitude budget of approximately US$8.1 million, comprising: geology and exploration US$2.0 million; metallurgy and process recovery US$1.5 million; mining and geotechnical engineering US$1.5 million; permitting US$1.0 million; engineering and infrastructure US$750,000; feasibility study integration and study preparation US$750,000; environmental and social programs US$500,000; process flowsheet reconciliation US$350,000; and Mineral Resource update and refinement US$250,000.<br>Exploration specific work comprises continued geological mapping and surface sampling; targeted drilling to improve geological confidence and to expand the Mineral Resource footprint where warranted, including evaluation of the Bluegrass and County Line areas within the broader Red Mountain Pluton; and additional infill drilling in selected portions of the existing Mineral Resource to support refinement of resource classification. A 2026 drilling program was in progress at the effective date, and its results are to be incorporated in any future Mineral Resource update supporting the Feasibility Study. (Section 23.) |

| **Section 3 Estimation and Reporting of Mineral Resources** | | |
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| (Criteria listed in the preceding section also apply to this section.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Database integrity* | *Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.*<br>*Data validation procedures used.* | All drill hole and surface sample data were imported into the DHDB drill hole database, maintained by Wyoming Rare since 2004 and tailored for rare earth element data. Assay and QA/QC data are imported directly from certified laboratory data, minimizing data entry errors, and detailed validation queries are applied to the drill hole data. |
| *Site visits* | *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.*<br>*If no site visits have been undertaken indicate why this is the case.* | Alfred Gillman (Odessa Resources) visited the site on 7 March 2024, including Red Mountain and the core storage facility at Western Research Institute (Wyoming Rare) in Laramie, Wyoming. Patrick Sobecke (Stantec) visited the site on 10 February 2025, accompanied by Erick Kennedy (Stantec) and Sara Stotter (ARR). Mark Travis (Arkenstone Exploration) visited the site on 12-13 May 2026. Kelton |

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| | | Smith (Tetra Tech) has visited the site on numerous occasions in 2024, 2025, and 2026. |
| *Geological interpretation* | *Confidence in (or conversely, the uncertainty of ) the geological interpretation of the mineral deposit.*<br>*Nature of the data used and of any assumptions made.*<br>*The effect, if any, of alternative interpretations on Mineral Resource estimation.*<br>*The use of geology in guiding and controlling Mineral Resource estimation.*<br>*The factors affecting continuity both of grade and geology.* | The geological resource model was created by Odessa Resources using Leapfrog Edge modeling tools. A revised three-dimensional geological model isolates the higher-grade Red Mountain Pluton (RMP) domain from surrounding lithologies. Modeling domains comprise Quaternary alluvium (QAL), RMP (clinopyroxene quartz monzonite), RMP1 (biotite-hornblende quartz syenite and fayalite monzonite), the unmineralized Elmers Rock Greenstone Belt (ERGB), low-grade Sybille intrusions (SYB), and the Laramie Anorthosite Complex country rock (LAC). |
| *Dimensions* | *The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.* | The Red Mountain project area is approximately 2,075 m x 1,013 m; the Overton Mountain project area is approximately 1,210 m x 1,648 m. Both deposits remain open at depth: mineralization has been observed to a depth of 302 m at Overton Mountain and 298 m at Red Mountain. |
| *Estimation and modelling techniques* | *The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.*<br>*The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.*<br>*The assumptions made regarding recovery of by-products.*<br>*Estimation of deleterious elements or other non-grade variables of economic significance (eg sulfur for acid mine drainage characterization).* | Grade estimation was carried out by Odessa Resources in Leapfrog Edge using ordinary kriging. A standard variogram was modeled on undomained TREO composites and the interpolant profile developed for TREO was applied to the individual rare earth elements and minerals. Estimations were carried out on each rare earth element together with $UO_2$, $ThO_2$, $ZrO_2$ and Fe, so deleterious and non-grade variables of economic significance were estimated alongside the pay elements. Final TREO, HREO, LREO and MREO grades are reported as sum calculations of the respective element grades.<br>An orthogonal block model was used with a parent block size of 20 m by 20 m by 10 m and a minimum block size of 5 m by 5 m by 2.5 m. Several block sizes were trialed; differences in the resulting estimates were almost imperceptible, and the 20 by 20 by 10 m parent block was selected for faster processing and reporting. Parent block size is small relative to the approximately 200 m drill spacing. No selective mining unit was applied within the Mineral Resource block model; a selective mining unit was applied separately when the model was regularized for Ore Reserve pit optimization.<br>Two estimation passes were used at Red Mountain: Pass 1 with a 150 by 150 by 120 m search ellipsoid, minimum 4 and maximum 15 samples; Pass 2 with a 500 by |

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| | *In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.*<br>*Any assumptions behind modelling of selective mining units.*<br>*Any assumptions about correlation between variables.*<br>*Description of how the geological interpretation was used to control the resource estimates.*<br>*Discussion of basis for using or not using grade cutting or capping.* | 500 by 200 m ellipsoid, minimum 2 and maximum 15 samples. The TREO variogram is spherical with a normalized nugget of 0.1, a normalized sill of 0.8 and ranges of 445 m, 240 m and 170 m. Resource boundary limits were set at 90% of the sill range from variography. Grades were not cut or capped and no outlier restrictions were applied, on the basis of the homogeneous, low-nugget nature of the mineralization.<br>Check estimates were run using inverse distance squared and nearest neighbor methods (see 'validation' below). The estimate supersedes the February 2025 Scoping Study estimate and the differences are reconciled in the Resource Estimate Differences section. There are no mine production records, as the Project has no production history. No by-products are currently associated with the Cowboy State Mine; recovery assumptions are applied only in the downstream economic analysis. (Sections 11.2 and 11.7.) |
| | *The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.* | Validation runs (inverse distance squared, isotropic ID2, ID2 with variogram, and nearest neighbor) were compared against the kriged estimator and against raw composite data in east-west and north-south swath plots across Red Mountain. The kriged estimator was found to estimate a global resource grade with no systematic bias towards overestimating grades. |
| *Moisture* | *Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.* | Tonnages are estimated on a dry in-situ basis, using a specific gravity / dry bulk density of 2.70 derived from hydrostatic testing. Natural moisture content was not separately determined and no moisture allowance is applied to the reported tonnages. (Sections 7.3 and 10.3.) |
| *Cut-off parameters* | *The basis of the adopted cut-off grade(s) or quality parameters applied.* | The Mineral Resource is reported at a cut-off grade of 1,000 ppm TREO. Stantec developed net smelter return (NSR) calculations based on recovering oxides of NdPr, La, Dy, Tb, and SEG (mixed samarium, europium, and gadolinium), which demonstrated that 1,000 ppm TREO is the economic cut-off grade for in situ resource estimates within the proposed resource limits. |
| *Mining factors or assumptions* | *Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and* | Resource material is at surface and can be mined with conventional open-pit mining equipment. Uncontrolled minerals (not controlled by ARR) were excluded from the resource estimate. Pit shell optimization using Whittle software confirms the Mineral Resource at CSM is amenable to open-pit mining at grades above the cut-off, with the resource located at or near surface at a low strip ratio. |

