ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

For

KAYAD LEAD - ZINC MINE EXPANSION

at

Village-Kayad,Tehsi&District- Ajmer, Rajasthan

Mine Lease Area- 480.45 Hectare

ML-16/92

Production Capacity

From 1.0to 1.2 million TPA(ROM) (20% Increase)

APPLICANT

Hindustan Zinc Limited,
Kayad Mine,Village- Kayad, Ajmer- 305023 (Rajasthan)
December' 2017

ENVIRONMENT CONSULTANT

GAURANG ENVIRONMENTAL SOLUTIONS PVT. LTD.

SIMPLIFYING SUSTAINABILITY

Accredited EIA Consultant Organization by NABET, QCI, New Delhi at S. No. 66 in list of Accredited EIA Consultant Organizations(as on 6th December, 2017)

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EXECUTIVE SUMMARY

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1. INTRODUCTION

Hindustan Zinc Limited (HZL) is Asia's largest non-ferrous metal producer of Zinc and Lead and is Head office at Udaipur, Rajasthan. HZL is world's second largest integrated producer of Zinc with a global share of approximately 6.2%. HZL has its operations in exploration, mining, ore processing, smelting and refining of Zinc, Lead, Cadmium, Copper and Silver. It is also a major producer of sulphuric acid, as a by-product of lead-zinc metal processing. HZL also has interest in wind and thermal power generation.

The Kayad Lead Zinc Mine is located in Ajmer Tehsil of District Ajmer Rajasthan. Environment Clearance was granted by MoEFCC, New Delhi for Enhancement in Production Capacity of Kayad Lead -Zinc Ore underground mine from 0.35 million TPA (ROM) to 1.0 million TPA (ROM) vide letter no. J-11015/47/2012-IA II(M) dated 23.09.2014. Copy of the same is enclosed as **Annexure I**.

Valid Consent to Operate is available from Rajasthan State Pollution Control Board (RSPCB), Jaipur for carrying Mining activities vide letter no.F(Mines)/Ajmer(Ajmer)/1(1)/2009-2010/7897-7901dated 04.03.2015 and valid upto 31.01.2018.

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 MMTPA (ROM) to 1.2MMTPA (ROM). The Ore Produced at the Kayad Mine is sent to Rampura Agucha Mine for ore beneficiation in the existing mills having capacity of 6.5 MTPA capacity located in Hurda Tehsil , Bhilwara Dist of Rajasthan. The ore concentrate produced at Rampura Agucha Mine shall be processed at existing HZL Smelters.

The Kayad deposit is located in Ajmer Tehsil of District Ajmer.

The Ministry of Environment and Forests, Govt. of India, through its EIA Notification of 14.09.2006 and its subsequent amendment on dated 1st December' 2009 and 04.04.2011 under the Environment Protection Act, 1986, classified the projects under two categories – A (more than 50 hect.) and B (less than 50 hect. and ≥ 5.0). ***The proposed project is categorized under category 1 (a) - A category {Mining of Minerals}***

as the lease area is 480.45 ha *as per the Gazette Notification 14th Sep. 2006 and its subsequent amendment till date.*

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 to 1.2 million TPA (ROM) (20% increase). Amendment in EC under clause 7 (ii) a of EIA notification 2006, & subsequent amendments is applied.

2. PROJECT SITE LOCATION AND DESCRIPTION

The Kayad Mine is 9 Km NNE of Ajmer city and is well connected by Motoarable road. Jaipur, the state capital is 127 km NE of Mine. Nearest Air port is Kishangarh at 20 KM , NE of 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 North Western Railway, 9 km SSE of Kayad. NH 79,Jaipur-Ajmer is at about half a km. from the lease area. The deposit falls in Survey of India Toposheet No. 45/J10. Kayad Deposit lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41"30.73"E-74°41'30.45"E.

3. Protected Areas in Study Area

The Project site and surrounding area of 10 km radius from the mining lease boundary does not have any protected areas such as National Parks or Wildlife Sanctuaries. Reserve forests & protected forest are available in buffer zone.

4. Project Description

Salient feature of the existing operational project and proposed expansion Project is given below in

Table no.1: Salient Features of existing and proposed capacity enhancement

S. No.	Description	Existing	After Proposed Expansion
1.	Mine lease area	480.45 ha	No Change
2.	Land Requirement	48.5 ha	No Change
3.	Ore mineral	Lead ,Zinc and associated Mineral	
4.	Established Depth	About 437 m	About 437 m
5.	Reserves & Resources	5.97Mt,12.7 % Zn, 1.78% Pb as on 01.04.2016	9.74 million tons, 7.23% Zn, 1.17%Pb as on 01.10.2017

6.	Mode of Entry	By a ramp Decline	No change
7.	Method of Mining	LHOS, TOS, Drift and fill with waste rock	No change
8.	Ore Production	1.0 million TPA	1.2 million TPA (20% increase)
9.	Ore Beneficiation	Nil	Nil
10.	Waste Rock Generation (2017-18 to 2020-21)	5,95,000 MT	8,55,000 MT*
11.	Waste dump area	1.0 Ha	No change
12.	Power requirement & Source	5.0 MW, AVVNL & Emergency 1.0 MW DG set	No change
13.	Water requirement & Source	560 m^3/day, (PHED+ STP+ Mine Dewatering)	No change
14.	Manpower requirement (Nos.)	629	No Change
15	Project Cost	Rs. 350 crores	Rs. 521 Crores
16	Environment Protection Cost	Rs. 4.3 crores	Rs. 18.8 Crores

*In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface beyond the already approved waste quantity and hence no additional waste dump is envisaged. The increased waste generated will be disposed off into the underground voids

5. METHOD OF MINING

Mode of Entry: Decline

The mine access is comprised of single decline from surface portal (487.6 mRL) to the top of the orebody, at the 419 mRL where it then splits into separate North and South declines. The South decline will go upto 50mRL and North Decline will go upto 150mRL.The declines are designed at a gradient of 1 in 7.

Development and Stoping method

Currently, the Underground mining method used in Kayad mine is Long Hole Open Stoping. After mining, every open stope is filled by Rock fill or Cemented Rockfill.

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. The upper, 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.

Mine Development in Block I and II is completed for main lens and Block III is currently being developed. In Block III wherever ore body is steeper Longitudinal Open Stoping Method is proposed. All the mining is planned with back filling with Rock fill (RF) and Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever ore body configuration requires.
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 of 5.5m x 5m (WxH) in dimension 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–fro 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.

Production drilling is planned from both the drill level. Rings shall be drilled from slot to FW contact of orebody using Simba/Solo/ITH drill machine covering the geometry of the stope.

Three main mechanical ventilators of 150 Cum/sec (450 KW) capacity are installed at bottom of South ventilation raise (3.5m diameter circular) at 400 mRL, North ventilation raise (3.5m diameter circular) at 375 mRL and Central ventilation raise (3.5m diameter circular) at 250 mRL. The fans serve as the main exhaust for both sections. Fresh air enters through main decline (130 Cum/sec) and through North surface ventilation intake raise (50 Cum/sec) and South surface ventilation intake raise (50 Cum/sec).

