Address: West End Office Park,
Building C, 3rd Floor,
246 Hall Street, Centurion,
Gauteng, South Africa
Tel: +27(0)12 644 1181
Fax: +27(0)12 644 1185

Exhibit 96.1

Hindustan Zinc Limited – SEC - SK 1300

Technical Summary Report

Kayad Mine

Document Version:	**Rev 1**
Customer Name:	**HZL Mine**
Date:	**20 July 2022**
Prepared by:	**ABGM**
Document Number:	**2022-07-25-KDM-SEC**

PREPARED AND REVIEWED BY:

TITLE	PREPARED / REVIEWED	SIGNATURE	DATE
Project Manager	Colin Little		28/07/2022

ACCEPTED AND APPROVED BY:

TITLE	NAME	SIGNATURE	DATE
Qualified Person – Resources	Andre van der Merwe		29/07/2022
Qualified Person - Reserves	Bill Gillespie		29/07/2022
Managing Director - ABGM	Devendra Vyas		29/07/2022

Disclaimer:

This document will serve only for the Purposes of Hindustan Zinc Limited (HZL) based on information received from the mine and its respective mining operations in India namely: Rampura Agucha Mine; Rajpura Dariba; Sindesar Khurd; Kayad and the four Zawar operations – Balaria, Baroi, Mochia and Zawarmala. The information within this technical report is aligned to the Securities Exchange Commission (SEC), SK-1300 guidelines and the information within is to be use for this purpose only.

LIST OF ABBREVIATIONS:

%	Percentage
^{0}C	degree Celsius
ABGM	A & B Global Mining Consultants
Ag	Silver
BOQ	Bill of Quantities
CAPEX	Capital expenditure
Coeff. Of Variation	coefficient of variation
COG	Cut-off Grade
Con	Concentrate
CSD	calc-silicate dolomites
g/t	grams per ton
GMS	graphite-mica schist
GSSA	Geological Society of South Africa
HDPE	High Density Polyethylene
Hr.	Hour
HZL	Hindustan Zinc Limited
IDW^2	Inverse Distance Weighting to the power of two
INR	Indian Rupee
kA	KiloAmpere
kL	KiloLitre
km	Kilometre
kN/m^2	KiloNewton per square metre
Koz	Kilo Ounces
Kt	Kilo tonne
kV	KiloVolt
lb	Pound
LHD	Load Haul Dumper
LOM	Life-of-Mine
LOM	Life of Mine
m	metre
m^2	Squared Metre

m^3	Cubic Metre
m^3/hr	Cubic metres per hour
mRL	Mean Relative Elevation
Mt	Million tonnes
mtpa	Million tonnes per annum
OGL	Original ground level (original surface elevation)
OK	Ordinary Kriging
OPEX	Operating expenditure
oz	Ounces
Pb	Lead
PbEQ	Lead Equivalent
PFS	Preliminary Feasibility Study
QA	Quality Assurance
QC	Quality Control
RAM	Rampura Agucha Mine
RAUG	Rampura-Agucha underground
RDM	Rajpura Dariba Mines
ROM	Run-of-Mine (ore/rock of economic value containing the target mineral(s)
ROM	Run of Mine
RPEEE	reasonable prospects of eventual economic extraction
SACNASP	South African Council for Natural Scientific professions
SEC	Securities Exchange Commission
SKM	Sindesar Khurd
Std Dev	standard deviation
t	tonnes
TRS	Technical Review
USD	Us Dollar
USD/g	US Dollar per gram
USD/pb	US Dollar per pound
USD/t	US Dollar per tonne
VDS/PDS	Vehicle Detection System / Personnel Detection System
ZAW	Zawar Complex

Zn	Zinc
ZnEQ	Zinc Equivalent

Glossary of Terms

Block model: This is the cubical representation in three dimensions of the Mineral Resource. The block model data is usually constructed using industry accepted geological software packages.

Concentrating: The process of separating milled ore into a waste stream (tailings) and a valuable mineral stream (concentrate) by floatation.

Orebody: A well-defined mineralised rock mass that can be defined or modelled based upon its distinct mineral content or associated rock type/lithology.

Run of Mine (ROM): A loose term used to describe ore produced from the mine available for processing.

Tailings: That portion of the ore from which most of the valuable material has been removed by concentrating and that is therefore low in value and rejected.

Tonne: Metric tonne, equal to 1000 kg, unless otherwise defined.

Total Station: Surveying tool which comprises an electronic theodolite and an electronic distance meter/measurement component.

Note that all physical measurements units used in this report are metric, i.e. based on the International System of Units (SI units), unless otherwise indicated.

Finance

Capital expenditure (CAPEX): Total capital expenditure on mining and non-mining property, plant, equipment, and capital work-in-progress.

Effective tax rate: Current taxation, deferred taxation, and tax normalization as a percentage of profit before taxation.

IRR: Internal Rate of Return (the discount rate at which the project "NPV" becomes zero).

NPV: Net Present Value (cash flow of the project discounted to current day value – includes project OPEX and CAPEX).

Operating expenditure (OPEX): Total operating expenditure for mining and non-mining functions pertaining to the project.

Definitions:

The following definitions apply to this report and are aligned to meanings ascribed in terms of internationally recognized institutions and standards namely the Canadian CIM Definition Standards for Mineral Resources and Mineral Reserves 2014 (CIM), The Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves 2012 Edition (JORC) and The South African Code for Reporting of Exploration Results, Mineral Resources and Mineral Reserves 2016 (SAMREC).

Mineral Resources:

A **'Mineral Resource'** is a concentration or occurrence of material of intrinsic economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. Mineral Resources are further sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured as categories.

Inferred Mineral Resource is the part of a Mineral Resource for which quantity, grade (or quality) and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which may be of limited or uncertain quality and reliability.

Indicated Mineral Resources are economic mineral occurrences that have been sampled (from locations such as outcrops, trenches, pits and drill holes) to a point where an estimate has been made, at a reasonable level of confidence, of their contained metal, grade, tonnage, shape, densities, physical characteristics.

Measured Mineral Resources are Indicated Mineral Resources that have undergone enough further sampling that a 'competent person' or ‘qualified person’ (defined by the norms of the relevant mining code; usually a geologist) has declared them to be an acceptable estimate, at a high degree of confidence, of the grade (or quality), quantity, shape, densities, physical characteristics of the mineral occurrence.

Ore Reserves / Mineral Reserves

An Ore Reserve or Mineral Reserve is the economically mineable part of a Measured Mineral Resource and/or Indicated Mineral Resource. Mineral Reserves are subdivided in order of increasing confidence into **Probable Mineral Reserves** or **Proved Mineral Reserves**.

Probable Mineral Reserve is the economically mineable part of an Indicated Mineral Resource, and in some circumstances, a Measured Mineral Resources. It includes diluting material and allowances for losses which may occur when the material is mined. A Probable Mineral Reserve has a lower level of confidence than a Proved Mineral Reserve but is of sufficient quality to serve as the basis for decision on the development of deposit.

Proved Mineral Reserve is the economically mineable part of a **Measured Mineral Resource**. It includes diluting materials and allowances for losses which occur when the material is mined.

Proved Mineral Reserve represents the highest confidence category of Mineral Reserve estimate. It implies a high degree of confidence in the geological factors and a high degree of confidence in the Modifying Factors. The style of mineralization or other factors could mean that Proved Mineral Reserves are not achievable in some deposits.

Generally the **conversion** of Mineral Resources into Mineral Reserves requires the application of various **Modifying Factors**, including, but not restricted to:

- mining factors
- mineral processing / ore dressing related factors
- metallurgical factors
- infrastructure factors
- economic factors
- marketing factors

- legal factors
- ESG factors: Environmental, Social (including Health and Safety) and Governance.

CONTENTS

1 EXECUTIVE SUMMARY ... 19

1.1 PROPERTY SUMMARY AND OWNERSHIP ... 19

1.2 MINERAL RESOURCE STATEMENT ... 19

1.3 MINERAL RESERVE STATEMENT ... 20

1.4 GEOLOGY AND MINERALIZATION ... 21

1.5 METALLURGICAL TESTING ... 22

1.6 MINE DESIGN, OPTIMIZATIONS AND SCHEDULING ... 22

1.7 MINERAL PROCESSING ... 23

1.8 ENVIRONMENTAL, PERMITTING AND COMMUNITY IMPACT ... 23

1.9 CAPITAL COSTS, OPERATING COSTS AND FINANCIAL ANALYSIS ... 24

2 INTRODUCTION ... 25

2.1 TERMS OF REFERENCE AND PURPOSE OF THE REPORT ... 25

2.2 SOURCES OF INFORMATION ... 26

2.3 LIST OF SOURCE MATERIALS ... 26

2.4 QUALIFIED PERSONS AND DETAILS OF INSPECTION ... 27

2.5 PREVIOUS REPORTS ON THE PROJECT ... 28

3 PROPERTY DESCRIPTION AND LOCATIONS ... 28

3.1 PROPERTY LOCATION ... 28

3.2 MINERAL TITLES, CLAIM RIGHTS, LEASES AND OPTIONS ... 31

3.2.1 Lease agreements - Details ... 31

3.2.2 Lease agreements – Area ... 31

3.2.3 Lease agreements – District ... 32

3.3 ENVIRONMENTAL IMPACTS, PERMITTING, OTHER SIGNIFICANT FACTORS AND ... 32

3.3.1 Commitments ... 32

3.3.2 Security bonds ... 32

3.3.3 Reclamations liabilities ... 33

3.4 ROYALTIES AND AGREEMENTS ... 33

3.4.1 Joint ventures ... 33

3.4.2 Royalty agreements ... 33

4 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY ... 33

4.1 TOPOGRAPHY, ELEVATION AND VEGETATION ... 33

4.1.1 Topography ... 33

4.1.2 Drainage Pattern 34

4.1.3 Vegetation 35

4.2 ACCESSIBILITY AND TRANSPORTATION TO THE PROPERTY 35

4.3 CLIMATE AND LENGTH OF OPERATING SEASON 35

4.3.1 Climate 35

4.3.2 Rainfall Data 36

4.4 INFRASTRUCTURE AVAILABILITY AND SOURCES 36

5 HISTORY 37

5.1 PRODUCTION 37

5.2 HISTORICAL EXPLORATION 37

6 GEOLOGICAL SETTING, MINERALIZATION AND DEPOSIT 39

6.1 REGIONAL GEOLOGY 39

6.2 PROPERTY GEOLOGY 39

6.3 DEPOSIT TYPES 42

6.4 MINERALIZATION 43

7 EXPLORATION 44

7.1 SUMMARY OF EXPLORATION ACTIVITIES 44

7.2 EXPLORATION WORK – DRILLING 44

7.3 GEOLOGICAL MAPPING AND GEOPHYSICS 45

7.4 DRILLING TECHNIQUE, SPATIAL DATA & LOGGING 46

7.5 SAMPLE PREPARATION 46

7.6 SAMPLE ANALYSIS AND QAQC PROTOCOLS 47

7.7 OPINION OF ADEQUACY 48

8 MINERAL PROCESSING AND METALLURGICAL TESTING 48

9 MINERAL RESOURCE ESTIMATE 48

9.1 INTRODUCTION 48

9.2 GEOLOGICAL MODELS 48

9.3 BLOCK MODEL ORIENTATION AND DIMENSIONS 51

9.4 DATABASE 51

9.5 EXPLORATORY DATA ANALYSIS 51

9.6 DATA COMPOSITING 56

9.7 DENSITY DETERMINATION 57

9.8 GRADE CAPPING / CUTTING 57

9.9 ESTIMATION/INTERPOLATION METHODS 57
9.10 REASONABLE PROSPECT OF EVENTUAL ECONOMIC EXTRACTION AND CUT-OFFS 58
9.11 CLASSIFICATION OF MINERAL RESOURCES 59
9.12 GRADE MODEL VALIDATION.... 62
9.13 MINERAL RESOURCE STATEMENT 64
9.14 RELEVANT FACTORS THAT MAY AFFECT THE MINERAL RESOURCE ESTIMATES 66
9.15 QUALIFIED PERSON'S OPINION 66

10 MINERAL RESERVE ESTIMATE 68

10.1 BASIS, ASSUMPTIONS, PARAMETERS AND METHODS.... 68
10.1.1 Exchange Rates and Financial Assumptions 68
10.1.2 Cut-off Grade 69
10.1.3 Modifying Factors and Reconciliation 70
10.2 MINERAL RESERVES.... 72
10.3 RELEVANT FACTORS.... 74

11 MINING METHODS 75

11.1 INTRODUCTION.... 75
11.1.1 Mode of Entry 75
11.1.2 Mine Development 76
11.1.3 Stoping.... 76
11.1.4 System of drilling and blasting 77
11.1.5 Method and sequence of stoping 79
11.2 GEOTECHNICAL PARAMETERS 84
11.2.1 Geotechnical Parameters & Pillar Designing for stope preparation.... 84
11.3 SUPPORT SYSTEM.... 85
11.4 HYDROGEOLOGICAL PARAMETERS 88
11.4.1 Hydrogeology of 10-km area (Buffer zone) 88
11.4.2 Ground Water and Conceptual Model.... 89
11.4.3 Nature of hydraulic conductivity 90
11.4.4 Recharge through rainwater harvesting structures 90
11.5 MINE DESIGN PARAMETERS.... 92
11.6 MINE SCHEDULE 92
11.7 MINING FLEET REQUIREMENTS.... 93
11.7.1 System of underground transportation 93
11.7.2 Surface Transportation.... 94
11.7.3 Equipment Productivity and Usage 94

11.8 MINE VENTILATION 95

12 **PROCESSING AND RECOVERY METHODS** **97**

12.1 INTRODUCTION 97

13 **PRIMARY SURFACE INFRASTRUCTURE** **97**

13.1 ROADS 97
13.2 STOCKPILE AND STORAGE FACILITIES 97
13.3 TAILINGS DISPOSAL 98
13.4 POWER AND WATER 98
13.4.1 Power requirements and sources *98*
13.4.2 Emergency Power *98*
13.4.3 Water requirements and sources *98*

14 **MARKET STUDIES** **98**

14.1 INTRODUCTION 98
14.2 ZINC 99
14.2.1 Application Of Zinc *99*
14.2.2 Supply and Demand *99*
14.2.3 Prices *100*
14.3 LEAD 103
14.3.1 Applications for Lead *103*
14.3.2 Supply and Demand *103*
14.3.3 Prices *104*
14.4 SILVER 107
14.4.1 Applications for Silver *107*
14.4.2 Supply and Demand *107*
14.4.3 Price *109*

15 **ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY** **109**

15.1 INTRODUCTION 109
15.2 ENVIRONMENTAL STUDIES 110
15.2.1 Land Use *110*
15.2.2 Climatology *112*
15.2.3 Air Quality *113*
15.2.4 Noise Pollution *115*
15.2.5 Surface Water and Wetlands *116*
15.2.6 Groundwater *117*

15.2.7 *Soil* ... 118
15.2.8 *Biological Environment* ... 118
15.3 Requirements and Plans for Waste and Tailings Disposal, Site Monitoring, and Water Management ... 119
15.3.1 *Waste and Tailings Disposal* ... 119
15.3.2 *Site Monitoring* ... 120
15.3.3 *Water Management* ... 121
15.4 Required Permits and Status ... 122
15.5 Community Engagement ... 122
15.6 Mine Closure ... 123
15.6.1 *Mined-out land:* ... 123
15.6.2 *Post Mine Land use & Reclamation and Rehabilitation* ... 123
15.6.3 *Topsoil Management* ... 124
15.6.4 *Tailings dam Management* ... 124
15.6.5 *Acid Mine Drainage* ... 124
15.6.6 *Surface Subsidence* ... 124
15.6.7 *Monitoring & Control* ... 124
15.7 Adequacy of Plans ... 127

16 CAPITAL AND OPERATING COSTS ... 127

16.1 Operating Cost Estimate ... 127
16.2 Capital Cost Estimate ... 128

17 ECONOMIC ANALYSIS ... 128

17.1 Model Parameters ... 128
17.2 Taxes, Royalties, Depreciation and Depletion ... 128
17.3 Cashflow Forecasts and Annual Production Forecasts ... 130
17.4 Sensitivity Analysis ... 131

18 ADJACENT PROPERTIES ... 131

19 OTHER RELEVANT DATA AND INFORMATION ... 131

20 INTERPRETATION AND CONCLUSIONS ... 132

20.1 Results ... 132
20.2 Significant Risks ... 132
20.3 Significant Opportunities ... 132

21 RECOMMENDATIONS ... 132

21.1 Pricing assumptions ... 132

21.2 ENVIRONMENTAL, SOCIAL STUDIES 132
21.3 CLOSURE PLANS 133
21.4 GEOTECHNICAL DRILL CORE LOGGING 133
21.5 SAMPLING TRANSPORTATION 133
21.6 INDEPENDENT LAB ANALYSIS 133
21.7 BULK DENSITY DATA 133

REFERENCES: 134

LIST OF FIGURES

FIGURE 1: OVERALL VIEW OF THE KDM DESIGN AND ACCESS TO THE S1 AND K18 ORE LENSES 22
FIGURE 2: : KDM FINANCIAL SENSITIVITY ANALYSIS (UNIT: MILLION US $) 24
FIGURE 3: FILE STRUCTURE AND EXTRACTION SOURCE OF DATA 27
FIGURE 4: LOCATION OF THE KAYAD MINE 29
FIGURE 5: KDM AND SURROUNDING FEATURES 30
FIGURE 6: KAYAD ELEVATION 34
FIGURE 7: KAYAD SURFACE GEOLOGY 41
FIGURE 8: TYPICAL KAYAD SECTION 42
FIGURE 9: KAYAD MINERALISED LENSES 43
FIGURE 10: THE 3D PLAN VIEW PLOT OF THE KDM DEPOSIT 45
FIGURE 11: REPRESENTATION OF THE MINERALIZED LENSES AT KAYAD 50
FIGURE 12: MULTI-VARIATE HISTOGRAMS OF THE MAIN 01 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 53
FIGURE 13: MULTI-VARIATE HISTOGRAMS OF THE MAIN 02 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 53
FIGURE 14: MULTI-VARIATE HISTOGRAMS OF THE MAIN 03 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 54
FIGURE 15: MULTI-VARIATE HISTOGRAMS OF THE K21 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 54
FIGURE 16: MULTI-VARIATE HISTOGRAMS OF THE K18 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 55
FIGURE 17: MULTI-VARIATE HISTOGRAMS OF THE NE LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 55
FIGURE 18: MULTI-VARIATE HISTOGRAMS OF THE S1 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 56
FIGURE 19: MULTI-VARIATE HISTOGRAMS OF THE S2 LENSE DRILL HOLE SAMPLES FOR ZN (%), PB (%), AND AG (G/T) 56
FIGURE 20: JORC MINERAL RESOURCE AND ORE RESERVE CLASSIFICATION FRAMEWORK 59
FIGURE 21: MINERAL RESOURCES FOR KAYAD– 31 MARCH 2021 62
FIGURE 22: SWATH PLOT (NORTH) FOR THE BLOCK MODELS OF ALL LENSES FOR ZN (%) ESTIMATES VERSUS DRILL HOLE GRADES 63
FIGURE 23: SWATH PLOT (NORTH) FOR BLOCK MODELS OF ALL LENSES FOR PB (%) ESTIMATES VERSUS DRILL HOLE GRADES 63
FIGURE 24: SWATH PLOT (EAST) FOR BLOCK MODELS OF ALL LENSES FOR AG (G/T) ESTIMATES VERSUS DRILL HOLE GRADES 64
FIGURE 25: LVS SHOWING RAMPS AND DECLINE 75
FIGURE 26: UNDERGROUND LAYOUT (PLAN) 76
FIGURE 27: DRILL PLAN (LEFT) AND SECTION (RIGHT) FOR LONGITUDINAL LHOS 77
FIGURE 28: BURN CUT DRILLING AND BLASTING PATTERN FOR DECLINE DEVELOPMENT 78
FIGURE 29: TYPICAL LONGITUDINAL LHOS 80
FIGURE 30: TYPICAL TRANSVERSE STOPE 80
FIGURE 31: DIAGRAM SHOWING BACKFILLING PROCESS 82
FIGURE 32: CROSS SECTIONAL DRAWING OF THE CRF FLOW 83
FIGURE 33: DIAGRAM SHOWING CEMENT SLURRY TRANSPORTATION FROM CRF PLANT TO 200 MRL 84
FIGURE 34: 4-WAY JUNCTION - SUPPORT 86
FIGURE 35: T SHAPE- JUNCTION - SUPPORT 87

FIGURE 36: PASSING WAY - SUPPORT 87
FIGURE 37: TYPICAL SECTION OF THE EARTHEN CHECK DAM/ GULLY PLUG CONSTRUCTED IN THE SRINAGAR BLOCK 91
FIGURE 38: 5-YEAR ZINC PRICE IN US DOLLARS 101
FIGURE 39: LME ZINC CONTRACT PRICES 102
FIGURE 40: HZL ZINC SPECIFICATIONS 102
FIGURE 41: WORLD PRODUCTION OF LEAD 104
FIGURE 42: 12-MONTH PRICE OF LEAD.... 105
FIGURE 43: 5-YEAR PRICE OF LEAD.... 105
FIGURE 44: LME CONTRACT PRICE ON JULY 2022. 106
FIGURE 45: HZL LEAD SPECIFICATIONS.... 106
FIGURE 46: HZL SILVER SPECIFICATIONS.... 108
FIGURE 47: 5-YEAR SILVER PRICE 109
FIGURE 48: NURSERY FOR RARE AND NATIVE PLANT SPECIES 126
FIGURE 49: PLANTATION DEVELOPMENT AROUND THE MINE 126
FIGURE 50: LAWN DEVELOPMENT OVER TOPSOIL NEAR ADMINISTRATIVE BUILDING 127
FIGURE 51: RAM FINANCIAL SENSITIVITY ANALYSIS (UNIT: MILLION US $).... 131
FIGURE 52: FILES & FOLDERS LIST - HZL DATA AND INFORMATION PACK – KDM 134
FIGURE 53: DATA PACK - RESOURCE TO RESERVE ESTIMATION (DATAMINE FILES) 135

LIST OF TABLES

Table 1: Kayad Mineral Resource Statement (exclusive of Mineral Reserves) – 31 March 2022 20
Table 2: Kayad Mineral Resource Statement (inclusive of Mineral Reserves) – 31 March 2022.............................. 20
Table 3: Mineral Reserves Estimates (2022).. 21
Table 4: Remaining LOM Schedule - KDM.. 23
Table 5:Kayad Mine Lease Coordinates 31
Table 6: Lease agreement - details.. 31
Table 7: Lease agreement - Area.. 32
Table 8: Lease Agreement - District... 32
Table 9: Summary of the Security Bonds.. 32
Table 10: Details of bank guarantees for financial assurance.. 33
Table 11: Rainfall per annum (mm).. 36
Table 13: Kayad Production 2017 – 2021.. 37
Table 14: Kayad Surface Exploration Drilling 38
Table 15: Kayad Underground Exploration Drilling.. 38
Table 16: Summary of Exploration Drill for HZL Complex (2017-2021)... 44
Table 17: Classical statistics of the Main (ML01 – 03), S1, S2, K21, K18 and NE lenses 52
Table 18: Kayad Mineral Resource Statement (exclusive of Mineral Reserves) – 31 March 2022 64
Table 19: Kayad Mineral Resource Statement (inclusive of Mineral Reserves) – 31 March 2022........................... 65
Table 20: Net difference between the 31 March 2022 and 31 March 2021 Minerals Resources exclusive of Mineral Reserves 66
Table 21: Historic Commodity Prices 69
Table 22: LME Projected Commodity Prices... 69
Table 23: Next three year average prices... 69
Table 24: Cut-Off Grades and NSR Calculation inputs 70
Table 25: CMS Stope Reconciliation 71
Table 26: Mined versus Processed Grades.. 71
Table 27: External Dilution and Mine Recoveries applied.. 72
Table 28: Mineral Reserves Estimates (2022)... 72
Table 29: Input and calculation parameters... 74
Table 30: Drill and Blast Parameters 78
Table 31: Drive width 5-7m (Ore body, Decline and X- cut) 88
Table 32: LOM Schedule - Kayad Mines - 2022 – 2026 [supplied by HZL] 93
Table 33: Underground Ore Transportation... 94
Table 34: Equipment Productivity 95
Table 35: Ventilation Requirements - KDM.. 96

TABLE 36: INTAKE AND RETURN AIRWAY SUMMARY 96
TABLE 37: HZL PRODUCT RANGE 100
TABLE 38: HZL FINANCIAL MODEL PRICES 101
TABLE 39: LAND USE AREA WITHIN KAYAD STUDY AREA (AREA IN HECTARES) 111
TABLE 40: LAND USE PATTERN (EXISTING VS END OF MINING PLAN PERIOD) 112
TABLE 41: DETAILS OF AMBIENT AIR QUALITY MONITORING 114
TABLE 42: WASTE (TONNES) GENERATED PER YEAR 119
TABLE 43: SUMMARY OF YEARLY PMCP PROGRAM 125
TABLE 44: SUMMARY OF OPERATING COSTS (SOURCE HZL) 127
TABLE 45: COSTING AND FINANCIAL INPUTS PER ANNUM (SUPPLIED BY HZL) 128
TABLE 46: FINANCIAL MODEL OUTCOME (2022 - 2025) 130

LIST OF GRAPHS

No table of figures entries found.

1 EXECUTIVE SUMMARY

1.1 Property summary and ownership

The deposit of the Kayad zinc lead mine is located on to east of Kayad village and lies between longitudes E74°41'8.79" to E74°42'30.99" and latitudes N26°31'1.15" to N26°32'55.95" and is covered under Survey of India topography sheet no 45J/10. The Kayad village is 9 km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital is 127 km and nearest airport is at Kishangarh 20 km from the Mine. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of Northwestern Railway, 9 km SSE of Kayad.

HZL acquired the Kayad Mining Lease of the deposit in February 1998 and started systematic exploration in different phases with advanced geological and geophysical techniques. HZL has drilled 228,678 m surface drilling in 459 bore holes by August 2020, as well as 72,810m in 970 bore holes from underground.

The Mining Lease is valid until 27.02.2048.

1.2 Mineral Resource Statement

The Mineral Resources described in this Item are based on appropriate geoscientific information, economic and technical parameters, and grade and tonnage estimation processes. The Mineral Resource estimates were determined using ordinary kriging (OK) geostatistical methodology and considered sample lengths, grade capping / cutting, the spatial distribution of drill holes and the quality assurance and quality control results for the analytical sample grades determined. Geological modelling and grade estimation used Datamine software.

The Mineral Resources exclusive of the Mineral Reserves as at the end of the last fiscal year are summarised in Table 1, whilst Table 2 summarises the same period where the Mineral Resources are inclusive of the Mineral Reserves. The Mineral Resources tabled below are reported at a ZnEQ COG of 3.89%.

Table 1: Kayad Mineral Resource Statement (exclusive of Mineral Reserves) – 31 March 2022

Classification	Tonnage	Grade			Metal Content		
	(Mt)	Zn (%)	Pb (%)	Ag (g/t)	Zn (Kt)	Pb (Kt)	Ag (Koz)
Measured	0.2	9.60	1.60	33	18	3	191
Indicated	2.4	7.90	1.10	20	192	26	1,590
Measured + Indicated	**2.6**	**8.00**	**1.10**	**21**	**210**	**29**	**1,781**
Inferred	2.4	6.60	0.90	14	159	21	1,067
Total	**5**	**7.40**	**1.00**	**18**	**368**	**51**	**2,849**

The Measured Mineral Resources as a proportion of the total Inclusive Mineral Resource as of 31 March 2022 accounts for ~9% of the tonnes, the Indicated Mineral Resources is ~53%, and the Inferred at ~38%

Table 2: Kayad Mineral Resource Statement (inclusive of Mineral Reserves) – 31 March 2022

Classification	Tonnage	Grade			Metal Content		
	(Mt)	Zn (%)	Pb (%)	Ag (g/t)	Zn (Kt)	Pb (Kt)	Ag (Koz)
Measured	0.6	11.10	1.80	33	62	10	601
Indicated	3.4	9.00	1.10	22	308	39	2,367
Measured + Indicated	**4.0**	**9.30**	**1.20**	**23**	**370**	**49**	**2,968**
Inferred	2.4	6.60	0.90	14	159	21	1,067
Total	**6.4**	**8.30**	**1.10**	**20**	**529**	**70**	**4,035**

1.3 Mineral Reserve Statement

The HZL mine operations and technical teams engage on annual industry statutory evaluation and conduct standard works that is applied across all the mine operation from the geology resource estimations to applying the mine designs and evaluating the potential Mineral Reserves. The HZL Resources and Reserves technical team has kept extensive data that is used annually to do the statutory mineral reserves statements and calculations that is audited and supervised by reputable consultant houses. Each mine undergoes individual assessments and apply the modifying factors, grade cut-off calculation and assumptions.

ABGM collated the data and reviewed the mine designs, input parameters and mine design criteria for the mine operation. KDM is an underground massive mining operation utilising a sub-level Long

Hole Open Stope (LHOS) mining extraction method with backfill. A comprehensive analysis and relevant input parameters is applied to the Mineral Resource to develop the Mineral Reserves.

The Mineral Reserve statement (March 2022) suggests KDM has 1.9Mt at 7.6g/t Zinc, 0.9% Lead and 18 g/t Silver within the minable Ore Reserve.

Table 3: Mineral Reserves Estimates (2022)

Ore Reserve summary							
Ore Reserve	Tonnage (Mt)	Grade (Zn %)	(Pb %)	(Ag g/t)	Metal (Zn kt)	(Pb kt)	(Ag koz)
Proved	0.6	6.9	1.1	20	42	7	386
Probable	1.3	7.9	0.8	16	105	11	702
Ore Reserves (Total)	**1.9**	**7.6**	**0.9**	**18**	**146**	**18**	**1,088**

1.4 Geology and Mineralization

The deposits are hosted by middle Proterozoic Delhi Fold Belt of metasediments (2000 my-750 my). Kayad lies near the centre of this 30 km wide belt in Ajmer area. The rocks are assumed to have been deposited in a shelf margin to a shelf interior environment. The deposit forms part of the pre-Aravalli Gneissic Complex. Later orogenesis with magmatism concomitant contributed a significant change in the overall setup and morphotectonic features.

The formation consists of gneisses, schists and intrusive acidic and basic igneous rocks that occupy predominantly the south-eastern plains of Ajmer and Bhilwara. The rock units show NE-SW strike with steep dips in hanging wall (75^0-80^0) and moderate dips in the footwall (60^0-65^0) towards the south-east and plunges towards NNE.

Economic mineralization is predominantly in graphite-mica-sillimanite gneiss schist over the strike length of 1,550m. The ore zone has a sharp contact with the hanging wall and footwall. The hanging wall side of the lode is the richest and widest, followed by comparatively lean grade in the middle and a narrow, rich, footwall zone. Coarse grained crystalline galena, associated with pyrite and pyrrhotite are seen in the hanging wall rocks. The mineralization in the hanging wall and footwall contacts is invariably fine to coarse grained and is made up of sphalerite and galena with numerous inclusions or rounded to sub-rounded discrete grains of feldspar, quartz, hornblende, sillimanite and dark green chlorite.

There are four major lenses – the Main lens, K1 lens, S1 lens & K18 lens. The main lens ranges in average width from 5 m in the steeper portions to about 35 m in the flat lying portion. Maximum strike of the main lens is 900 m at the depth of approximately 250 m from the surface.

1.5 Metallurgical Testing

The HZL has a network of operations across India and KDM is currently an operating mine and sends ROM to the RAM CPP for processing. . The mineral processing is well understood and there is no need to conduct any additional metallurgical test work at the current operations.

1.6 Mine Design, Optimizations and Scheduling

The current mine design implemented at KDM is to date been successfully extracted and maintained as per the original design. There is currently no indication that the mine cannot continue in the current stage. Additional stability pillars have also been included in the LOM design to ensure the overall stability of the mine operations. The mine will be extracting the last of its reserves from the adjacent S1 and K18 blocks and will require capital development to reach the ore lenses.

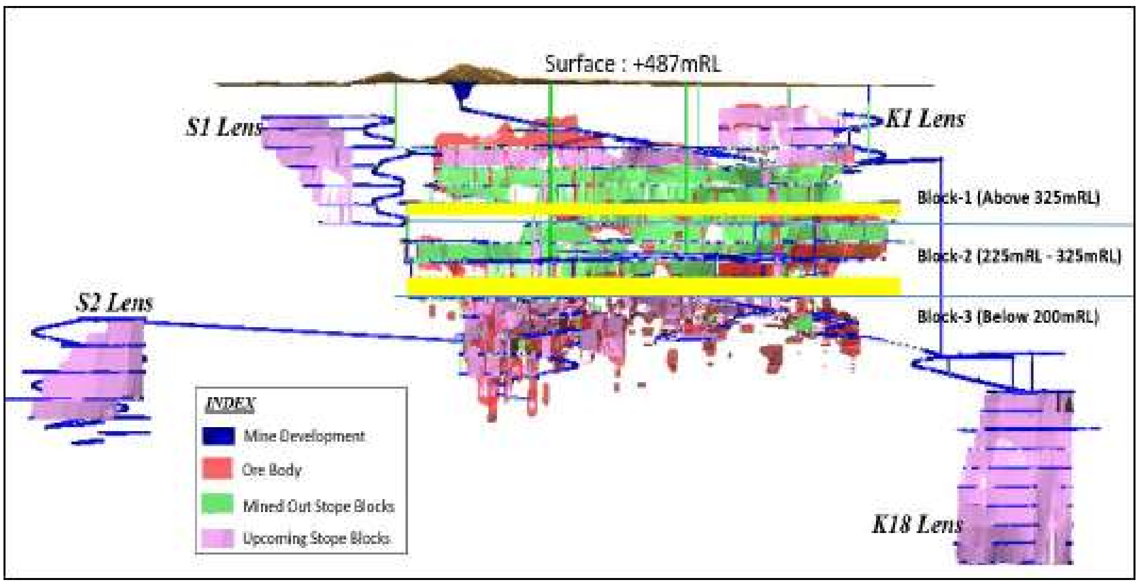


Figure 1: Overall view of the KDM design and access to the S1 and K18 Ore Lenses

The mine is schedules to produce 0.8mtpa in 2022 and will be mined out by 2026, with the current reserves estimated remaining.