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| | *parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.* | |
| *Metallurgical factors or assumptions* | *The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.* | Metallurgical and mineralogical studies indicate that REE recoveries are broadly homogeneous across the Red Mountain and Overton Mountain resource areas. Representative core material from both areas was used to establish the concentration flowsheet, and geologist's logs and REE assays are consistent with the observed homogeneity of the deposit. |
| *Environmental factors or assumptions* | *Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.* | The Mineral Resource is assumed to be amenable to conventional open-pit mining. The material is at or near surface and can be mined with conventional open-pit equipment, and minerals not controlled by ARR were excluded from the resource estimates.<br>Pit shell optimization using Whittle software, carried out for the Pre-feasibility Study, confirms that the Mineral Resource at the Cowboy State Mine is amenable to open-pit mining at grades above the cut-off and that the resource sits at or near surface with a low strip ratio. The Pre-feasibility Study mine plan assumes a base-case processing rate of 4.5 Mtpa over 26 years of production, mining 116.4 Mt of ore and 18.7 Mt of waste at a life-of-Project strip ratio of 0.16:1. Indicated Mineral Resources only are scheduled as mill feed; Inferred material falling within the designed pits is scheduled as waste.<br>No selective mining unit was assumed within the Mineral Resource block model. For the Ore Reserve, the resource block model was regularized to 10 m by 10 m by 10 m blocks representing the selective mining unit for the anticipated equipment, minimum mining widths of 32.5 m per bench and 28 m at the pit bottom were adopted, and both internal and external mining dilution were assessed as negligible. (Sections 11.4 and 12.2.) |

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| *Bulk density* | *Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.* | Dry bulk density is based on hydrostatic testing of 10 core samples from Cowboy State Mine core, including both untreated and wax impregnated samples. A fixed specific gravity of 2.70 was adopted and applied as a constant value across all domains to derive tonnage; no domain-specific SG values were applied. |
| | *The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.*<br>*Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.* | Hydrostatic testing of untreated and wax-impregnated samples confirmed a narrow range of specific gravity values across the deposit, supporting the use of a single fixed SG of 2.70. The full Halleck Creek composite weighted average SG (untreated) was 2.70, based on the 10 core samples tested. |
| *Classification* | *The basis for the classification of the Mineral Resources into varying confidence categories.*<br>*Whether appropriate account has been taken of all relevant factors (ie relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).*<br>*Whether the result appropriately reflects the Competent Person's view of the deposit.* | The Mineral Resource is classified as either Indicated or Inferred; no Measured Mineral Resource is reported. Classification is based on geological continuity, as mineralization is controlled by batholith-scale fractionation rather than by structure, with a high degree of continuity confirmed by empirical observation, statistical analysis and variography, and on drill spacing, which is mostly irregular at approximately 200 m. Relative to the previous estimate, the Indicated limit was extended to the west to approximately 200 m below surface on the basis of the 2025 surface channel samples, the lateral limit of Inferred was extended west to take in all of the Red Mountain Pluton, and the vertical limit of Inferred was extended to 510 RL on the basis of additional drilling results. The Competent Person considers the classification strategy and methodology appropriate and reasonable for this style of mineralization. (Section 11.2.7.) |
| *Audits or reviews* | *The results of any audits or reviews of Mineral Resource estimates.* | No external audit or review of the Mineral Resource estimate is reported. The estimate was prepared by Odessa Resources and validated internally against inverse distance squared and nearest neighbor check estimates and against raw composite data in swath plots. The current estimate is reconciled against the February 2025 Scoping Study estimate, which shows the Cowboy State Mine tonnage increasing by approximately 4.5 Mt (1%) and the TREO grade decreasing by approximately 94 ppm (3%), with approximately 68.4 Mt reclassified from Inferred to Indicated following the 2025 channel sampling program. (Sections 11.2.5 and 11.7.) |
| *Discussion of relative* | *Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an* | Uncertainty associated with sampling, drilling, geological interpretation, data processing, density assignment, and resource estimation has been incorporated |

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| *accuracy/ confidence* | *approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.*<br>*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*<br>*These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.* | into the Mineral Resource classification. The Competent Person concluded that the quantity and quality of available geological, drilling, sampling, density, analytical, and estimation data are sufficient to support the reported Mineral Resource in accordance with the JORC Code (2012 Edition), and that the deposit retains potential for further expansion through additional drilling beyond the limits of the current resource model. (Sections 9.2 and 11.8.) |

| **Section 4 Estimation and Reporting of Ore Reserves** | | |
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| (Criteria listed in section 1, and where relevant in sections 2 and 3, also apply to this section.) | | |
| ***Criteria*** | ***JORC Code explanation*** | ***Commentary*** |
| *Mineral Resource estimate for conversion to Ore Reserves* | *Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.*<br>*Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.* | The Ore Reserve is converted from the Indicated Mineral Resource within the Cowboy State Mine area, estimated by Odessa Resources and reported at a 1,000 ppm TREO cut-off with an effective date of November 2025. The Indicated Mineral Resource for the Cowboy State Mine area is 391.4 Mt at 3,295 ppm TREO. Ore Reserves are reported as a subset of, and are therefore included in, the Mineral Resource; they are not additional to it. Only Indicated Mineral Resources were converted to Ore Reserves. Inferred material falling inside the designed pit, 2.8 Mt above the cut-off grade, is treated as waste and contributes no Ore Reserve. (Sections 14.6 and 22.) |
| *Site visits* | *Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* | Alfred Gillman (Odessa Resources) visited the site on 7 March 2024, including Red Mountain and the core storage facility at Western Research Institute (Wyoming Rare) in Laramie, Wyoming. Patrick Sobecke (Stantec) visited the site on 10 February 2025, accompanied by Erick Kennedy (Stantec) and Sara Stotter (ARR). |