The blasted muck from stope is then withdrawn at extraction level through LHDs and then directly loaded in to mine trucks for hauling through ramps from underground to surface stock yard. From stock yard, ore is dispatched to Rampura Agucha Mine for further processing.

While blasting in stopes, each ring in the stope will be blasted with multiple delays, so that the blast vibrations are kept within the safe limits. Care shall be taken to maintain through proper hole measurement, charge length, stemming and adequate delay in holes. Adequate numbers of detonators shall be used to keep the charge per delay in permissible limit and each blast vibration and sound will be monitored by CIMFR, Dhanbad.

6. RESOURCE REQUIREMENT & SOURCES

Water requirement& its sources

No additional water is required for proposed expansion over existing 560 m^3/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.

Power Requirement & its 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.

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.

Land requirement

Total Mine lease area is 480.45 ha, out of which 48.50 ha has been acquired within mining lease. There shall be no requirement to acquire land beyond the existing acquired land. The mine area in operational use will suffice the requirement. The proposed expansion of mine is from 1.0 to 1.2 MMTPA ROM of Lead-Zinc Ore Production **(20% increase).**

Manpower requirement

Existing trained manpower is sufficient to cater the need of industry. However, there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

7. MINE WASTE GENERATION AND MANAGEMENT

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 tonne. 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 off into the underground voids. If any additional waste required for backfilling will be utilized from Rampura Agucha Mine.

Tailing 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.

Used oil and other waste

Used oil generated shall be stored at earmarked area in drums and shall be sold to registered/ authorized recyclers; No additional used oil and Oil contaminated waste generation is envisaged .No change in other waste for the proposed expansion.

8. ENVIRONMENT BASELINE

As part of expansion plant, Environmental, Ecological and social baseline study was conducted during the period March to May 2017 representing the pre-monsoon/summer season. Brief findings of the same is given below

Site Meteorology

The predominant wind direction observed during the study period was 25.2% in SW followed by WSW for 10.1% is representing in site specific wind rose.

8.1 Soil Quality

The soil analysis results are presented in table no. 3.5 of EIA report for 8 locations during the study period. The result obtained is compared with the standard soil classification given in Agriculture Soil Limits. 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.

8.2 Ambient Air Quality

The analysis results for the study period are presented in table no.3.10 of EIA for 8 locations during the study period.Various statistical parameters like 98^{th} percentile, average, maximum and minimum values have been computed from the observed data for all the AAQ monitoring stations. These are compared with the standards prescribed by Central Pollution Control Board (CPCB) and it is observed that all values are within the prescribed limit.

8.3Ambient Noise Level

The baseline noise monitoring in the study area was carried out at 8 locations during the study period. The day time and night time equivalent noise levels monitored at all the residential receptors were found within the prescribed norms. The noise levels within the ML were observed to be within the prescribed industrial noise limit during day and night time.

8.4 Ground& Surface Water quality

The baseline ground & surface water quality monitoring in the study area was carried out at 5 locations & 2 locations respectively during the study period.The ground and surface

water samples were analyzed as per drinking water standards of IS: 10500, 2012. Few of the ground water samples show some values higher than the desirable limits but within permissible limits for drinking water standards. However, there is no evidence of any industrial contamination. Level of Phenolic compounds and Heavy Metals was observed to be BDL in all the groundwater samples.

9. ANTICIPATED IMPACTS

Anticipated key environment, ecological and social issues associated with proposed capacity enhancement are listed below in table

Components	Key Impacts
Land and soil Environment	• Impact on soil and land environment due debottlenecking process and associated activities; • Storage and handling of hazardous materials (e.g., fuel and lubricant) and waste generated from operation of construction equipment and machinery and their maintenance may lead to soil contamination due to leaks/ spillage; • Land Subsidence due to blasting;
Ambient Air Quality	• Dust emissions due to movement of machinery and vehicles; • Indoor fugitive dust emissions due to blasting, excavation and back filling activities etc; • Fugitive dust emission due to operation of primary and secondary crusher in underground and above ground, loading & unloading and transport of ore and concentrate;
Ambient Noise and vibration	• Noise generation due to movement of vehicles and heavy machineries; • Noise from debottlenecking activities; • Noise from additional ore handling, crushing of ore both underground and above ground, • Vibration due to blasting;
Water Environment	• No process related wastewater is anticipated to generated;

Components	Key Impacts
Ecology	• No change in surface infrastructure or surface related activities are anticipated to cause impact on surface ecology;
Visual Landscape	• No change in surface infrastructure or structure is anticipated.
Occupational health and safety	• Occupational health hazards due to dust and noise pollution; • Safety risk due to wrong handling of machinery,
Demographics	• No additional manpower or influx is anticipated;
Social and cultural fabric	• No Additional direct manpower due to capacity enhancement is anticipated however ample indirect employment opportunities will be created.
Economy and Employment	• Indirect impact on local economy through development of secondary facilities.
Land based Livelihood	• No land acquisition is associated with proposed activity and no impact is anticipated;
Community health and safety	• Transportation of concentrate components and associated increased vehicular movement will lead to traffic hazards for community residing close to the access roads;

10. ENVIRONMENTAL MANAGEMENT PLAN

Kayad Mine is currently implementing the Environmental and social management plan approved by MOEF&CC and regularly submitting the compliance report to RO of MoEF & CC. Also Vedanta Resources Plc has Sustainability Governance System for all its operations globally which provides an overarching umbrella for environment, health, safety and social management for all its assets and subsidiary companies.

Various impacts associated with proposed capacity enhancement activities are similar to the impact and mitigation measures of existing operational project. The project is continued to implement the various mitigation measures and comply with EC conditions and various conditions of other approvals obtained earlier.

A total sum of Rs. Rs. 18.8 Crores (Rs. 4.3 cr existing + Rs. 14.5 cr. proposed) will be spent on environmental protection measures

11. PROJECT BENEFITS

11.1 Financial Benefit

The proposed project shall generate foreign exchange to the country by exporting Zinc; additionally, it will also reduce import of phosphoric acid thus saving of foreign exchange. This will also generate revenue to the state Government as well as central government. The people around the region will get direct and indirect employment thus improves the financial status.

11.2 Employment generation due to project

The existing operation has direct employment of about 629 persons and the proposed project will be managed by the existing resources but there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

11.3 Social Economic Development

The proposed expansion project will bring in people from different cultures for secondary employment like transporters, vendors, local canteen and tea stall operators etc. such as:

- Generate indirect employment opportunities;
- Real estate development;
- Increase in purchasing power;
- Development of ancillary small scale supporting electro mechanical services for automobile's, civil, electrical and mechanicals etc. as part of CSR.
- Agriculture marketing and increased demand for locally produced farm products for large number of employees existing in the project;
- Access to high quality health care facilities;
- Women empowerment;

11.4 National Economic Development

The present production capacities of Zinc in India are sufficient to meet the domestic requirements. However, the demand for zinc in India is expected to grow at a rate of 7.1%which makes it viable for the expansion of the zinc production capacities. Further the deficit in international market during the upcoming years provides opportunity for export.