Table 4: Remaining LOM Schedule - KDM

Area / Block	2022-23	2023-24	2024-25	2025-26	Total
Access_Block1&2				47,692	**47,692**
N200_Sill Pillar	70,724				**70,724**
EF Access	59,620				**59,620**
S1 Block	223,134				**223,134**
K18_Connecting	178,078	19,320			**197,398**
K18 Block	276,000	800,000	251,059		**1,327,059**
Total Ore Production (Tons)	**807,556**	**819,320**	**251,059**	**47,692**	**1,925,627**
Grade	**2022-23**	**2023-24**	**2024-25**	**2025-26**	
Zn %	7.21	7.82	7.77	9.28	**7.59**
Pb %	1.06	0.83	0.81	1.29	**0.93**
TMC %	**8.27**	**8.64**	**8.59**	**10.57**	**8.53**
Ag ppm	20	17	16	17	**18**

1.7 Mineral Processing

The ROM of Kayad mine is sent to the Processing facilities at RAM. The ore taken to the RAM Plant is separately treated in one of the streams. All the vital parameters are monitored through instream analysers and chemical composition of the feed, concentrates and tails are continuously sampled and analysed at site laboratory well equipped with state-of-the-art instruments. The table shown below typically depicts the assays of ore treated from Rampura-Agucha underground (RAUG) mine and Kayad mine for a day. However, it may vary depending upon the mineral composition of the respective mine

1.8 Environmental, Permitting and Community Impact

KDM is doing sufficient work around the environmental assessments and are continuously monitoring all vital statutory aspects required. There is various sites and locations where site monitoring is conducted in regard to the following main elements:

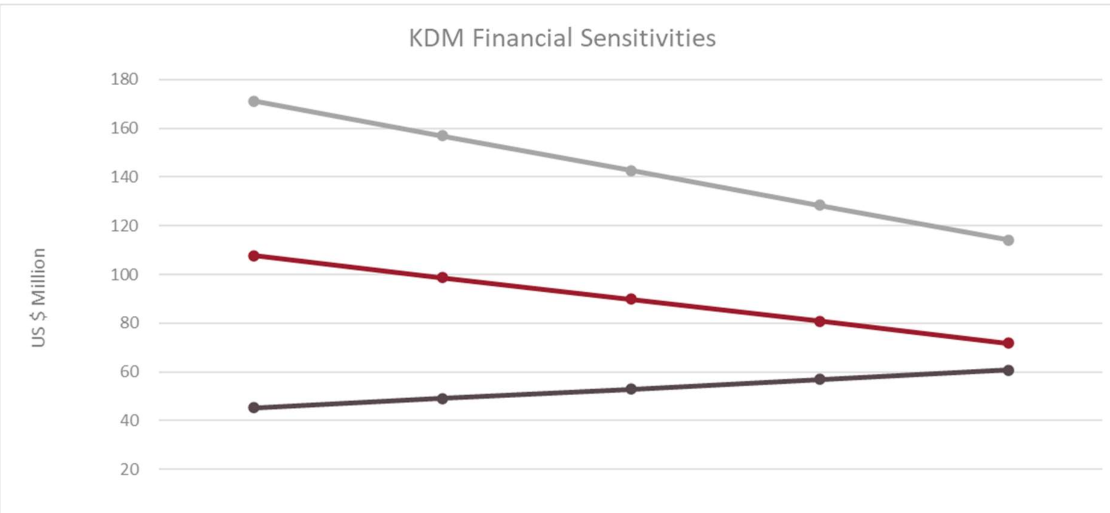
- Land Use
- Water Quality and Management
- Air Quality
- Noise Pollution
- Soil Monitoring
- Tailing disposal

The mine is also engaging with the local communities to ensure alignment with EIA requirements overall. The mine is also planning, reviewing, and executing the annual mine closure plan as required by IBM.

1.9 Capital Costs, Operating Costs and Financial Analysis

ABGM had limited access to all the financial inputs and did not have adequate time to develop comprehensive techno-economic evaluations on the mine operations, however HZL did provide their operational estimates for the mine operations to develop financial sensitivities. The mine is undergoing numerous projects, but the capital expenses of these projects are not known by ABGM. KDM is nearing the end of its planned current LOM and there is not a foreseen massive capital injection planned for this mine. The mine will however need to do some capital development to reach the adjacent lenses and to keep development ongoing to extract the ore lenses.

The operating costs for KDM is indicated in this document and financial sensitives indicate that KDM is not very sensitive to economic parameters at plus and minus 20%



	20%	10%	100%	-10%	-20%
Cashflow	108	99	90	81	72
Cost	45	49	53	57	61
Revenue	171	157	143	128	114

Figure 2: : KDM Financial Sensitivity Analysis (unit: Million US $)

2 Introduction

2.1 Terms of Reference and Purpose of the Report

A&B Global Mining (ABGM) was commissioned by Hindustan Zinc Limited (HZL) to prepare a review on the Mineral Resources and Ore Reserves – 31 March 2022 Statement, for the following mine operations that are operated by HZL namely:

- Rampura Agucha (RAM)
- Kayad (KDM)
- Sindesar Khurd (SKM)
- Rajpura Dariba (RDM)
- Zawar Mines (ZAW)

This report is a Technical Report Summary (TRS) which summarizes the findings of the review in accordance with Securities Exchange Commission Part 229 Standard Instructions for Filing Forms Regulation S-K subpart 1300 (S-K 1300).

The purpose of this TRS is to report the review of Resource and Reserve Estimates as stated in their Draft document dated 31 March 2022, and to review the data & information received from HZL that will potentially be included in the 2022 Resource and reserve Statement Technical report. The effective date of this report is 29 July 2022.

The quality of information, conclusions, and estimates contained herein is based on the data and information received from HZL and is consistent with the level of effort involved in ABGM's services, based on:

i. information available at the time of preparation,
ii. data supplied by the client, and
iii. the assumptions, conditions, and qualifications set forth in this report.
iv. The time available to complete this review

Any opinions, analysis, evaluations, or recommendations issued by ABGM under this report are for the sole use and benefit of HZL. Because there are no intended third-party beneficiaries, ABGM (and its affiliates) shall have no liability whatsoever to any third parties for any defect, deficiency, error, omission in any statement contained in or in any way related to its deliverables provided under this Report.

2.2 Sources of Information

The information, opinions, conclusions, and estimates presented in this report are based on the following:

- Information and technical data provided by HZL
- Review and assessment of previous investigations
- Assumptions, conditions, and qualifications as set forth in the report
- Review and assessment of data, reports, and conclusions from other consulting organizations and previous property owners.

These sources of information are presented throughout this report and in the References section. The qualified persons are unaware of any material technical data other than that presented by HZL.

ABGM and their associates received a database of information of the HZL operations between 30 June 2022 and 25 July 2022 and reviewed the documents, datasets, and information to consolidated into the document presented as of date 29 July 2022

2.3 List of source materials

HZL provided AGBM with access to a data room housed in EthosData. Here HZL delivered the required documentation and design data from the modelling to the string. Point and wireframes used in the development of the resources model estimates and the reserve estimates.

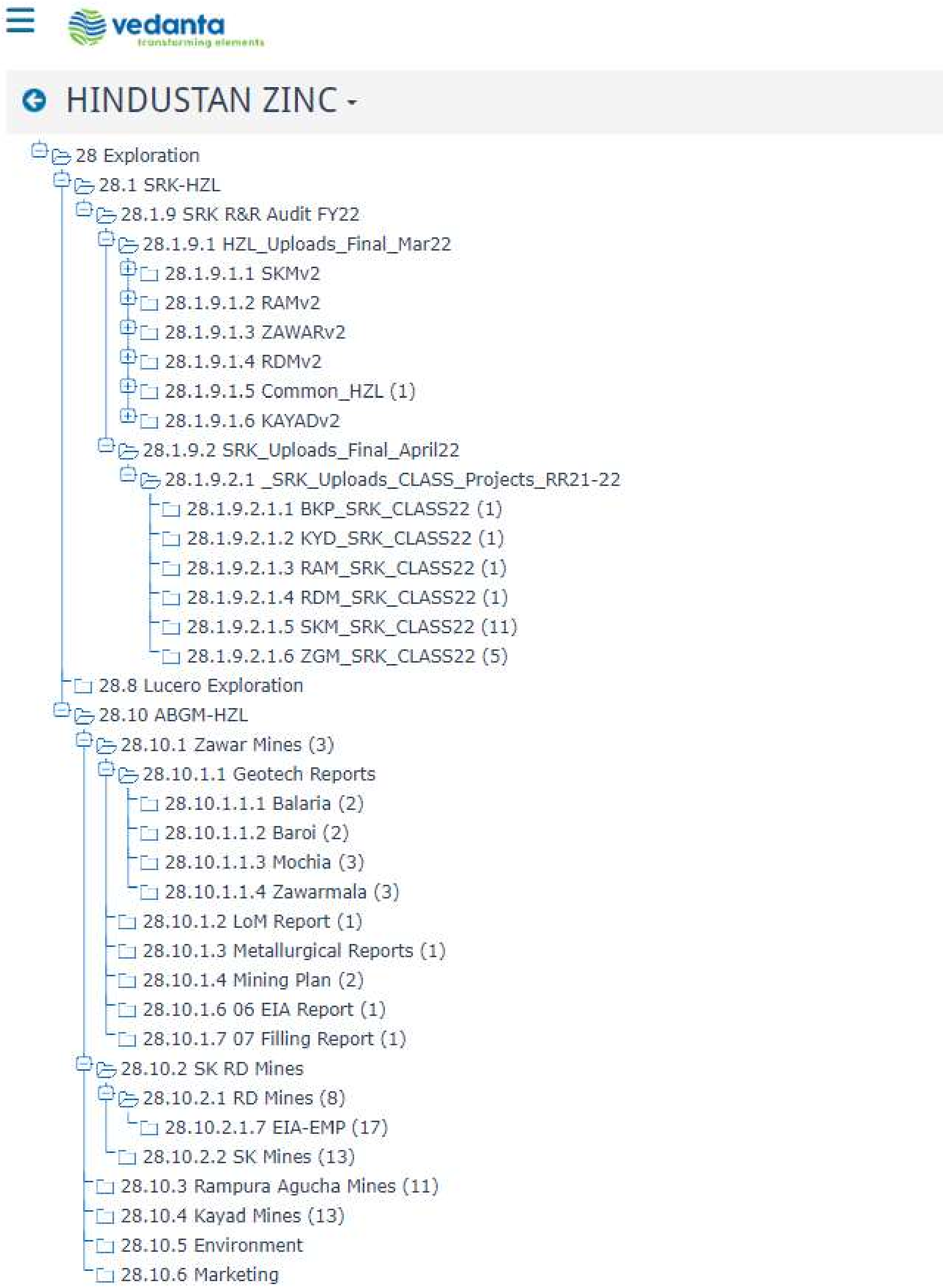


Figure 3: File Structure and extraction source of data

2.4 Qualified Persons and Details of Inspection

A comprehensive site visit was conducted in the week of 17 July to 25 July 2022. The objectives of the site visits was to conduct the following:

- Physical verification of the mining operations and onsite infrastructure.

- Obtain outstanding information required to complete the technical report.
- Interact with the mine technical team to obtain further clarifications.

Three consultants from ABGM attended the site visits at the various mines.

- **Devendra Vyas:** Managing Director and Principal Mining Engineer
- **Andre van der Merwe:** General Manager and Principal Consultant (Geophysics, Hydrogeology, Geology, Mineral Processing and Environmental Engineering)
- **Pieter Groenewald:** Head – Technical Services and Principal Consultant (Rock Engineering and Hydrogeology)

ABGM Authors and contributors:

- Resource Geologist - **Dr Heather King**
- Resource Geologist - **Mpai Mosiuoa**
- Mine Engineer **- Hans Erasmus**
- Project Manager / Mine Engineer – **Colin Little**

2.5 Previous Reports on the Project

This is the only SEC -S-K 1300 TRS, A&B Global Mining (ABGM) has submitted for the Hindustan Zinc Limited (HZL) and authors are not aware of any other TRS submitted by prior owners of the project.

3 Property Description and Locations

3.1 Property Location

The deposit of the Kayad zinc lead mine is located beneath flat agricultural terrain located at the edge of Kayad village. The Kayad village is 9 km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital is 127 km, and the nearest airport is at Kishangarh 20 km from the mine. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of Northwestern Railway, 9 km SSE of Kayad.

The Kayad lead-zinc deposit is located on the east of Kayad village and lies between longitudes E74°41’8.79” to E74°42’30.99” and latitudes N26°31’1.15” to N26°32’55.95” and is covered under Survey of India topo sheet no 45J/10.

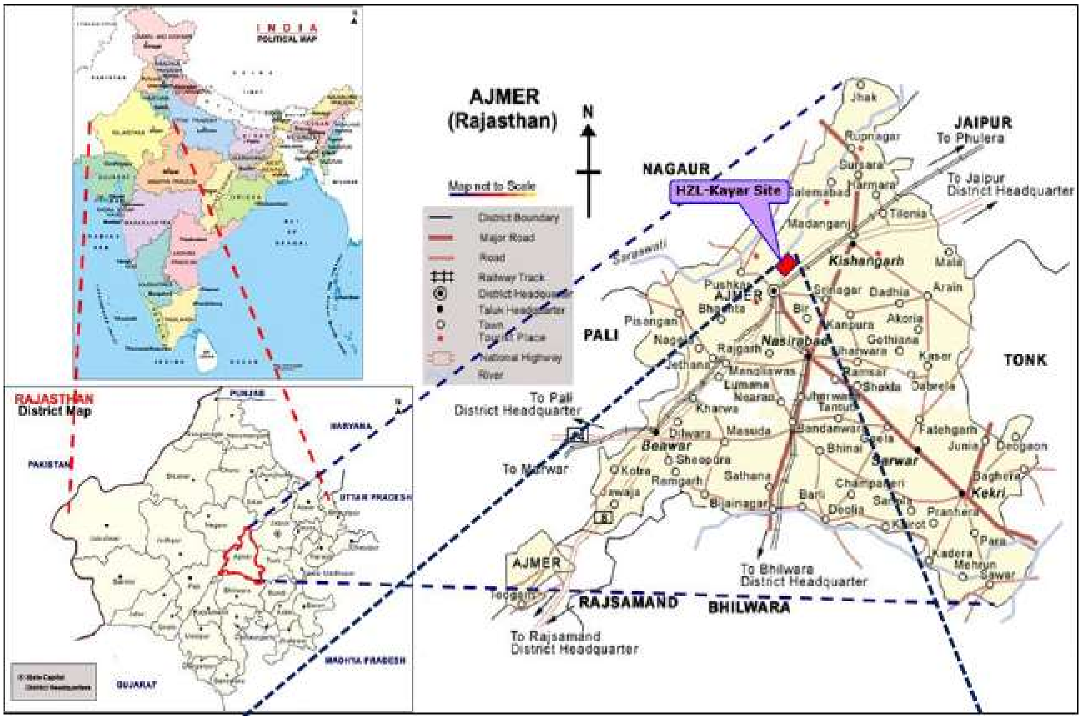


Figure 4: Location of the Kayad Mine

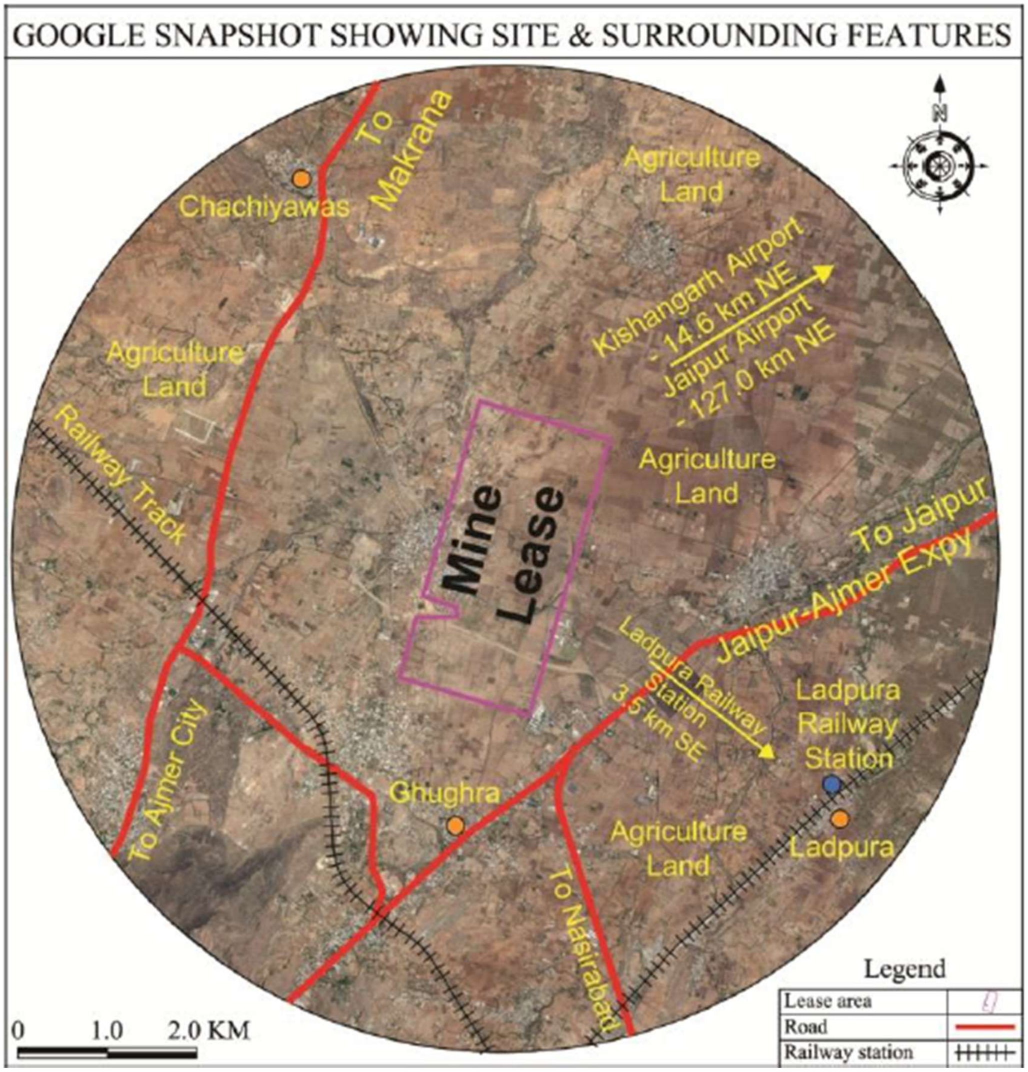


Figure 5: KDM and Surrounding Features

Table 5:Kayad Mine Lease Coordinates

Lease Pillar Co-Ordinate			UTM Coordinate	
Point	Longitude	Latitude	EASTING	NORTHING
A	74°41'38.6"	26°32'55.95"	43R469516.57mE	2936503.43 mN
B	74°42'30.99"	26°32'43.44"	43R470969.44mE	2936123.42 mN
C7	74°42'12.39"	26°31'40.41"	43R470451.56mE	2934179.46 mN
C6	74°42'9.06"	26°31'42.92"	43R470361.76 mE	2934258.3 mN
C5	74°42'0.1"	26°31'36.35"	43R47013.31 mE	2934053.42 mN
L	74°41'57.01"	26°31'29.93"	43R470026.37 mE	2933860.19 mN
M	74°41'56.03"	26°31'26.81"	43R469962.23 mE	2933592.16 mN
C4	74°41'53.32"	26°31'15.7"	43R469923.46 mE	2933416.95 mN
C3	74°41'59.33"	26°31'12.71"	43R470090.82 mE	2933333.1 mN
C2	74°42'5.01"	26°31'23.24"	43R470248.16 mE	2933648.02 mN
C1	74°42'7.52"	26°31'22.64"	43R470315.94 mE	2933629.19 mN
C	74°42'1.18"	26°31'1.15"	43R470132.87 mE	2932967.86 mN
D	74°41'8.79"	26°31'13.66"	43R468680.3 mE	2933363.22 mN
E	74°41'15.28"	26°31'35.65"	43R468883.71 mE	2934044.44 mN
F	74°41'31.54"	26°31'35.69"	43R469323.78 mE	2934036.35 mN
G	74°41'31.53"	26°31'40.24"	43R469324.53 mE	2934179.57 mN
H	74°41'31.1"	26°31'39"	43R469310.56 mE	2934140.23 mN
I	74°41'17.3"	26°31'42.88"	43R468930.21 mE	2934263.03 mN

3.2 Mineral Titles, Claim Rights, Leases and Options

3.2.1 Lease agreements - Details

Table 6: Lease agreement - details

Lease Details	Existing Mine
Name of the Mine	Kayad Lead Zinc Mine
Lat/long of any boundary point	Pillar A (Latitude 26°32'55.95" Longitude74°41'38.6")
Date of Grant of Lease	Initial – 28.02.1998
	The mining lease of Kayad lead-zinc was sanctioned as ML no. 16/92 for a period of 20 years to M/S Hindustan Zinc Limited vides GoR order no. F.17 (57) Mines/Gr. I/93 dated 03.10.97. Since the date of registration of deed was 28.02.98, the validity of the lease stood till 27.02.18. Subsequently, vide letter no. Kha/Aj/Pradhan/Kha.P.-16/92/2537 dated 27.02.15 the validity of the lease stands extended to 27.02.48 (50 years from 28.02.98) owing to the MMDR (Amendment) Act, 2015.
Period/Expiry Date	Till 27.02.2048 as per Section 8A(5) of MMDR (Amendment) Act,2015

3.2.2 Lease agreements – Area

Table 7: Lease agreement - Area

Forest Land	Nil Ha	Non-Forest	Area (Ha)
		(i) Waste Land	23.53
		(ii) Grazing land	11.1
		(iii) Agriculture Land	445.82
		(iv) Others	
Total Forest	**Nil**	**Total Non-forest**	**480.45 Ha**

3.2.3 Lease agreements – District

Table 8: Lease Agreement - District

District & State	Ajmer, Rajasthan
Taluka / Tehsil (Administration Area)	Ajmer
Village	Kayad
Whether the area falls under Coastal Regulation Zone (CRZ)	Not Applicable

3.3 Environmental Impacts, Permitting, Other Significant Factors and

3.3.1 Commitments

No major commitments other than continuous Ambient Air Monitoring. Ambient Air Quality Monitoring (AAQM) stations were set up and are addressed later in the document.

3.3.2 Security bonds

Bank Guarantee for degraded land has been submitted and reclamation plan submitted to IBM. The total breakup of land calculated for financial assurance of around 48.5 hectares. Bank guarantee for the same shall be INR 2,42,50,000.

Table 9: Summary of the Security Bonds

Area put in use	Rate/Ha (Rs.)	Bank Guarantee Amount (Rs.)
48.5	5,00,000	2,42,50,000

Bank Guarantee covering amount of Rs.2,42,50000 (two crore, forty two lakhs, Fifty thousand only) has already been submitted.

Table 10: Details of bank guarantees for financial assurance

Date	Bank	Amount in Rs.
23-02-2022	IDBI, Udaipur	2,42,50,000

3.3.3 Reclamations liabilities

There is no Reclamation liabilities in the surface area. However all the stopped out required to backfilled in order to mined the other adjacent area.

3.4 Royalties and Agreements

3.4.1 Joint ventures

Kayad Mine is in no current joint venture with third parties or other companies.

3.4.2 Royalty agreements

Kayad Mine's ROM is removed from the leased area to a processing plant which is located outside the leased area, then royalties are charged on the unprocessed run-of-mine and not on the processed product.

The Lead and Zinc Mineral royalty is to be paid based on London Metal Exchange or London Bullion Market Association price, the royalty shall be calculated at the specified percentage of the average sale price of the metal for the month as published by the Indian Bureau of Mines, for the metal contained in the ore removed of such mineral for the month.

The Rates of royalty declared as per Mine and Mineral (Regulation and Development Act 2021 and royalty rates are:

1.The Royalty for Lead is 8.5% of London Metal Exchange lead metal price chargeable on the contained lead metal in ore produced.

2. The Royalty for Zinc is 9.5% of London Metal Exchange Zinc metal price on ad valorem basis chargeable on contained zinc metal in ore produced.

4 Accessibility, Climate, Local Resources, Infrastructure and Physiography

4.1 Topography, Elevation and Vegetation

4.1.1 Topography

The area is undulating with altitude varying from 480 to 506 mRL. The highest point is a small mountain just east of the village Kayad, attaining an altitude of 506 mRL. The area is mostly soil covered with a few outcrops here and there.

The Kayad village falls on the western end of lease boundary. The topsoil is fertile and suitable for agriculture. Seasonal crops are jawar, maize, bazra and other cereals etc. The lease area is almost flat having altitude of around 486 mRL.

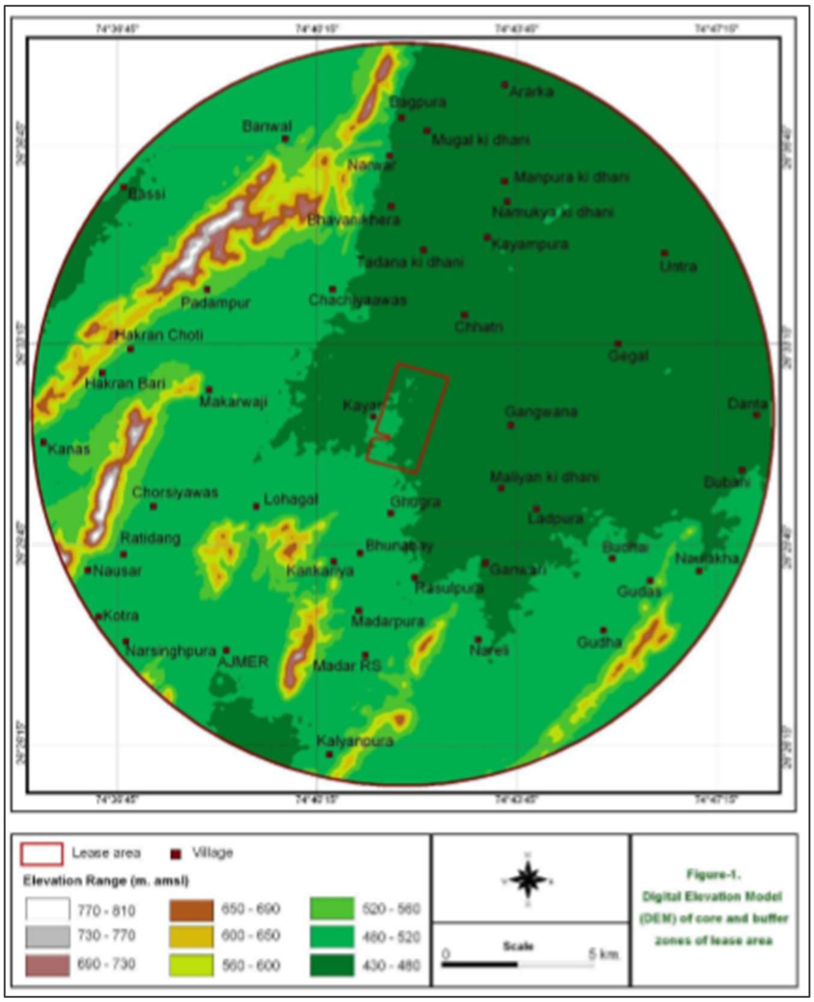


Figure 6: Kayad Elevation

4.1.2 Drainage Pattern

The prominent "Kala Nala" (outside the ML) flowing from south to north joins Phool Sagar reservoir near Kayad village. The drainage is a seasonal and is mostly of dendritic pattern and there is no prominent watercourse other than "Kala Nala" in the area. A number of dug well with water table varying between 20 to 30 m are present.

Ground water movement is controlled mainly by the hydraulic conductivity of the crystalline metamorphics and hydraulic gradient. The ground water movement mainly takes place through the fractures and joints of the crystalline rocks. A review of the topography and drainage pattern in the major part of the buffer zone reveals that the general slope of the area is towards northeast and is 4.0 to 5.0 m/km. The ground water flow in this part of the buffer zone is also towards NE with hydraulic gradient as 3.75 to 3.88 m/km as calculated from the monitoring of the wells in the area. The Ground water occurs under water table condition and is transmitted through fractures, joints and foliations. Mica schists and quartzites are impervious in nature and have developed secondary porosity only due to joints and fractures. There is very limited thickness of weathered zone and generally it lies above the zone of saturation. The depth of water in crystalline metamorphics, during post monsoon period ranges within very wide limit from 6 to 30 metres below the land surface. It is shallow near the river course, ponds and surface water reservoirs while it is deeper in the area from 8 to 37 m below the land surface during per-monsoon period. The fluctuations due to rainfall and ground water withdrawal are significant as the rocks have very low fracture porosity and hydraulic conductivity.

Highest Flood Level (HFL) recorded as 483.719 mRL recorded on 18.07.1975. The mine entry is at 487.6 mRL which is above HFL

4.1.3 Vegetation

The topsoil is fertile and suitable for agriculture. Seasonal crops are jawar, maize, bazra and other cereals, etc. The lease area is almost flat having altitude of around 486 m. The area is mostly covered by 1 m to 15 m thick sandy loam. The trees found in the area are neem, babool, and tamarind. Sporadically there is a growth of thorny bushes and cactus.

4.2 Accessibility and Transportation to the Property

The Kayad village is 9 km NNE of Ajmer city and is connected by tar road. Jaipur, the state capital is 127 km away and the nearest airport is at Kishangarh, 20 km from the Mine. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of Northwestern Railway, 9 km SSE of Kayad.

The area is undulating with altitude varying from 480 to 506 m. The highest point is a small mountain just east of the village Kayad, attaining an altitude of 506 m.

4.3 Climate and Length of Operating Season

4.3.1 Climate

Based on the Koppen classification of climatic patterns, the sub-basin may be classified as tropical steppe, semi-arid and hot. The winter season from mid-December to February and is followed by the hot summer season from March to mid-July, including the pre-monsoon season from April to June. The period from July to mid-September constitutes the southwest monsoon season and the period from the second half of September to Mid-December as post monsoon season.

The average annual rainfall based on data recorded at Kayad mines for 14 years (2006 – 2012) has been recorded as 281.6 mm. The annual rainfall for 2019 was 885 mm.

May is the hottest months of the year with mean daily maximum and minimum temperature (in May) of 39.5 ^{0}C and 27.3 ^{0}C respectively. In January, the coldest month, the day and night temperature can range between 22 ^{0}C and 7.2 ^{0}C.

4.3.2 Rainfall Data

Study area is largely plain, and the area lies in the belt of arid region with an average rainfall of 571mm in last 10 years (during the period from 2011 to 2020), which consist maximum rainfall of 885mm in 2019 and minimum of 385mm in year 2018. The nearest rainfall measuring station is at Gegal at 26°32’N, 74°45’E in catchment no. 406. The occurrence and movement of the ground water is controlled by the topography and the physical characteristics of the rocks occurring in the area. The rainfall in Kayad and Ajmer area is given in Table 11

Table 11: Rainfall per annum (mm)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Kayad Area	417	441	702	283	653	492	596	707	578	478	557	440	385	885

4.4 Infrastructure Availability and Sources

The surface facilities at the Kayak Mine include, workshops, stores, offices, electrical substation, cement silos, waste rock dump, ore stockpiles and other minor installations. Stope production commenced towards the end of 2013. All the Kayak ore is transported by truck to RAM and processed at the RAM concentrator Stream 3, with the resultant tailings in the RAM TSFA.

The quality of surface water is good as the rocks are mostly crystalline metamorphics with this alluvial cover. With the moderate rainfall and good run-off, the water remains free from salinity.

5 History

5.1 Production

Table 12: Kayad Production 2017 – 2021

Description	Unit	F2017	F2018	F2019	F2020	F2021
		Actual	Actual	Actual	Actual	Actual
Ore Mined	Mt	1	1.2	1.19	1.14	1.17
Ore Processed	Mt	0.85	1.17	1.27	1.1	1.18
Zn grades	%	9.8	8.74	8.16	6.86	5.15
Pb grade	%	1.33	1.17	1.1	0.92	0.8
Ag grade	g/t	38.2	35.6	34.7	29.9	25.6
Zn Recovery	%	92	89.8	88.2	87.9	89.3
Pb recovery	%	63.9	60.4	56.3	54.9	57.8
Ag recovery	%	68.9	72.1	64.2	60.2	61.1
ZN metal produced	kt	77.8	92.9	92.2	67.2	54.8
Pb metal produced	kt	7.2	8.3	7.8	5.6	5.4
Ag metal produced	koz	778	1137	1,090	719	674

5.2 Historical Exploration

The deposit was discovered in 1968 by the Geological Survey of India ("GSI") during ground follow-up of an aerial electromagnetic anomalies survey, which was later proven to be unrelated to the deposit. By 1997, following two drilling campaigns, a largely 'inferred' resource of 10 Mt, close to 15% Zn was reported by a government agency.

HZL initiated additional drilling, as the previous work indicated a complex shape and low confidence mineralisation limits.

HZL acquired the Kayad Mining Lease of the deposit in February 1998 and started systematic exploration in different phases with advanced geological and geophysical techniques. HZL has drilled 228,678 m surface drilling in 459 bore holes by August 2020. The objective was the delineation of the deposit, filling the gaps, establish firm geological, metallurgical and geotechnical parameters for conceptual mine planning and the preparation of feasibility report.

From October 2010 extensive underground drilling (72,810m in 970 bore holes) was carried out to rectify the discrepancies noticed in shape & size of ore body and final delineation for ore extraction at Kayad mine. The KDM project commenced construction in 2012.

Multiple holes were drilled from each section in fan shape manner to define the ore body below 325 m at regular intervals of 12.5 m along the dip direction from 325 m and 250 m HW exploratory drives.

This has resulted in conversion of G3 resources to G1 reserve and increase in resource & better delineation of ore lenses both in strike and depth.

Underground exploration boreholes drilled on 25x12.5 m pattern (along strike and dip). This was carried out simultaneously with mine development at different levels, viz. 400, 375, 350, 325, 300, 250, 225 & 200 m of the mine, as well as from dedicated exploratory drives at 325 & 250 m. This allowed the ore resource to be upgraded and boundaries defined for stope planning and extraction.

The recent ore production is steady at approximately 1.2 Mt/a is listed below.

The yearly exploration carried from surface and underground are given in the following tables:

Table 13: Kayad Surface Exploration Drilling

Period	Drilling (m)	NO. of Boreholes
1999-2011	40144	111
2012	17802	39
2013	4583	11
2014	25862	67
2015	10591	19
2016	4950	7
2017	6148	11
2018	44818	70
2019	40496	64
2020	29414	51
2021	3870	9

Table 14: Kayad Underground Exploration Drilling

Period	Drilling (m)	NO. of Boreholes
2012	-	0
2013	241	14
2014	2,971	40
2015	20,062	479
2016	21,890	201
2017	10,248	93
2018	1,731	13
2019	4,728	26
2020	6,314	66
2021	4,625	38
Total	**68,185**	**932**

6 Geological Setting, Mineralization and Deposit

6.1 Regional Geology

The deposits are hosted by middle Proterozoic Delhi Fold Belt of metasediments (2000 my-750 my). Kayad lies near the centre of this 30 km wide belt in Ajmer area. While a major Kaliguman lineament forms the boundary of Delhi supergroup with Sandmata / Mangalwar complex in the east, Marwar Supergroup lithology bounds this in the west.