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| | *If no site visits have been undertaken indicate why this is the case.* | Mark Travis (Arkenstone Exploration) visited the site on 12-13 May 2026. Kelton Smith (Tetra Tech) has visited the site on numerous occasions in 2024, 2025, and 2026. |
| *Study status* | *The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.*<br>*The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.* | The Project has been evaluated to Pre-feasibility Study level. This Report is a Pre-feasibility Study prepared by Stantec, which has determined a mine plan that is technically achievable and economically viable and has considered the material Modifying Factors. The capital and operating cost estimates carry a target accuracy of plus or minus 25%, consistent with a pre-feasibility level of study. A Probable Ore Reserve is reported on this basis, and the Report recommends further work to advance the Project to the feasibility stage. (Sections 2.1.1, 22 and 20.6.) |
| *Cut-off parameters* | *The basis of the cut-off grade(s) or quality parameters applied.* | The Ore Reserve is reported above a payable rare earth oxide (PREO) cut-off grade of approximately 875 ppm, calculated as the sum of mining cost, process cost and general and administrative cost, divided by the product of the PREO price less royalty and the recovery. The pit optimization inputs were a mining cost of US$5.38 per tonne, a process cost of US$28.28 per tonne, general and administrative costs of US$1.10 per tonne and a Wyoming State royalty of 2.50%. Material above the cut-off is sent to the process plant and material below it reports to the waste rock storage facility or is used as construction material. The Mineral Resource is separately reported above a 1,000 ppm TREO cut-off derived from Stantec net smelter return calculations. (Sections 14.5 and 22.2.6.) |
| *Mining factors or assumptions* | *The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimization or by preliminary or detailed design).*<br>*The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.*<br>*The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.* | The Cowboy State Mine deposit will be mined by open-pit methods using conventional truck-and-shovel extraction; the mine plan does not include underground mining. Pit optimization was carried out in Whittle and the life-of-mine schedule was developed in Deswik. The mine plan moves 135.0 Mt of total material, comprising 116.4 Mt of ore and 18.7 Mt of waste at a strip ratio of 0.16:1, feeding the plant at 4.5 Mtpa over 26 years of production following a three-year construction period. Mining recovery is taken as 100% and mining dilution as nil, because the geological interpretation treats nearly all material within the pit as mineralized and the waste adjacent to the reserve is itself above cut-off grade Inferred material. Minimum mining widths are 32.5 m per bench and 28 m at the pit bottom, set by shovel swing radius, truck turning circle and safety berm requirements. Overall slope angles range from 54 degrees at a 300 m slope height |

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| | *The major assumptions made and Mineral Resource model used for pit and stope optimization (if appropriate).*<br>*The mining dilution factors used.*<br>*The mining recovery factors used.*<br>*Any minimum mining widths used.*<br>*The manner in which Inferred Mineral Resources are utilized in mining studies and the sensitivity of the outcome to their inclusion.*<br>*The infrastructure requirements of the selected mining methods.* | to 45 degrees at 700 m, with a 50 degree inter-ramp angle applied in optimization; groundwater data was not available and was not incorporated in the geotechnical analysis. All ore in the schedule is drawn from the Indicated Mineral Resource; no Inferred material is scheduled as ore. (Sections 22.2 to 22.5 and 15.) |
| *Metallurgical factors or assumptions* | *The metallurgical process proposed and the appropriateness of that process to the style of mineralization.*<br>*Whether the metallurgical process is well-tested technology or novel in nature.*<br>*The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.*<br>*Any assumptions or allowances made for deleterious elements.* | Run-of-mine ore is crushed to 100% passing 300 micron through a jaw crusher, cone crusher and vertical roller mill at the mine site, then concentrated approximately ten times using gravity separation in a reflux classifier concentrator together with dry induced roll magnetic separation and wet high intensity magnetic separation on the minus 50 micron fines stream. Concentrate is trucked to a refinery proposed at Wheatland, Wyoming, for dilute sulfuric acid tank leaching, impurity removal through two neutralization stages and uranium ion exchange, bulk solvent extraction, and solvent extraction separation and finishing into separate oxide products. Recoveries by unit operation are 78% through gravity and magnetic separation, 85% through leaching, 98% through partial neutralization and 96% through separation and finishing for NdPr oxide and 98% for the other products. The recoveries applied in the economic model are 58.2% for NdPr oxide, 25.8% for SEG oxide, 28.7% for terbium oxide and 12.4% for dysprosium oxide, giving an overall recovery of 49.9% of contained payable rare earth oxide. The process uses conventional unit operations, but yield losses downstream of the leach are based on the Competent Person's rare earth processing experience rather than on completed test work, and the recoveries remain subject to confirmation by the pilot and demonstration plant program. (Sections 13.8 and 16.) |
| | *The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.* | A test pit of approximately 629 $m^2$ was excavated at the Cowboy State Mine in August 2025 under a License to Explore by Dozer permit from WDEQ-LQD, in two benches each approximately 4 m deep. Approximately 5,430 tonnes of weathered ore was excavated and stockpiled and approximately 3,080 tonnes of fresh ore was |

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| | *For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?* | excavated and crushed to minus 55 mm. Approximately 14.9 tonnes of fresh ore was bagged and shipped to FLSmidth, Loesche, DISA and COREM for comminution testing and downstream flowsheet work, approximately 72 tonnes was hauled to the Wyoming Rare warehouse in Laramie, and approximately 2,357 tonnes remained stockpiled on site. Seven stockpile samples averaged 4,590 ppm TREO and are considered representative of the Cowboy State Mine resource area at Red Mountain. No pilot plant has yet been operated; completion of the pilot and demonstration plant program, targeted for the end of 2026, is identified as the highest-priority metallurgical workstream. (Sections 11.8 and 26.8.) |
| *Environmental* | *The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterization and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.* | Baseline environmental studies have been underway across the proposed permit area since 2024 to support the permit-to-mine application, covering cultural resources, climatology, geology and waste characterization, groundwater and surface water hydrology, soils, vegetation, wildlife, wetlands and aquatic resources, and air quality, each carried out by named specialist contractors. A Class III Cultural Resource Inventory has been completed and the Wyoming State Historic Preservation Office issued a concurrence letter dated 31 July 2025. Wyoming Rare has not yet filed a mine permitting application and is working with WWC Engineering to compile it for WDEQ-LQD; an Industrial Siting Permit will be sought once the refinery site is selected. Three closure scenarios were evaluated, a best case assuming continued mining onto adjacent federal ground, an intermediate pit lake case and a worst case involving full pit regrading, and closure costs of US$55.9 million are carried in operating costs in the final year of the mine plan. Waste rock characterization and water management remain open items identified in the risk register. (Sections 15.6 and 19.) |
| *Infrastructure* | *The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labor, accommodation; or the ease with which the infrastructure can be provided, or accessed.* | Regional infrastructure is based out of the town of Wheatland (population 3,560), approximately 39 km from the Cowboy State Mine by Wyoming State Highway 34 and served by the BNSF Railroad mainline and Interstate 25. A 46 kV substation lies approximately 3.7 km from the western side of the state mineral leases. Power will be taken from the Wheatland Rural Electric Association grid, with a new mine site substation fed by a transmission line following Wyoming Highway 34 and Halleck Creek Road from an existing substation approximately 6 miles away, which requires upgrading; the association has confirmed the arrangement will be suitable by the time power is required. Planned infrastructure also covers access and |