11.5 Export Possibility

Indian exports majorly catered to South East Asian and African nations. In India, since, Hindustan Zinc is the largest producer of primary zinc, export of zinc is highly feasible and shall bring value addition.

11.6 Land value appreciation

The infrastructure development related to the proposed project is likely to cause appreciation of real estate prices in the nearby areas. Locals with land holdings in neighbouring areas are likely to benefit economically.

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CHAPTER -1

INTRODUCTION

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1.1 INTRODUCTION

The term Environment Impact Assessment (EIA) refers to the anticipation of various impacts a project will have on the environment and the local community. It is a decision making tool, which guides decision makers in taking appropriate decisions prior to sanctioning clearance. According to the UNEP-DTIE, Environmental Impact Assessment (EIA) is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.

1.2 PURPOSE OF THE REPORT

Gaurang Environmental Solutions was assigned the job of conducting and preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) report for the proposed expansion of "Kayad Mine - Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM) (20% increase)".

Kayad Lead-Zinc Mine commissioned in year 2011. Environment Clearance was granted by MoEF&CC, New Delhi for Enhancement in Production Capacity of Kayad Lead -Zinc Ore underground mine from 0.35 million TPA (ROM) to 1.0 million TPA (ROM) vide letter no. J-11015/47/2012-IA II(M) dated 23.09.2014. Copy of the same is enclosed as **Annexure I.**

Presently Valid Consent to Operate is available from Rajasthan State Pollution Control Board (RSPCB), Jaipur for carrying Mining activities vide letter no.F(Mines)/Ajmer(Ajmer)/1(1)/2009-2010/7897-7901dated 04.03.2015.

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0million TPA (ROM) to 1.2million TPA (ROM). The Ore Produced at the Kayad Mine is sent to Rampura Agucha Mine for ore beneficiation in the existing mills having capacity of 6.5 MTPA capacity located in Hurda Tehsil, Bhilwara Dist of Rajasthan. The ore concentrate produced at Rampura Agucha Mine shall be processed at existing HZL Smelters.

The Kayad Lead Zinc Mine is located in District & Tehsil of Ajmer.

The Ministry of Environment and Forests, Govt. of India, through its EIA Notification of 14.09.2006 and its subsequent amendment on dated 1st December' 2009 and 04.04.2011 under the Environment Protection Act, 1986, classified the projects under two categories – A (more than 50 hect.) and B (less than 50 hect. and ≥ 5.0). ***The proposed project is categorized under category 1 (a) - A category {Mining of Minerals} as the lease area is* 480.45 ha** as per the Gazette Notification 14th Sep. 2006 and its subsequent amendment till date

The proposed expansion of mining project will require an Environmental Impact Assessment (EIA) study to be undertaken as per requirement of the EIA Notification 2006 and as amended, which notifies all mining projects having a mining lease area of 50 ha or more as **category A** under item **1(a) of the** EIA Notification 2006 and as amended.

As per Clause 7 (ii) of EIA Notification, 2006 and subsequent amendments till date along with OM issued by MoEF&CC, New Delhi {Guidelines for granting Environment Clearance for expansion of Coal Mining Projects involving one time Production Capacity Expansion in the existing operation - dated 19.12.2012, 07.1.2014, 30.05.2014 and 28.07.2014}, allowed Coal Mines one time capacity expansion upto 25% in the existing operations, within the existing mine lease area under clause 7 (ii) of the EIA Notification 2006 subject to following conditions-

- Existing EC and have undergone Public Hearing during the process of obtaining EC.
- One time capacity expansion of up to 25% in the existing mine
- No additional mine lease area involved
- No change in mining method
- Certified EC compliance report

Since, the proposal meets all the above requirements, therefore, Environmental Clearance may be granted under Clause 7 (ii) of EIA Notification, 2006.

This Environmental Impact Assessment (EIA) report has been prepared to provide information on the potential negative and positive environmental, social and economic impacts of the project. It also aims to make recommendations for mitigation of the potential negative impacts and enhancement of the positive ones. A field survey of the project site was conducted and potential environmental impacts of the project activities were identified, assessed and documented.

1.3 IDENTIFICATION OF PROJECT & PROJECT PROPONENT

1.3.1 Identification of Project

Kayad Mine is Lead -Zinc Ore underground mine. Validity of the mining lease is upto 27th February 2048, and will be renewed thereafter.

The reason for expansion of Kayad Lead-Zinc Ore Underground Mine from 1.0million TPA (ROM) to 1.2 million TPA (ROM) (20% increase) is that the ore produced at the Kayad Mine is sent to Rampura Agucha Mines for beneficiation in the existing mills of 6.5 MTPA capacities. Production from opencast mine at Rampura Agucha is now on a decreasing trend due to increasing pit depth. In order to increase the indigenous production of concentrates for captive smelters it is necessary to utilize the milling capacity of Rampura Agucha mine mill to full extent.

Kayad Mine deposit extends over a lease area of 480.45ha in Ajmer District of Rajasthan has been sanctioned to Hindustan Zinc Limited (HZL), Vide ML No. 16/92 Government of Rajasthan dated 03/10/1997 and renewed on 27/02/15

The estimated insitu ore reserves& resources as on 01.10.2017is 9.74Mt (1.17% Pb and 7.23% Zn). The proposed expansion of mine is from 1.0 to 1.2million TPA of Lead-Zinc Ore Production (20% increase).Total cost of the proposed expansion is estimated to be Rs.171crores and after expansion the total project cost will be Rs. 521 crores.

Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of Metasediments (2000 my-750 my).Mining Lease is demarcated on part plan of Survey of India Toposheet no.

45J/10. Kayad Deposit lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41"30.73"E-74°41'30.45"E.

1.3.2 Project proponent

Hindustan Zinc Limited (HZL) is the only integrated Lead & Zinc manufacturer in India and owns captive lead and zinc mines at Rampura Agucha, Rajpura Dariba, Kayad, Sindesar Khurd and Zawar Mines that cater to the requirement of lead and zinc concentrate for its smelters located at Chanderiya, Dariba & Debari. All the mining & smelting operations are based at Rajasthan.

1.4 BRIEF DESCRIPTION OF PROJECT

1.4.1Nature of the Project

The projects is a mechanised underground Lead-Zinc mine project and is classified as **"category A** under item **1(a)"** by Ministry of Environment Forests& Climate Change, New Delhi as per EIA notification dated on 14th September 2006.