The litho-units belong to the Ajmer Formation of Ajabgarh Group in Delhi Supergroup of rocks. Fareeduddin (1995) classified the rocks of Ajmer-Sambhar lake region into lower Anasagar migmatites and upper Ajmer formation comprising metamorphosed argillaceous, arenites and carbonates showing an overall trend ranging from NNE-SSW to NE-SW and dipping steeply towards east or west. Based on the radiometric dating of Anasagar granite and lead isotope dating of Ghugara Lead-Zinc deposit (Gopalan, Sen) the rocks of the region are time equivalent of Aravallis.

The rocks are assumed to have been deposited in a shelf margin to a shelf interior environment. Later orogenesis with magmatism concomitant contributed a significant change in the overall setup and morphotectonic features.

6.2 Property Geology

The deposit forms part of the pre-Aravalli Gneissic Complex. This consists of gneisses, schists and intrusive acidic and basic igneous rocks that occupy predominantly the south-eastern plains of Ajmer and Bhilwara. The rock units show NE-SW strike with steep dips in the hanging wall (750-800) and moderate dips in the footwall (600-650) towards the south-east and plunges NNE. The sequence of rocks, from hanging wall to footwall, can be broadly grouped as:

- Garnet-biotite-sillimanite gneiss with intermittent bands of calc-granulites, amphibolites and aplites or pegmatites.
- Garnet-mica-sillimanite gneiss/schist.
- Garnet-biotite-sillimanite gneiss with lenses of quartzo-feldspathic bands, amphibolites, pegmatites and aplites.
- Granite gneiss
- Mylonitic rocks

Economic mineralization is predominantly in graphite-mica-sillimanite schist over the strike length of 1,550m. The ore zone has a sharp contact with the hanging wall and footwall. The hanging wall side of the lode is the richest and widest, followed by comparatively lean grade in the middle and a narrow, rich, footwall zone. Coarse grained crystalline galena, associated with pyrite and pyrrhotite is noted in the hanging wall rocks. The mineralization in the hanging wall and footwall contacts is invariably fine to coarse grained and is made up of sphalerite and galena with numerous inclusions or rounded to sub-rounded discrete grains of feldspar, quartz, hornblende, sillimanite and dark green chlorite.

The general strike of the ore zone is parallel to the enclosing rocks, which is roughly NE-SW. The dip of the ore zone varies along the strike and depth. Near the surface, the dip of the hanging wall is steeper (75^0-80^0 SE) as compared to footwall contact (about 60^0 SE). In deeper levels, both the hanging wall and footwall contacts show a tendency to flatten. In general, the dip varies from 50^0 to 80^0.The ore zone show a variation in width, both along strike and dip. The width of the ore zone gradually widens to about 95m to 100m between -200m north and -400m north.

The Kayad deposit is hosted within NNE-SSW to NE-SW trending amphibolite facies units contained within the Ajmer Formation of the Ajabgarh Group, which is part of Proterozoic Delhi Supergroup. The local stratigraphic succession, as interpreted by surface geological mapping and drill core logging, is characterised by a basal succession of gneisses and migmatites, which are overlain by quartzites, calc-silicates and quartz-mica schists of the Ajmer Formation. Subsequently the host rocks have been intruded by a series of irregular pegmatite dykes.

Core logging and geophysical interpretation indicate the local structure to be defined by an NNE-SSW trending asymmetric open synform, with a shallow north-easterly plunging hinge line. Zinc-lead mineralisation is predominantly hosted within quartz-mica schist close to the footwall contact with the underlying calc-silicate unit. The mineralisation comprises sphalerite, pyrrhotite and minor amounts of galena and pyrite, occurring as discontinuous veinlets, massive bands, fracture fillings and occasionally as disseminations.

The main ore mineralisation is predominantly contained within two lenses, namely the Main Lens and K1 Lens. Both the Main and K1 Lenses trend NNE-SSW to NE-SW, parallel to the dominant structural trend defined by the open synformal fold. The Main Lens strikes over 900 m and extends to a depth of approximately 375 m. The body is characterised by a strong pinch and swell geometry, ranging in width from 5-40 m, and is regularly intruded by barren pegmatite dykes. The K1 Lens is a steeply (75-80°) SE dipping body, striking NE-SW over a strike length of approximately 250 m. The K1 Lens has an average width of 4 m and extends to a maximum depth of 110 m.

Figure 7: Kayad Surface Geology

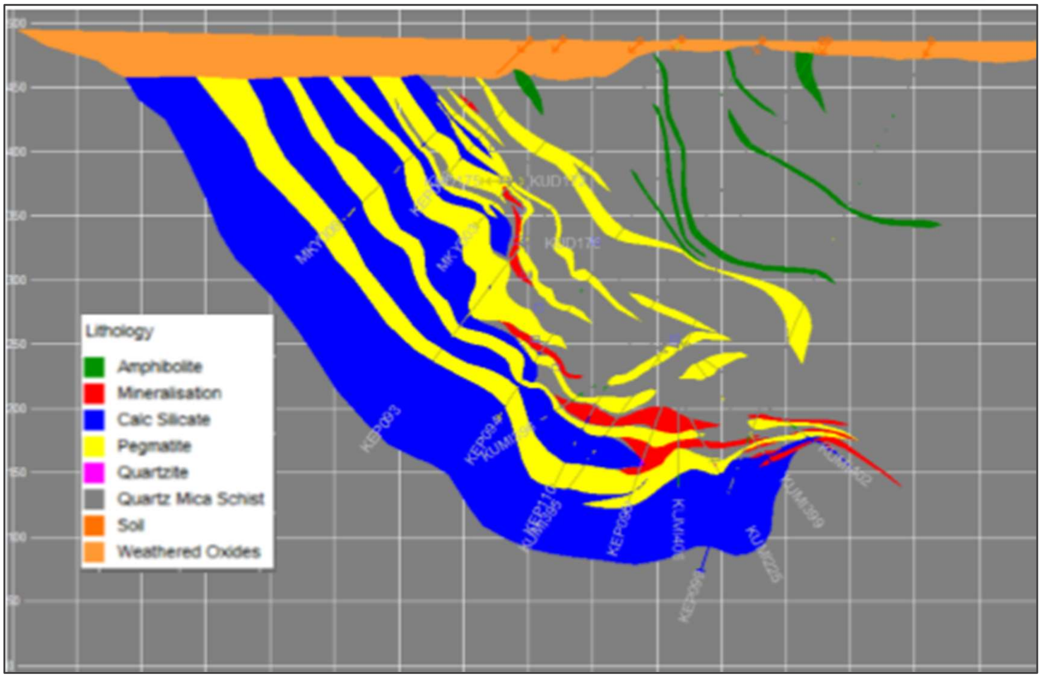


Figure 8: Typical Kayad Section

6.3 Deposit Types

As per MEMC rule 2015, the deposits comes under class deposits II stated as “Lenticular bodies of all dimensions including bodies occurring en-echelon, silicified linear ones of composite veins, lenses, pockets, stockworks; irregular shaped modest to small sized bodies.”

Since 2014 a significant quantity of infill drilling was undertaken to better define the mineralisation; the resultant data has led material changes in the geological interpretation. Specifically, Kayad has been found to be narrower and less continuous with locally higher grades than original interpreted.

There are four major lenses – the Main lens, K1 lens, S1 lens & K18 lens and two minor lenses in resources category namely S2 lens & NEML lens. The main host rock is quartz mica schist with some mineralization in calc silicate. The Main Lens has been dissected in many places by pegmatite. The lenses lie parallel to the axial plane foliation/ cleavage/ fracture of the fold system or shear fractures governed by the lithological variations. The main lens has been explored to variable depths and maximum up to 50 mRL.

The main lens ranges in average width from 5 m in steeper portions to about 35 m in the flat lying portion. Maximum strike of the main lens is 900 m at the depth of approximately 250 m from the surface. It shows a general reducing trend in depth. This lens shows swelling and pinching nature probably because of superimposition of different phases of folding.

K1 lens has strike of 250 m and the average width of 4 m. This is comparatively a richer lens as far as the metal content is concerned. The exploration during December 2011 has delineated a minor lens (S1 lens) on the southern side of the main lens which has strike of 150m and the average width of 3m.

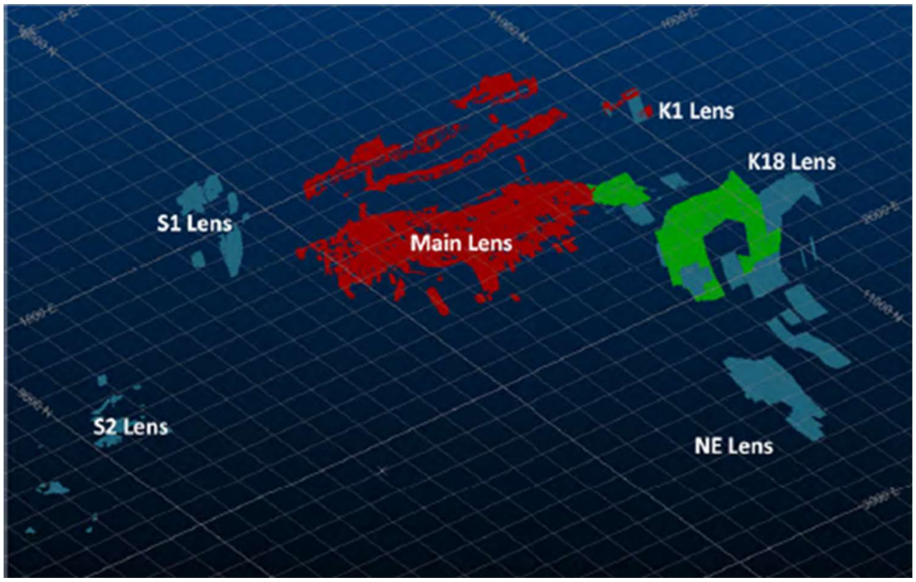


Figure 9: Kayad Mineralised Lenses

6.4 Mineralization

The mineralization occurs predominantly in quartz mica schist along with calc silicate rock. The massive Zn-Pb mineralization is hosted by QMS in contact with Calc-silicate. The Calc-silicate and quartzite occurring to West, towards foot wall side carry minor disseminations and stringers.

Lead zinc mineralization occurs mainly at the interface of QMS and Calc Silicate with the earlier rock seeming to be the main host rock. The main host rock is QMS with some mineralization also occurring in calc silicate. The main ore minerals are sphalerite and galena. Chalcopyrite occurs in minor proportions mostly on footwall of the ore body. Other sulphides like pyrrhotite and some pyrite also constitutes the assemblage. The sulphides occur as discontinuous veins, massive bands, fracture fillings, and occasionally as disseminations. Sphalerite is coarse to medium grained. Galena occurs as medium grained inclusions, patches and small stringers within sphalerite and pyrrhotite. Chalcopyrite is observed as fracture fillings within pyrrhotite and occasionally in sphalerite. Quartz, biotite, muscovite, feldspar with occasional amphiboles (hornblende) and garnet are the main gangue minerals.

The main ore minerals are sphalerite and galena. Chalcopyrite occurs in minor proportions mostly on footwall of the orebody. Other sulphides like pyrrhotite and some pyrite also occur. The sulphides occur as discontinuous veins, massive bands, fracture fillings, and occasionally as disseminations. Sphalerite is coarse to medium grained. Galena occurs as medium grained inclusions, patches, and small stringers within sphalerite and pyrrhotite. Chalcopyrite is observed as fracture fillings within pyrrhotite and occasionally in sphalerite. Quartz, biotite, muscovite, feldspar with occasional Amphiboles (hornblende) and garnet are main gangue minerals.

7 Exploration

The HZL complex has undergone extensive exploration since their discovery in the mid-1970's. In the past few years, exploration has been undertaken by means of diamond drilling underground for two purposes, namely grade control and extension of current mineral envelopes to deeper levels.

7.1 Summary of Exploration Activities

In general, the underground exploration drilling is undertaken during the underground mining activities. On-reef drilling is carried out by the mine and constitutes the majority of the meterage drilled.

Table 15: Summary of Exploration Drill for KDM (2017-2022)

Mine/Deposit	F2017		F2018		F2019		F2020		F2021		F2022
	No.Holes	(m)	No.Holes	(m)	No.Holes	(m)	No.Holes	(m)	No.Holes	(m)	(m)
Kayad	100	16,154	75	46,365	90	46,891	118	37,371	199	44,950	75,628

In the year F2021, the Company drilled a total 356.5km between both exploration and mining related targets, representing a decrease of 80.1km (-18%) from the that achieved in F2020. Exploration drilling activities have been planned for all of HZL mining properties in F2022, most notably Zawar and Sindesar Khurd.

7.2 Exploration Work – Drilling

The deposit was discovered in 1968 by the Geological Survey of India ("GSI") during ground follow-up of an aerial electromagnetic anomalies survey, which was later proven to be unrelated to the deposit. By 1997, following two drilling campaigns, a largely 'inferred' resource of 10 Mt, close to 15%Zn was reported by a government agency, and HZL was granted the mining lease.

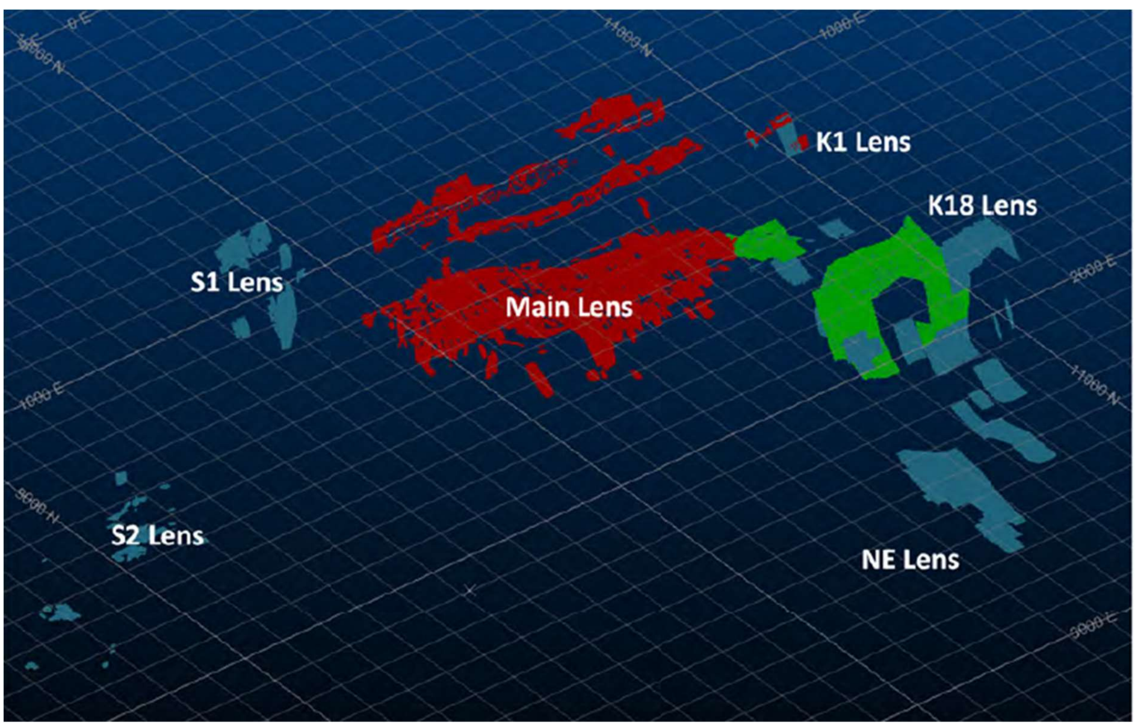
HZL initiated additional drilling, as the previous work indicated a complex shape and low confidence mineralisation limits. Exploration work was initially undertaken by the GSI in 1986, with aerial electromagnetic surveys (the detected anomalies were later proven to be unrelated to the deposit); drilling commenced in 1988. From 1999 to 2003 a further 50 holes were drilled, totalling almost 15,000 m. In 2008, independent consultants undertook a study that demonstrated a strong correlation between lead and silver both in which allowed the calculation and interpretation of a Pb:Ag ratio of approximately 23, which can be applied to calculate silver grade where it is absent.

The KDM project commenced construction in 2012.

7.3 Geological Mapping and Geophysics

Two main lenses have been defined by means of exploration methods combining geophysical (interpretation of geophysical surveys) and geological (core logging and field observations) investigations, namely the Main and K1 Lenses as shown in Figure 10. However, in F2021, the K18 lens, which lies some 300 m to the northeast of the main ore, was explored with the view of extending the mineral resources and upgrading of portions of the lens from Inferred into the Indicated category.

Figure 10: The 3D Plan View Plot of the KDM Deposit



7.4 Drilling Technique, Spatial Data & Logging

The main surface exploration drillholes are drilled on a 50x50 m grid, giving coverage across the majority of KDM, in certain areas this spacing ranges from 25x25 m to 75x75 m. Underground fan drilling is being undertaken on 12.5 m centres, with a spacing of 12.5-25.0 m on section, covering the majority of the main deposit. In total, over 230 km have been drilled from surface and over 130 km drilled from UG, across over 420 holes from surface and over 1100 from UG.

Standard diamond core drilling is undertaken, with core recovery averaging some 95%, which is considered above average and efficient. Drill core appears to be of extremely high quality with excellent recovery, which is only slightly reduced in faulted/sheared areas. Surface Drill Collars are initially located on ground using GPS. Subsequently, these are tied up with Local Grid by the mine survey team using Total Station. Down-hole direction arrows are marked on every core piece by the driller. Similarly run ends and meter pegs are neatly marked and placed. Meter depth is also painted on the core just before the peg. Geologists ensure that run pegs are at the correct locations.

Logging practices are adequate for resource estimate purposes. Almost all of the available core, particularly within 100m of the deposit extents on the hanging wall and up to the end of the holes on the footwall side, has been photographed using a digital camera. Only the most basic geotechnical parameters are collected.

7.5 Sample Preparation

The following sample splitting and preparation methods are employed:

- 1m length core samples in the visible mineralised zones.
- Separate samples for notably different core recoveries in two contiguous runs.
- Separate samples for visibly significant grade variations (Zn and / or Pb).
- Longitudinal split line is marked along the marked sample so as to ensure equal division of ore portion in the two halves.
- Samples are clearly labelled and there is good control of samples through the preparation and analytical process

Note: *Sample preparation is performed diligently and in line with best practices. The dispatch and sample control systems was observed by the CP on site and deemed acceptable. No clear mention of security, transport and chain of responsibility and custody, but no incidents have been reported either.*

7.6 Sample Analysis and QAQC Protocols

Samples are analysed for the following metals:

- Pb, Zn, Fe, Cd, Cu, Co, Sb, Bi, Ni and Mn

by 4-acid digest and ICPOES finish. Ag and As by aqua regia digestion followed by AAS finish.

The primary analytical laboratory, Shiva, introduces its own standards at 1 in 30 samples and repeats the analysis for our every 10th sample. Sample preparation is undertaken by accredited Shiva Analytical Pvt Ltd, Bangalore.

In accordance with the HZL's QA/QC programme consists of:

- Insertion of blank material (quartz/pegmatite) into the numbered sequence as the first sample at the beginning of the mineralization in each sample batch.
- Systematic insertion of certified reference material ("CRM")(GESTAT and OREAS) at frequency of 1 in 25. The choice of CRM is at the discretion of the logging Geologist.
- Random insertion of duplicate pulp checks, at a frequency of 1 in 10.
- Annual umpire assay in HZL's laboratory at RAM.

ABGM has reviewed the QAQC data in detail since 2004 and notes that the performance is good.

Note: *It is recommended for an independent laboratory analyse umpire samples. It is also recommended for the geologists on site to insert the blanks and standards during sample preparation before the samples reach the lab. It would be advisable for the CP to visit the laboratory, just to observe the sample preparation and analytical procedures.*

A weight / volumetric displacement method is used to assess bulk density, which reconcile well against production data. Bulk density for each sample is measured by volumetric method using Archimedes' Principle. Where correlation s between metal and density measurements is well established, and the adequacy of measurements is sufficient, the bulk density is estimated from regression analysis.

Note: *While bulk density data has been reconciled with production data, independent bulk density analyses should be undertaken at an independent laboratory during the exploration phase to avoid errors.*

Samples are stored securely onsite at RAM but no detail as to the packaging, sample storage, transport or chain of custody has been provided for comment.

7.7 Opinion of adequacy

The QP believe that the procedures used in the sampling are adequate for mineral estimation purposes and reporting of mineral resources and reserves

8 Mineral Processing and Metallurgical Testing

HZL has many years of experience with the ores extracted from their mines located on the Delhi Fold Belt. Original metallurgical testwork was executed on ore from Kayad, but the results have been superseded by the experience gained from actually processing the Kayad ore in the dedicated plant located at the Rampura Agucha complex. The mineral processing is therefore well understood and there is no need to conduct any additional metallurgical test work at the current operations.

9 Mineral Resource Estimate

9.1 Introduction

The Mineral Resources described in this Item are based on appropriate geoscientific information, economic and technical parameters, and grade and tonnage estimation processes. The Mineral Resource estimates were determined using ordinary kriging (OK) geostatistical methodology and considered sample lengths, grade capping / cutting, the spatial distribution of drill holes and the quality assurance and quality control results for the analytical sample grades determined. Geological modelling and grade estimation used Datamine software.

9.2 Geological Models

The zinc (Zn) and lead (Pb) sulphide mineralization at Kayad is a sedimentary exhalative (SEDEX) deposit type. The deposit is hosted by NNE-SSW to NE-SW trending amphibolite grade metamorphosed dolomite, carbonaceous chert and graphite chert of the Ajmer Formation, Delhi Supergroup. A series of irregular pegmatite dykes intruded the lithologies. The Zn-Pb mineralization, which is hosted by quartz-mica schist and concentrated towards the bottom contact of the schist with calc-silicate rocks, occur as discontinuous veinlets, massive bands, fracture fillings and lesser disseminations. The deposit is located within an NNE-SSW trending asymmetric open synform that has a shallow plunge to the NE.

The primary sulphide mineral is sphalerite (ZnS) and minor galena (PbS). The gangue minerals are pyrite, pyrrhotite and graphite.

The Kayad deposit is subdivided into seven mineralised lenses known as the Main (subdivided into three zones), K1, S1, S2, NE, and K18 lenses. The geometry, strike, dip, dip direction, and thickness of the lenses are:

- Main: a strike length of ~900 m NS dipping at ~65^{o} to the east, to a depth of ~375 m below surface, between ~5 – 40 m thick, and characterised by a strong pinch and swell geometry
- K1: a strike length of ~250 m NE-SW, dipping at ~75 - 80^{o} to the SE, to a depth of ~110 m below surface, with a thickness between 4 - 8 m
- S1: a strike length of ~175 m NE-SW, dipping to the SE, to a depth of ~100 m below surface between ~15 – 50 m thick.

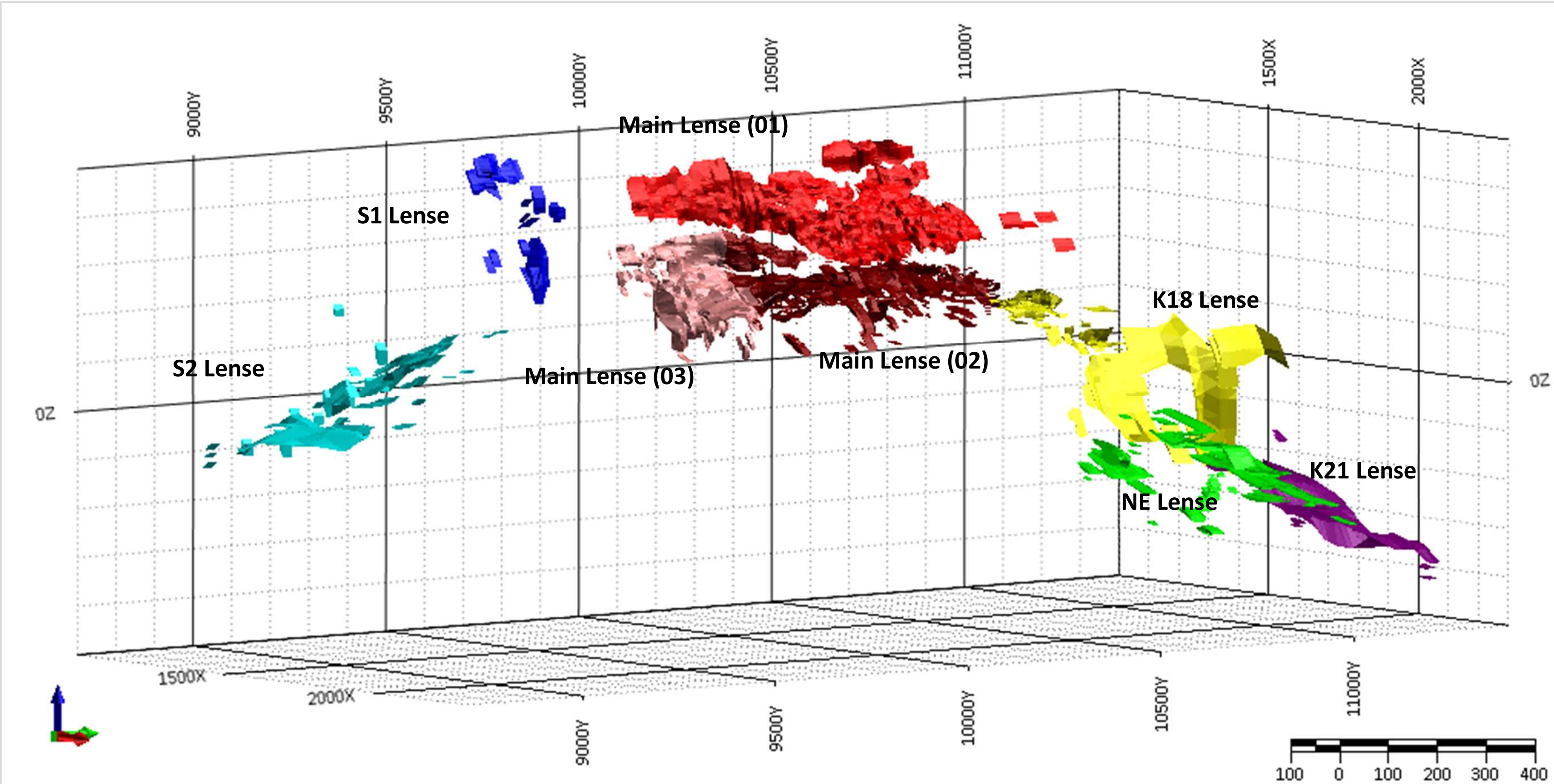


Figure 11: Representation of the mineralized lenses at Kayad

9.3 Block Model Orientation and Dimensions

The wireframes were constructed using cross-sections taken across the ore body with principal sections on a 25 m spacing with and infill sections at ~12.5 m where necessary. Maximum distance of extrapolation from data was 3 m. A geological cut-off of 3% Zn + Pb cut-off over a 2 m minimum horizontal thickness defined the limits of the mineralized zones. A separate wireframe was constructed for the barren pegmatite.

The wireframes were filled with a block model based on a parent-block size of 5 x 12.5 x 12.5 m (across-strike (X) / along-strike (Y) / vertical height (Z)). Appropriate sub-blocking has been used at mineralisation contacts to honour the geometry and volume.

9.4 Database

The database used for the grade estimates is based on data received from Hindustan Zinc Limited. A total of 1,766 drill holes were available for use in generating the wireframes, and grade and tonnage estimates. The cut-off date for the database for used in the Mineral Resource estimation process is the end of F2021.

The surface drill holes have an average grid spacing of 50 x 50 m and In several areas of the deposit the average grid spacing ranges from 25 x 25 m to 75 x 75 m. The underground fan drill holes have a spacing of 12.5 m to 25 m on section. Approximately 230 km has been drilled for the surface drill holes and more than 1,100 km for the underground drill holes.

ABGM has reviewed the drill hole database up to F2022 and concluded that the drill hole data is adequate for use in the Mineral Resource estimation process. The post-2015 drill holes were found to have adequate industry standard quality assurance and quality control (QAQC) quality assurance programmes and procedures which allowed for replication, precision and accuracy of the sample grades. Assay results prior to 2015 were also reviewed by ABGM who concluded that the grade results are satisfactory although short-comings were noted. The reader is directed to Item 8 for sample preparation, analytical techniques and security.

9.5 Exploratory Data Analysis

The table below summarizes the classical statistics for the Main (ML01 – ML03), K21, K18, NE, S1, and S2.

Table 16: Classical statistics of the Main (ML01 – 03), S1, S2, K21, K18 and NE lenses

Deposit	Metal	Minimum	Maximum	No. of Points	Mean	Median	Mode	Coeff. of Variation
S1	Zn (%)	0.00	31.19	366	4.54	2.83	0.10	1.10
S2	Zn (%)	0.01	12.55	745	1.45	0.60	0.05	1.30
ML01	Zn (%)	0.00	51.38	2,779	16.07	11.44	0.17	0.88
ML02	Zn (%)	0.00	49.90	5,683	11.38	8.14	0.17	0.92
ML03	Zn (%)	0.04	40.80	1,600	8.53	6.70	0.25	0.82
K18	Zn (%)	0.00	44.60	408	14.75	12.79	0.50	0.79
K21	Zn (%)	0.04	36.32	189	6.95	5.15	0.25	0.98
NE	Zn (%)	0.03	24.91	423	5.60	4.36	3.10	0.79
S1	Pb (%)	0.00	10.73	366	0.87	0.21	0.03	1.75
S2	Pb (%)	0.00	19.16	745	1.78	1.02	0.04	1.23
ML01	Pb (%)	0.00	11.65	2,779	2.09	1.37	0.03	0.95
ML02	Pb (%)	0.00	18.08	5,683	1.59	1.14	0.03	1.01
ML03	Pb (%)	0.00	15.74	1,600	1.35	1.06	0.04	1.07
K18	Pb (%)	0.00	8.95	408	1.89	1.44	-0.05	0.99
K21	Pb (%)	0.00	9.28	189	1.04	0.69	0.03	1.21
NE	Pb (%)	0.00	13.48	423	0.67	0.16	0.03	2.11
S1	Ag (%)	0.00	312.00	356	14.64	5.00	1.50	1.78
S2	Ag (%)	0.50	80.00	745	10.60	7.00	0.75	1.13
ML01	Ag (%)	0.00	229.00	2,766	26.60	7.00	2.00	1.44
ML02	Ag (%)	0.00	344.00	5,654	28.46	15.00	1.00	1.24
ML03	Ag (%)	0.00	173.00	1,600	19.00	9.00	2.50	1.21
K18	Ag (%)	0.50	288.00	375	38.66	27.00	1.00	1.02
K21	Ag (%)	0.50	106.00	189	18.18	12.00	5.50	1.06
NE	Ag (%)	0.50	67.00	422	10.22	6.00	1.00	1.23

Normal space histograms for the drill hole samples show that Zn (%), Pb (%) and Ag (g/t) represent strongly skewed distributions indicating that the mean is greater than the median value which is greater than the mode. This indicates that the mean value is influenced by higher grade values.