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| | | haulage roads, natural gas supply, a pipeline, concentrate and tailings trucking, dewatering, water supply and the manufactured sand byproduct storage facility. American Rare Earths Limited has entered into a signed lease agreement under which up to 1,620 acre-feet of water can be supplied per year to the Project. Under the current water-supply basis, water may be pumped from the period of 1 June to 15 September, subject to the terms and conditions of the agreement and applicable regulatory requirements. A conceptual monthly water balance has been developed for the project. It indicates an average annual make-up raw-water requirement of approximately 820 acre-feet per year. To manage the seasonal availability of the contracted water supply, a water-supply pond with an indicative capacity of approximately 550 acre-feet is currently proposed. Further engineering, hydrological and operational studies are required to confirm the required storage capacity and the timing and reliability of water availability. Hydrological and hydrogeological studies being undertaken by WWC Engineering are ongoing and will support further refinement of the Project water balance and water-supply design. The signed agreement provides a contractual basis for the Project's proposed water supply of up to 1,620 acre-feet per year; however, any additional permits, approvals, infrastructure, or water-related authorizations required to abstract, convey, store and use the water for the Project remain subject to confirmation as the project design and permitting program advance. No mining-related infrastructure has yet been constructed at the site. (Sections 4.5, 5.4 and 17.) |
| *Costs* | *The derivation of, or assumptions made, regarding projected capital costs in the study.*<br>*The methodology used to estimate operating costs.*<br>*Allowances made for the content of deleterious elements.*<br>*The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co-products.*<br>*The source of exchange rates used in the study.*<br>*Derivation of transportation charges.* | Initial capital expenditure is estimated at US$873.1 million, comprising direct capital of US$759.2 million and a 15% contingency of US$113.9 million. Of this, US$840.0 million is spent over the three-year construction period and US$33.0 million is expansion capital for staged development of the refinery waste disposal facility in 2034 and 2044, so total life-of-Project capital cost is US$873.1 million. Refinery processing capital of US$590.1 million is based on Tetra Tech's Class 4 estimate (Revision 3), comprising direct costs of US$536.5 million and indirect costs of 10% for detailed engineering, construction management and third-party QA/QC; Tetra Tech's own contingency allowance is not carried, and the Project contingency of 15% is applied instead. Closure costs of US$55.9 million, |

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| | | comprising US$30.9 million of mine closure and US$25.0 million of refinery waste disposal closure, carry no contingency and are included in operating costs in the final year of the mine plan rather than in capital. Life-of-Project operating cost is estimated at US$4,726.4 million undiscounted, equivalent to US$40.62 per tonne of ROM ore processed, of which downstream hydrometallurgical processing accounts for 51.2% and mining for 15.6%; reagents represent 45.6% of life-of-Project operating cost across all functional areas. Processing and refining operating costs were estimated by Tetra Tech on a unit cost per ROM tonne basis, totaling US$31.03 per tonne and 76.4% of life-of-Project operating cost; mining, material movement, refinery waste disposal and closure costs were estimated by Stantec (22.6%), and water supply costs were provided by ARR (1.0%). Canadian-based cost data in the Stantec mining estimate is converted at 1 USD to 1.38 CAD; this conversion applies only to that input data, and all revenues, capital costs, operating costs, royalties and taxes are denominated in US dollars, so no exchange rate risk is carried in the economic analysis. The estimate carries a target accuracy of plus or minus 25%. Sustaining capital for the mining fleet, including mobile equipment rebuilds and replacements, is included in the mining operating cost of US$5.47 per tonne of total material mined. No sustaining capital has been estimated for the processing and refinery facilities or site infrastructure beyond the staged refinery waste disposal expansion; this will be developed at the feasibility stage. (Section 20.) |
| | *The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc. The allowances made for royalties payable, both Government and private.* | The Project is subject to a Wyoming State royalty applied on a sliding scale by product against factored revenue per short ton processed, at 5% below US$50 per ton, 7% from US$50 to US$100 per ton, 9% from US$100 to US$150 per ton and 10% above US$150 per ton, or US$0.50 per saleable short ton processed, whichever is greater. Under base case assumptions NdPr is levied at 7% and SEG, terbium and dysprosium at 5% in all production years. The Project also pays a 2% Wyoming severance tax and a 7% Albany County ad valorem tax, both on a netback basis, and a 0.875% industrial property tax on the net book value of infrastructure capital. Royalties and levies total US$927.9 million over the life of the Project, of which US$816.7 million is the Wyoming State royalty, and total royalties, levies and federal income tax are estimated at US$1,785.1 million. No treatment or refining charges or specification penalties are modeled, as the products are sold FOB. (Section 21.1.3.) |