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 to 1.2million TPA (ROM) (20% increase). Amendment in EC under clause 7 (ii) a of EIA notification 2006, & subsequent amendments is applied.

1.4.2 Size of the Project

Kayad Mine deposit extends over a lease area of 480.45ha with an estimated insitu ore reserves& resources as on 01.10.2017is 9.74Mt (1.17% Pb and 7.23% Zn). The proposed expansion of mine is from 1.0 to 1.2million TPA of Lead-Zinc Ore Production (20% increase).Total cost of the proposed expansion is estimated to be Rs.171crores.

1.4.3 Location of the Project

The Kayad village is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital and nearest airport is Kishangarh Airport 14.6 km towards NE of the deposit. Although the nearest railway station is Ladpura at 5.5 km to the East of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH 8 Jaipur-Ajmer is at about half a km. Mining Lease is demarcated on part plan of Survey of India Toposheet no. 45J/10. Kayad Deposit lies

between Latitudes 26°31'41.47"N-26°31'37.04"Nand Longitudes 74°41"30.73"E-74°41'30.45"

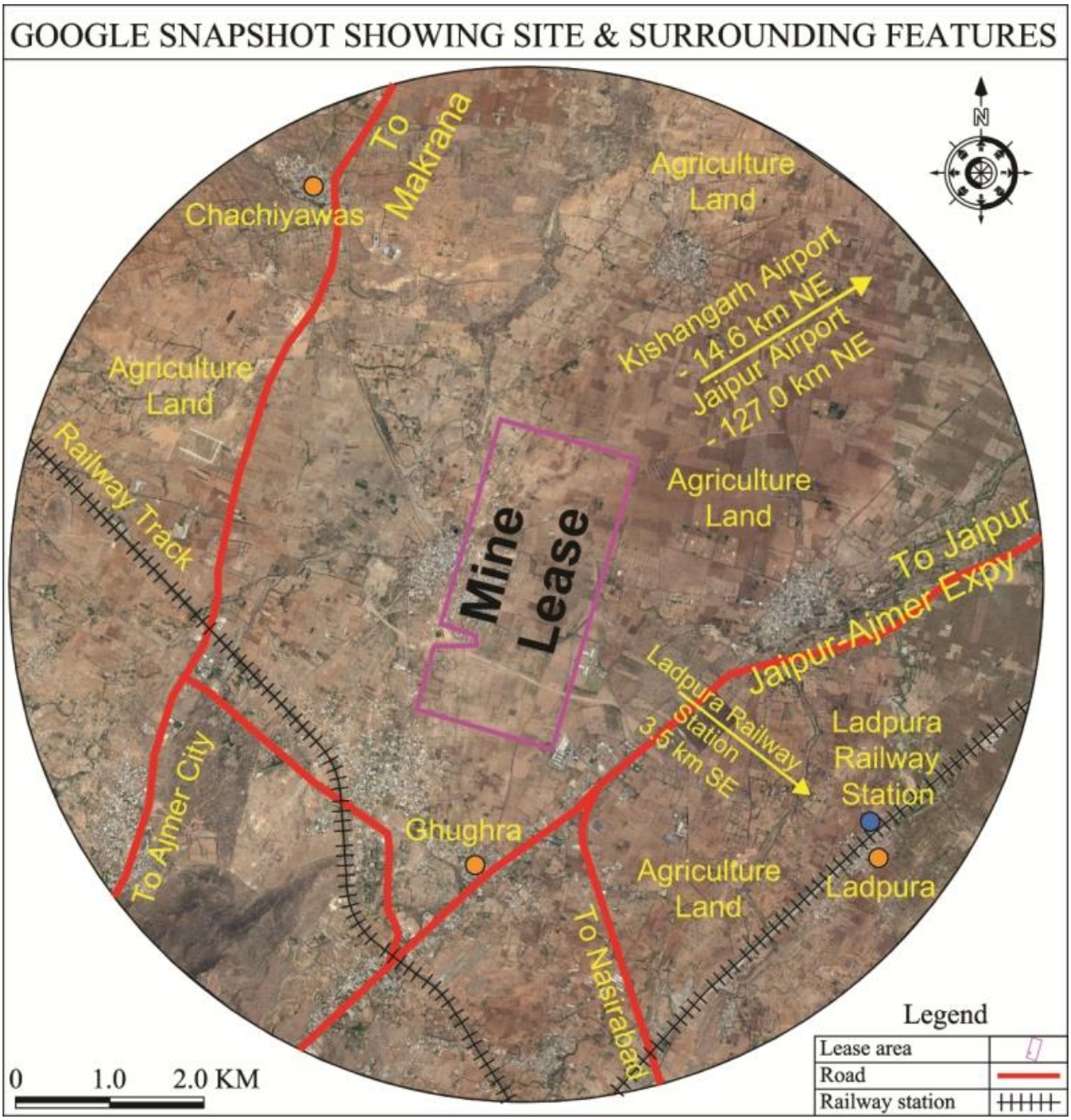

Figure1.1: Google Map Showing Site & Surrounding Features

4.4 Mining Method

Currently, the Underground mining method used in Kayad mine is Long Hole Open Stoping. After mining, every open stope is filled by Rock fill or Cemented Rock fill.

Longitudinal Long hole open stoping (LHOS) method is proposed for the steeper portion up to225 mRL and Long Hole Open Transverse stoping is proposed for the shallow (almost flat)portion of ore body below 225 mRL.

1.4.5 Importance to the Country & Region

Mining this Lead-Zinc deposit is critically important for the country's long-term economic growth. By mining the deposit, HZL will provide the country with increased revenue earnings. This will transform the region's economy from predominantly agricultural to significantly industrial, and accelerate the pace of industrial development in the region.

1.5 STATUS OF REGULATORY CLEARANCES

- The total ML area is 480.45 ha. Validity of the mining lease is upto 27th February 2048, and will be renewed thereafter.
- Scheme of Mining with progressive mine closure plan has been approved vide letter no. 584(4)(3)(1706)/ 2017-क्षेखानि-अजम/2210 dated 3.11.2017 under rule 17(3) of MCR,2016
- Environment Clearance was granted by MoEF&CC, New Delhi for Enhancement in Production Capacity of Kayad Lead -Zinc Ore underground mine from 0.35 million TPA (ROM) to 1.0 million TPA (ROM) vide letter no. J-11015/47/2012-IA II(M) dated 23.09.2014.
- Presently Valid Consent to Operate is available from Rajasthan State Pollution Control Board (RSPCB), Jaipur for carrying Mining activities vide letter no.F(Mines)/Ajmer(Ajmer)/1(1)/2009-2010/7897-7901dated 04.03.2015. (valid till 31.01.2018).
- NOC from CGWA for mine dewatering (75 m^3/day) has been obtained wide letter no.21-4(176)/WR/CGWA/2007-4861 dated 19.11.2012 Renewal for the same was obtained vide letter no.21-4(176)/WR/CGWA/2007 dated 06.08.2014
- NOC from CGWA for additional ground water dewatering (72 m^3/day) has been obtained vide letter no. 21-4(176)/WR/CGWA/2007-2216 on dated 10.10.2016 and valid upto 2 years

1.6 SCOPE OF THE STUDY

The study area map is shown in **Figure-1.2**.