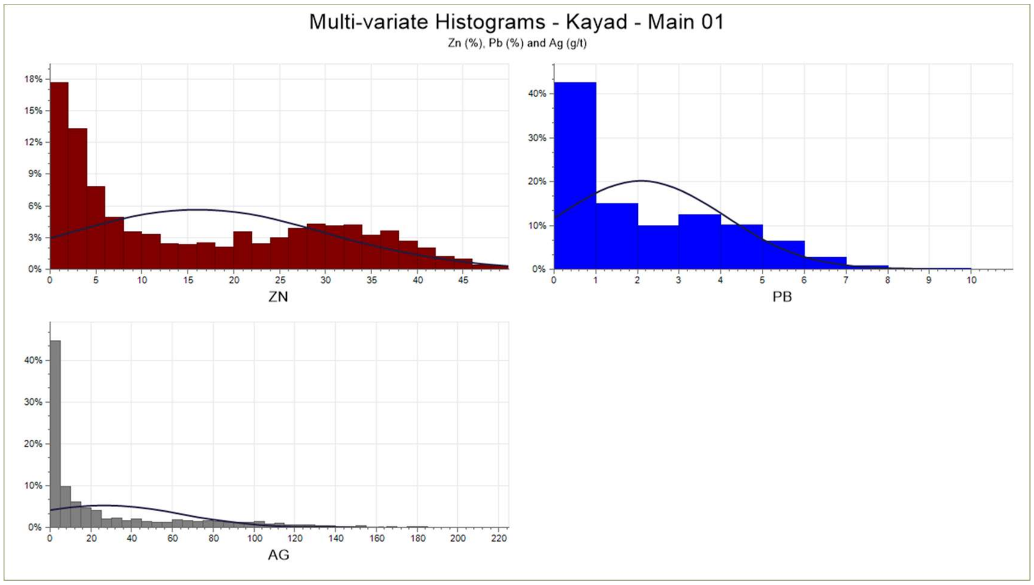


Figure 12: Multi-variate histograms of the Main 01 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

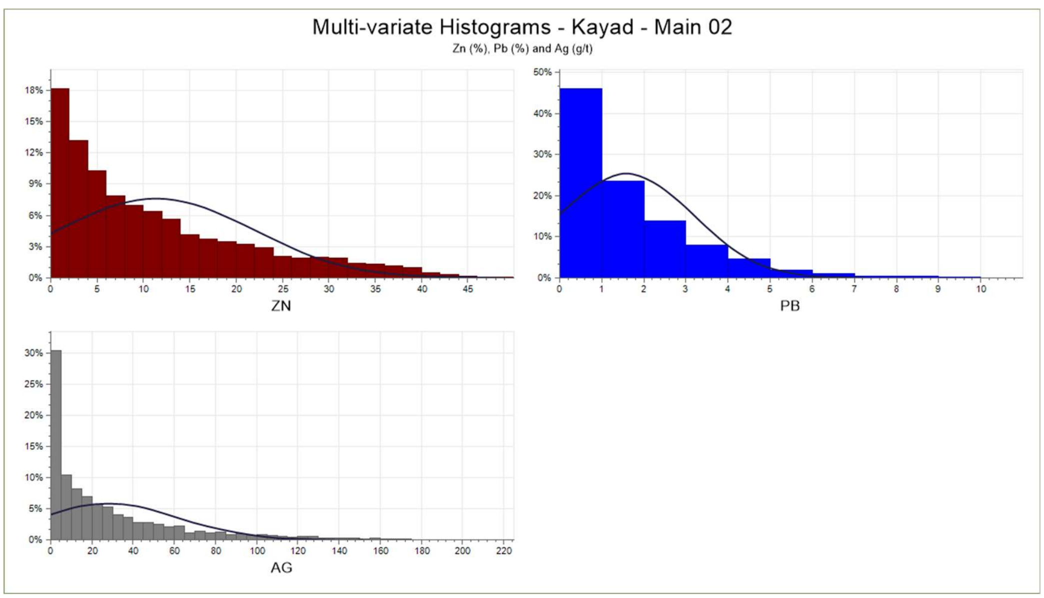


Figure 13: Multi-variate histograms of the Main 02 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

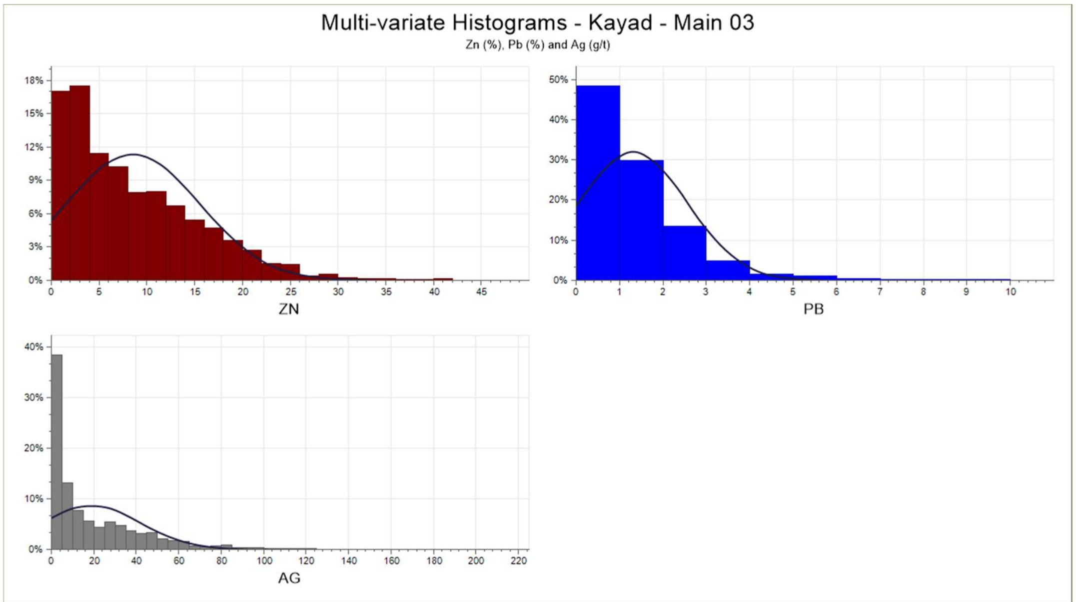


Figure 14: Multi-variate histograms of the Main 03 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

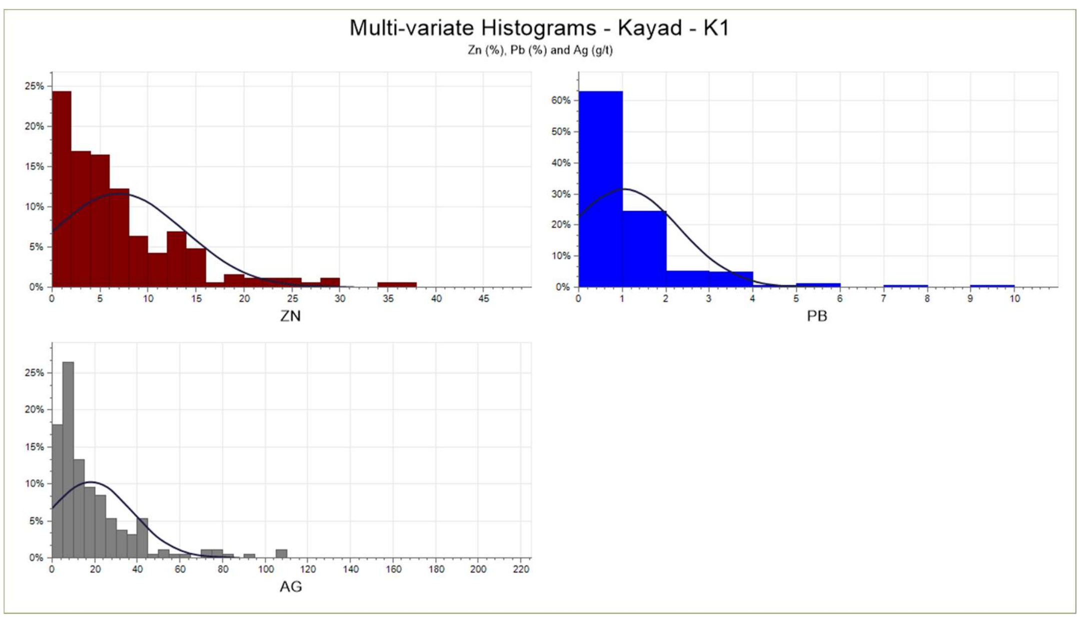


Figure 15: Multi-variate histograms of the K21 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

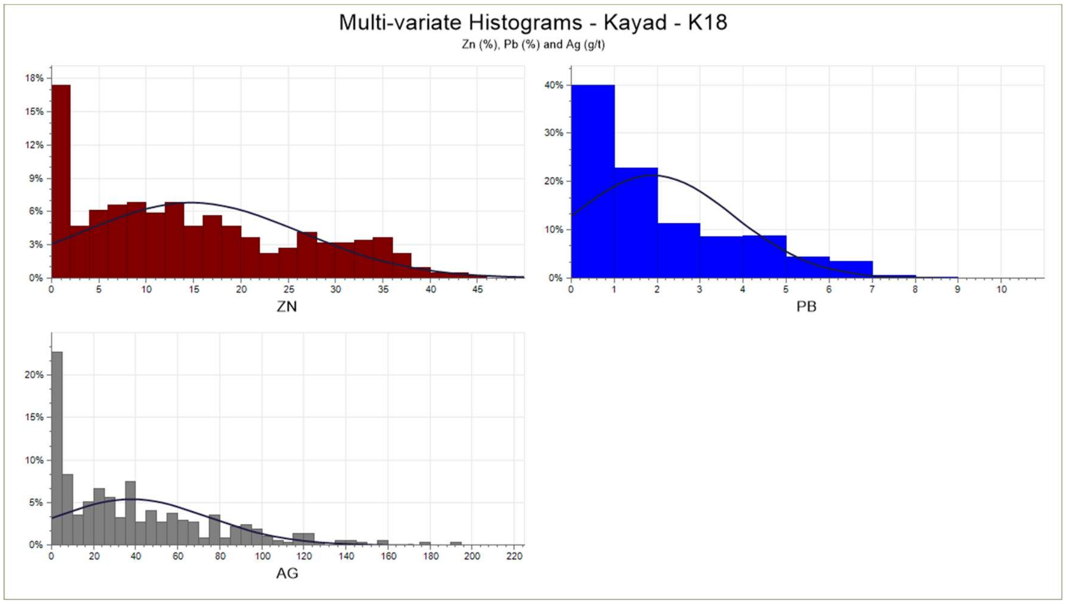


Figure 16: Multi-variate histograms of the K18 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

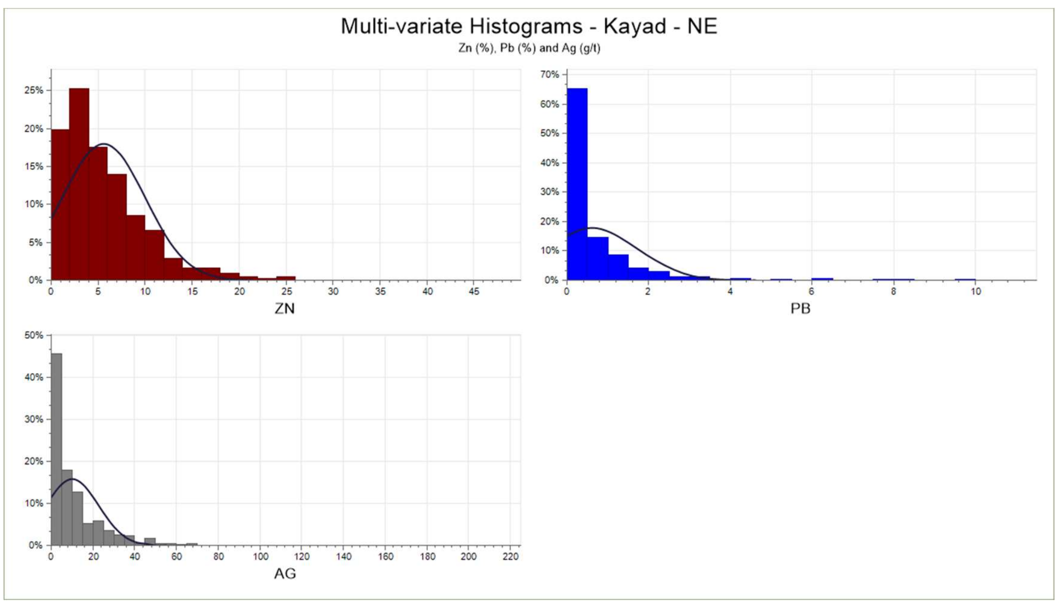


Figure 17: Multi-variate histograms of the NE Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

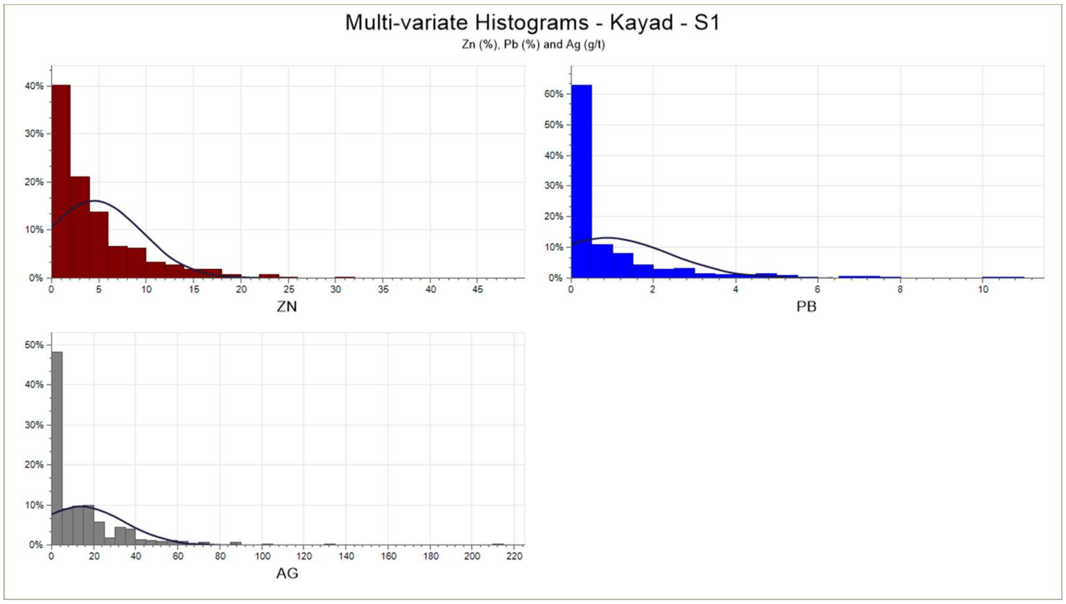


Figure 18: Multi-variate histograms of the S1 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

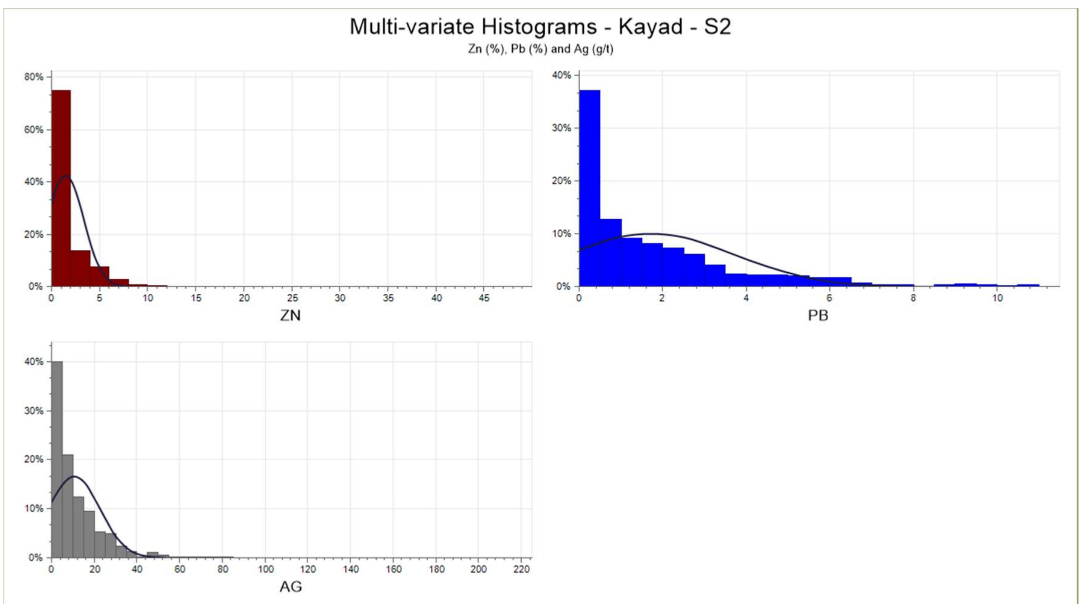


Figure 19: Multi-variate histograms of the S2 Lense drill hole samples for Zn (%), Pb (%), and Ag (g/t)

9.6 Data Compositing

Most of the drill hole samples are 1.0 m in length and were therefore composited to 1.0 m lengths. Data compositing reduces the data population variability and contributes to a more uniform data support for estimation purposes. The drill hole and composite data populations correspond with each other for the normal space histograms drill hole samples demonstrating the data population distribution has been maintained.

9.7 Density Determination

Specific gravity (density) was analysed using the Archimedes' Principle methodology. The Archimedes' Principle measures the weight / volumetric displacement of a sample within air and water. The correlation between the values reconciles well against production data. Where the density values between metal and density values is well established the bulk density is derived from multi-linear regression formulae.

The formula applied for the Main Lense :

Density (t/m^3) = 2.685358 + (0.013744 x QMS_Zn) + (0.033513 x QMS_Pb) + (0.012968 x QMS_Fe).
(QMS – quartz-mica schist)

For areas which have not been interpolated a density of $3.06t/m^3$ for QMS and 3.0 t/m^3 for all other rock types has been applied. An average density of $3.06t/m^3$ results from the resource model.

9.8 Grade Capping / Cutting

No grade capping or cutting have been applied.

9.9 Estimation/Interpolation Methods

Ordinary kriging (OK) was used to estimate Zn, Pb and Ag for the Main Lense, using hard boundaries and search ellipsoids with anisotropic weighting that encompasses the geological trends were used to both interpolate and extrapolate the Zn, Pb, and Ag grades. Inverse Distance Weighting to the power of two (IDW^2) was used for the S1, S2, NE, K18 lenses using search ellipsoids with anisotropic weighting that encompasses the geological trends were used to both interpolate and extrapolate the Zn (%), Pb (%) , Ag (g/t) grades.

For the three zones of the Main lense the composited samples were split into samples that are mineralised but logged as QMS, and samples outside of the QMS (CLS). The QMS domains were further subdivided into two separate zones each, with the same sample files but with different search parameters to reflect different geometries. Following the separate estimates for the QMS and CLS, a QMS Indicator value based on these separate lithology types was estimated into the models to assign a probability/proportion QMS. This value was applied as a weighting to back-calculate block grades using both the QMS and CLS grade estimates.

Restricted local search applied to some of the zones are as follows:

- Main: a minimum of 8 and maximum of 50 - 75 samples, a maximum of six composites per drill hole, a search pass of 100 - 150 m (X), 75 - 150 m (Y), and 15 - 30 m (Z) depending on block sizes, and a discretization of 4, 6 and 6 (X, Y, and Z)
- QMS: a minimum of 8 and maximum of 50 - 75 samples, a maximum of six composites per drill hole, a search pass of 75 - 175 m (X), 60 - 150 m (Y), and 25 - 30 m (Z) depending on block sizes, and a discretization of 4, 6 and 6 (X, Y, and Z)
- CLS: a minimum of 8 and maximum 50 - 75 samples, a maximum of six composites per drill hole, a search pass of 75 - 150 m (X), 100 - 175 m (Y), and 15 - 20 m (Z) depending on block sizes, and a discretization of 4, 6 and 6 (X, Y, and Z)
- S1, S2, K1, K18 and NE: a minimum of 8 and maximum of 40 samples, a maximum of four composites per drill hole, a search pass of 25 m (X), 50 m (Y), and 25 m (Z) depending on block sizes, and a discretization of 3, 3 and 3 (X, Y, and Z).

9.10 Reasonable Prospect of Eventual Economic Extraction and Cut-offs

Mineral Resources must demonstrate reasonable prospects for eventual economic extraction (RPEEE). Consideration of geological, mining engineering, processing, metallurgical, legal, infrastructural, environmental, marketing, socio-political and economic assumptions used should satisfy that the project is economically viable eventually.

At Kayad confidence can be placed on the geological understanding and models, the mining methods and planning as well as the understanding of the metallurgy, processing legal, infrastructural, environmental, marketing, socio-political and economic assumptions. The reader is referred to the relevant Items within this report for detail and opinions.

The cut-off grade (COG) applied to the Mineral Resources are stated on a Zn equivalent (ZnEQ) basis is 3.89%. To derive the ZnEQ a calculation the relationship between Zn, Pb and Ag is:

- ZnEQ = Zn + (0.456 x Pb) + (0.01027 x Ag).

The COGs used for the Mineral Resource were calculated using on nett smelter return (NSR) values for the individual metals of Pb, Zn and Ag and based on the following:

- at prices of USD 2,057/t, USD 2,759/t and USD 21.24/oz, respectively
- costs based on the F2022 Business Plan
- no mining factors have been applied
- includes planned and unplanned dilution
- no metallurgical factors have been applied; however, metallurgical recoveries were based on metallurgical and smelter performance.

9.11 Classification of Mineral Resources

The level of confidence in the geology and the volume, tonnage and grade estimates determines the classification/s of a Mineral Resource. The lowest level of confidence is an Inferred Mineral Resource and with increasing levels of confidence Indicated followed by a Measured Mineral Resources can be classified. The universal requirement across the three categories is the requirement of reasonable prospects of eventual economic extraction (RPEEE) must exist. Mineral Resources are not Mineral Reserves and do not necessarily demonstrate economic viability. There is no certainty that all or any part of this Mineral Resource will be converted into Mineral Reserve.

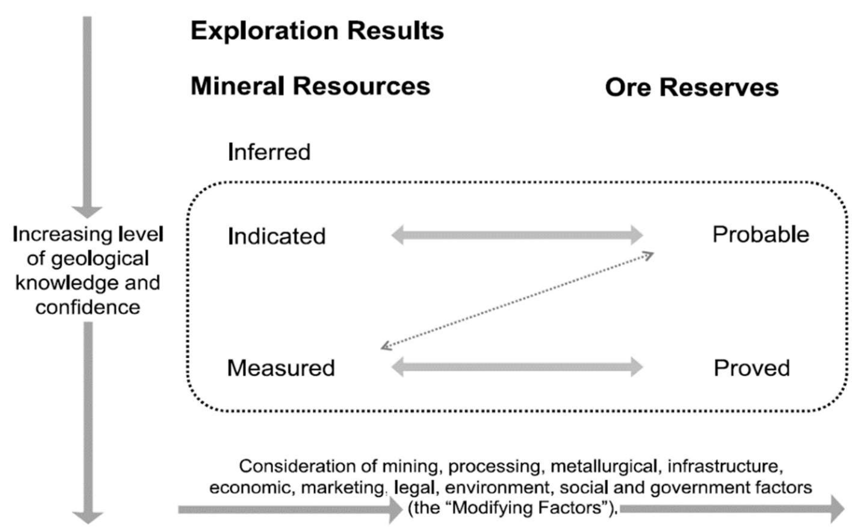


Figure 20: JORC Mineral Resource and Ore Reserve classification framework

Source: The Australasian Code for Reporting Exploration Results, Mineral Resources and Ore Reserves (the JORC Code), p9.

Mineral Resource classification is based on both technical and economic factors, namely:

- geological understanding, continuity and confidence
- grade continuity
- drill hole / sample spatial representativity and spacing
- data quality assurance and control
- appropriate geochemical analytical and density techniques applied
- application of the appropriate estimation methodologies and confidence therein
- RPEEE
- validity and ownership of the relevant government license types such as exploration, and environmental licenses
- consideration of social factors
- legal and governmental risk factors.

Inferred, indicated and Measured classification are based on increasing order of confidence. Various international mineral reporting codes define the criteria required for each confidence category.

An Inferred Mineral Resource is defined as:

- quantity and quality of the grade or quality data is based on 'limited geological evidence and sampling
- geological evidence is sufficient to imply but not verify geological and grade or quality continuity
- has demonstrated RPEEE
- it may not be considered in the assessment of the economic viability of a mining project
- it cannot be converted to Mineral/Ore Reserves
- it is expected that most of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with further exploration (Code of Federal Regulations, 229.1300, 2022).

An Indicated Mineral Resource is defined as:

- quantity and quality of the grade or quality data is sufficient to allow the application of modifying factors in sufficient details that will support mine planning and economic viability
- data has been gathered from adequately detailed and reliable exploration, sampling and testing
- geological evidence is sufficient to assume geological and grade or quality continuity between data points
- has demonstrated RPEEE
- can be converted to a probable Mineral Reserve with the application of reliable modifying factors (Code of Federal Regulations, 229.1300, 2022).

A Measured Mineral Resource is defined as:

- the confidence in the quantity and quality of the grade and scientific data is sufficient to allow the application of modifying factors to support detailed mine planning and final determination of the economic viability of the deposit
- data has been gathered from detailed and reliable exploration, sampling and testing data
- geological and grade or quality continuity between data points has been demonstrated
- has demonstrated RPEEE
- can be converted to a Probable and Proven Mineral Reserve with the application of reliable modifying factors (Code of Federal Regulations, 229.1300, 2022).

The Mineral Resources stated for the previous and most current completed fiscal years were based on these factors. The data spacing for the Measured classification is defined by a combination of surface drilling and underground 'fan' drilling from the hanging wall exploration drive (325 m and N250 m levels). The drillhole fences are spaced at roughly 20 m intervals with the mineralisation is intersected at 10 to 25 m intervals. For Indicated classification, a grid spacing of 50 m x 40- 70 m, and for Inferred classification, a grid spacing of greater than 60 – 75 m.

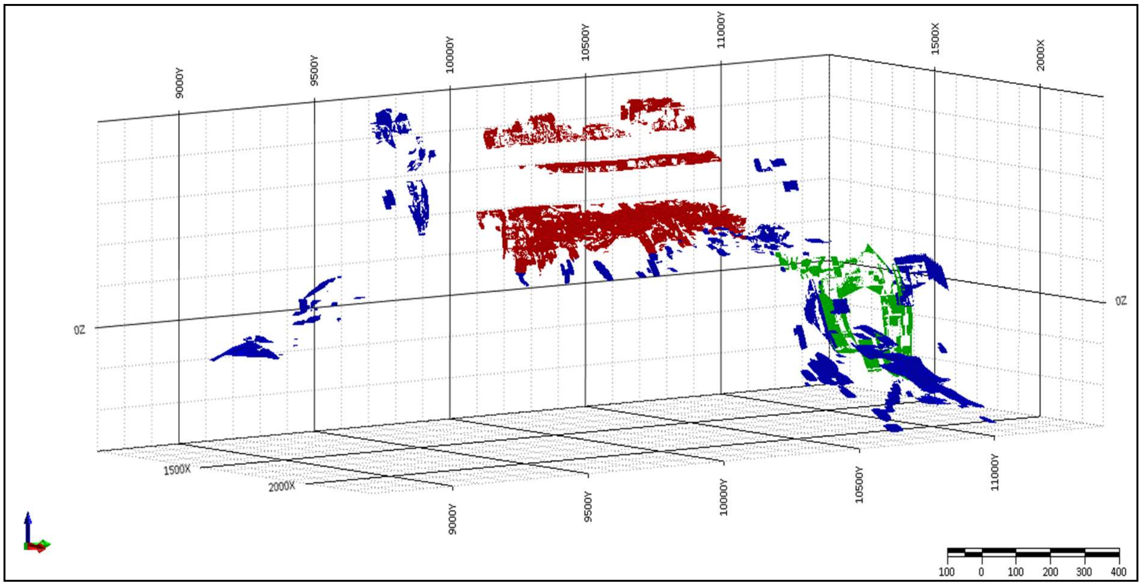


Figure 21: Mineral Resources for Kayad– 31 March 2022

Measured Indicated Inferred

9.12 Grade Model Validation

Grade model validation methods included visually and statistically validating the estimated block grades relative against the original sample results and the generation of swath plots.

Statistically validation indicated that the data population for the grade estimates mirror those of the sample and composited grades. Swath analysis of the block model estimates for the Zn versus the composite grades are relatable indicating the estimates honour the input data population.

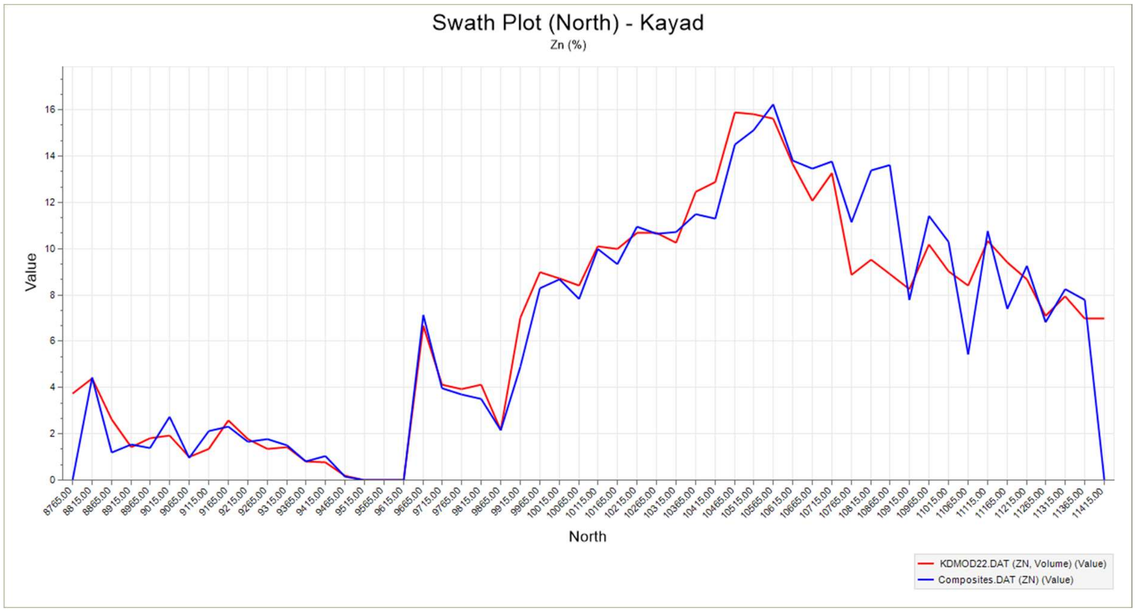


Figure 22: Swath plot (north) for the block models of all lenses for Zn (%) estimates versus drill hole grades

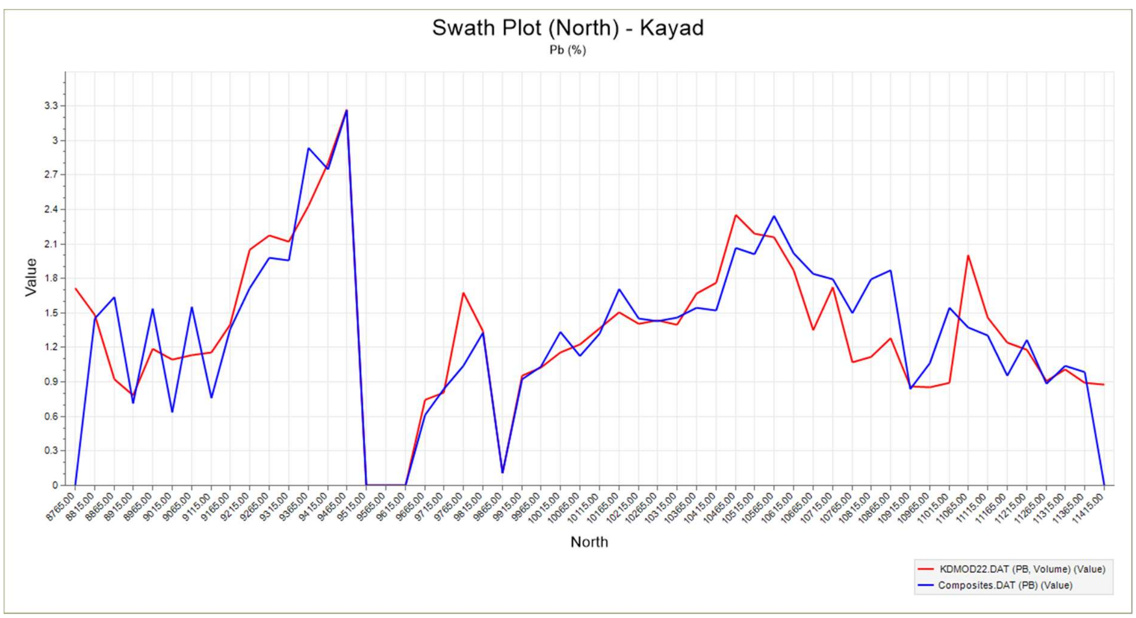


Figure 23: Swath plot (north) for block models of all lenses for Pb (%) estimates versus drill hole grades

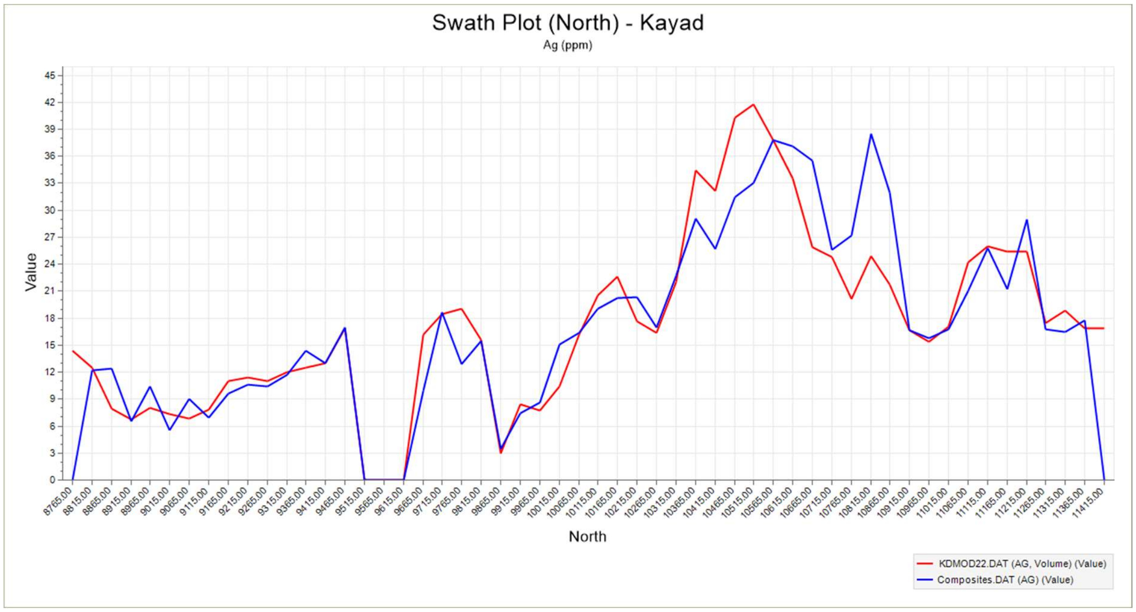


Figure 24: Swath plot (east) for block models of all lenses for Ag (g/t) estimates versus drill hole grades

ABGM considers that sufficient check calculations have been conducted to conclude that the tonnage and grade estimates are considered valid, however there is room for improvement in terms of the estimation scheme and optimisation of the estimation parameters.

9.13 Mineral Resource Statement

The Mineral Resources exclusive of the Mineral Reserves as at the end of the last fiscal year are summarised in Table 17, whilst Table 18 summarises the same period where the Mineral Resources are inclusive of the Mineral Reserves. The Mineral Resources tabled below are reported at a ZnEQ COG of 3.89%.

Table 17: Kayad Mineral Resource Statement (exclusive of Mineral Reserves) – 31 March 2022

Classification	Tonnage	Grade			Metal Content		
	(Mt)	Zn (%)	Pb (%)	Ag (g/t)	Zn (Kt)	Pb (Kt)	Ag (Koz)
Measured	0.2	9.60	1.60	33	18	3	191
Indicated	2.4	7.90	1.10	20	192	26	1,590
Measured + Indicated	**2.6**	**8.00**	**1.10**	**21**	**210**	**29**	**1,781**
Inferred	2.4	6.60	0.90	14	159	21	1,067
Total	**5**	**7.40**	**1.00**	**18**	**368**	**51**	**2,849**

- Stated as exclusive of Mineral Reserves

- Stated as underground Mineral Resources
- The Mineral Resource is limited to a depth from surface of ~900 m below surface
- Mineral Resources are reported on a 100% basis
- Mineral Resources are reported stated as dry metric tonnes
- Totals may not sum due to rounding

The Measured Mineral Resources as a proportion of the total Inclusive Mineral Resource as of 31 March 2022 accounts for ~9% of the tonnes, the Indicated Mineral Resources is ~53%, and the Inferred at ~38% .

Table 18: Kayad Mineral Resource Statement (inclusive of Mineral Reserves) – 31 March 2022

Classification	Tonnage	Grade			Metal Content		
	(Mt)	Zn (%)	Pb (%)	Ag (g/t)	Zn (Kt)	Pb (Kt)	Ag (Koz)
Measured	0.6	11.10	1.80	33	62	10	601
Indicated	3.4	9.00	1.10	22	308	39	2,367
Measured + Indicated	**4.0**	**9.30**	**1.20**	**23**	**370**	**49**	**2,968**
Inferred	2.4	6.60	0.90	14	159	21	1,067
Total	**6.4**	**8.30**	**1.10**	**20**	**529**	**70**	**4,035**

- Stated as inclusive of Mineral Reserves
- Stated as underground Mineral Resources
- The Mineral Resource is limited to a depth from surface of ~900 m below surface
- Mineral Resources are reported on a 100% basis
- Mineral Resources are reported stated as dry metric tonnes
- Totals may not sum due to rounding

The net material difference between the Mineral Resource at the end of the 31 March 2022 fiscal year and the preceding fiscal year is demonstrated below. The differences relate to depletion or production, changes in commodity prices, additional resources discovered through exploration, and changes due to the methods employed.