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| *Revenue factors* | *The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.*<br>*The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.* | Four rare earth oxide products are modeled for revenue: NdPr oxide, terbium oxide, dysprosium oxide and SEG mixed oxide. Lanthanum carbonate is excluded from base case revenue given current market pricing conditions. Base case pricing is US$163.00 per kg for NdPr oxide, US$2,010.00 per kg for terbium oxide, US$552.50 per kg for dysprosium oxide and US$34.58 per kg for SEG oxide, applied on an FOB basis and held constant in real terms across the life of the Project. Pricing was derived from ARR's assessment of market expectations, drawing on forecasts from investment bank analysts and specialist rare earth market consultants, and is not based on spot prices at the date of the Report. Total life-of-Project revenue is US$12,103.0 million, of which NdPr oxide contributes 87.4%, terbium oxide 6.9%, dysprosium oxide 3.8% and SEG oxide 2.0%. Floor, downside and upside pricing scenarios are also defined, with NdPr oxide priced at US$110.00, US$131.80 and US$193.50 per kg respectively. No offtake agreements are currently in place, and no off-take discounts have been modeled. (Sections 18.5 and 21.3.1.) |
| *Market assessment* | *The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.*<br>*A customer and competitor analysis along with the identification of likely market windows for the product.*<br>*Price and volume forecasts and the basis for these forecasts.*<br>*For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.* | As of 2025, China was responsible for 67% of global mine production of magnet rare earths and over 89% of each subsequent step, making it the world's dominant producer of refined rare earth oxides, metals and alloys, magnetic alloys, and NdFeB permanent magnets. Demand for Nd, Pr, Tb, and Dy (the "magnet" rare earths) is driven principally by permanent magnets used in defense, electric vehicles, and consumer electronics. Adamas forecasts that global TREO demand will increase at a CAGR of 6.0% going forward, from 252,000 tonnes in 2025 to 607,000 tonnes in 2040, driven primarily by the permanent magnet sector. Over the same period, global demand for permanent magnets is forecast to grow at an 8.4% CAGR, while magnet rare earth production grows more slowly at 7.8% CAGR, implying a widening supply deficit. In all scenarios examined, Adamas projects that magnet rare earths will collectively drive over 77% of the Halleck Creek project basket value (i.e., value of rare earth oxides contained in one kilogram of separated TREO) each year from 2031 to 2040. In its base case scenario, Adamas forecasts the Halleck Creek TREO basket value will reach $66.37 per kilogram in 2031, before gradually declining to $54.58 per kilogram in 2036, then plateauing through 2040. No offtake agreements are currently in place. (Section 18.) |
| *Economic* | *The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these* | The economic evaluation is presented in constant Q1 2026 USD with no escalation, assuming an owner-operated open-pit mine and two-stage processing comprising |

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| | *economic inputs including estimated inflation, discount rate, etc.*<br>*NPV ranges and sensitivity to variations in the significant assumptions and inputs.* | mine site concentration and an off-site refinery, a 4.5 Mtpa base case processing rate, a three-year construction period from 2028 to 2030 and 26 production years from 2031 to 2056. A real after-tax discount rate of 8.0% is adopted for the base case, with 10.0% shown for comparison. The analysis applies the 21% U.S. federal corporate income tax rate, with no Wyoming state income tax, a 14% depletion allowance limited to 50% of taxable income, and MACRS depreciation. The base case returns an after-tax NPV of US$1,309.8 million at 8%, an after-tax NPV of US$965.6 million at 10%, an after-tax IRR of 23.94% and an after-tax payback period of 6.38 years from first capital expenditure. On a pre-tax basis the Project returns an NPV of US$1,579.5 million at 8%, an IRR of 25.93% and a payback period of 6.19 years. Peak funding requirement is US$840.0 million. Under the upside and downside price scenarios, the after-tax NPV at 8% is US$2,081.1 million (IRR 31.27%) and US$713.3 million (IRR 17.45%) respectively. Single-variable sensitivity analysis over minus 30% to plus 30% shows the Project is most sensitive to NdPr price and NdPr recovery, each giving an NPV spread of US$1,669.7 million and remaining positive at the minus 30% case with an IRR of 14.33%, followed by discount rate, processing operating cost and processing capital cost. (Section 21.) |
| *Social* | *The status of agreements with key stakeholders and matters leading to social license to operate.* | Stantec and Wyoming Rare completed an initial impact-based materiality assessment, guided by the Sustainability Accounting Standards Board standards for the Metals and Mining industry and the Global Reporting Initiative framework, engaging internal stakeholders responsible for project and corporate level risks. Key external stakeholders were identified, covering permitting engagement with state and federal agencies, indigenous relations, community engagement, adjacent landowners, and funding agency and investor engagement. Both parties concluded that full external stakeholder engagement was premature for the Project's current stage, and external outreach plans associated with permitting and community engagement are in development and expected to mature as the Project advances. ARR intends to engage and employ local contractors and operators throughout permitting, construction and operations wherever practical, supported by an established regional workforce. Wyoming Rare has developed working relationships with local surface owners and has secured long-term exploration access across the project area. No agreements with key stakeholders are reported as concluded. (Sections 4.8 and 19.5.) |

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| *Other* | *To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:*<br>*Any identified material naturally occurring risks.*<br>*The status of material legal agreements and marketing arrangements.*<br>*The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.* | A workshop level risk and opportunity register was prepared as part of the Pre-feasibility Study, covering geology, mining, processing, marketing, ESG and cost domains. The principal risks identified are grade variability or dilution exceeding modeled assumptions, adverse geotechnical outcomes requiring flatter slopes or additional dewatering, lower than modeled recoveries, sustained low rare earth prices or changes to Chinese export policy, tailings characterization or water management issues arising during permitting, inflationary pressure on reagent, energy and labor costs, and the absence of a sustaining capital estimate for the processing and refinery facilities and site infrastructure over the 26-year mine life (mining fleet sustaining capital is included in the mining operating cost). Commodity price risk is the dominant economic risk, as NdPr oxide accounts for 87.4% of life-of-Project revenue. The Project holds its mineral rights through four Wyoming State Mineral Leases and 365 unpatented federal lode claims in good standing, has received no violations or fines, and has not yet filed a mine permitting application; water rights have not been adjudicated and no offtake agreements are in place. The risks have not been probability-weighted, and a quantitative risk assessment is recommended at the feasibility stage. (Sections 4, 22.6 and 21.5.) |
| *Classification* | *The basis for the classification of the Ore Reserves into varying confidence categories.*<br>*Whether the result appropriately reflects the Competent Person's view of the deposit.*<br>*The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).* | The Ore Reserve is classified entirely as Probable; no Proved Ore Reserve is reported. The Probable Ore Reserve is 116.4 Mt at 1,257 ppm PREO, containing 146.3 Mkg of PREO, with contained grades of 958 ppm NdPr, 230 ppm SEG, 12 ppm Tb4O7 and 57 ppm Dy2O3. The classification follows directly from the Mineral Resource, in which no Measured Mineral Resource is reported, so no part of the Ore Reserve can be classified as Proved. The Competent Person for the Ore Reserve estimate is Patrick Sobecke of Stantec. (Section 22.5.) |
| *Audits or reviews* | *The results of any audits or reviews of Ore Reserve estimates.* | No external audit or review of the Ore Reserve estimate is reported. The estimate was prepared by Stantec and reviewed internally by the Competent Person, who has reviewed the risks, opportunities, conclusions and recommendations and is not aware of any unique conditions that would place the Ore Reserve at a higher level of risk than any other developing project. The Reserve pit designs were compared against the selected Whittle optimization shell as a check, which showed a 14% increase in waste material relative to the shell, reflecting the design and operational constraints that the optimization cannot model. (Sections 22.1 and 22.5.1.) |