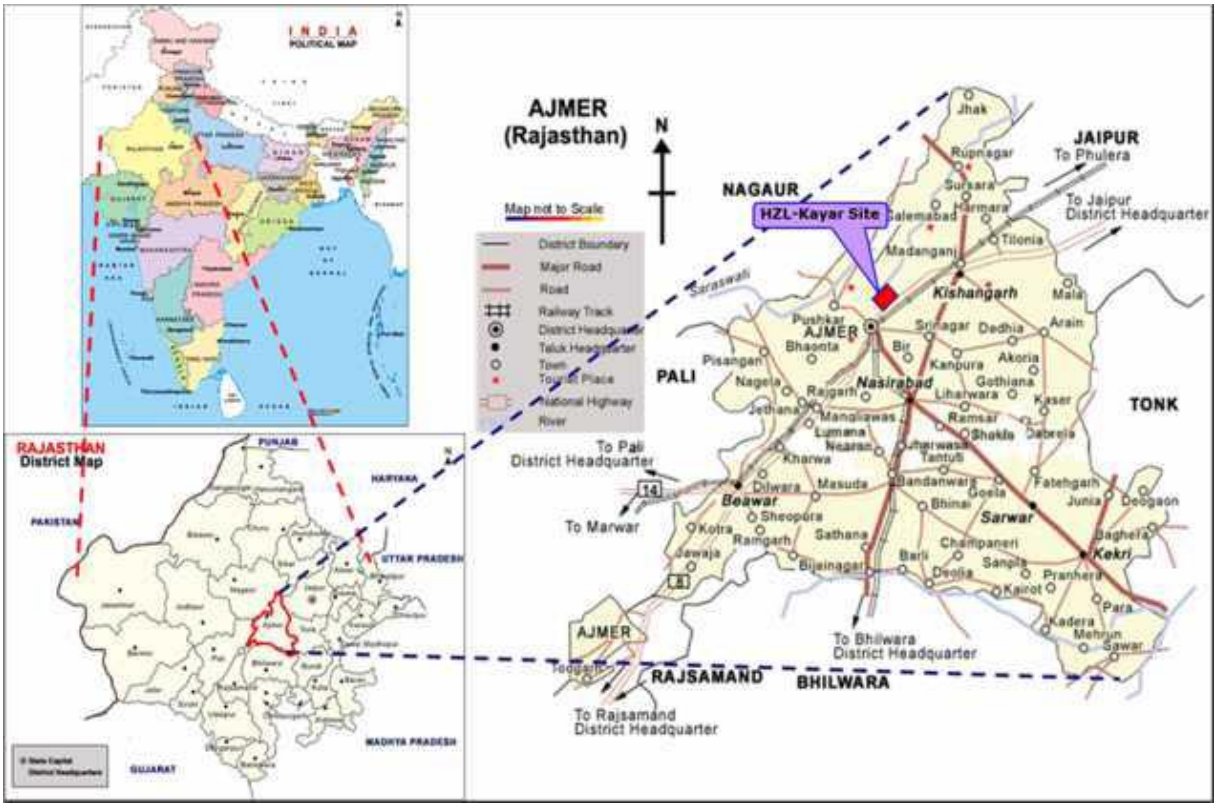

Figure 1.2: Geographical Location of the Project

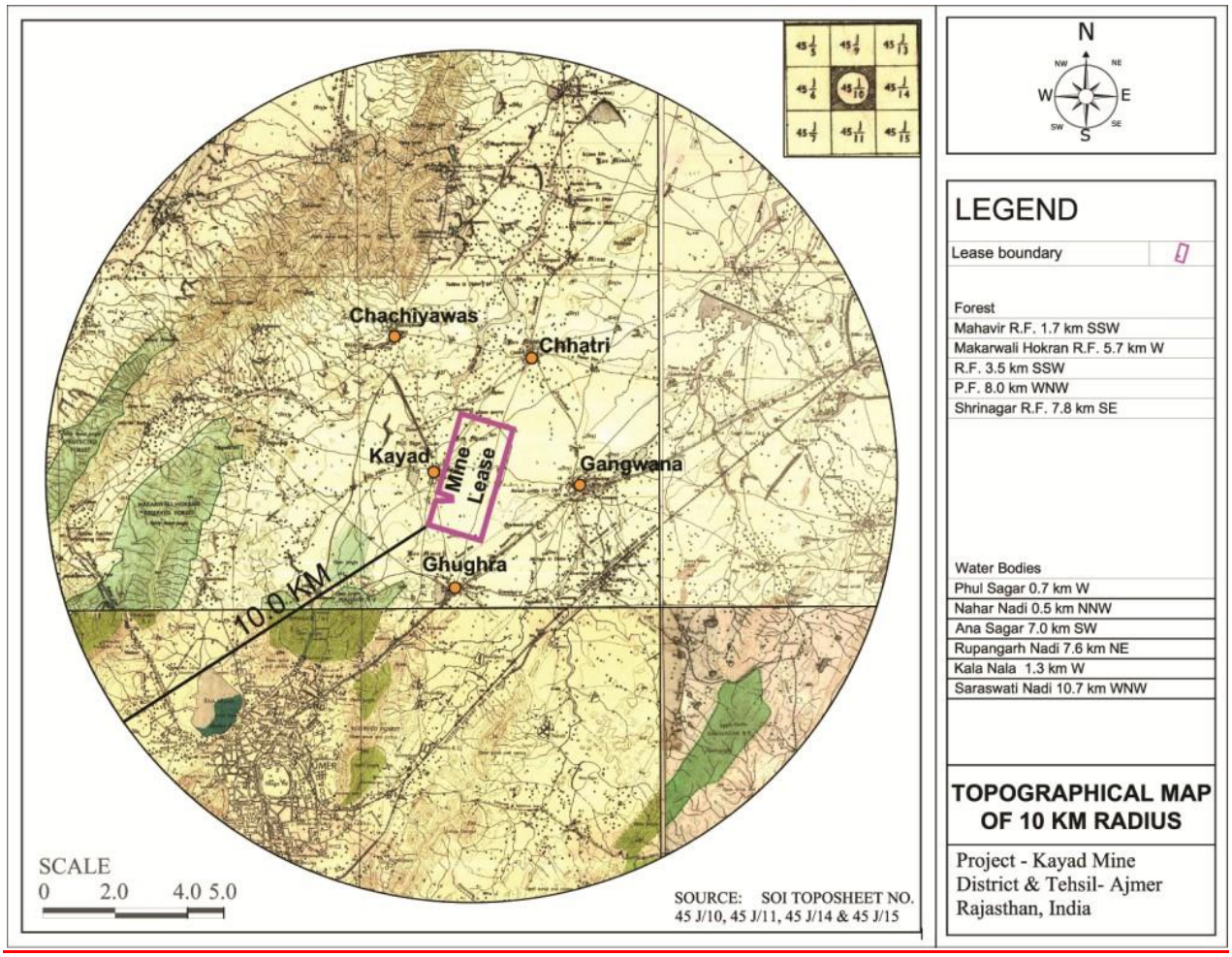

Figure 1.3: Study Area Map

The scope of study broadly includes:

- To conduct literature review and to collect data relevant to the study area;
- Establishing the baseline environmental aspects in and around the project area;
- Identifying various existing pollution loads;
- Predicting incremental levels of pollutants in the study area due to the proposed enhancement in mining operations;
- Evaluating the predicted impacts on various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies;

- To prepare an Environment Management Plan (EMP), outlining the measures for improving the environmental quality in view of proposed enhanced mining & allied activities for environmentally sustainable development; and

- Identifying critical environmental attributes that are required to be monitored in the post-project scenario.

To determine existing conditions of various environmental attributes, field studies have been conducted during 1stMarch, 2017 to 31st May, 2017 covering summer season 2017.

1.7 ENVIRONMENT CLEARENCE PROCESS

The proposed expansion of mining project will require an Environmental Impact Assessment (EIA) study to be undertaken as per requirement of the EIA Notification 2006 and as amended, which notifies all mining projects having a mining lease area of 50 ha or more as **category A** under item **1(a) of the** EIA Notification 2006 and as amended.

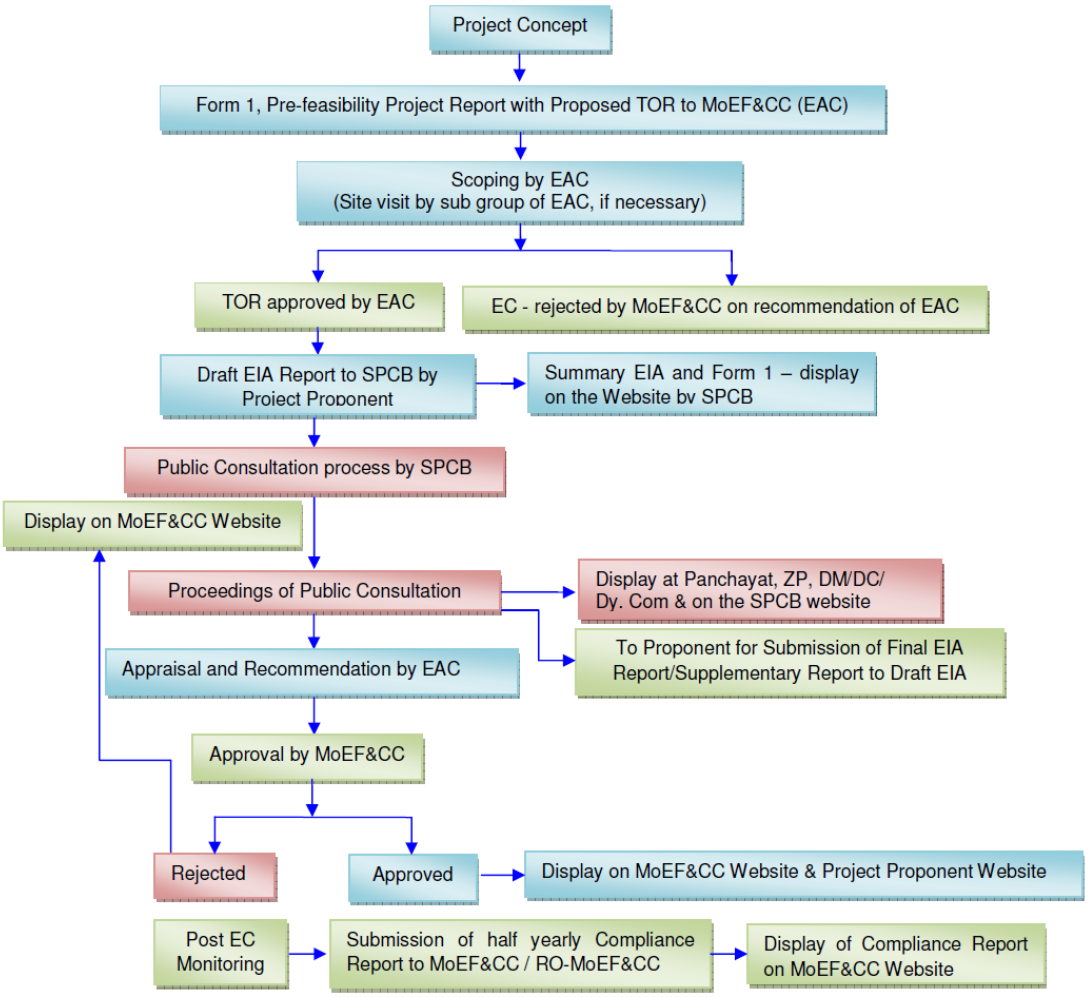

Figure 1.4: Environmental Clearance process chart

1.8 STRUCTURE OF ENVIRONMENTAL IMPACT ASSESSMENT

In terms of the EIA Notification of the MoEF & CC dated 14th September 2006 and subsequent amendment till date, the generic structure of EIA documents shall be as under:

1. Introduction
2. Project Description
3. Description of the Environment
4. Anticipated Environmental Impact & Mitigation Measures
5. Analysis of alternatives (Technology & Site)
6. Environmental Monitoring Program
7. Additional Studies
8. Project Benefits

9. Environmental cost benefit analysis
10. Environmental Management Plan
11. Summary & Conclusion
12. Disclosure of Consultant Engaged.

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CHAPTER -2

PROJECT DESCRIPTION

CHAPTER-2

PROJECT DESCRIPTION

2.1 TYPE OF PROJECT

The proposed project is a mechanized underground lead-zinc mining brown field project involving 20% increase in ore production i.e from 1.0 to 1.2 million TPA (ROM) of Lead-Zinc Ore Production

Kayad Mine deposit extends over a lease area of 480.45 ha with estimated insitu ore reserves & resources of ore reserves& resources as on 01.10.2017is 9.74Mt (1.17% Pb and 7.23% Zn)

Ore produced at the Kayad Mine is sent to Rampura Agucha Mines for beneficiation in the existing mills of 6.5 MTPA capacities.