Table 19: Net difference between the 31 March 2022 and 31 March 2021 Minerals Resources exclusive of Mineral Reserves

Classification	Tonnage	Grade			Metal Content		
	(Mt)	Zn (%)	Pb (%)	Ag (g/t)	Zn (Kt)	Pb (Kt)	Ag (Koz)
Measured	-0.2	-2.1	-0.1	5	-26	-3	-147
Indicated	2.3	-5.0	-0.5	-3	182	25	1,531
Measured + Indicated	**2.1**	**-3.9**	**-0.5**	**-6**	**156**	**22**	**1,384**
Inferred	0.1	-0.2	-0.3	-2	4	-7	-111
Total	**2.3**	**-0.2**	**-0.3**	**0**	**159**	**15**	**1,274**

9.14 Relevant Factors that may affect the Mineral Resource Estimates

It is the opinion of the Qualified Person that the likelihood of high-risk factors affecting the Mineral Resource estimates is low.

Risks that can affect Mineral Resource estimates include:

- Geological model
- Spatial representivity of the drill hole data
- Sample QAQC
- Estimation methodology and assumptions
- Estimation search parameters
- Application of grade capping and/or cutting
- Further drill hole results that may impact the grade and tonnage estimates
- Changes to the parameters used to derive the COGs, such as metal prices, operating costs, metallurgical recoveries.

ABGM is of the opinion that these risks have a low probability of having a material impact on the Mineral Resource estimates.

9.15 Qualified Person's Opinion

Conclusions:

- The geology is understood well and the geological model is sufficiently detailed to estimate reliable Zn, Pb, and Ag grades

- Historical reviews of the data and QAQC and concluded there is sufficient and spatially representative drill holes to estimate reliable grade and tonnage estimates. Shortcomings in QAQC for older data and in documentation were noted and deems it is suitable inclusion in the Mineral Resource estimation.
- The regression method to determine the missing Ag assay results is appropriate
- The use of Ordinary Kriging is appropriate as is the related estimation parameters applied.
- Sufficient estimation model validations have been undertaken and indicate the grade estimates are reliable
- The criteria used to define the Mineral Resource confidence categories are appropriate
- The parameters used to determine the COGs are appropriate
- The Mineral Resources are amenable to underground mining
- The estimation of the grades and tonnages have been performed to industry best practices and conform to the requirements of international Mineral Resource reporting codes
- Successful brown-fields exploration to replace Mineral Resources depleted by production has occurred and is on-going
- The nett differences between the most recent Mineral Resources and the previous fiscal year's Mineral Resources are well understood
- The persons undertaking the estimation and classification of the Mineral Resources are sufficiently experienced to undertake such
- The March 31, 2022, Mineral Resource estimate has been estimated in accordance with the December 26, 2018, SEC S-K1300 regulations.

Dr Heather King who reviewed the Mineral Resource estimates and statements is independent of HZL and registered as a professional with the South African Council for Natural Scientific professions (SACNASP) and the Geological Society of South Africa (GSSA).

The Mineral Resource is based on a geological model prepared by the HZL and Kayad technical teams. It has been independently reviewed by the Dr King. Furthermore, the review relies on information provided by HZL, along with technical reports by specialist consultants, and other relevant published and unpublished data, which include relevant geological data and information, and reports.

ABGM has endeavoured, by making all reasonable enquiries, to confirm the authenticity and completeness of the technical data upon which the review and Mineral Resource statement has relied. Dr Heather King is suitably qualified and experienced to act as the Qualified Person for the Mineral Resources. Dr Heather King was unable to visit the site.

Recommendations:

- The commodity prices for Zn and Ag be reassessed based on both long-term prices and reliable forecasts
- Interpolation and extrapolation of density estimates to facilitate a higher accuracy in the tonnage and metal content estimates
- Consideration of geological and mining loss factors to facilitate a higher accuracy in the tonnage and metal content estimates.

10 Mineral Reserve Estimate

10.1 Basis, Assumptions, Parameters and Methods

The HZL mine operations and technical teams engage on a universal standard that is applied across all the mine operation from the geology resource estimations to applying the mine designs and evaluating the potential Mineral Reserves. The HZL Resources and Reserves technical team has kept extensive data that is used annually to do the annual mineral reserves statements and calculation. Each mine undergoes individual assessments and apply the modifying factors, grade cut-off calculation and assumptions.

10.1.1 Exchange Rates and Financial Assumptions

The exchange rates applied in the cut-off calculation are based on the LME forecasted indicated in the document below. The following rates were used by HZL:

Dollar to INR Conversion	Long term 5yrs
Dollar value in INR	76.65

Information received from HZL indicate the following parameters were used to calculate the cut-off grade.

Historical prices are stipulated in table below illustrating the last six years of commodity prices.

Table 20: Historic Commodity Prices

Year	LME Zinc		LME Lead		LBE Silver
(USc/lb)	(USD/t)	(USc/lb)	(USD/t)	(USD/oz)	(USD/oz)
2016	95	2,101	85	1,878	17.1
2017	131	2,892	106	2,327	17.1
2018	131	2,893	102	2,251	15.7
2019	114	2,504	91	2,006	16.2
2020	103	2,278	83	1,836	20.5
2021	120	2,646	88	1,940	23.8

LME Forecast used by HZL for the calculation of the cut-off grades are indicated below. The ten year average of the forecasted prices indicated were used to calculate the cut-off grades.

Table 21: LME Projected Commodity Prices

Particulars	UOM	FY'23	FY'24	FY'25	FY'26	FY'27	FY'28	FY'29	FY'30	FY'31	FY'32	Average
LME - Zinc	$/MT	3,183	2,911	2,684	2,621	2,658	2,706	2,706	2,706	2,706	2,706	2,759
- Lead	$/MT	2,179	2,047	1,974	1,962	1,997	2,082	2,082	2,082	2,082	2,082	2,057
- Silver	$/Troz	22.19	20.47	21.61	21.33	21.30	21.10	21.10	21.10	21.10	21.10	21.24
Ex Rate	Rs/USD	74.94	75.43	76.52	77.73	78.64	79.11	79.51	79.51	79.51	79.51	76.65

The 3 year and 10 year averages is indicated below

Table 22: Next three year average prices

Particulars	UOM	3yr Avg	10yr Avg
LME - Zinc	$/MT	2,926	2,759
- Lead	$/MT	2,067	2,057
- Silver	$/Troz	21.42	21.24
Ex Rate	Rs/USD	75.63	76.65

10.1.2 Cut-off Grade

The ROM ore is transported to RAM by road for treatment where is it processed in a separate processing stream. The principal metal is zinc followed by lead and silver which have a similar contribution. The COG and NSR assumptions and values used to support the F2022 Ore Reserve estimate are indicated below.

Table 23: Cut-Off Grades and NSR Calculation inputs

Description	Units	Pb Con	Pb Con	Zn Con
Input Assumptions		**Pb**	**Ag**	**Zn**
Commodity Price	USD/t or USD/oz	2,057	21.24	2,759
Commodity Price	USD/t or USD/g	2,057	0.68	2,759
Exchange rate	USD:INR	76.65	76.65	76.65
Average grade	% or g/t	0.66	23.57	4.577
Concentrator recovery	%	74.69	36.54	93.69
Concentrate grade	% or g/t	71.4	898.6	55.1
Moisture content	%			
Payability/ smelter rec	%	94.5	98.3	95.7
Minimum deduction	% or g/t			
Treatment charge	USD/dmt	424.9		244.8
Refining charge	USD/lb or USD/g		0.0	
Transport cost	USD/dmt			
Freight cost	USD/dmt	8.2		10.0
Mineral royalty	%	15.7	25.7	14.2
NSR Values		**Pb**	**Ag**	**Zn**
Gross payable	USD/dmt	1,389	603	1,455
Treatment charge	USD/dmt	-424.9		-244.8
Refining charge	USD/dmt		-21.1	
Transport cost	USD/dmt			
Freight cost	USD/dmt	-8.2		-10.0
Mineral royalty	USD/dmt	-218.1	-155.2	-206.0
Net payable	**USD/dmt**	**737.4**	**426.6**	**994.1**
Equivalent Grade Calculation				
Metal values	USD/t or USD/g	771.2	0.2	1689.5
Equivalent grade factors	**no**	**0.5**	**0.0**	**1.0**
Equivalent grade	%Zn or %Pb	5.65	7.14	0.01
Total equivalent grade	%Zn or %Pb			**12.8**
NSR	USD/t rom	55.1	69.6	0.1
Total NSR	USD/t rom			**124.8**

10.1.3 Modifying Factors and Reconciliation

The mine uses CMS for surveying all stope voids and the results are compared with the mine design. The results the CMS surveys completed to date is tabulated below in terms of the pre-mining planned stope (includes planned dilution and ore loss) and the post-mining stope void. For F2022 the planned and external dilution was 42% and 9% respectively.

Table 24: CMS Stope Reconciliation

Description	Unit	F2017 Actual	F2018 Actual	F2019 Actual	F2020 Actual	F2021 Actual
Planned Stopes	Mt		1.17	1.12	1.06	1
Zn grade	%		10.17	8.92	8.89	5.73
Pb grade	%		1.34	1.26	1.23	0.83
Ag grade	g/t		34.2	32.9	28.1	13
Mined stopes	Mt		1.16	1.13	1.14	1.06
Zn grades	%		9.71	8.42	7.79	5.43
Pb grade	%		1.28	1.19	1.08	0.79
Ag grade	g/t		32.6	31.2	24.7	12.3
Planned dilution	%		57.6	75.6	41.8	61.6
External dilution	%		3.8	3	8.7	5.6
Mining recovery	%		94.4	97.6	93.7	87.3

Table 25: Mined versus Processed Grades

Description	Unit	F2017 Actual	F2018 Actual	F2019 Actual	F2020 Actual	F2021 Actual
Mined	Mt	1	1.31	1.26	1.14	1.06
Zn grade	%	11.07	9.21	8.05	7.96	5.39
Pb grade	%	1.39	1.2	1.13	1.11	0.78
Ag grade	g/t	39.1	31.9	29.9	25.2	12.2
Processed		1	1.31	1.27	1.1	1.08
Zn grade	%	9.83	8.75	8.16	6.86	5.17
Pb grade	%	1.31	1.16	1.1	0.92	0.8
Ag grade	g/t	37.7	35.6	34.7	29.9	25.8
Tonnes Factor	%	1	1	1	0.97	1.02
Zn grade factor	factor	0.89	0.95	1.01	0.86	0.96
Pb grade factor	factor	0.94	0.96	0.97	0.83	1.02
Ag grade factor	factor	0.97	1.11	1.16	1.19	2.11

The high planned dilution is due to the morphology of the lower Block 3 orebody and the use of LHOS. The long ore drives needed for the LHOS method and the undulating hanging wall and footwall contacts lead to the inclusion of significant waste within the stope design. External dilution is consequently low. Overall the grades reported as head feed to the plant compare reasonably to that projected.

The modifying factors are well understood and based on the CMS reconciliation of 155 stopes mined to date. The results of the reconciliation have been investigated and a relationship between the modifying factors and mining methods has been established. The mine continues with a number of initiatives to improve performance.

Table 26: External Dilution and Mine Recoveries applied

Type	External Dilution (%)	Mining Recovery (%)
TV Stoping	8.0	90.0
LS Stoping	12.5	90.0
Pillar mining	15.0	90.0

10.2 Mineral Reserves

The classification block model reports developed by HZL was scrutinised and the tonnes were evaluated. This classification model is the start point of the Reserve estimation before external dilution and mine recoveries are applied. The model report suggests there is sufficient tonnes and grade in the model that is used by HZL to develop the Reserve Statement drafted in March 2022, to determine the final Mineral Reserves.

The current Reserve statement reports there is 1.9Mt at 7.6 g/t Zinc, 0.9% Lead and 18 g/t Silver.

Table 27: Mineral Reserves Estimates (2022)

Ore Reserve summary							
Ore Reserve	Tonnage (Mt)	Grade (Zn %)	(Pb %)	(Ag g/t)	Metal (Zn kt)	(Pb kt)	(Ag koz)
Proved	0.6	6.9	1.1	20	42	7	386
Probable	1.3	7.9	0.8	16	105	11	702
Ore Reserves (Total)	1.9	7.6	0.9	18	146	18	1,088

The Ore Reserve estimate for KDM is supported by a fully engineered mine design and LoM schedule and includes estimates for external dilution and mining recovery based on CMS results and reconciliation. Although total dilution of 50% is very high this is principally related to the use of LHOS mining methods for Block 3 where the drilling and loading drives are unable to cope well with variations in the roof and floor contacts of the orebody. The mine has implemented specific design modifications and techniques in an effort to improve mining quality and the external dilution and mining recovery factors are good. HZL consider the estimates of the modifying factors appropriate for the nature of the orebody and mining methods.

The COG at KDM of 2.72% ZnEq has been determined according to current results and mining costs and is in line with that budgeted. The same mining methods are to be continued for the remaining reserves and the COG is considered appropriate by HZL.

The future of mining at KDM is dependent on the results of exploration where efforts are currently focused on extending or finding further satellite orebodies. A certain amount of pillar recovery is included in the current Ore Reserve estimate. The mine is planned to continue at current production rates of 1.0 Mtpa.

The Mineral Resource for KDM has been reported from the 3D Mineral Resource block models, post application of depletion and classification, and the application of cut-off grades. Mine designs have been used to allow the reporting of both Exclusive and inclusive Mineral Resource statements.

The Mineral Resource has been reported using a zinc equivalent cut-off grade of 3.89% (ZnEQ=Zn+0.456xPb+0.01027xAg). For the remaining Measured Mineral Resource at Kayad Main orebody, HZL has applied a factor of 15% to account for material likely to be sterilised by both historical depleted areas and future depleted areas, that are not considered to have reasonable prospects for Eventual Economic extraction ("RPEEE"), as required by JORC. This material needs further investigation in F2021 and will likely require further write-down.

The Ore Reserve estimate for KDM has been derived from a fully engineered design of the stope and ore development shapes as illustrated in the figures above. The contents of the stope and ore development shapes have been queried against the Mineral Resource block model to derive tonnages and grades inclusive of planned dilution and ore loss. The reported results have been further modified by application of an external dilution and mining recovery factors.

10.3 Relevant Factors

Table 28: Input and calculation parameters

No	Description	Units	KDM ZnEq Kayad Mine Mine (Res+Rev) Pb Con Pb	 Pb Con Ag	 Zn Con Zn
1.00	**Input Assumptions**				
1.01	Commodity Price	USD/t or USD/oz	2,057	21.24	2,759
1.02	Commodity Price	USD/t or USD/g	2,057	0.683	2,759
1.03	Exchange rate	USD:INR	76.65	76.65	76.65
1.04	Average grade	% or g/t	0.66	23.6	4.58
1.05	Concentrator recovery	%	74.7	36.5	93.7
1.09	Concentrate grade	% or g/t	71.4	899	55.1
1.10	Moisture content	%			
1.11	Payability/ smelter rec	%	94.5	98.3	95.7
1.12	Minimum deduction	% or g/t			
1.13	Treatment charge	USD/dmt	424.9		244.8
1.14	Refining charge	USD/lb or USD/g		0.024	
1.15	Transport cost	USD/dmt			
1.16	Freight cost	USD/dmt	8.2		10.0
1.17	Mineral royalty	%	15.7	25.7	14.2
2.00	**NSR Values**				
2.01	Gross payable	USD/dmt	1,389	603	1,455
2.02	Treatment charge	USD/dmt	-425		-245
2.03	Refining charge	USD/dmt		-21	
2.04	Transport cost	USD/dmt			
2.05	Freight cost	USD/dmt	-8		-10
2.06	Mineral royalty	USD/dmt	-218	-155	-206
2.07	**Net payable**	**USD/dmt**	**737**	**427**	**994**
3.00	**Equivalent Grade Calculation**				
3.01	Metal values	USD/t or USD/g	771	0.17	1,689
3.02	**Equivalent grade factors**	**no**	**0.456**	**0.01027**	**1.000**
3.03	Equivalent grade	%Zn or %Pb	0.30	0.24	4.58
3.04	Total equivalent grade	%Zn or %Pb			**5.12**
3.05	NSR	USD/t rom	5.1	4.1	77.3
3.06	Total NSR	USD/t rom			**86.5**
4.00	**Costs and COG Calculation**		**F2022 Act**	**F2022 BP**	**F2023 BP**
4.01	Mining	INR/t rom	1,715		1,779
4.02	Processing	INR/t rom	1,172		1,220
4.03	Overhead	INR/t rom	0		0
4.04	Transport	INR/t rom			
4.05	Sub-total operating cost	INR/t rom	2,888		2,998
4.06	Corporate, royalty & others	INR/t rom			
4.07	Other costs	INR/t rom			
4.08	Sustaining capex	INR/t rom	641		760
4.09	Sub-total other costs	INR/t rom	641		760
4.10	Total cost	INR/t rom	3,529		3,758
4.11	Total cost (USD)	USD/t rom	46.0		49.0
4.12	Waste development cost	INR/t rom	495		540
4.13	Economic cut-off margin	%			
4.14	**Diluted %ZnEq Cut-off Grades**				
4.15	Operating cut-off (diluted)	%ZnEq or %PbEq	2.72	0.00	2.90
4.16	Section cut-off (diluted)	%ZnEq or %PbEq	3.11	0.00	3.32
4.17	Economic cut-off (diluted)	%ZnEq or %PbEq	2.72	0.00	2.90
4.18	**Modifying Factors**				
4.19	Planned dilution	%	28.6		28.6
4.20	External dilution	%	11.0		11.0
4.21	Mining recovery	%	86.7		86.7
4.22	**Insitu %ZnEq Cut-off Grades**				
4.23	Operating cut-off (insitu)	%ZnEq or %PbEq	3.89		4.14
4.24	Section cut-off (insitu)	%ZnEq or %PbEq	4.44		4.74
4.25	Economic cut-off (insitu)	%ZnEq or %PbEq	3.89		4.14
5.00	**Cut-off grade formulas**				
5.01			ZnEq for Zn = 1.000 x %Zn		
5.02			ZnEq for Pb = 0.456 x %Pb		
5.03			ZnEq for Cu = 0.000 x %Cu		
5.04			ZnEq for Ag = 0.01027 x g/t Ag		
5.05			Ore Reserve COG = 2.72 %ZnEq (diluted)		
5.06			Mineral Resource COG = 3.89 %ZnEq (insitu)		

11 Mining methods

11.1 Introduction

11.1.1 Mode of Entry

The initial box cut excavation for decline portal was made on 11.06.2011 at 487.6 mRL. The decline portal starts at 467 mRL. The mine access is comprised of single decline from surface portal to the top of the orebody, at the 419 mRL where it then splits into separate North and South declines. The declines are designed at a gradient of 1 in 7. North & South Declines are connected at multiple levels. North Decline further splits into two declines at 190mRL, where one decline reach to central part and another reach to northern part of the orebody. All three declines are accessible from 180mRL FWD.

Decline access is best suited for the shallow depth of Kayad deposit, proposed high mechanization for the planned production capacity. It posed easy transport of man & material and ventilation intake to mine.

Secondary access to mine is maintained through shaft & cage winder from surface 487 mRL to 400 mRL, which connects to decline at 400 mRL.

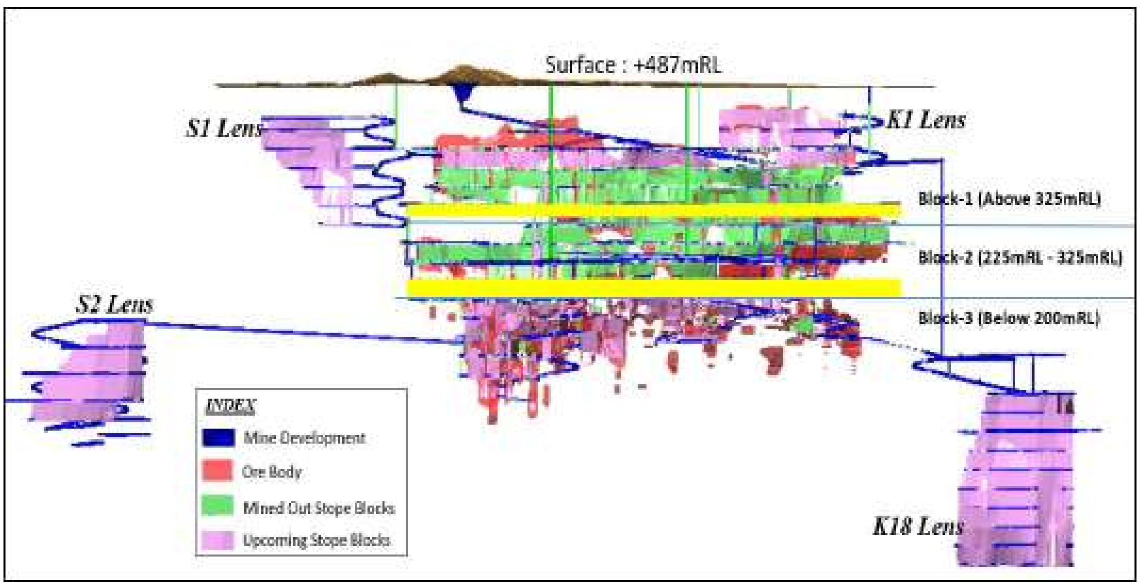


Figure 25: LVS showing Ramps and Decline

11.1.2 Mine Development

The mine is having one main decline from surface, which splits into two declines at 419 mRL as North and South decline. The decline divides the mine into North and South sections.

Ore body is being accessed by developing ore drives of 5 m x 4.5 m (WxH) in dimension from all these main levels. The decline is serving the purpose of hauling of waste and ore up to surface. In addition, the decline also serves as man, material & ventilation intake to the mine. Decline is also used for the to-and–from transport of all heavy earth moving and drilling equipment. The second egress to the mine is provided in ventilation raise of 3.5m dia. at North of the mine.

Development is ongoing in Block III Eastern Fringe area and K1 lens and development activity started in K18 area. The bulk of ore production during proposed years will be from Block III Main lens & Eastern Fringe area, K1, K18, Block-I and S1. The proposed mine development is based on the existing information about the ore body geometry and configuration and may undergo some changes if there is change in ore body configuration.

If the orebody continuity is found to extend beyond current limits (vertical & lateral extent) within lease boundary, it will be considered for stoping to maximize ore recovery keeping in point of view with mineral conservation after approval of modification in approved Mining Plan from IBM.

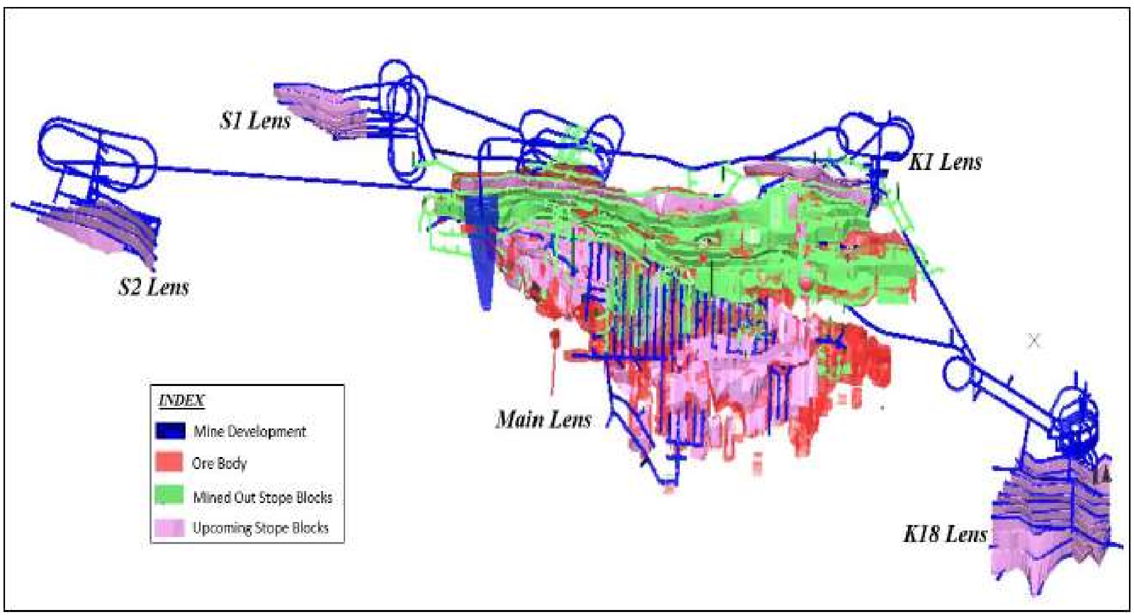


Figure 26: Underground Layout (Plan)

11.1.3 Stoping

The upper & K18, steep dipping section of the orebody is accessed via a central level access from each decline which connects to longitudinal (along strike) north and south ore drives. Stopes are mined in a retreat sequence back to the central access. The lower, flat lying section of the orebody is accessed via footwall drives developed north and south from the decline accesses, along the strike extent of the orebody. Transverse drives provide access to the stopes from the footwall drives.

Longitudinal Long hole open stoping (LHOS) method is planned for the steeper portion up to 225 mRL & K18 lens and Long Hole Open Transverse stoping is planned for the shallow (almost flat) portion of ore body below 225 mRL. All the mining is planned with backfilling with Rock fill (RF) / Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever orebody configuration requires.

11.1.4 System of drilling and blasting

Production drilling is being done using Electrohydraulic drilling m/c for drilling 76 – 102 mm dia. holes. Holes shall be drilled in upward/downward direction in fan shape or parallel holes according to the geometry and configuration of the ore body.

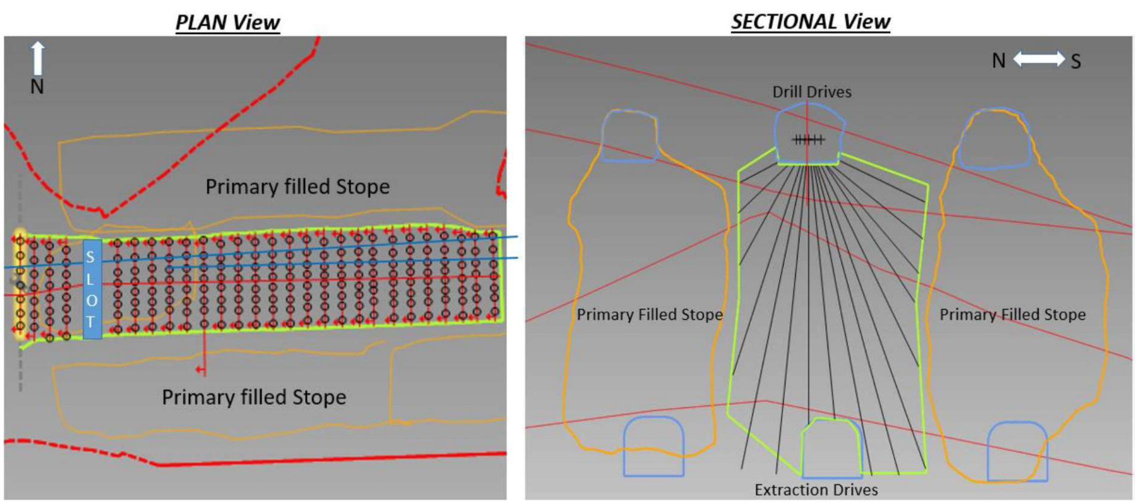


Figure 27: Drill plan (Left) and section (Right) for Longitudinal LHOS

Drill Jumbo is used in mine development drilling. Burn cut pattern is used for development blasting. Typically, 5.5m x 5.0m excavation have 61-70 holes of 45 mm dia and 4 holes of 102 mm (reamed holes) for creating free face in burn cut. All holes will be drilled to a depth of 3.5 to 3.8 m. Burn cut pattern for 5.5 m x 5.0 m decline development is shown in Figure below.

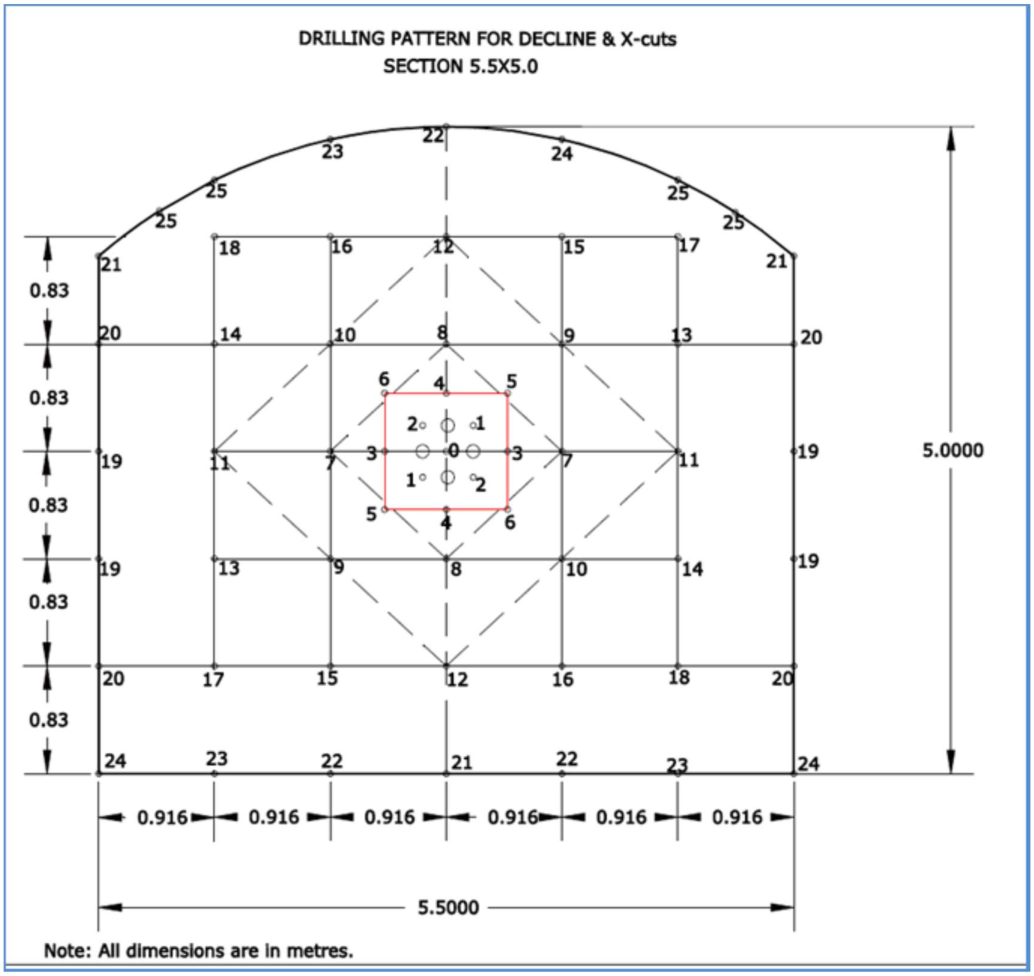


Figure 28: Burn Cut drilling and blasting Pattern for Decline Development

Emulsion or slurry explosive in tandem with electronic / non-electric detonator combination is used for blasting of development faces

Explosive: - Emulsion / Slurry explosive / ANFO.

Detonator: - Combination of electric detonator, nonex, cordtex or electronic detonator

The drilling and blasting parameters for Longitudinal and Transverse stopes are shown in following table:

Table 29: Drill and Blast Parameters

Drilling pattern in Ore	Burn cut
Drilling pattern in Rock	Burn cut
Drilling pattern in Stopes	Ring/Parallel hole drilling
Maximum number of holes blasted in a round.	65 holes
Charge per round (Kg)	250 to 2000 Kg

Charge per hole (kg)	35 to 160 Kg
Type of explosive	ANFO / Emulsion / Slurry Explosive
Powder factor (Norms)	
Rock development	0.90 to 1.20 kg/t
Ore development	0.90 to 1.15 kg/t
Stope	0.30 to 0.50 kg/t
Powder Factor (Actual)	
Rock development-	0.9 to 1.20 kg/t
Ore development-	0.9 to 1.10 kg/t
Stope	0.30 to 0.50 kg/t

11.1.5 Method and sequence of stoping

The upper & K18, steep dipping section of the orebody is accessed via a central level access from each decline which connects to longitudinal (along strike) north and south ore drives. Stopes are mined in a retreat sequence back to the central access. The lower, flat lying section of the orebody is accessed via footwall drives developed north and south from the decline accesses, along the strike extent of the orebody. Transverse drives provide access to the stopes from the footwall drives.

Longitudinal Long hole open stoping (LHOS) method is proposed for the steeper portion up to 225 mRL & K18 lens and Long Hole Open Transverse stoping is proposed for the shallow (almost flat) portion of ore body below 225 mRL. All the mining is planned with backfilling with Rock fill (RF) / Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever orebody configuration requires.

11.1.5.1 Longitudinal Long Hole Open Stoping (LHOS):

For Longitudinal Long hole open stoping method, the stope size planned is 20-25m height, 25-50m length (along strike) depending upon the geometry of the orebody and geotechnical consideration.

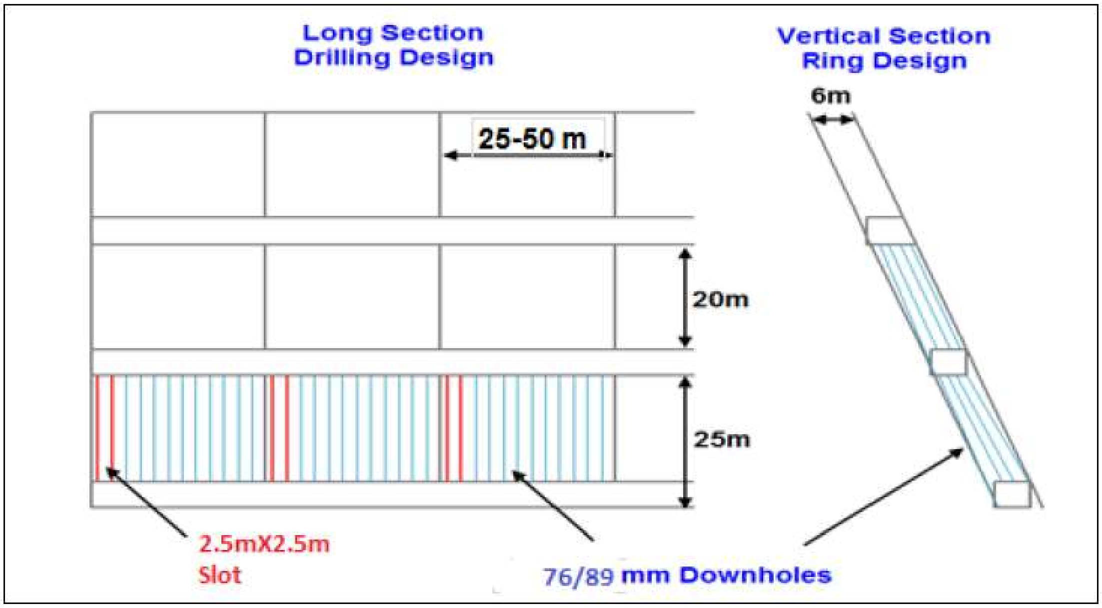


Figure 29: Typical Longitudinal LHOS

11.1.5.2 Transverse Long Hole Open Stoping (LHOS):

The stopes are planned across the strike in transverse direction with individual stopes of 15-25m height, 15 m width and length of stope equal to width of ore body. All primary stopes will be back filled with CRF only and Secondary stopes will be back filled with CRF and RF combination.