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| *Discussion of relative accuracy/ confidence* | *Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.*<br>*The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.*<br>*Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage.*<br>*It is recognized that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available* | No statistical or geostatistical quantification of the relative accuracy of the Ore Reserve has been carried out. The estimate is global rather than local and carries the plus or minus 25% target accuracy of the underlying pre-feasibility level cost estimates. Confidence is supported by the conversion of Indicated Mineral Resources only, 100% mining recovery with nil dilution, and a mine plan returning a positive after-tax net present value in every single-variable downside case tested. Factors that may affect the estimate are unexpected variations in the quantity of mineralized material, grade or recovery, geotechnical conditions differing from those assumed, failure of plant, equipment or processes to operate as anticipated, and variations in project costs or metal prices. Groundwater data was not incorporated in the geotechnical analysis, no sustaining capital has been estimated for the processing and refinery facilities or site infrastructure over the 26-year mine life (mining fleet sustaining capital is included in the mining operating cost), and the metallurgical recoveries remain subject to pilot-scale confirmation. There are no production records against which to compare the estimate. A quantitative risk assessment is recommended at the feasibility stage. (Sections 22.6, 20.6, 21.4 and 21.5.) |

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# Appendix B Certificates of Qualification

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**CERTIFICATION OF QUALIFICATIONS**
**Darren L. Smith, MSc., P.Geo**
**Dahrouge Geological Consulting USA Ltd.**

I, Darren L. Smith, HEREBY CERTIFY THAT:

1. I am currently engaged as Mentor and Senior Technical Advisor, Rare Earths and Niobium with Dahrouge Geological Consulting USA Ltd., with an office in Centennial, Colorado, USA, and have been engaged, through Adamas Intelligence Inc., by American Rare Earths Ltd. and Wyoming Rare (USA) Inc. in connection with rare earth market studies for the Halleck Creek Rare Earth Project.
2. I graduated in 2005 with an M.Sc. in Geology from Carleton University in Ottawa.
3. I am a Registered Professional Geologist (P.Geo.) with the Ordre des Géologues du Québec with a Geologist Permit, number 1968, and Association of Professional Engineers and Geoscientists of Alberta, number 87868. I have more than 20 years' experience in the mineral exploration industry covering various commodities and deposit models, with a strong focus on critical minerals including rare earth elements and its market.
4. This certificate relates to the report titled "Halleck Creek Rare Earth Project- Cowboy State Mine- Pre-Feasibility Study" dated 12 November 2026 (the "Report"), prepared for American Rare Earths Ltd. and its U.S. operating subsidiary, Wyoming Rare (USA) Inc.
5. I am the Competent Person responsible for Market Studies (18) of the Report.
6. I have read the definition of "Competent Person" set out in the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code) and consider myself qualified, based on my education, registration, and experience described above, for which I accept responsibility.
7. I have not visited the Project.
8. I am not an employee of American Rare Earths Ltd. or Wyoming Rare (USA) Inc. Neither I nor Dahrouge Geological Consulting USA Ltd. nor Adamas Intelligence Inc. is affiliated with the Registrant or with another entity having an ownership, royalty, or other interest in the Project. Neither I nor Dahrouge Geological Consulting USA Ltd. nor Adamas Intelligence Inc. holds any direct or indirect ownership interest in the Registrant or the Project, and my compensation is limited to customary professional fees and is not contingent upon the conclusions or contents of the Report.
9. As of the effective date of the Report, to the best of my knowledge, information, and belief, Section 18 of the Report contains all scientific and technical information required to be disclosed to make those portions of the Report not misleading.
10. I consent to the use to any extracts from, or summary of, the report dated 12 November 2026, for which I am responsible in the Report, and to the filing of the Report with the Australian Securities Exchange, applicable stock exchanges, and other regulatory authorities, and to publication of the Report as applicable.

DATED at Edmonton, Alberta, Canada this 12th day of November 2026.

*SIGNED AND SEALED*

Signature: ___*Daren L. Smith*_____

**Darren L. Smith, M.Sc., P.Geo**
**Mentor and Senior Technical Advisor, Rare Earths and Niobium**
*Dahrouge Geological Consulting USA Ltd.*

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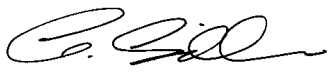
**CERTIFICATION OF QUALIFICATIONS**
**ALFRED J. GILLMAN, BSc (Hons), FAusIMM (CP Geol) 107303**
**ODESSA RESOURCES PTY LTD.**

I, ALFRED J. GILLMAN, HEREBY CERTIFY THAT:

1. I am currently the Principal of Odessa Resources Pty Ltd (ABN 16 133 543 727), an independent resource-estimation consulting firm based in Perth, Western Australia, and have been engaged by American Rare Earths Ltd. and Wyoming Rare (USA) Inc. to undertake Mineral Resource estimation work for the Halleck Creek Rare Earth Project.
2. I am a graduate of the University of Western Australia (1980), holding a Bachelor of Science degree with Honours in Geology, and have practiced in my profession since 1980.
3. I am a Chartered Professional (Geology) and Fellow of the Australasian Institute of Mining and Metallurgy (AusIMM), member number 107303, and have been actively employed in various capacities in the mining industry in numerous locations around the world since 1980.
4. This certificate relates to the report titled "Halleck Creek Rare Earth Project- Cowboy State Mine- Pre-Feasibility Study" dated 18 November 2026 (the "Report"), prepared for American Rare Earths Ltd. and its U.S. operating subsidiary, Wyoming Rare (USA) Inc.
5. I am the Qualified Person responsible for Chapters 12, 14 and relevant portions of Sections 1, 25 and 26 of the Report.
6. I have read the definition of "Competent Person" set out in the Australasian Code for Reporting of Metallurgy and Processing and Recovery Methods (JORC2012 Code) and consider myself qualified, based on my education, registration, and experience described above, for the resource estimation activities for which I accept responsibility.
7. I have visited the Project on 7 March 2024, with American Rare Earths personnel, including inspection of the Red Mountain project area and the core storage facility operated by Wyoming Rare (USA) Inc. in Laramie, Wyoming.
8. I am not an employee of American Rare Earths Ltd. or Wyoming Rare (USA) Inc. Neither I nor Odessa Resources Pty Ltd. is affiliated with the Registrant or with another entity having an ownership, royalty, or other interest in the Project. Neither I nor Odessa Resources Pty Ltd. holds any direct or indirect ownership interest in the Registrant or the Project, and my compensation is limited to customary professional fees and is not contingent upon the conclusions or contents of the Report.
9. As of the effective date of the Report, to the best of my knowledge, information, and belief, Chapters 12, 14 and relevant portions of Sections 1, 25 and 26 of the Report contains all scientific and technical information required to be disclosed to make that portion of the Report not misleading.
10. I consent to the use of my name as a Qualified Person, to the quotation from or summarization of the scientific and technical information for which I am responsible in the Report, and to the filing of the Report as an exhibit with the U.S. Securities and Exchange Commission, applicable stock exchanges, and other regulatory authorities, and to publication of the Report as applicable.

DATED at Perth, Western Australia this 18th day of November 2026.

Signature: 

**Alfred J. Gillman, BSc (Hons), FAusIMM (CP Geol) 107303**
*Qualified Person — Mineral Resource Estimates (Chapter 14)*
*Odessa Resources Pty Ltd.*

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**CERTIFICATION OF QUALIFICATIONS**

**PATRICK A. SOBECKE, PE, RM-SME 04133849RM**

**Stantec Consulting Services Inc.**

I, PATRICK A. SOBECKE, HEREBY CERTIFY THAT:

1. I am currently employed as Senior Mining Consultant at Stantec Consulting Services Inc., with an office in Raleigh, NC USA, and have been engaged, through Stantec Consulting Services Inc., by American Rare Earths Ltd. and Wyoming Rare (USA) Inc. in connection with mining, infrastructure, cost-estimation, and economic-analysis work for the Halleck Creek Rare Earth Project.
2. I am a graduate of Virginia Polytechnic and State University, with a B.S. degree in Mining Engineering (2004), and have practiced in my profession since 2004.
3. I am a registered Professional Engineer (PE) and a Qualified Professional Member of the Society for Mining, Metallurgy & Exploration (SME), QP No. 04133849RM, and have been actively employed in various capacities in the mining industry in numerous locations in North America and Australia since 2004.
4. This certificate relates to the report titled "Halleck Creek Rare Earth Project- Cowboy State Mine- Pre-Feasibility Study," dated November 2026 (the "Report"), prepared for American Rare Earths Ltd. and its U.S. operating subsidiary, Wyoming Rare (USA) Inc.
5. I have read the definition of "qualified person" set out in Regulation S-K Subpart 1300 (17 CFR §229.1300) and consider myself qualified, based on my education, registration, and experience described above, for the mining, infrastructure, cost-estimation, and economic-analysis activities for which I accept responsibility.
6. I am the Qualified Person responsible for Sections 1-3; Mining Methods (15); Environmental (19); Capital and Operating Costs for mining, benign refinery waste disposal and closure (20); Economic Analysis (21); Mineral Reserves (22); Adjacent Properties (23); relevant portions of Sections 25-27.
7. I am a Competent Person as Defined by the JORC Code 2012 Edition. I have reviewed and approved the information provided in the accompanying JORC Code – Table 1 relating to the items listed in item 6 above (Section 28).
8. I conducted a site visit to the Project on 10 February 2025, accompanied by Erick Kennedy, Senior Mining Engineer, Stantec, and Sara Stotter, geologist, American Rare Earths Ltd., including inspection of the Red Mountain project area and core storage facilities at the Wyoming Rare (USA) Inc. facility.
9. I am not an employee of American Rare Earths Ltd. or Wyoming Rare (USA) Inc. Neither I nor Stantec Consulting Services Inc. is affiliated with the Registrant or with another entity having an ownership, royalty, or other interest in the Project. Neither I nor Stantec Consulting Services Inc. holds any direct or indirect ownership interest in the Registrant or the Project, and my compensation is limited to customary professional fees and is not contingent upon the conclusions or contents of the Report.
10. As of the effective date of the Report, to the best of my knowledge, information, and belief, the Report contains all scientific and technical information required to be disclosed to make those portions of the Report not misleading.
11. I consent to the use of my name as a Qualified Person (Competent Person), to the quotation from or summarization of the scientific and technical information for which I am responsible in the Report, and to the filing of the Report as an exhibit with the U.S. Securities and Exchange Commission and/or Australian Stock Exchange, applicable stock exchanges, and other regulatory authorities, and to publication of the Report as applicable.

DATED at Raleigh, NC on the 18th day of November 2026.

Signature: Sobecke, Patrick Digitally signed by Sobecke, Patrick Date: 2026.11.18 17:13:57 -05'00'

**Patrick A. Sobecke, PE, RM-SME 04133849RM**

*Stantec Consulting Services Inc.*

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**CERTIFICATION OF QUALIFICATIONS**
**MARK W. TRAVIS, CPG-12090**
**Arkenstone Exploration**

I, MARK W. TRAVIS, HEREBY CERTIFY THAT:

1. I am the Principal Geologist and owner of Arkenstone Exploration, an independent geological and technical advisory practice based in Elko, Nevada, USA, and have been engaged by American Rare Earths Ltd. and Wyoming Rare (USA) Inc. in connection with geological review, technical integration, Qualified Person oversight, and preparation of the Halleck Creek Rare Earth Project Pre-Feasibility Study technical reporting.
2. I am a graduate of University of Wyoming, with a Bachelor's of Science in Geology (2006), and have practiced in my profession since 2006.
3. I am a Certified Professional Geologist (CPG-12090) with the American Institute of Professional Geologists (AIPG), and have been actively employed in various geological, mineral exploration, project evaluation, and technical advisory capacities in the mining and mineral exploration industry since 2006.
4. This certificate relates to the report titled "Pre-Feasibility Study — Cowboy State Mine Project, Halleck Creek Rare Earth Project," Stantec Project/File 182925552 / RPT_25552-0001, dated 18 November 2026 (the "Report"), prepared by Stantec Consulting Services Inc. for Wyoming Rare (USA) Inc., the U.S. operating subsidiary of American Rare Earths Limited, in accordance with Subpart 1300 of Regulation S-K ("S-K 1300") and the JORC Code (2012 Edition).
5. I am responsible for Sections 4 through 12 of the Report, covering Property Description; Accessibility, Climate, Local Resources, Infrastructure and Physiography; History; Geological Setting and Mineralization; Deposit Type; Exploration; Drilling; and Sample Preparation, Analyses, and Security, including QA/QC & Data Verification, together with those portions of Section 1 (Executive Summary), Section 25 (Interpretation and Conclusions), and Section 26 (Recommendations) that relate to Sections 4 through 12.
6. I have read the definition of "Qualified Person" set out in S-K 1300 (17 CFR § 229.1300) and the definition of "Competent Person" set out in the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code), and certify that, by reason of my education, my membership in good standing with a recognized professional organization, and my relevant experience, I meet the requirements of a Qualified Person and a Competent Person for the property, geological, exploration, drilling, sampling, and QA/QC matters for which I accept responsibility.
7. I conducted a site visit to the Halleck Creek Rare Earth Project on May 12 and 13, 2026, with Wyoming Rare (USA) Inc. personnel. The site visit included inspection of the Red Mountain area of the Cowboy State Mine Project and related site facilities.
8. I am not an employee of American Rare Earths Limited or Wyoming Rare (USA) Inc. Neither I nor Arkenstone Exploration is affiliated with the Registrant or with another entity having an ownership, royalty, or other interest in the Project. Neither I nor Arkenstone Exploration holds any direct or indirect ownership interest in the Registrant or the Project, and my compensation is limited to customary professional fees and is not contingent upon the conclusions or contents of the Report.
9. As of the effective date of the Report, to the best of my knowledge, information, and belief, Sections 4 through 12 of the Report, and the related portions of Sections 1, 25, and 26 for which I am responsible, contain all scientific and technical information required to be disclosed to make those portions of the Report not misleading. In preparing those Sections, I have relied on information provided by other specialists and by the Registrant as described in Section 3 (Reliance on Other Specialists) of the Report, including legal, title, and land tenure information supporting Section 4.
10. I consent to the use of my name as a Qualified Person and Competent Person, to the quotation from or summarization of the scientific and technical information for which I am responsible in the Report, and to the filing of the Report with the Australian Securities Exchange (ASX), the U.S. Securities and Exchange Commission where applicable, and other applicable regulatory authorities, and to publication of the Report as applicable.

DATED at Elko, NV this 18th day of November 2026.

Signature:

**Mark W. Travis, CPG-12090**
*Qualified Person / Competent Person — Property, Geology, Exploration, Drilling, Sampling, and QA/QC*
*d/b/a Arkenstone Exploration*

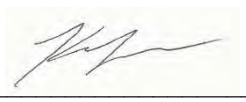


**CERTIFICATION OF QUALIFICATIONS**
**KELTON SMITH, RM-SME 4227309RM**
**TETRA TECH, INC.**

I, KELTON SMITH, HEREBY CERTIFY THAT:

1. I am currently employed as Process Department Lead at Tetra Tech, Inc., with an office in Parker, Colorado, USA, and have been engaged, through Tetra Tech, by American Rare Earths Ltd. and Wyoming Rare (USA) Inc. in connection with metallurgical test work and process design for the Halleck Creek Rare Earth Project.
2. I am a graduate of the University of Utah, with a B.S. degree in Chemical Engineering (1997), and have practiced in my profession since 1997.
3. I am a Qualified Professional Member of the Society for Mining, Metallurgy & Exploration (SME), QP No. 4227309RM, and have had extensive prior involvement with rare earth properties similar to Halleck Creek for approximately 15 years, as both an employee of mining companies and as a consultant.
4. This certificate relates to the report titled "Halleck Creek Rare Earth Project- Cowboy State Mine- Pre-Feasibility Study" dated 12 November 2026 (the "Report"), prepared for American Rare Earths Ltd. and its U.S. operating subsidiary, Wyoming Rare (USA) Inc.
5. I am the Qualified Person responsible for Mineral Processing and Metallurgical Testing (13); Process and Recovery Methods (16); Processing and Infrastructure Capital Costs and Processing and Refining Operating Costs (20); relevant portions of Sections 1, 17, 25 and 26 of the Report.
6. I have read the definition of "Competent Person" set out in the Australasian Code for Reporting of Metallurgy and Processing and Recovery Methods (JORC Code 2012) and consider myself qualified, based on my education, registration, and experience described above, for the mineral processing and metallurgical testing activities for which I accept responsibility.
7. I have visited the Project on numerous occasions during 2024, 2025, and 2026 in connection with directing and reviewing the metallurgical test work and process-development programs described in Chapters 13 and 16, including a site visit on July 18, 2025.
8. I am not an employee of American Rare Earths Ltd. or Wyoming Rare (USA) Inc. Neither I nor Tetra Tech, Inc. is affiliated with the Registrant or with another entity having an ownership, royalty, or other interest in the Project. Neither I nor Tetra Tech, Inc. holds any direct or indirect ownership interest in the Registrant or the Project, and my compensation is limited to customary professional fees and is not contingent upon the conclusions or contents of the Report.
9. As of the effective date of the Report, to the best of my knowledge, information, and belief, Sections 1, 13, 16, 17, 20, 25 and 26 of the Report contain all scientific and technical information required to be disclosed to make those portions of the Report not misleading.
10. I consent to the use of my name as a Qualified Person, to the quotation from or summarization of the scientific and technical information for which I am responsible in the Report, and to the filing of the Report as an exhibit with the U.S. Securities and Exchange Commission, applicable stock exchanges, and other regulatory authorities, and to publication of the Report as applicable.

DATED at Parker, Colorado, USA this 18th day of November 2026.

Signature: 

**Kelton Smith, RM-SME 4227309RM**
*Qualified Person —Mineral Processing and Metallurgical Testing (13); Process and Recovery Methods (16); Processing and Infrastructure Capital Costs and Processing and Refining Operating Costs (20); relevant portions of Sections 1, 17, 25 and 26 of the Report.*
*Tetra Tech, Inc.*

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**With every community, we redefine what's possible.**

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

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