The salient features of the project along with the proposed incremental load are elaborated in following **Table no.2.1.**

Table No.2.1: Salient features of the project

S. No.	Description	Existing	After Proposed Expansion
1.	Mine lease area	480.45 ha	No Change
2.	Land Requirement	48.5 ha	No Change
3.	Ore mineral	Lead ,Zinc and associated Mineral	
4.	Established Depth	About 437 m	About 437 m
5.	Reserves & Resources	5.97Mt,12.7 % Zn, 1.78% Pb as on 01.04.2016	9.74 million tons, 7.23% Zn, 1.17%Pb as on 01.10.2017
6.	Mode of Entry	By a ramp Decline	No change
7.	Method of Mining	LHOS, TOS, Drift and fill with waste rock	No change
8.	Ore Production	1.0 million TPA	1.2 million TPA (20% increase)
9.	Ore Beneficiation	Nil	Nil
10.	Waste Rock Generation (2017-18 to 2020-21)	5,95,000 MT	8,55,000 MT*
11.	Waste dump area	1.0 Ha	No change
12.	Power requirement & Source	5.0 MW, AVVNL & Emergency 1.0 MW DG set	No change
13.	Water requirement &	560 m^3/day, (PHED+	No change

	Source	STP+ Mine Dewatering)	
14.	Manpower requirement (Nos.)	629	No Change
15	Project Cost	Rs. 350 crores	Rs. 521 Crores
16	Environment Protection Cost	Rs. 4.3 crores	Rs. 18.8 Crores

***** In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface beyond the already approved waste quantity and hence no additional waste dump is envisaged. The increased waste generated will be disposed off into the underground voids. Additional waste required for backfilling will be brought from Rampura Agucha Mine.

2.2 NEED OF THE PROJECT

Zinc is a very versatile non-ferrous metal. Zinc's different applications rank it as the 4th most common metal in use after iron, aluminum and copper. Global zinc consumption is forecast to grow at a compound average annual rate of 2.4% p.a. over the period 2016-2021. Global zinc consumption is projected to grow to 20Mt in 2035 representing an average annual increase of 0.28Mt.

Consumption growth sets a requirement for extra raw material supply to smelters (concentrate and secondary materials) of 0.28Mt/a Zn. Whilst some of the extra mine capacity will come from expansions and mine life extensions of existing producers, the majority will be from new mines. HZL's largest producer Rampura Agucha open pit mine is in closure stage, so by mining this deposit, HZL will provide the country with increased revenue earnings. This will also transform the region's economy..

2.3 PROJECT LOCATION & CONNECTIVITY

The Kayad village is 9 Km NNE of Ajmer city and is well connected by tar road. Jaipur, the state capital and nearest airport is Kishangarh Airport 14.6 km towards NE of the deposit. Although the nearest railway station is Ladpura at 5.5 km to the East of Kayad, the main railway station is at Ajmer on Ajmer-Kishangarh section of North Western Railway, 9 km SSE of Kayad. NH 8 Jaipur-Ajmer is at about 2.0 km towards SE.

Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of Metasediments (2000 my-750 my). Kayad Lies near the center of this 30 km wise belt in Ajmer Area. Mining Lease is demarcated on part plan of Survey of India Toposheet no. 45J/10. It lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41"30.73"E-74°41'30.45"E.

The nearest connectivity details are given as under:-

- **Nearest Airport**- Kishangarh Airport (14.6 km aerial distance towards NE) from mine site and
- **Nearest Railway Station** - Ladpura Railway Station -5.5 km aerial distance towards E from mine site and
- **Nearest Highway** - NH -8 at a distance of 2.0 km SE from mine site

The details of environmental setting are given above. Location map is shown in **Figure-2.1**. The mine Geological Map is shown in **Figure-2.3** and the Google map is shown in **Figure-2.2.**