In both mining methods, production drilling is carried out from level drives below supported roof and mucking through drives and cross cuts below solid roof which eliminates exposure to potential rock falls.

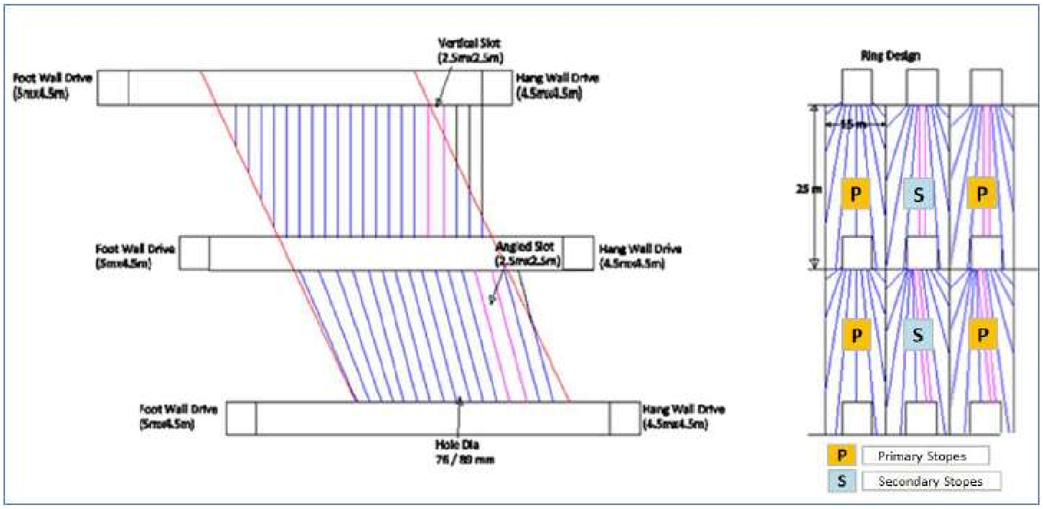


Figure 30: Typical Transverse stope

The blasted muck from stope is then withdrawn at extraction level through LHDs and then directly loaded into mine trucks for hauling through ramps from underground to surface stock yard.

11.1.5.3 Pillar Mining:

Left out Pillar Mining shall be initiated on mining of Eastern Fringe area in same area. The technical study for detail design is ongoing by CIMFR and shall be completed by Jan'21 itself. Firstly, Pillar between Main Lens & Eastern fringe area shall be mined by retrieving to North & South side. In continuation, the left-out pillars in Main lens shall be mined maintaining safe egress to the working area.

Applicability of Long hole open stoping (LHOS) and Long Hole Open Transverse stoping methods depends on the nature of the ore body geometry, dip of the hang wall and footwall, width and geology of the deposit and geotechnical conditions. The mined-out stope voids are to be backfilled with either rock fill (RF) or cemented rock fill (CRF) or combination of both as per the requirement.

Proposed Block wise development Schedule of mine development and production for proposed years is illustrated below. However, stoping will be commenced after duly considering various factors viz. completion of stope development, assessing the grade of the mining block, width of ore body, fixing of mining limits and backfilling of all stopes with cemented rock fill and after grant of stoping permissions from IBM & DGMS.

The narrow vein deposit being concealed to a depth of around 35 m from the general surface profile is only amenable to underground mining. Longitudinal Long hole open stoping (LHOS) method is proposed for the steeper portion up to 225 mRL and Long Hole Open Transverse Stoping is proposed for the shallow (almost flat) portion of ore body below 225 mRL.

11.1.5.4 Mucking and Haulage

After blasting, the broken ore shall be drawn using 17t/21t capacity diesel LHDs operating under solid and well supported roof from extraction level. Once the brow for ore drawl is open, next round of rings shall be blasted. It will be ensured that the operator operates the LHD below a solid roof.

Remote control operation of the LHD shall be used to recover ore from the hanging wall side of the slot area at the final clean up stage. For rest of the stope area complete ore is recovered from the trough drives and cross cuts.

The drawn ore will be directly loaded into 30t/50t/60t/65t LPDT through 17t/21t LHDs. Ore will be hauled to surface through the ramp, to surface ore stockpile. The ore from surface stockpile shall be transported to beneficiation plant at Rampura Agucha Mine through trucks for treatment.

11.1.5.5 Back Filling

After a stope is mined out, the void is being filled with cemented rock fill (CRF) that comprises of a mixture of development waste called rock fill (RF) with approximately 5% cement by weight. Dumping of CRF/RF is being done by LHDs from the upper level of the respective stope. Mining of adjacent stope is taken up after completely filling the mined-out stopes and allowing for the consolidation of the same. All primary transverse stopes of Block III will be filled with CRF only and secondary stopes with waste rockfill.

The method is very safe as all the operations like production drilling and mucking are done below the solid and supported roof. CRF also helps in controlling dilution from adjacent stopes and provides working floor for immediate upper lift.

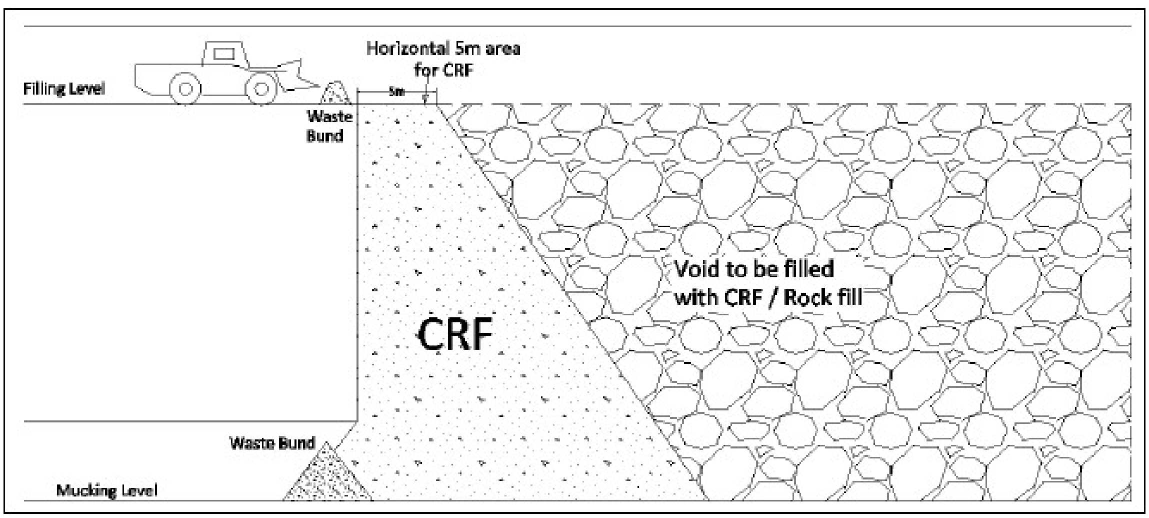


Figure 31: Diagram showing backfilling process

11.1.5.6 CRF Reticulation

Major ore production in current and upcoming years will be from Block-III which is below 200 mRL Almost 75% of total backfilling will be done below 200 mRL

Currently the cement slurry is being discharged directly to 200 mRL from surface. On surface, there are two storage tanks delivering the cement slurry separately on both North and South of Block-III. There are total 4 holes (2 for North and 2 for South section) drilled vertically from surface to 200 mRL. The vertical length is approximately 290 m and energy dissipaters installed at the bottom of the hole to reduce the pressure of slurry coming from surface. The slurry delivered directly into stope brow where an LHD mix waste rock with the cement slurry. Also, there is an arrangement of filling miller at 200 mRL so that the miller can deliver the cement slurry wherever required.

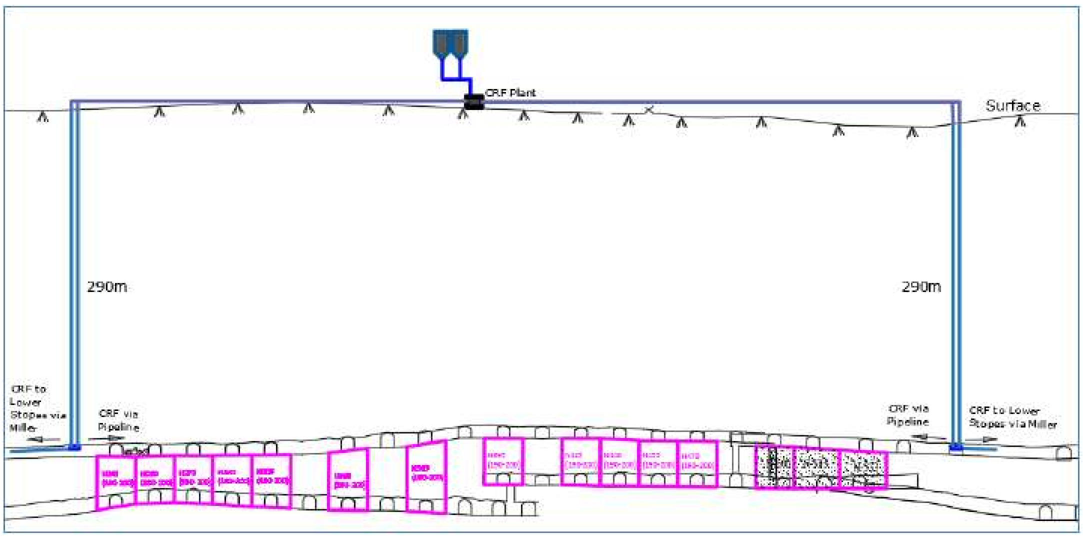


Figure 32: Cross sectional drawing of the CRF flow

Figure 33: Diagram showing Cement slurry transportation from CRF plant to 200 mRL

11.2 Geotechnical Parameters

11.2.1 Geotechnical Parameters & Pillar Designing for stope preparation

The main host rock in Kayad Mines is Quartz mica schist with some mineralization also occurring in calc silicate. Main lens has been dissected at many places by pegmatite. The lenses lie parallel to the axial plane foliation/ cleavage/ fracture of the fold system or shear fractures governed by the lithological variations. As per in-house and third-party numerical modelling, maximum displacement at any part of the surface is not more than 5 mm.

Scientific studies for assessing the global stability of mines are carried out periodically. Few recent studies are highlighted below –

- Determination of stope dimensions for stability and their supporting methods for Kayad mine, HZL – "CSIR-CIMFR" - 2014
- Advice for optimization of blast design parameters at Kayad underground mines of Hindustan Zinc Limited for the safety and stability of surface structures and subsequent monitoring of vibration on the surface structures for their long-term stability- "CSIR - 2014"
- Long term monitoring and interpretation of rock movement and suggestion of remedial measures in Decline, Stopes & Cap rock at Kayad mine of HZL – "CSIR - 2014"

- Advice for optimization of blast design parameters at Kayad underground mines of Hindustan Zinc Limited for the safety and stability of surface structures and subsequent monitoring of vibration on the surface structures for their long-term stability- "CSIR - 2015"
- Advice for optimization of blast design parameters at Kayad underground mines of Hindustan Zinc Limited to control blast induced vibration within safe limits for the safety and stability of surface structures – "CSIR - 2017"
- Numerical modelling and advice for optimization of stoping parameters and sequence of mining for BLOCK- III deposit between 200 mRL to 50 mRL at Kayad mine, HZL – "CENTRAL INSTITUTE OF MINING & FUEL RESEARCH – CSIR - 2017"
- Numerical modelling and advice on stoping parameters for K1 lens (400-450mRL), S1 lens (300-450mRL) and Block 1 (375-400mRL) of Kayad Mine HZL by CIMFR, Dhanbad in Sep'2019
- Scientific Study for optimization of stoping parameters and sequence of mining for BLOCK-III Eastern Fringe between 230 to 110mRL of Kayad mine, HZL by CIMFR, Dhanbad in Jan'2020

The stoping parameters for each stope are determined by looking into the stability aspects at the local as well as the global level by empirical and numerical tools. Initially, the stope strike/height is determined by empirical methods (Mathew's Stability method in particular). Then the stability of same geometry is checked by numerical modelling with Flac 3D as numerical solver.

11.3 Support System

To ensure additional safety all the level developments including that in the waste and ore are systematically supported with rock bolts /cable bolts and Wire mesh as per Systematic Support Rule (SSR).

Systematic support system in the form of rock bolts, wire mesh is installed in the excavation drives and crosscuts to ensure long term stability of the strata and roof of development viz., drives and crosscuts, ramp, incline etc. If poor ground or any geological discontinuity plane is encountered like faults and shear zones etc., some additional support elements are used in the form of Dowels/Steel sets and concreting and/or anything else as per the scenario.

Ground support to be installed :

1. Primary ground support be installed prior to cable bolt installation.
2. At Loading junction, install 6.0m long, single strand, fully grouted cable bolts with ring spacing 2.0m and hole spacing 2m.

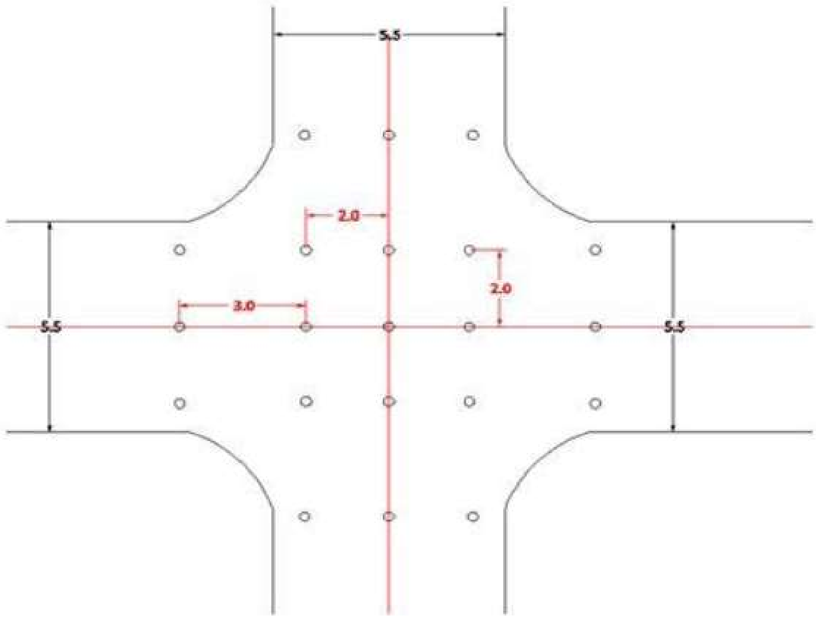


Figure 34: 4-way Junction - Support

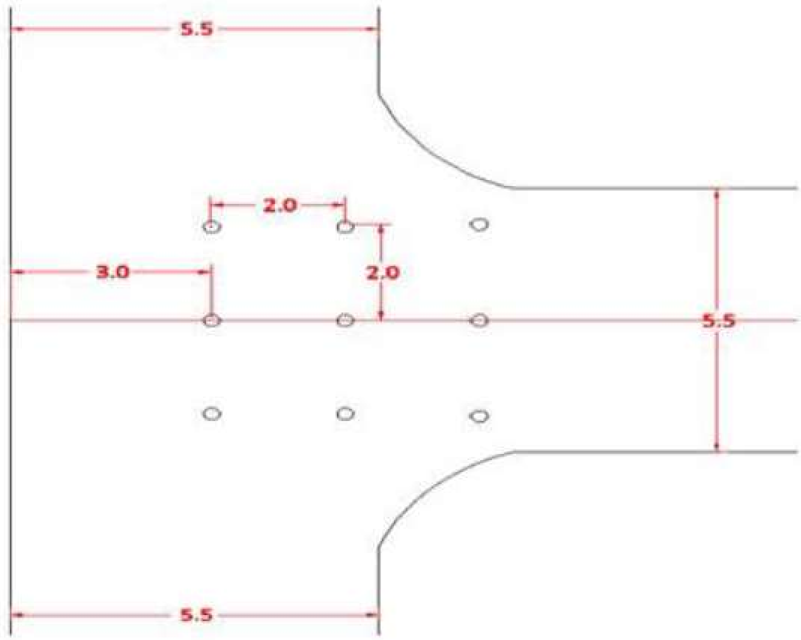


Figure 35: T Shape- Junction - Support

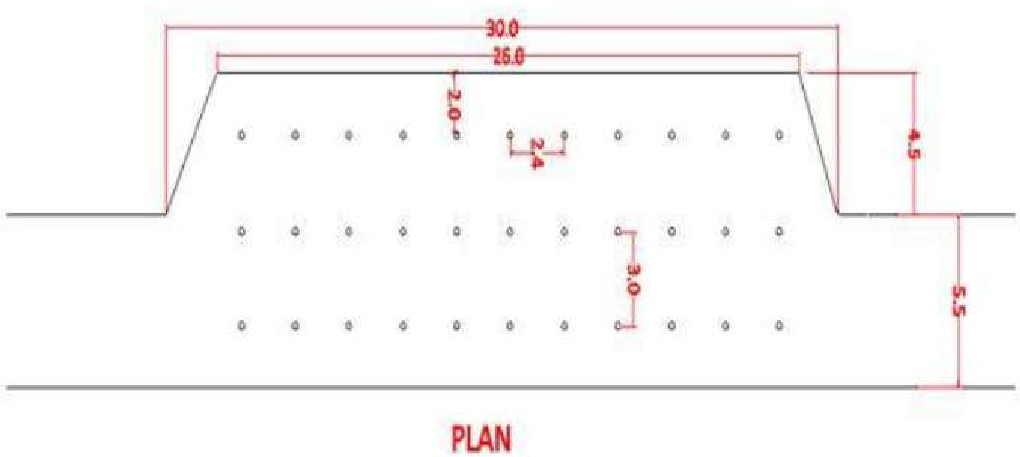


Figure 36: Passing Way - Support

To avoid hanging wall failure leading to in-stope dilution, cable bolts are being installed extending into the hanging wall to arrest excessive wall rock failure, especially in areas where the wall rocks are having low RMR or low angle dipping of ore lenses.

The designed SSR has been validated by CIMFR, Dhanbad to ascertain better stability of developments and Stope through field observations and physical inspection of the area. Also, the study is aimed to suggest possible remedial measures to safeguard present and future ground stability. The major recommendation is as below.

Table 30: Drive width 5-7m (Ore body, Decline and X- cut)

RMR	CLASS	SUPPORT
<20	V. POOR	CONCRETE LINING + STEEL SET
21-40	POOR	ROCK BOLT (0.75m * 0.75m) + CABLE BOLT + WIRE MESH
41-50	FAIR	ROCK BOLT (1m*1m)+ WIRE MESH
51-60	FAIR	ROCK BOLT (1m*1m)
61-80	GOOD	ROCK BOLT (1.2m*1.2m)
>80	V.GOOD	SPOT BOLTING

From the empirical and numerical modelling studies the estimated rock bolting parameters for various locations are tabulated below. The pattern of rock bolting and cable bolting for various areas of the mine are shown in the table attached. Cable bolts are suggested only in the Ramp where “fair” rock mass of RMR <60 are encountered, at all the junctions occurring at a ramp section, and at the brow area. In Kayad mines 2.4 m long rock bolts (full column resin) are used for Ground support and larger size excavations such as passing bays, loading point and workshop.

11.4 Hydrogeological Parameters

The Kayad operations have a good control on the groundwater and manages the water using numerous control dams in and around the mine operations.

The geology of the area is mainly composed of thin alluvial cover, belonging to Sub-Recent to Recent period of Quaternary Period followed by Ajmer formations of Ajabgarh Group of Delhi Super Group of lower to middle Proterozoic Era. Lead–zinc mineralization is hosted mainly by quartz mica schist. Other rocks which also carry mineralization are quartzite, calc-silicate and vein quartz. Of all the rocks exposed in the area, alluvium, mica schist and quartzite form aquifers in which mica schist and quartzite forms poor aquifer.

11.4.1 Hydrogeology of 10-km area (Buffer zone)

Mica schist and quartzite are the main rocks exposed in the buffer zone. Quartzite are generally exposed as hills but in the eastern part of the buffer zone, these are exposed as low raised hills and form aquifer. Mica schist are exposed in valleys and in buried piedmonts. Mica schist is intruded by pegmatite and quartz veins; and also by basic intrusive rocks. The general strike of the rocks are NNE-SSW to NE-SW with steep dips either towards east or west.

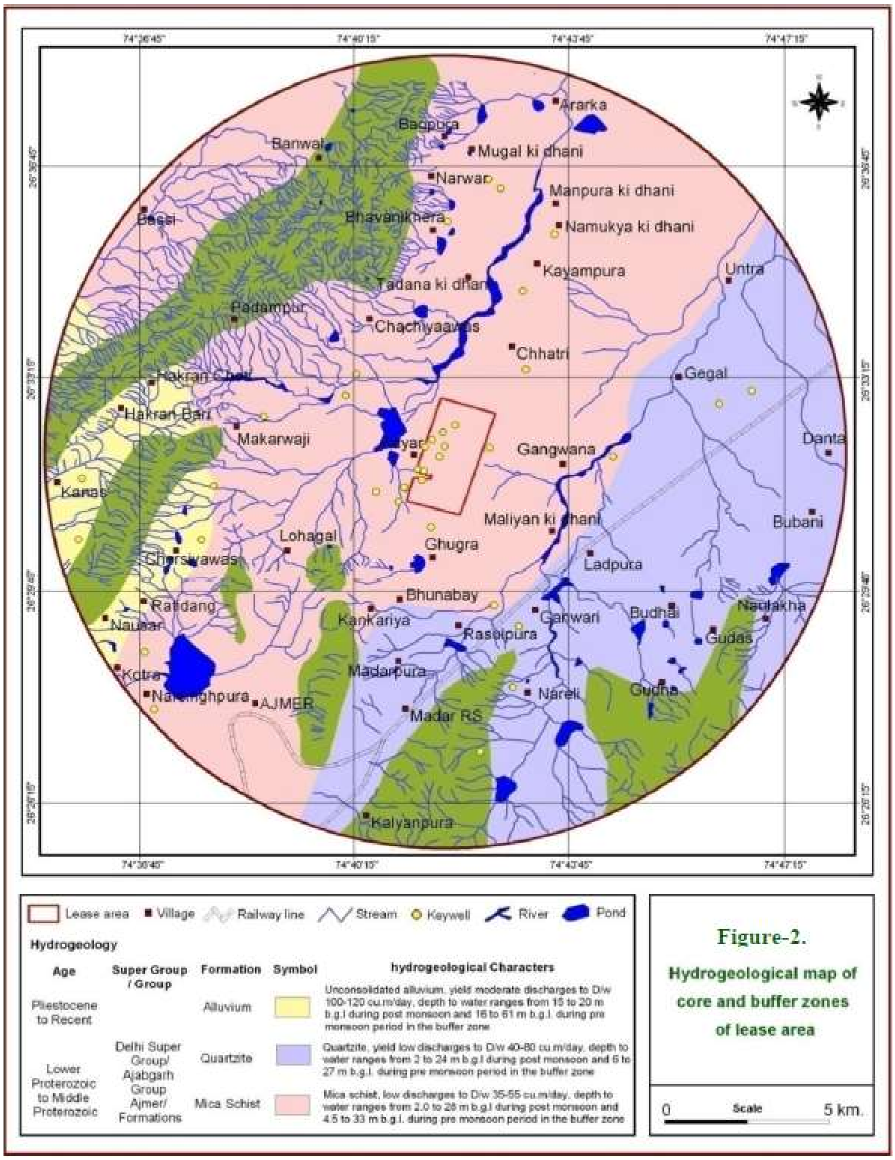


Figure-2.

Hydrogeological map of core and buffer zones of lease area

11.4.2 Ground Water and Conceptual Model

Ground water movement is controlled mainly by the hydraulic conductivity of the crystalline metamorphics and hydraulic gradient. The ground water movement mainly takes place through the fractures and joints of the crystalline rocks and in alluvium the ground water is transmitted through the voids and interstitial openings. A review of the topography and drainage pattern in the major part of the buffer zone reveals that the general slope of the area is towards northeast and is 4.0 to 5.0 m/km. The ground water flow in this part of the buffer zone is also towards NE with hydraulic gradient as 3.75

to 3.88 m/km during the post monsoon period for the year 2012 as calculated from the monitoring of wells of the area.

11.4.3 Nature of hydraulic conductivity

As the principal aquifer of the area is mica schist in Kayad area, the hydraulic conductivity is mainly developed due to fractures, foliations and joints. The hydraulic conductivity is very low. The depth of productive hydraulic conductivity has been observed up to maximum depth of 200 meters in the metamorphic as quartz and pegmatite intrusive as well as the deep seated shear zone also induce secondary porosity in the area, beyond which there are hardly any secondary openings, making the metamorphics completely barren.

11.4.4 Recharge through rainwater harvesting structures

Gully plugs, weirs, earthen check dams and cemented check dams along with deepening of existing village ponds are the structures built across Srinagar Block (Kayad Underground Mine buffer zone) during the period 2015-2018.

Twenty four earthen check dams were constructed during the 2016-2018 period under the Mukhyamantri Jal SwavlamanYojna in co-ordination with Project Implementing Agency (PIA), Integrated Watershed Management Programme (IWMP), Panchayat Samiti Srinagar, Ajmer district.

The objective being to minimize the soil erosion, to control the effect of water runoff, mitigating erosion phenomena, to decrease the bed gradient and thus to reduce flow velocity and drinking water for wildlife in the forest region and recharge the groundwater. The Weir height is generally limited to between 1.5 m and 3 m to prevent erosion damage immediately downstream which could cause weir undermining.

Factors which were considered that influenced the suitability of check dam/ weirs are:

- Availability of local construction materials (stone, earth, water);
- Relatively straight longitudinal stream section, in order to avoid bank erosion downstream of the structure;
- Compatibility between stream bed level and outlet level;
- Potential for establishing a series of gabion weirs (check dams) along the stream;
- Adequate geotechnical characteristics of the site to support structure loads;
- Appropriate basin runoff characteristics (e.g. floods, flow volume, seasonal variability).

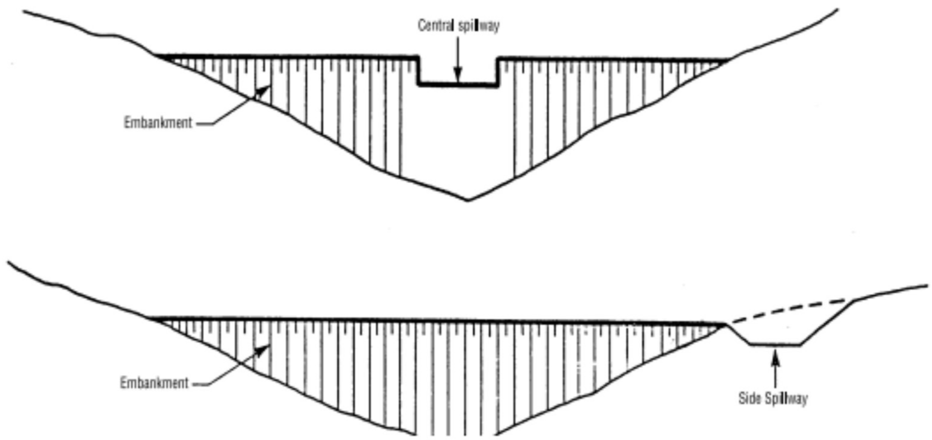


Figure 37: Typical section of the earthen check dam/ gully plug constructed in the Srinagar Block

The selection of a particular type of small check dam depended on several factors including its future use, the geomorphological and hydrological characteristics of the catchment area, the geotechnical characteristics of the site, the local availability of construction materials and the skills and experience of the local workforce.

All the check dams/structures were constructed on small streams of first to second order to conserve stream flow with practically no submergence beyond stream course. These are prepared by either constructing a masonry wall across the stream using local boulder/rocks and sand and cement (in some cases) or simply an earthen embankment across the stream of 1.5 to 3 m in width. The height of such structures ranges between 1.0 to 3.0 metres with length ranging from 20 to 100meters. Excess water overflows this structure or seeps through the masonry wall boulders and is again harnessed by another check dam downstream, may be at a length of 100 to 200 meters. Twenty four such structures have been constructed and assessed in the area so far.

11.5 Mine Design Parameters

S.No	Particulars	Stope parameters:
1	Number of working stopes	6
2	Size of the panel	10-25m (H) x 25 – 40 m(L) x 3– 20m (W)
3	Level interval	25m
4	Thickness of crown pillar	17-25m
5	Thickness of Sill pillar	17-25m
6	Thickness of Rib pillar	NA
7	Size and interval of Stope pillar	NA
8	Size/shape of man way	1.8mH x 0.8mW x 1.2mD
9	Size/shape of ore pass	NA
10	Method of stowing/back filling	Cemented Rock filling / Rock filling
11	Method of drainage of stowed water	NA

11.6 Mine Schedule

The mine has currently only supplied this schedule to mine out the current reserves that is currently stated in the reserves estimates. The mine is targeting 0.8mtpa per annum for the next 3 years as illustrated below.

Table 31: LOM Schedule - Kayad Mines - 2022 – 2026 [supplied by HZL]

Area / Block	2022-23	2023-24	2024-25	2025-26	Total
Access_Block1&2				47,692	**47,692**
N200_Sill Pillar	70,724				**70,724**
EF Access	59,620				**59,620**
S1 Block	223,134				**223,134**
K18_Connecting	178,078	19,320			**197,398**
K18 Block	276,000	800,000	251,059		**1,327,059**
Total Ore Production (Tons)	**807,556**	**819,320**	**251,059**	**47,692**	**1,925,627**
Grade	**2022-23**	**2023-24**	**2024-25**	**2025-26**	
Zn %	7.21	7.82	7.77	9.28	**7.59**
Pb %	1.06	0.83	0.81	1.29	**0.93**
TMC %	**8.27**	**8.64**	**8.59**	**10.57**	**8.53**
Ag ppm	20	17	16	17	**18**
Plant Recovery	**2022-23**	**2023-24**	**2024-25**	**2025-26**	
Recovery_Zn	94.00	94.00	94.00	94.00	**94.00**
Recovery_Pb	74.50	74.50	74.50	74.50	**74.50**
Metal Produced	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**Total**
Zn_MIC	54,756	60,198	18,343	4,159	**137,456**
Pb_MIC	6,364	5,038	1,521	460	**13,383**
Total MIC	**61,120**	**65,236**	**19,863**	**4,619**	**150,839**
Development	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**Total**
Mine Development (m)	10,250	5,550	1,500	200	**17,500**
Waste Generation (Tons)	540,340	489,601	129,238	1,886	**1,161,064**
Backfilling (Tons)	700,000	600,000	150,000	72,000	**1,522,000**
Production Drilling (m)	158,000	136,600	41,800	7,900	**344,300**
SIB Development	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**Total**
Decline Dev (m)	2,063	900	-	-	**2,963**
Lateral Dev (m)	8,187	4,650	1,500	200	**14,537**
Vertical Dev (m)	1,140	250	100	-	**1,490**

11.7 Mining Fleet Requirements

11.7.1 System of underground transportation

The mine is having one main decline from surface, which splits into two declines at 419 mRL as North and South decline. The decline divides the mine into North and South sections. Ramp (5.5m x 5.0m, 1 in 7 gradients) are suitable to deploy personal carrier of 16 & 32 people's capacity and light moving vehicles for transportation from surface to underground. Manholes, at every 20m are provided in ramp.

Mucking is done at the extraction levels by diesel LHDs of 17T/21T capacity. Ore from extraction level is directly loaded into 30T/50T/60T/65T LPDT. LPDT further transports the muck to designated surface stockpile area.

Table 32: Underground Ore Transportation

From face to loading point	LHD
From loading point to surface	LPDT through Decline
From Surface to end use plant	Surface Truck transport
Safety Features provided on haulage track /roadway & Belt Conveyor	**haulage track /roadway** Man hole at 20m interval Regular road maintenance for smooth road free from bumps
Belt Conveyor - NA	

11.7.2 Surface Transportation

The ore from underground is stacked at Surface stockpiles. From surface stockpiles, the ore is transported to Rampura Agucha Mine for beneficiation by surface trucks of 30-40t capacity for further processing. Rock breaker is also deployed at surface stockpiles for breaking large sized boulders.

11.7.2.1 System of winding / hoisting:

A shaft having diameter of 3.5m has been made at the central portion of the mine. It connects from surface to the belowground at 400mRL to the main decline. The shaft serves as second outlet for man & material and intake. A winder of 60 HP with cage for 6 persons capacity has been installed.

Ore hoisting is being done through Decline using 30T/50T/60T/65T LPDT and has capacity of 2 Mtpa. The mine shall be having adequate capacity of ore handling system for proposed production.

11.7.3 Equipment Productivity and Usage

The fleet potential and quantum planned under proposal indicated in above table depict that adequate equipment are planned to achieve the proposed quantum

Table 33: Equipment Productivity

Equipment	Availability	Utilization	Run Hrs	Productivity		Equipment Nos.	Equipment Potential	
Plan	Plan	Plan	Plan	UoM	Plan		UoM	Potential
LPDT - 65T	75%	75%	4,860	Mt.k pa	0.72	4	Mt.k	6.66
LPDT - 60T	70%	70%	4,234	Mt.k pa	0.59	2		
LPDT - 50T	70%	70%	4,234	Mt.k pa	0.56	2		
LPDT - 30T	75%	60%	3,888	Mt.k pa	0.37	4		
LHD - 21T	75%	75%	4,860	Mt pa	0.46	2	Mt	3.12
LHD - 17T	75%	75%	4,860	Mt pa	0.44	5		
Drill Jumbo	65%	45%	2,527	Km pa	2	6	Km	9
Prod. Drill	70%	30%	1,814	Km pa	54	3	Km	162

11.8 Mine Ventilation

Three main mechanical ventilators having a capacity of 150m3/s (450 KW) each the bottom of South return raise at 400mRL, North return raise at 375mRL and Central return raise at 250mRL. The diameter of the raise bored return raises is 3.5m. The fans serve as the main exhaust fans for the mine. Fresh Intake air enters the mine through the main decline (189m3/s), North Intake raise (73m3/s), South Intake raise (95m3/s) and Secondary Outlet (30m3/s). Provisions have been made to operate all main fans at the required operating points by changing the respective fan speed using VFD as per the suggestions in the report of 'Modelling and simulation studies for designing ventilation system of Kayad mine, Hindustan zinc limited' by Prof. D. C. Panigrahi.

The main decline splits into two, South decline and North decline at 419mRL. The North and South section intake air is connected to 180mRL and 75mRL respectively by subsequent drop raises. The decline primary air flows down to 175mRL in respective sections and will be extended below as the mine development progresses. The Mine ventilation requirement can be achieved by running the three main return fans at optimized speed depending on air requirements in working areas.

The development headings are ventilated by auxiliary ventilation fans of 22kW (15m3/s), 75 KW (20m3/s), 132KW (35m3/s) through 1200mm and 900mm diameter ventilation ducts. The mine air returns to the main exhaust fans through a series of internal boundary return raises. Mine air is being regulated using ventilation door, stoping wall, brattices, secondary ventilation fan, booster fan etc. Exhausted stopes are being sealed-off by constructing stoping wall (i.e. complete or with provision of door) at stope entry point or at drawl crosscuts.

The ventilation quantity is accessed based on ventilation requirement for Diesel Equipment planned to be deployed. Equipment KWH & Load factor is considered for estimating overall KWH running at mine. At the full production rate, maximum total primary air requirement has been estimated to be ~386m³/sec and accordingly adequate intake and exhaust ventilation network are in place having total capacity of 450 m3/sec as tabulated below

Table 34: Ventilation Requirements - KDM

Operating Equipment	KW	Nos	Total kW	Air Req. (@ 0.06cum/s/kW)
LPDT 65T	485	3	1455	87.3
LPDT 50/60T	485	5	2425	145.5
LDPT 30T	298	3	894	53.64
LHD 17/21T	275	6	1650	99
Total Air Requirement	m3 / sec		6424	385.44

Table 35: Intake and Return Airway Summary

Main Intake	Size	Present (Qty.) Cu.m/Sec	Proposed (Qty.) Cu.m/Sec
Decline	5m*5.5m	189	193
Secondary outlet	3.5 m dia	30	28
North intake raise	3.5 m dia	73	75
South intake raise	3.5 m dia	95	93
Total		**387**	**389**
Main Exhaust	**Size**	**Present (Qty.) Cu.m/Sec**	**Proposed (Qty.) Cu.m/Sec**
South section return (Fan – 150 m3/sec)	3.5 m dia	124	120
North section return (Fan – 150 m3/sec)	3.5 m dia	128	132
Central return (Fan – 150 m3/sec)	3.5 m dia	138	140
Total		**390**	**392**

12 Processing and Recovery Methods

12.1 Introduction

The ROM ore from Kayad mine is received on surface at the ROM Ore Yard. Here the ore is broken down further to -500 mm with a track-mounted rock breaker, before transport by road to Rampura Agucha for treatment at a dedicated processing stream. Selective removal of some waste is performed during the rock-breaking process. The waste/ore boundary is sharp and easily identified visually.

The process by which the Kayad ore is treated to lead and zinc concentrates ready for smelting is described in detail in the Rampura Agucha report.

13 Primary Surface Infrastructure

13.1 Roads

The Kayad village is 9 km NNE of Ajmer city and is connected by tar road. Jaipur, the state capital is 127 km away and the nearest airport is at Kishangarh, 20 km from the Mine. Although the nearest railway station is Madar (B.G.) at 6 km to the south of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of Northwestern Railway, 9 km SSE of Kayad.

The area is undulating with altitude varying from 480 to 506 m. The highest point is a small mountain just east of the village Kayad, attaining an altitude of 506 m.

13.2 Stockpile and Storage Facilities

The waste rock generated during mining operations was earlier being stacked at waste dump at surface. The waste dump area is of 1.0 Ha and on the surface acquired area. With the subsequent increase in quantum of stoping, the waste rock was being directly taken into use as cemented rock fill in belowground. Additional waste generation due to development activities is envisaged to 8,55,000 tonnes. Thus as per proposed plan Waste generation during next 4 years will be 14,50,000 tonne as compared to existing 5,95,000 tonne.

In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface and hence no additional waste dump is envisaged. The increased waste generated will be disposed of into the underground voids. If any additional waste required for backfilling will be utilized from Rampura Agucha Mine.

13.3 Tailings Disposal

As the ROM ore is being transported to Rampura Agucha Lead Zinc Mines for beneficiation, no tailing will be generated at site. The mine water will be re-used and there will not be any discharge from the mine, hence no adverse impact is anticipated on ground water quality.

13.4 Power and Water

13.4.1 Power requirements and sources

No additional power requirement is envisaged. Power is supplied by AVVNL through grid and distributed to mine via surface sub-station (33KV) located within the mine boundary. Present power requirement is around 5.0 MW.

13.4.2 Emergency Power

In case of any power shortage or failure the captive stand by DG (1MVA) set is available provide power. No additional emergency power required for the proposed expansion project.

13.4.3 Water requirements and sources

No additional water is required for proposed expansion over existing 560 m3/day(KLD) requirement. Existing Water is sourced from PHED for domestic consumption to the tune of 75 KLD and 200 KLD of treated sewage water sourced from Ajmer city with recycled quantity of 50 KLD from internal STP and 88 KLD from operations and 147 KLD mine dewatering will be reused for dust suppression. The approvals for water drawl are in place.

14 Market Studies

14.1 Introduction

Hindustan Zinc (HZL) is India's largest and world's second largest zinc-lead miner. With more than 50 years of operational experience, they have a reserve base of 161.2 million MT and an average zinc-lead grade of 5.9% and mineral resources of 286.7 million MT, our mine life is over 25 years. Their fully integrated zinc operations hold 78% market share in India's primary zinc industry, and they are the 6th largest silver producers globally with an annual production of 913,000t.

The market was negatively impacted by COVID-19 in 2020 and 2021. Considering the pandemic scenario, the construction activities were stopped temporarily during the lockdown to curb the spread of new COVID-19 cases, thereby decreasing the demand for zinc and lead-based products such as galvanised metal, lead sheets, and others from the construction industry. Furthermore, the demand for lead-acid batteries decreased due to the temporary pause of the automotive manufacturing units during the lockdown. However, the demand for lead-acid batteries, especially valve-regulated lead-acid (VRLA) batteries, from the electronics and telecommunication industry increased during this period, as people opted to work online from their residence, which enhanced the demand in the market studied. With the lifting of restrictions, companies are keen to see a return to pre-2020 levels of activity.

14.2 Zinc

14.2.1 Application Of Zinc

Approximately 14% is used in the production of zinc die casting alloys. Nearly 9% of the zinc is utilized for oxides and chemicals and approximately 10% is used in alloys and castings. Some of the most common applications of zinc are listed below:

- **Galvanising**: Zinc offers one of the best forms of protection for steel against corrosion. It is used extensively in building & construction, infrastructure, household appliances, automobiles, steel furniture and other applications where lasting steel products are required.
- **Zinc Oxide**: The most widely used zinc compound, zinc oxide is used in the vulcanisation of rubber, as well as in ceramics, paints, animal feed, pharmaceuticals and several other products and processes. A special grade of zinc oxide has long been used in photocopiers.
- **Die Castings**: Zinc is an ideal material for die casting and is extensively used in hardware, electrical equipment, automotive and electronic components. Zinc die cast alloys are used in production of highly durable and visually appealing hardware fittings.
- **Alloys**: Zinc is extensively used in making alloys, especially brass, which is an alloy of copper and zinc.

14.2.2 Supply and Demand

The price of zinc is driven mostly by these five factors:

- Chinese Demand
- Chinese Supply
- Global Stocks
- US Demand

As with most industrial commodities, China plays a pivotal role in determining zinc prices. China is the top consumer of refined zinc used in galvanized steel. Therefore, a key indicator of zinc demand in China and elsewhere is steel demand. Decisions about whether to undertake or hold off on infrastructure projects can create huge fluctuations in steel demand. Ultimately, these decisions can flow through to the zinc market. A key factor impacting zinc output in China is the country's increasing environmental awareness. Poor air quality has forced the government to take a harder look at the mining industry as a contributor to pollution. If China curbs the production of zinc to deal with this problem, then the country will be more reliant on imports. This could drive prices higher. The London Metals Exchange (LME) keeps track of global stock levels for zinc and other industrial metals.
Current world production is approximately 13 million tonnes. HZL produces approximately 913,000t of zinc per year and is well established in the market.

Table 36: HZL Product Range

Product	Form	Weight
Special High Grade (SHG)	Standard Ingot	25 kgs
	Jumbo Ingots	1000kgs
Continuous Galvanising Grade (CGG)	Jumbo Ingots	1000kgs
High Grade (HG)	Standard Ingot	25 kgs
	Jumbo Ingots	600 kgs
Prime Western (PW)	Standard Ingot	25 kgs
Electro-Plating SHG (EPG SHG)	Standard Ingot	25 kgs
Hindustan Zinc Die-Cast Alloy (AZDA)	Standard Ingot	9 kgs

14.2.3 Prices

As with all commodities, prices fluctuate. Prices in general are Zinc price predictions from the leading international agencies for the next few years are as follows:

- **The World Bank** in its commodity forecast report estimated that the average spot price for zinc will fall to $2,400 per metric ton (t) in 2022, down from $2,700/t at the end of 2021. After that, a slow growth period will start.
- **The IMF'**s report indicated a completely different expectation: a rise from $2,828/t in the end of 2021 to $2,859 in 2022. For the following period, IMF experts expect a smooth, gradual decline. They predict the price will drop to $2,818/t by 2026.

- **The Industry Innovation and Science Australia**'s prediction is like the World Bank's predictions: they expect a decrease in the zinc spot price from $2,686 at the end of 2021 to $2,362 in 2022, with further slow increase through 2026.
- HZL is using prices as projected by LME as listed below:

Table 37: HZL Financial Model Prices

Particulars	UOM	FY'23	FY'24	FY'25	FY'26	FY'27	FY'28	FY'29	FY'30	FY'31	FY'32	Average
LME - Zinc	$/MT	3,183	2,911	2,684	2,621	2,658	2,706	2,706	2,706	2,706	2,706	2,759
- Lead	$/MT	2,179	2,047	1,974	1,962	1,997	2,082	2,082	2,082	2,082	2,082	2,057
- Silver	$/Troz	22.19	20.47	21.61	21.33	21.30	21.10	21.10	21.10	21.10	21.10	21.24
Ex Rate	Rs/USD	74.94	75.43	76.52	77.73	78.64	79.11	79.51	79.51	79.51	79.51	76.65

The figure below displays the price for zinc over the last five years. The price projections above agree in general with the historic average prices although it has been as low as US$1,500/t in January 2016 and as high as US$ 4,000/t in April 2022. In our opinion, the recent high price may be because of stock shortages created by the pandemic. These high levels are not sustainable, and we already see a substantial drop in prices which should stabilise at the levels projected by the LME, World Bank and others.

Figure 38: 5-Year Zinc Price in US Dollars

Source: Trading Economics

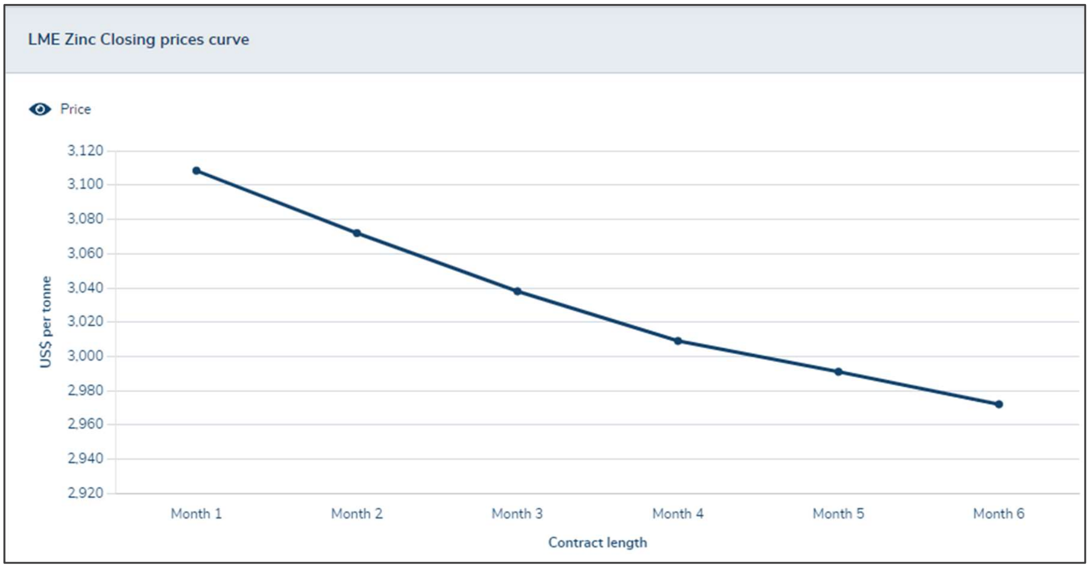


Figure 39: LME Zinc Contract Prices

Source: LME Website 12 July 2012.

Chemical Composition

Component	Guaranteed Content	HZL Typical
Zinc Zn)	99.9950%Min	99.9960% Min
Lead (Pb)	0.0030% Max	0.0020% Max
Copper (Cu)	0.0010% Max	0.0003% Max
Cadmium (Cd)	0.0030% Max	0.0002% Max
Iron(Fe)	0.0020% Max	0.0010% Max
Aluminium (Al)	0.0010% Max	0.0001% Max
Tin (Sn)	0.0010% Max	0.0001% Max

Hindustan Zinc Special High Grade Zinc 99.995% conforms the following standards:

ASTM B6-SHG Z13001 Grade
BS EN 1179:2003 – ZI Grade
ISO 752:2004 – ZN – Grade

Hindustan Zinc's – LME Registered Brands:

"HZL SHG 99.995%"
"HZL Zn SHG 99.995%"
"VEDANTA SHG 99.995%"
"VEDANTA Zn SHG 99.995%"

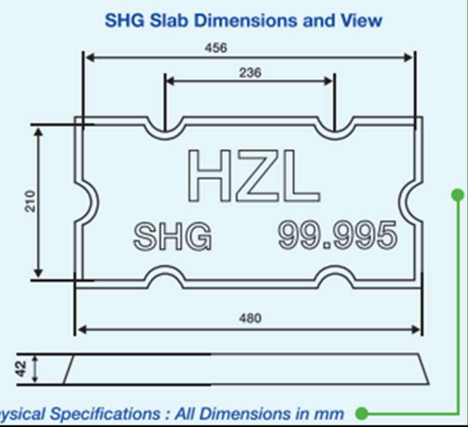


Figure 40: HZL Zinc Specifications

14.3 Lead

14.3.1 Applications for Lead

The battery sector is the single largest consumer of lead, accounting for around three-quarters of the demand. It can be sub-divided into the following groups:

- **SLI (Starting-Lighting-Ignition) batteries**, which currently accounts for over half of the total lead demand. These are mainly used in cars and light vehicles but are also found in other applications such as golf carts and boats. SLI battery demand in turn can be split into original equipment and replacement, with replacement demand outstripping original equipment demand by about 4:1 in mature markets.
- **Industrial batteries**, which currently consumes around a quarter of the total lead produced. This sector can be split roughly 50:50 into stationery and traction batteries. Stationary batteries are principally used in back up power supply systems; traction batteries are used for motive power in equipment such as forklift trucks and motorised wheelchairs.
- The remainder is used in non-battery applications. The second largest current end use of lead for non-battery applications, accounting for around 20% of lead consumption, is the alloys and chemical industry. Principal markets are for cathode ray tubes used in television screens and computer monitors, for Poly Vinyl Chloride (PVC) stabilisers and for making pigments for industrial use. Cable and other industries account for the remaining 5% of lead demand.

14.3.2 Supply and Demand

Growth in the construction industries was driving the overall market growth for a long time. High demand from renovation in the construction sector, including gutter and gutter joints and metal for roofing materials were propelling the market demand. Now, high demand for the electrical vehicle is influencing lead acid batteries demand emerging as the key driving factor for the market growth. Additionally, vigorous investment in improving telecom networks along with significant development in data centres are expected to enhance the industry position.

However, high production cost with stringent challenging processes is inhibiting the growth of lead market globally.

By the application segment, batteries segment is expected to dominate the market during the forecast period. As lead-acid battery is utilised in the form of stationary batteries, SLI batteries, portable batteries which includes electronics, consumers, telecom, energy storage system and others. SLI batteries have vast application in automobile designing and installation specifically with the automobile's charging system, that allow continuous cycle of charge and discharge in the battery each time the vehicle is in use. Furthermore, development in construction, machineries, and other battery dependent end-product is helping the market to grow.

Regionally, Asia Pacific is expected to dominate the lead market and is expected to grow during the forecast period. Developing countries like Japan, China, and India have boosted the market growth due to an increase in manufactures for machinery and tools across the world. This is expected to drive the market demand in this region.

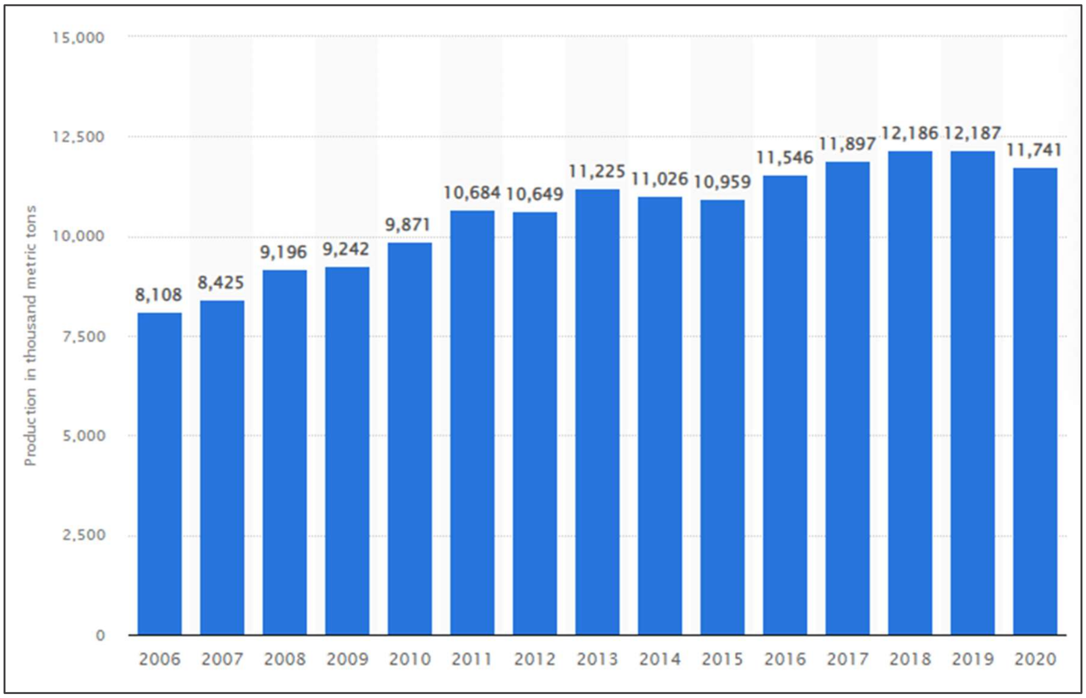


Figure 41: World Production of Lead

Figures above indicates a slow growth over the last 5 years with a slight dip in 2020, possibly due to COVID 19 restrictions. In our opinion, the production will recover and continue the slow growth of pre-pandemic years.

HZL produces lead ingots with a minimum of 99.99% purity which are registered with LME at a level of 210,000 t/a. This is expected to continue for the forecast period.

14.3.3 Prices

As with almost all commodities, prices are cyclical. Based on the 12-month price chart, there appears to be a severe reduction in price from around US$2,400/t to US$1,971 in July 2022. The 10-year price curve indicates that this is probably only a market correction. It is too early to guess at what level the price would stabilise.

Figure 42: 12-Month Price of Lead

Source – Trading Economics

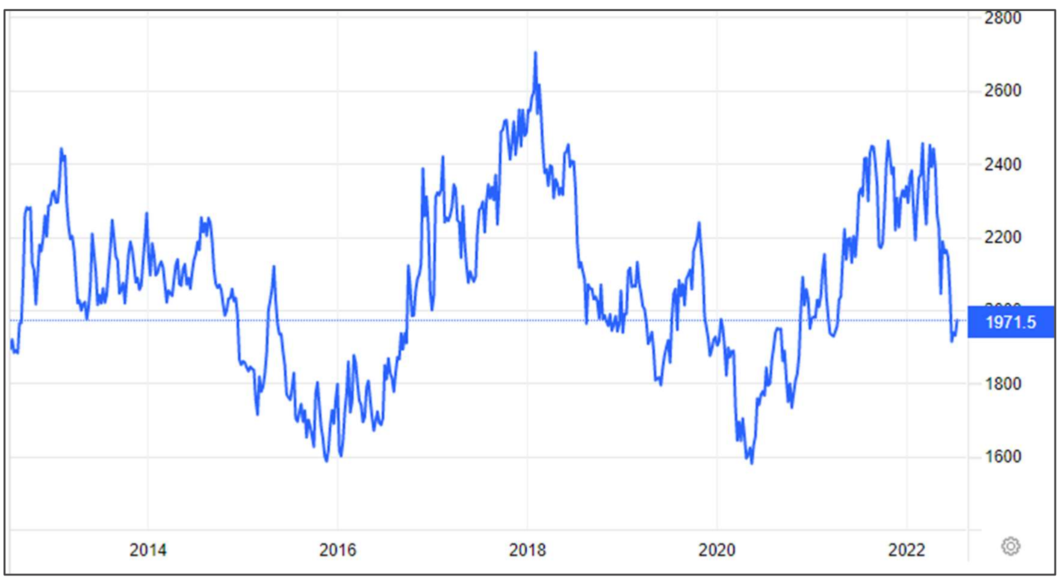


Figure 43: 5-Year Price of Lead

Source – Trading Economics

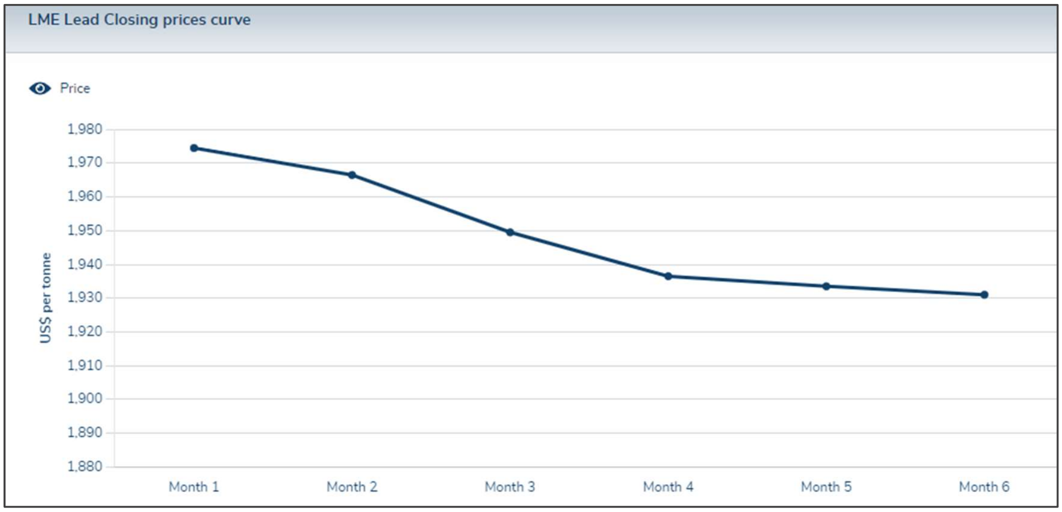


Figure 44: LME Contract Price on July 2022.

Source: LME July 2022

Chemical Composition — **LME Brand : Vedanta 99.99**

Component	Composition- BS EN 12659 : 1999 PB990R	HZL Typical
Lead(Pb)	99.99% Min	99.993%
Silver(Ag)	0.0015% Max	<0.0005%
Arsenic(As)	0.0005% Max	<0.0003%
Bismuth(Bi)	0.0100% Max	<0.0050%
Cadmium(Cd)	0.0002% Max	<0.0002%
Copper (Cu)	0.0005% Max	<0.0005%
Nickel (Ni)	0.0002% Max	<0.0002%
Antimony(Sb)	0.0005% Max	<0.0005%
Tin (Sn)	0.0005% Max	<0.0005%
Zinc(Zn)	0.0002% Max	<0.0002%

Vedanta 99.99% (Bundle Specification)

Ingot Weight	25 Kg (+/- 1.2 Kg)
Ingot Dimensions	85 (+/-2)mm Width | 535(+/-2)mm Length | 75(+/-2) mm Height
Bundle Weight	1050 Kg (+/-50 Kg)
Bundle Configuration	6 ingots/layer x 7 layers | 42 ingots
Bundle Dimension	510(+/-12)mm Width | 535(+/-2) mm Length | 520(+/-14) mm Heig
Strapping	32 mm Tenax strap | 2*2 strapping

Vedanta 99.99 & Vedanta Pb 99.99- Hindustan Zinc Lead Ingots are LME Registere

Figure 45: HZL Lead Specifications

14.4 Silver

The extraordinary events of 2020 have had a profound effect on virtually all markets around the globe and silver has been no exception. The metal's supply/demand fundamentals, investment, prices, trade-flows and inventories have all experienced sensational fluctuations over the past 12 months or so. The effect of the pandemic is set to remain relevant to silver for some time to come. Several key silver mining countries were hit hard by lockdown restrictions, and global silver supply declined. This was more than offset, however, by losses across most of silver's physical demand segments, which suffered as a result of restrictions to economic activity as well as depressed consumer sentiment and/or income loss. This resulted in a large silver market surplus. One notable exception was physical investment. A growing appetite for safe haven assets and, initially, the strength of the gold price all boosted investors' appetite for silver bars and coins last year, culminating in an 8% rise overall.

14.4.1 Applications for Silver

Silver metal has been known since ancient times for its brilliant white metallic lustre with high ductility and malleability properties. The precious metal has varied uses backed by its excellent heat and electrical conductivity levels.

In India, the highest usage of silver is in jewellery, followed by coins & bars silverware and industrial fabrication. With growing Indian economy, silver demand especially in the industrial sector is expected to follow a healthy growth in the coming years with an increased off take especially in electrical and electronics as well as brazing alloys and solders.

14.4.2 Supply and Demand

According to the Silver Institutes report “World Silver Survey 2021”, In 2020, global mine production suffered its biggest decline of the last decade, falling by 5.9% y/y to 784.4Moz (24,399t). This was caused by temporary mine closures in several major silver producing countries in the first half of the year as a direct result of the COVID-19 pandemic. Output from primary silver mines declined by 11.9% y/y to 209.4Moz (6,513t). This exceeded the drop that silver by-product output from lead-zinc and gold mines suffered, which fell by 7.4% to 248.3Moz (7,724t) and by 5.7% to 123.3Moz (3,834t), respectively. Countering this trend, silver production from copper mines increased by 3.5% y/y to 198.3Moz (6,169t).

At the county level, the largest declines were in nations which implemented COVID-19 lockdowns that required mines to temporarily halt operations. This led to substantially lower silver production in Peru (-26.1Moz, 810t), Argentina (-10.0Moz, 311t), Mexico (-9.6Moz, 299t) and Bolivia (-7.2Moz, 223t). Despite the disruption caused by the pandemic, mines in other countries were able to continue operating at full capacity throughout the year and output increased in Chile (+9.1Moz, 284t), India (+1.2Moz, 38t) and Australia (+1.2Moz, 37t).

Chemical Composition

Silver Ingot Specification		
Ingot Weight	:	30 Kg
Length (Top)	:	310 mm
Length (Bottom)	:	280 mm
Width (Top)	:	150 mm
Width (Bottom)	:	120 mm
Height	:	75 mm

LBMA Accredited Good Delivery Bars.

Component	Composition
Silver (Ag)	99.99 % Min
Antimony (Sb)	0.0020 % Max
Lead (Pb)	0.0020 % Max
Copper (Cu)	0.0020 % Max
Iron (Fe)	0.0020 % Max
Bismuth (Bi)	0.0015 % Max
Zinc (Zn)	0.0020 % Max
Selenium (Se)	0.0001 % Max
Telurium (Te)	0.0002 % Max
Calcium (Ca)	0.0001 % Max
Magnesium (Mg)	0.0001 % Max
Silicon (Si)	0.0001 % Max
Aluminium (Al)	0.0001 % Max
Arsenic (As)	0.0001 % Max
Cadmium (Cd)	0.0001 % Max
Chromium (Cr)	0.0001 % Max
Cobalt (Co)	0.0001 % Max
Nickel (ni)	0.0001 % Max
Gold (Au)	0.0001 % Max
Platinium (Pt)	0.0001 % Max
Palladium (Pd)	0.0001 % Max
Tin (Sn)	0.0001 % Max
Indium (In)	0.0001 % Max
Manganese (Mn)	0.0001 % Max

Figure 46: HZL Silver Specifications

After rising for two years, global silver demand weakened by 10% in 2020 to 896.1Moz (27,872t) as the impressive gains in physical investment were more than offset by heavy losses in jewellery and silverware. After falling just short of record levels in 2019, industrial fabrication fell 5% last year to a five-year low of 486.8Moz (15,142t). Unsurprisingly, this was overwhelmingly due to the impact of the COVID-19 pandemic on economic activity and, in turn, many silver end-users. Regional performances diverged, with Europe suffering a notable 8% decline, while North America rose by 2%, chiefly through higher demand in such areas as silver powder for photovoltaic (PV) ends. Demand in East Asia also fell overall, although performances were very mixed at the country-level; losses were seen in China, but Japan and Taiwan enjoyed gains.

On a sectoral basis, electronics & electrical demand fell a modest 4% as gains for PV offset losses elsewhere. Other industrial offtake in turn fell 7% as a strong showing for EO catalysts could only partially counter India's heavy losses in this segment. In general, thrifting and substitution had a limited impact on silver use as the price was insufficiently high for long enough to trigger interest and as many areas present little room for further savings.

Strong growth in mine production this year is expected to be followed by continued growth in the medium term. This will be driven by increased output from a number of major operating mines alongside new projects, with a significant contribution coming from primary silver operations in Mexico.

14.4.3 Price

Figure 47: 5-Year Silver Price

(source – Trading Economics)

In the period 2015 to 2020, the price varied around an average of approximately US$16.5/oz. During the world pandemic, silver offered a haven for storing wealth which is reflected in the average price shooting up to an average above US$24/oz. With the acceptance that the pandemic was over in mid-July 2022, the price is starting to return to earlier levels and may stabilise near to the pre-2020 levels.

15 Environmental Studies, Permitting and Social or Community

15.1 Introduction

The knowledge of present environment of the core and buffer zone of the existing mining area is important to assess the impact of various project activities on environment. The knowledge of present-day environment is also helpful in planning management of environment and planning of mitigation measures. To assess the composite baseline of mine and processing facilities related to the environmental quality of the area, field assessment has been conducted considering following components of the environment, viz. land, meteorology, air, noise, water, soil, biological and socio-economic. The relevant information and data (both primary and secondary) were collected in core as well as buffer zone (10 km distance from the Mine Lease boundary) in accordance with the guidelines of MoEF&CC for undertaking EIA Studies and preparation of Draft EIA/EMP reports.

The Rajasthan State falls in a region of low Seismic hazard zone with the exception being moderate hazard in areas along west state border. It mainly lies in Zones II and III. Several faults have been identified in this region out of which many show evidence of movement during the Holocene epoch.

15.2 Environmental Studies

The projects should not cause any significant impact on the environment of the area, as adequate preventive measures have been adopted to contain various pollutants generated due to the proposed current and proposed expansion projects within permissible limits. Development of Greenbelt / Plantation around the mining lease will minimize the environment pollution and improve the overall aesthetic beauty.

Environmental Monitoring Programme has been and will be continued for various environmental components as per conditions stipulated in Environmental Clearance Letters issued by MoEFCC & Consent to Operate issued by SPCB. Six monthly compliance reports will be submitted every year to Regional Office by 1st of June & 1st of December. Quarterly compliance Report for conditions stipulated in Consent to Operate will be submitted to SPCB on regular basis.

15.2.1 Land Use

Land use studies, delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features were completed. Land use plans of mine lease areas were prepared to encompass preoperational, operational and post operational phases.

Existing area is open and flat, 485 m above sea level, consisting predominantly of agricultural fields. The data of land use pattern available with the district administration, Ajmer, is from the year 2009-10 and is collated below. The land use pattern is classified in five types, viz. Forest; irrigated arable land; unirrigated arable land; Barren land and Charagah land and its pattern of the study area i.e. within 10 km. is given below:

Table 38: Land Use Area within Kayad study area (Area in Hectares)

Name of Village	Radius in km from Kayad	Total Area	Forest	Irrigated Arable land	Un-irrigated Arable land	Waste Land	
						Barren	Charagah
Kayad	0.0	1699		883	594	151	71
Chachiyawas	3.5	1373	258	417	329	290	79
Gagwana	3.5	1531		556	761	171	43
Ghugra	4.0	1001	3	323	398	187	90
Chhatri	4.0	867		675	103	55	34
Chandiawas	4.0	859		589	199	52	19
Makarwali	4.5	1648	334	537	476	185	116
Lohagal	5.0	581		38	256	287	
Padampura	5.0	565	131	276	25	96	37
Narwar	5.0	900	151	488	141	90	30
Gegal	5.0	936		513	257	90	76
Kankrarda-Bhoonabay	5.0	310		65	70	141	34
Bhawani Khera	5.0	1074	460	396	71	77	70
Kayampura	5.0	562	8	270	225	33	26
Ladpura	6.0	345		239	8	65	33
Bhudol	8.0	1066		736	79	147	104
Total		**15317**	**1345**	**7001**	**3992**	**2117**	**862**
		In %	**8.78%**	**45.71%**	**26.06%**	**13.82%**	**5.63%**

The study area has no ecological sensitive areas such as forest areas, national parks, wildlife sanctuaries etc. The details of land use pattern are given below:

Table 39: Land Use Pattern (Existing Vs End of Mining Plan period)

Particular	Present Position of Area (Ha)	Position at the end of Plan Period (Ha)
Mining Activity		
Mining	0.73	0.73
Dumping (Ore & Waste Storage)	2.4	2.4
Roads	0.88	0.88
Process Plant & Tailing Dam		
Infrastructure & Workshop	4.52	4.52
Township		
Others (Green Belt, Garden)	17.04	17.04
Others (Open Space, Solar)	22.93	22.93
Remaining Land	431.95	431.95
Total Area	**480.45**	**480.45**

Since this is an underground mine, the topsoil will not be affected. The changes in the topography and landscape for storage of overburden, storage of ore and construction of buildings for office and machineries is adequate and no additional infrastructure is proposed. Out of total leased area of 480.45 Ha only 48.50 Ha land is acquired for the mining, ore handling system, waste dump, workshop, dispensary office et. No township is envisaged to be constructed for the project, in view of the sufficient infrastructure available in the nearby area adjoining Ajmer city.

15.2.2 Climatology

For studying the meteorology of the area, data on wind direction, wind speed, temperature, relative humidity, cloud cover & rainfall data were collected from Ajmer meteorological station and the census handbook. The average data on climatic conditions are represented below:

- Temperature: Max. 45.7°C, Min. 0 4.6°C
- District average rainfall: 50.73 cm (10 years)
- Wind direction (winter): Southwest and West
- Wind direction (post monsoon): Southwest followed by Northeast & North West
- Avg. wind speed: 1 to 20 km/h
- Avg. relative humidity: 46%

15.2.3 Air Quality

Ambient air quality monitoring has been carried out within the study areas to determine the baseline concentration of various air pollutants in the ambient air. The ambient air quality depends upon the emission sources, meteorological conditions, and the background concentration of specific pollutants. This helps in providing a data base for predicting impact on the surrounding area due to a project activity. It is a standard to ensure the quality of air environment is in conformity to standards of the ambient air quality during operation phase of the projects.

- The mine sites have provided mechanical ventilators for air circulation
- Wet drilling is being used to suppress the dust generation
- The trucks are being covered with tarpaulin sheets
- Dust generation during working will be minimized by adoption of dust suppression systems at working faces.
- Water spraying on haul road.
- During transportation and unloading points, water sprinkling is being/ will be done to suppress the fugitive emissions.
- The crusher and Screens houses are provided with dust extraction system with outlets
- Development of green belt within lease area & plantation within ML Area is being done.
- Regular monitoring of air quality
- On surface, blacktop paved/ concrete roads
- Deployment of mechanized vacuum road sweeper on surface roads

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality-monitoring network. The Ambient Air Quality Monitoring (AAQM) stations were set up at five permanent locations and three mobile locations.

The details of environmental setting around each monitoring station with reference to the project site is indicated in the map and detailed in the following table:

Table 40: Details of Ambient Air Quality monitoring

Station Code	Location	Distance	Direction	Environmental Setting
Ambient Air Quality Locations				
AAQ1	Kayad	0.2	W	Rural setting with vehicular traffic and mixed land use
AAQ2	Gagwana	1.6	E	Rural setting with residential land use associated with vehicular movements on NH-08
AAQ3	Kayampura	4.1	NE	Rural setting with residential land use
AAQ4	Chhatri	1.7	NNE	Rural setting with residential land use
AAQ5	Lohagal	2.7	SW	Rural setting with residential land use
AAQ6	Ghoghra	2	SW	Sub-Urban with residential land use
AAQ7	Mine Area	0		Indutrial Zone
Mobile Ambiant Air Quality Location				
MA 1	Makarwali	3.8	W	Rural setting with residential land use
MA 2	Ladpura	2.6	SE	Rural setting with residential land use
MA 3	Chachiyawas	2.3	NNW	Rural setting with residential land use
MA 4	Madarpura	7.6	SSW	Open Forest area (Scrub land) with residential land uses

Ore loading activities, waste dumping and vehicular movement are the sources to air pollution on the surface. Drilling, blasting, and crushing are confined to underground. The dust generated during drilling, blasting, and breaking are suppressed through wet drilling & water sprinkling and very low quantum of finer particles will escape from main ventilation raises of the mine.

Dust and gaseous emissions are expected during blasting. The blasting is being carried out at depth of more than 40 to 100 below ground level. The dust generated is suppressed with water sprinkling system for proper setting within mine.

The drilling and loading activities are carried out below ground. The dust generated is suppressed immediately (through use of wet drilling and water spraying) within the mine.

The waste rock and ore generated during mining are transported by low profile dumper tippers (LPDT) from below ground workings to waste dump/ ore stockpile at surface. The LPDT plying on the haul road contribute to dust generation.

Ore loading/ unloading, waste dumping and vehicular movements are the only source of air pollution on the surface. Regular water sprinkling is being used for dust suppression.

It can be noted that most of the activities are operated below ground. The above surface activities too cause insignificant emission and confined to acquired area only and not have any adverse impact on the outside community.

The ore transportation from Kayad mine to RA Mine will be carried out with tarpaulin covered trucks, so as to avoid fly over of dust on the roads.

Dust particles, which are normally generated during mining operations, become air borne. Adequate control measures are adopted during mining operations. The control measures are:

- Blacktop and cemented paved roads within the mine boundary to control dust
- generation due to traffic on haul roads.
- Water is sprayed on the waste dump during breaking and loading.
- Water spray is used on ore stockpiles for reducing dust generated during
- unloading / loading.
- Plantation around the boundaries
- Regular maintenance of HEMM

15.2.4 Noise Pollution

As most mining activities are restricted to underground, the effect on the surrounding population is limited. Regardless, HZL has taken all necessary measures to minimise the noise effects:

- Compressors are installed in isolated building with acoustic enclosures.
- Ventilation fans are provided with silencers
- DG sets have acoustic enclosures.
- All vehicles and machineries used have noise emissions within permissible limits through regular maintenance.
- Improved design of chutes and mill liners.
- Good grindability due to soft ore.
- Regular monitoring of noise level of mining & milling equipment.
- UG HEMM are procured with latest emission standard engines.
- UG HEMMs are equipped with airconditioned cabins thereby attenuating noise level while operating the equipment.
- A green belt is developed to attenuate the noise levels
- Reducing the exposure time of workers to the higher levels of noise
- Provision of personnel protective equipment such as ear plugs, earmuffs etc.

The noise monitoring has been conducted at 6 locations during all seasons. The noise levels at each of the locations were recorded for 24 hours during the season.

Residential zone: The daytime noise levels at the residential locations ranged between 46.2 – 54.3 dB(A). The maximum value of 54.3 dB(A) was recorded at Lohagal and the minimum value of 46.2 dB(A) was recorded at the Chatri village. It is observed that the daytime noise levels at maximum in the residential locations, are within the prescribed limit of 55 dB(A). The night-time noise levels ranged between 40.6 - 44.1 dB(A). The maximum value of 44.1 dB(A) was recorded at Lohagal and the minimum value of 40.6 dB(A) was recorded at the Chatri Village. It is observed that the night-time noise levels at maximum residential locations are within the prescribed limit of 45 dB(A).

Industrial Zone: The day noise level in Mine ambient Noise level s are in the range of 52.3 – 67.8 dB(A). This noise levels observed to be below the prescribed limits of 75 dB(A). The night-time noise level in are in the range of 42 – 59 dB(A). This noise levels are observed to be below the prescribed limits of 70 dB(A).

15.2.5 Surface Water and Wetlands

The study area is largely a plain, and in the arid belt with an average rainfall of 407 mm, as measured during the period from 2010 to 2015. The closest rainfall measuring station is at Gegal at 26°32 'N, 74°45'E. During 2015, the annual rainfall in the neighbouring areas of Ajmer and Gegal were 478.3 mm and 313 mm respectively. The occurrence and movement of the ground water is controlled by the topography and the physical characteristics of the rocks.

The mining plan does not envisage any disturbance or change to the drainage pattern of the Mine lease area or the Acquired lease area. The overburden, mineral storage and mine portal are constructed with proper garland drain and desalting pit and filtration bed to ensure no rainwater runoff enters the mine.

The topography of the site has a slope from SW to NE with a level difference of 1.3 - 1.5 m. The appropriate size of drains (1.0m x 1.5m) with proper gradient and length have been constructed around the mine working and waste and ore dumps and connected to a designed siltation pond of 6,000 Cum to allow proper retention period for settling of silt material. The collected water is utilized for watering the mine area, roads, green belt development etc. thereby ensuring a zero discharge. The drains are regularly desilted, particularly after the monsoon and maintained properly to avoid any stagnation. The measurement of ground water quality is done on a seasonal basis as per MoEF.

The mine water generated during underground operations would be utilized for dust suppression. No adverse impact is envisaged on surface water quality because of limited quantity of water to be used and no beneficiation at the site.

As the ROM ore is being transported to RA Mine for beneficiation, no tailing will be generated. The mine water will be re-used and there will not be any discharge from the mine, hence no adverse impact is anticipated on ground water quality.

To mitigate any impact on the ground water quality, the mine operations operate on zero discharge principle as follows All surface runoff from the OB dump, Mineral storage area shall be collected through proper garland drains and routed through desilting pits to remove suspended particles. The desilted runoff water shall be collected in large surface storage ponds for reuse in mining operations and green belt development.

- The mine generated pit water is completely used for mining operations, dust suppression and green belt development.
- The garage is constructed with concrete floor and provided with oil and grease collection system.
- Piezometer have been constructed to monitor the water level and quality.
- Rainwater harvesting has been developed for roof top and for open & green belt area for ground water recharging through recharge wells.

15.2.6 Groundwater

Ground water movement is controlled mainly by the hydraulic conductivity of the Crystalline metamorphics and hydraulic gradient. The ground water movement mainly takes place through the fractures and joints of the crystalline rocks. A review of the topography and drainage pattern in a major part of the buffer zone reveals that the general slope of the area is towards northeast and is 0.6m/km. The ground water flow in this part of the buffer zone is also towards NE with hydraulic gradient as 2.58 to 2.66 m/km as calculated from the monitoring of the wells in the area. The Ground water occurs under water table condition and is transmitted through fractures, joints, and foliations. Mica schists and quartzites are impervious in nature and have developed secondary porosity due to joints and fractures. There is very limited thickness of weathered zone and generally it lies above the zone of saturation. The depth of water in crystalline metamorphics, during post monsoon period ranges within very wide limit from 6 to 30 metres below the land surface. It is shallow near the river course, ponds and surface water reservoirs while it is deeper in the area from 8 to 37 m below the land surface during per-monsoon period. The fluctuations due to rainfall and ground water withdrawal significant as the rocks have very low fracture porosity and hydraulic conductivity.

15.2.7 Soil

The information on soil quality has been arrived by collection and analysis of soil samples from representative locations. To assess the base line characteristics of soil profile of the mine lease area representing project and nearby areas, the samples were analysed for key and chemical parameters. The sampling locations were finalized with the following considerations:

- To enable information on baseline characteristics and,
- To determine the impact of mining activities on soil characteristics.
- To determine the type of plantation

Soil may be defined as a thin layer of earth's crust, which serves as a natural medium for the growth of plants. The soil characteristics include both physical and chemical details. The soil survey was carried out to assess the soil characteristics of the area. For studying soil quality of the region four samples were collected to assess the existing soil conditions in and around the area.
Six locations in and around the proposed project were selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and are homogenized. It has been observed that the soil is sandy loam in texture and slightly alkaline in nature. The nutrient and organic matter contents are medium, and the soil is normally fertile.

15.2.8 Biological Environment

The area falling within 10 km radius zone has reserve forest as well as protected forest as shown in the Topo Sheet No. 45J/10. Only 8.78% of the total study area is under forest. A large area is covered by open scrubland.
Flora: The common floral species found within study area are Acacia rupestris, Boswellia, Serrata, Prospis Spcicigera, Zizyphus, Rhuslannea gloandees, Euphorbia, Nerifolia. Herbaceous community is represented by Dactylatenium. In general, cultivated fields with woody species dominate the area. Wastelands and fallow land shows very poor growth of vegetation due to stray grazing.
Fauna: Among the wild animal black buck and nilgai are commonly found. Leopards and hyenas are also found in the hill of Nagpahar. Besides, wild pig and sambhar are also found. Hares, grey partridges

and monkeys also exist in the area. The habitat is good for reptiles and small mammals. Generally migratory birds visit the area during winter.

15.3 Requirements and Plans for Waste and Tailings Disposal, Site Monitoring, and Water Management

15.3.1 Waste and Tailings Disposal

The muck generated from the development heading is quartz mica schist, calc silicate and pegmatite. Waste generated from the mine development is brought to the surface waste dump area or disposed-off in mined out stopes for backfilling (RF / CRF). The waste brought outside is also sent to underground for backfilling using LPDT & LHD.

The estimated quantity of waste generation, commensurate to the available geological data during proposal period is given in following table:

Table 41: Waste (tonnes) generated per year

Year	Top Soil (Cum)			Waste (tonnes)		
	Generation	Reuse / Spreading	Storage	Generations	Backfilling	Storage
2019-20	400	400		326,816	654,181	
2020-21	242	242		317,000	650,000	
2021-22				334,000	500,000	
2021-23				108,000	110,000	
2021-24					80,000	
2021-25					68,000	

The additional waste required for backfilling is purchased from nearby quarry, or the waste generated in Rampura Agucha mine will be transported back to mine by the trucks, to be used for backfilling. The mine has facilities for the handling of waste and dumping it into exhausted stope voids.

No permanent solid waste dump is proposed on surface inside the lease area. However, a waste dump area was created for temporary storage and rehandling. The waste dump area has a bottom floor elevation at 486 mRL for a maximum height of 20m in two lifts. A retaining wall (411 meter) and a garland drain (430 meter) along the periphery of base of the waste dump is constructed as a protective measure. This drain discharges the water into a pit constructed at the low-lying area near the waste dump where the water is allowed to de-silt and the run-of water is taken for recycling in the mine. The waste dump will be removed at the end of mine life as all waste generated will be backfilled in the mine.

No sub grade minerals will be produced. However, if any sub grade mineral is encountered, it will be stacked separately from waste dump site for use in future depending upon economic viability.

Currently, the tailings from the plant is being pumped to exiting tailing dam of Rampura Agucha Mine. There is a continuous process of raising the tailing dam dike wall height in order to cater this expanded capacity. It is proposed to utilize the tailings in the stope backfill. Around 30% tailing generated from the mill will be utilized for mine back fill. The balance is pumped through a pipeline to the tailing dam. In the tailing dam periphery, a piezometer is installed for water sampling.

15.3.2 Site Monitoring

Environmental monitoring is be defined as the systematic sampling of air, water, soil, and biota in order to observe and study the environment, as well as to derive knowledge from this process. Post Project Monitoring is an essential part to check the impact of any project activity. Hence, monitoring of various environmental parameters is carried out on a regular basis to ascertain the following:

- Status of Pollution within the mine site and in its vicinity.
- Generate data for predictive or corrective purpose in respect of pollution control.
- Examine the efficiency of pollution control system adopted at the site.
- To assess environmental impacts.

Monitoring is carried out at the site as per the norms of CPCB. Environmental Monitoring Programme is conducted for various environmental components as per conditions stipulated in Environmental Clearance Letter issued by MOEF & Consent to Operate issued by SPCB. Six monthly compliance reports are submitted to Regional office of MoEF on 1st of June & 1st of December. Quarterly compliance Report for conditions stipulated in Consent to Operate are submitted to SPCB on regular basis.

Monitoring ensures that commitments are being met with. This takes the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It also requires measurement of ambient environmental quality in the vicinity of a site using ecological/ biological, physical and chemical indicators. Monitoring includes socio-economic interaction, through local liaison activities or even assessment of complaints.

The key aims of monitoring are, first to ensure that results/ conditions are as per forecast during the planning stage and where they are not, to pinpoint the cause and implement action to remedy the situation. A second objective is to verify the evaluations made during the planning process, in particular with risk and impact assessments and standard & target setting and to measure operational and process efficiency. Monitoring is also required to meet compliance with statutory and corporate requirements. Finally, monitoring results provide the basis for auditing.

A centralized environmental monitoring cell is established for monitoring of important and crucial environmental parameters, which are of immense importance to assess the status of environment during mine operation.

15.3.3 Water Management

It is an underground mine. The ground water table has already been intersected, but there is no negative impact anticipated on ground or surface water. Several measures have also been undertaken for water conservation and augmentation of ground water resources:

- The sewage generated is being treated in sewage treatment plant and it is reused in mining operation, dust suppression and green belt development.
- Garland drains around waste dumps are constructed to channelise rainwater.
- No water will be allowed to discharge outside and maintain zero discharge, as the suitable garland drain has been constructed around the waste dump to collect the run-off water from the dump and to prevent contamination of land, surface and groundwater of the surrounding area. The water collected will be pumped and reused in mining operation, dust suppression
- The vehicle maintenance garage is also a source of surface water contamination due to leaks and spills of oil and grease. The entire garage is under covered shed and concrete floor. Further, the vehicle maintenance area is provided with water containment area and oil collection system. All garage effluent will be treated for oil and sediments before reused in vehicles maintenance, mining operation and dust suppression.
- Mine water is being used for dust suppression, road sprinkling, CRF and plantation.
- Monitoring of groundwater level and quality around area are carried out regularly to ensure no groundwater contamination and seepage.
- Construction of garland drains of suitable size around waste dump and tailing dam with proper gradients to prevent rainwater descent into ML area and other surface activity area.

- Garland drains are connected to siltation tank of appropriate size and is de-silted at regular intervals. The water collected is utilized for watering the mine area, roads, green belt development etc.
- Minimum use of water in cleaning/washing of equipment's and vehicles.
- Garland drains (size, gradient and length) and sump capacity are designed keeping 50% safety margin over and above the peak, sudden rainfall and maximum discharge in the area adjoining the mine site.

15.4 Required Permits and Status

15.5 Community Engagement

An essential part of environmental study which includes demographic structure of the area, provision of basic amenities viz., housing, education, health and medical services, occupation, water supply, sanitation, communication, transportation, prevailing diseases pattern as well as feature of aesthetic significance such as temples, historical monuments etc. at the baseline level. This composite baseline assessment of mine and CPP helps in visualizing and predicting the possible impact, depending upon the nature and magnitude of the project.

The core village named Kayad is within 500 m from the mine project. Improvement measures for socio-economic development in the region are basically sponsored by the local state government. In-addition to this HZL is following up Govt. policies on development. The baseline socio-economic index of the Kayad village and also the seven buffer villages bring out the needs of the community that are not sufficiently addressed and makes place for Corporate Social Responsibility intervention by HZL

Based on the requirement of the people in the area the development activities are being taken up. The basic requirement of the community are being strengthened by extending health care, educational facilities developed in the township to the community, providing drinking water to the villages and cattle, medical check-up camps, building/strengthening of existing roads in the area. Also the development of SHG and sanitation work, and supply of furniture, study material and uniforms to schools etc. Kayad School was upgraded to secondary level from the middle level in the current year.

HZL initiated the above amenities either by providing or by improving the facilities in the area, which helps in uplifting the living standards of local communities.

The Corporate Social Responsibility (CSR) activities being done includes the following:

- Health and hygiene
- Education
- Sustainable Livelihood
- Infrastructure Development
- Social Mobilization
- Environmental Conservation
- Agriculture and Animal Husbandry
- Self-help groups for self-employment

HZL has established itself as a proactive leader that facilitates the nearby communities in their every endeavour to become self-reliant. Engaging the communities in their pursuits of sustainable and constructive development thereby facilitating social cohesion.

15.6 Mine Closure

15.6.1 Mined-out land:

There is no change in conditions as assumed in the approved Mine Plans/Modified Mining Plans. The mining activity is fully confined to below ground. After exploitation of ore, the voids are back filled by a mixture of cement and rock which obviates the scope of possible subsidence. However, to monitor the subsidence movement, HZL has installed a network of reference posts at strategic locations as suggested by CIMFR, Dhanbad in line with Mining Plan. During the operation phase, periodical monitoring is being and will be carried out to note any subsidence movement. This monitoring of subsidence movement shall be in addition to preventive measurements and monitoring of stress in the pillars and also vibration monitoring carried out for every blast.

At present waste generated by mine developments is being used for back filling of mine voids and brought to surface and dumped at designated waste dumps which will further used for backfilling.

15.6.2 Post Mine Land use & Reclamation and Rehabilitation

- Waste generated from mining operation and lying on surface shall be completely backfilled into the mine voids
- All the equipment shall be removed from surface and below ground. The decline shall be sealed at the mouth and the mine portal filled up with overburden and grassing will be done above it.

- Since the surface rights of land has been obtained through acquisition process and in some part solar plant is constructed so it is proposed to further increase the capacity of Solar plant by adding more panels along with plantation in other open spaces.
- The infrastructure and buildings that may be deemed suitable for use will be handed over to State Government for judicious use of the same. If not, these will be dismantled and taken away by the mine management.
- Before proposing mine abandonment, adequate care shall be taken to ensure prevention of erosion, wash off and leaching etc. in the 'mined' area
- Any potential area of soil contamination be checked and decontaminated by removing the contaminated portion
- Plantation done on the 'mined' area will be maintained for a period of three years till the plants achieve self-sustenance
- Necessary approvals will get from various competent authorities for Reclamation plan.

15.6.3 Topsoil Management

The topsoil removed during the mine development stage has been stacked at earmarked area and a garden has been developed for conservation of soil. Since Kayad is an underground mine, surface activities will be minimum. However, the topsoil generated of about 9,000 m^3 during construction of infrastructures like, portal, workshop, offices, stores, sub-station, etc., has been preserved about at an ear marked area and developed a lawn over it and some quantity utilized in plantation. Any further generation of Topsoil shall be preserved and used for Plantation works.

15.6.4 Tailings dam Management

Not applicable as no ore beneficiation activity being carried out in Kayad Lease area.

15.6.5 Acid Mine Drainage

As the nature of rock in non-pyritic, no acid water is generated in mine.

15.6.6 Surface Subsidence

The deposits are being mined out by underground mining and filled with cemented rock-fill. Hence there is no significant effect of mining activity on the environment. There is no land degradation and subsidence anticipated since the hanging and footwall are quite competent and the RMR is "good to fair".

15.6.7 Monitoring & Control

- Hang wall movement is monitored with Multi Point Bore Hole Extensometers from the top drill level. Movement is monitored weekly.
- Stress is monitoring with Uniaxial Borehole Stress meters in pillars.
- Subsidence is monitored above the stoping area at designated locations on a monthly basis.

Table 42: Summary of Yearly PMCP Program

Items	Details	21-22	22-23	23-24	24-25	25-26	Remarks
Dump management	Area afforested (ha)	-	-	-	-	-	
	No of saplings planted	-	-	-	-	-	
	Cumulative no of plants	-	-	-	-	-	
	Cost including watch and care during the year						
Management of worked out benches	Area available for rehabilitation (ha)	-	-	-	-	-	
	Afforestation done(ha)						
	No of saplings planted in the year						
	Cumulative no of plants						
	Any other method of rehabilitation (specify)						
	Cost including watch and care during the year						
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise /stope wise (MT)	772000 MT	589000 MT	194000 MT	148000 MT	68000 MT	
	Void filled by waste /~~tailings~~ (MT)	650000 MT	500000 MT	110000 MT	80000 MT	68000 MT	
	Afforestation on the backfilled area	-	-	-	-	-	
	Rehabilitation by making water reservoir	-	-	-	-	-	
	Any other means (specify)	-	-	-	-	-	
Rehabilitation of waste land within lease	Area available (ha)*	-	-	-	-	-	
	Area rehabilitated	1 Ha as Gap fill plantation	1 Ha as Gap fill plantation	1 Ha as Gap fill plantation	1 Ha as Gap fill plantation	1 Ha as Gap fill plantation	
	Method of rehabilitation - Plantation (No. of saplings)	1000	1000	1000	1000	1000	
Others (specify)							

* No additional free space available for plantation in acquired land, therefore gap filling plantation planned in Mining Plan period.

Figure 48: Nursery for rare and native plant species

Figure 49: Plantation Development around the mine

Figure 50: Lawn Development over topsoil near administrative building

15.7 Adequacy of Plans

16 Capital and Operating Costs

16.1 Operating Cost Estimate

ABGM did not undertake any techno-economic assessments on the mining costs, processing costs and fixed royalties. The following operating cost estimates was received from HZL that is used in their financial and budget planning for FY2022 – 2025.

Table 43: Summary of Operating Costs (source HZL)

Particulars	UoM	Yr 2022	Yr2023	Yr 2024	Yr 2025
Mining Cost	$/MT Ore	22	23	25	26
Processing Costs	$/MT Ore	15	16	17	18
Development	$/MT Ore	6	7	7	7
Smelter Cost					
Zn Metal	$/MT Metal	448	448	448	448
Lead Metal	$/MT Metal	458	458	458	458
Silver Metal	$/MT Metal	24	24	24	24
Overall Cost					
Mining Cost	$ Mn	36	38	12	2
Smelter Cost	$ Mn	28	29	9	2
Royalty Cost	$ Mn	23	24	7	2

16.2 Capital Cost Estimate

No capital cost estimates was evaluated in the limited timeframe of this technical review.

17 Economic Analysis

ABGM did not undertake any techno-economic assessments on the reserves and only evaluated the mining cost and applied the high level mining cost, processing costs and fixed royalties to determine a nominal cashflow with some limited sensitivities.

17.1 Model Parameters

Table 44: Costing and Financial Inputs per annum (supplied by HZL)

Assumption	Yr 2022	Yr2023	Yr 2024	Yr 2025
Grade				
Zn	7.21	7.82	7.77	9.28
Pb	1.06	0.83	0.81	1.29
Silver	19.64	16.55	16.29	17.25
Recovery-Mill				
Zn	96	96	96	96
Pb	95	95	95	95
Silver	98	98	98	98
Recovery-Smelter				
Zn	96	96	96	96
Pb	98	98	98	98
Silver	100	100	100	100
Impact on Cost				
Mining	5.0%	5.0%	5.0%	5.0%
Zn Premium	180	180	180	180
Pb Premium	150	150	150	150
Ag Premium	2.4	2.4	2.4	2.4

17.2 Taxes, Royalties, Depreciation and Depletion

The normal government taxes have been applied to the models indicated below. The exact percentages were not disclosed by HZL. The royalties applied in the models are indicated in the start of document but can be seen below.

- The Royalty for Lead is 14.5% of London Metal Exchange lead metal price chargeable on the contained lead metal in the concentrate produced.
- The Royalty for Zinc is 10% of London Metal Exchange Zinc metal price on ad valorem basis chargeable on contained zinc metal in the concentrate produced.

17.3 Cashflow Forecasts and Annual Production Forecasts

Table 45: Financial model outcome (2022 - 2025)

Particulars	UoM	Yr 2022	Yr2023	Yr 2024	Yr 2025
Ore production	MT	807,556	819,320	251,059	47,692
Zn Metal in Concentrate	MT	55,898	61,453	18,725	4,246
Lead Metal in Concentrate	MT	8,094	6,408	1,934	585
Silver Metal in Concentrate	KG	16	13	4	1
Zn Metal	MT	53,750	59,092	18,006	4,083
Lead Metal	MT	7,898	6,252	1,887	571
Silver Metal	KG	16	13	4	1
Mining Cost	$/MT Ore	22	23	25	26
Processing Costs	$/MT Ore	15	16	17	18
Development	$/MT Ore	6	7	7	7
Smelter Cost					
Zn Metal	$/MT Metal	448	448	448	448
Lead Metal	$/MT Metal	458	458	458	458
Silver Metal	$/MT Metal	24	24	24	24
Royalty					
Zinc	$/MT Metal	364	364	364	364
Lead	$/MT Metal	394	394	394	394
Silver	$/MT Metal	60	60	60	60
Zn LME	$/MT	2,759	2,759	2,759	2,759
Pb LME	$/MT	2,057	2,057	2,057	2,057
Ag LBMA	$/Troz	21.24	21.24	21.24	21.24
Ex Rate	Rs/USD	76.65	76.65	76.65	76.65
Revenues					
Zn	$ Mn	158	174	53	12
Pb	$ Mn	17	14	4	1
Ag	$ Mn	12	10	3	1
Mining Cost	$ Mn	36	38	12	2
Smelter Cost	$ Mn	28	29	9	2
Royalty Cost	$ Mn	23	24	7	2
Net Cashflow	**$ Mn**	**101**	**106**	**32**	**8**

17.4 Sensitivity Analysis

A high level sensitivity analysis is illustrated below that indicates the KDM mining operations is in good position with up to 30% variation illustrate and overall positive financial outcome.

Figure 51: KDM Financial Sensitivity Analysis (unit: Million US $)

	20%	10%	100%	-10%	-20%
Cashflow	108	99	90	81	72
Cost	45	49	53	57	61
Revenue	171	157	143	128	114

18 Adjacent Properties

All of the HZL mines are in well-established mining areas where the local geology is well understood and extensively explored. Any surrounding orebodies have probably been discovered and if well mineralised, included in the exploration by HZL. As far as could be determined, there are no exploration activity by other mining companies in the areas surrounding the HZL mines.

19 Other Relevant Data and Information

There is an abundance of information and other data that was not fully reviewed by ABGM during this review process as there was not enough time to conduct thorough investigation in all the data sets and documents. However, the key aspects were addressed as far as possible to ensure the relevant data and information required for this technical review was addressed.

20 Interpretation and Conclusions

20.1 Results

The results of the technical review indicate that the property contains a Mineral Resource, and a significant portion of that Mineral Resource converts to a Mineral Reserve. The project / operation has a positive economic outcome given the data, parameters and estimates outlined in the TRS. Due to the short time allocated to conduct this review.

ABGM is satisfied that the mine operation is conducting the required annual statutory work and reviews and submits to the IBM (Indian Bureau of Mines). The mine is compliant in order to develop the data, scrutinize and report on information for the development of Mineral Resources and Reserves in conjunction with their current consultancy professionals.

20.2 Significant Risks

No significant risks was observed during the site visits and neither were any picked up in the data and information provided by HZL.

20.3 Significant Opportunities

No significant opportunities was observed during the site visits and neither were any picked up in the data and information provided by HZL. However some suggestions will be listed in the consolidated report.

21 Recommendations

21.1 Pricing assumptions

Comparing the market research and the current trend of commodity pricing. The assumptions used by HZL seem to be on the higher side to establish the cut-off grades. However, running the sensitivities, all the operations seem to be well established and not sensitive to volatile changes. HZL used the 10 year pricing average in their estimates, the three year LME forecast average seems to be higher than the last 3 year average.

21.2 Environmental, Social Studies

Where information is available, environmental studies are done to an acceptable level for the Indian authorities. In some cases exemplary work is being done, beyond what is strictly necessary. Sites are monitored on strict schedules and the regular submission of updated reports are sufficient for the permits to be renewed again. Standardisation of programmes and procedures is recommended for all operations as this will prevent some areas of not receiving the correct attention. Interaction with and contributions to the local staff and communities appears to be positive with the establishing of medical centres and schools.

21.3 Closure Plans

Mine closure plans are not always easy to see in the provided documents, but the plans appear to be well thought out and implemented. As the mining activities are mostly underground, the effect on the environment is limited to the dust and noise generated due to ore transport and the storage of tailings, a large portion of which is used for backfilling mined stopes.

21.4 Geotechnical Drill Core Logging

The mines need to continue its practise with respect to core logging. Recommend more detailed geotechnical logging and recording of structures.

21.5 Sampling Transportation

Even though no information was provided around this practise, the site inspections proved that core, as well as samples from core, are transported in solid, closed and locked metal containers. Logging, tagging and security of the custody chain for samples are tracked in acQuire database, with unique barcodes and numbers. However it is suggested that the procedures followed need to be documented and recorded better.

21.6 Independent Lab Analysis

It is recommended that regular pulp duplicates are submitted an independent laboratory to be analysed as umpire samples.

21.7 Bulk Density Data

While bulk density data has been reconciled with production data, independent bulk density analyses should be undertaken at an independent laboratory during the exploration phase to avoid errors.

References:

- 31161 HZL Audit 2021_Report_Finalr

Environmental Impact.docx	2022/07/25 18:44	Microsoft Word Docum...	32 KB
Kayad_EIA.zip	2022/07/14 14:30	WinZip File	14,167 KB
HZL-Kayad_LOM_Schedule.xlsx	2022/07/12 09:55	Microsoft Excel Worksh...	1,528 KB
Kayad Mining Plan Volume A_ Text.pdf	2022/06/30 12:03	Adobe Acrobat Docum...	7,252 KB
SSR_PATTERN.pdf	2022/06/27 14:28	Adobe Acrobat Docum...	470 KB
OEE_FY'22_sheet.xlsx	2022/06/27 14:28	Microsoft Excel Worksh...	244 KB
Liberation_characteristics_and_metallurgical_assessm...	2022/06/27 14:28	Adobe Acrobat Docum...	1,031 KB
Kayad_K18_Metallurgical_Testing_Report.pdf	2022/06/27 14:28	Adobe Acrobat Docum...	236 KB
Kayad_Mining_Plan__Volume_A__Text.pdf	2022/06/27 14:28	Adobe Acrobat Docum...	7,252 KB
Kayad_-_Ground_Water_Study.pdf	2022/06/27 14:27	Adobe Acrobat Docum...	11,956 KB
HZL-Kayad_ABGM_Que_Ans.xlsx	2022/06/27 14:27	Microsoft Excel Worksh...	17 KB
Geotechnical_Report_4_(SUBSIDENCE_STUDY).pdf	2022/06/27 14:27	Adobe Acrobat Docum...	7,194 KB
Geotechnical_Report_3_(S1).pdf	2022/06/27 14:27	Adobe Acrobat Docum...	4,409 KB
Geotechnical_Report_1_(K_18).pdf	2022/06/27 14:27	Adobe Acrobat Docum...	3,935 KB
Geotechnical_Report_2_(BVM_REPORT_FY'20).pdf	2022/06/27 14:27	Adobe Acrobat Docum...	7,429 KB
Kayad_EIA	2022/07/21 22:11	File folder	

Figure 52: Files & Folders List - HZL Data and Information Pack – KDM

block19pt.dm	2022/04/08 19:08	DM File	8 KB
block19tr.dm	2022/04/08 19:08	DM File	8 KB
depl22fta2pt.dm	2022/04/08 19:06	DM File	6,512 KB
depl22fta2tr.dm	2022/04/08 19:06	DM File	22,792 KB
depl22ftapt.dm	2022/04/01 15:48	DM File	6,512 KB
depl22ftatr.dm	2022/04/01 15:48	DM File	22,792 KB
dmstusub.dat	2022/04/01 15:28	DAT	0 KB
IND22pt.dm	2022/04/08 19:08	DM File	12 KB
IND22tr.dm	2022/04/08 19:08	DM File	16 KB
INF22pt.dm	2022/04/08 19:09	DM File	12 KB
INF22tr.dm	2022/04/08 19:09	DM File	40 KB
KDMOD22.dm	2022/03/25 12:12	DM File	1,130,420 KB
kdmod22cl.dm	2022/04/08 20:34	DM File	1,286,084 KB
kdmod22cl_r.csv	2022/04/08 20:35	Microsoft Excel C...	5 KB
kdmod22cl_r.dm	2022/04/08 20:35	DM File	12 KB
KYD_RR22_CLASS_V7.mac	2022/04/08 19:05	MAC File	21 KB
KYD22.rmproj	2022/04/08 21:36	RMPROJ File	121 KB
KYM_Reserves_FY'22_22032021_camm_J...	2022/04/02 14:21	Microsoft Excel W...	614 KB
TongradLog.txt	2022/04/08 20:35	Text Document	78 KB
wf_fxs_2pt.dm	2022/04/08 19:07	DM File	3,264 KB
wf_fxs_2tr.dm	2022/04/08 19:07	DM File	138,376 KB
WF_FXS_pt.dm	2022/03/16 17:29	DM File	3,264 KB
WF_FXS_tr.dm	2022/03/16 17:29	DM File	138,376 KB
wres_cxs2pt.dm	2022/04/08 19:07	DM File	108 KB
wres_cxs2tr.dm	2022/04/08 19:07	DM File	2,736 KB
WRES_CXSpt.dm	2022/03/16 17:29	DM File	108 KB
WRES_CXStr.dm	2022/03/16 18:04	DM File	2,736 KB

Figure 53: Data Pack - Resource to Reserve Estimation (DataMine Files)