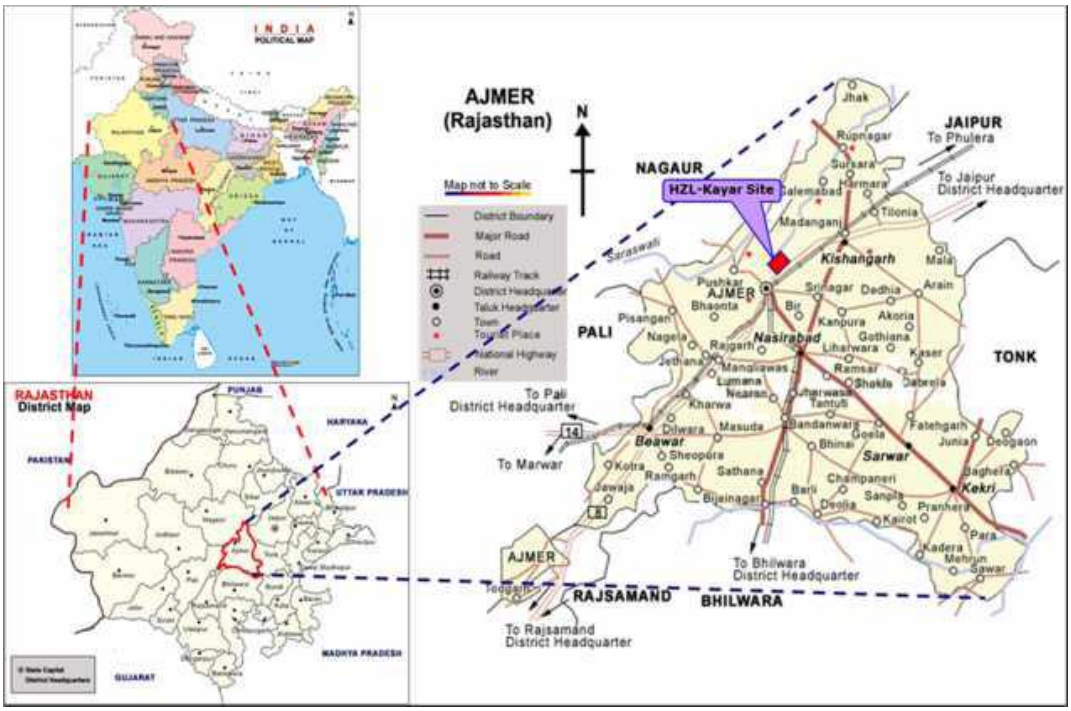

Figure 2.1: Location Map

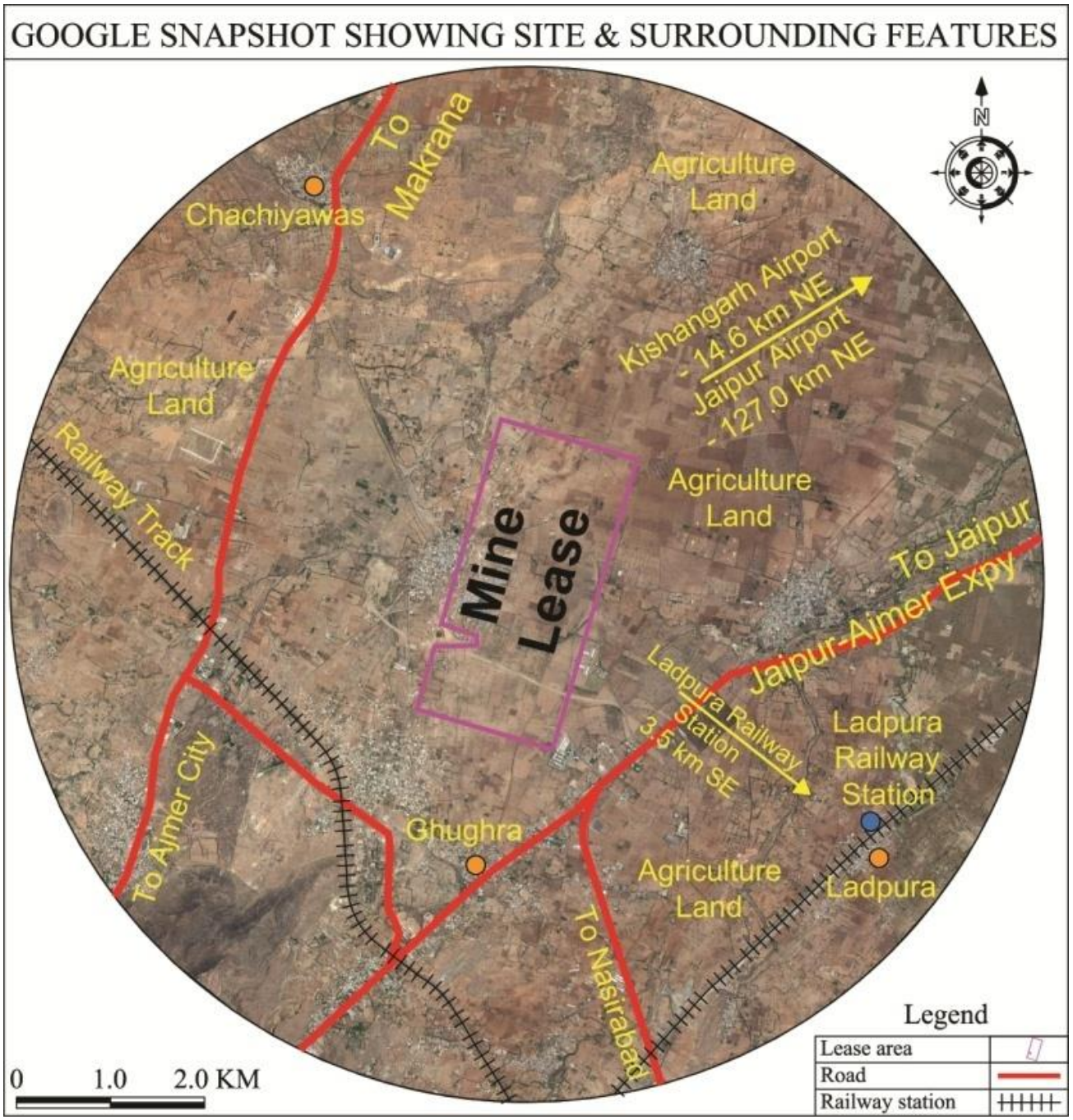

Figure 2.2: Google Map

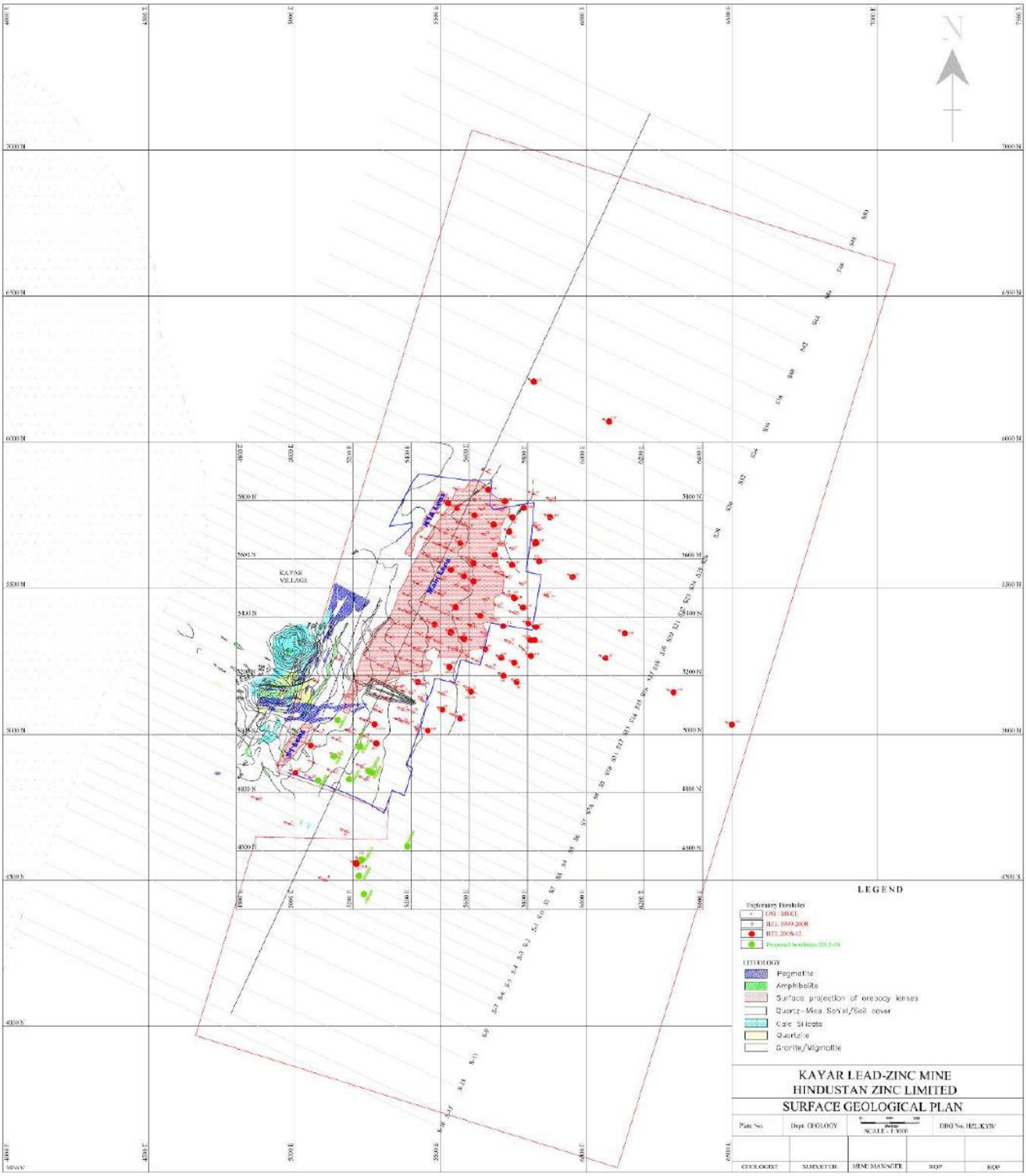

Figure 2.3: Geological Map

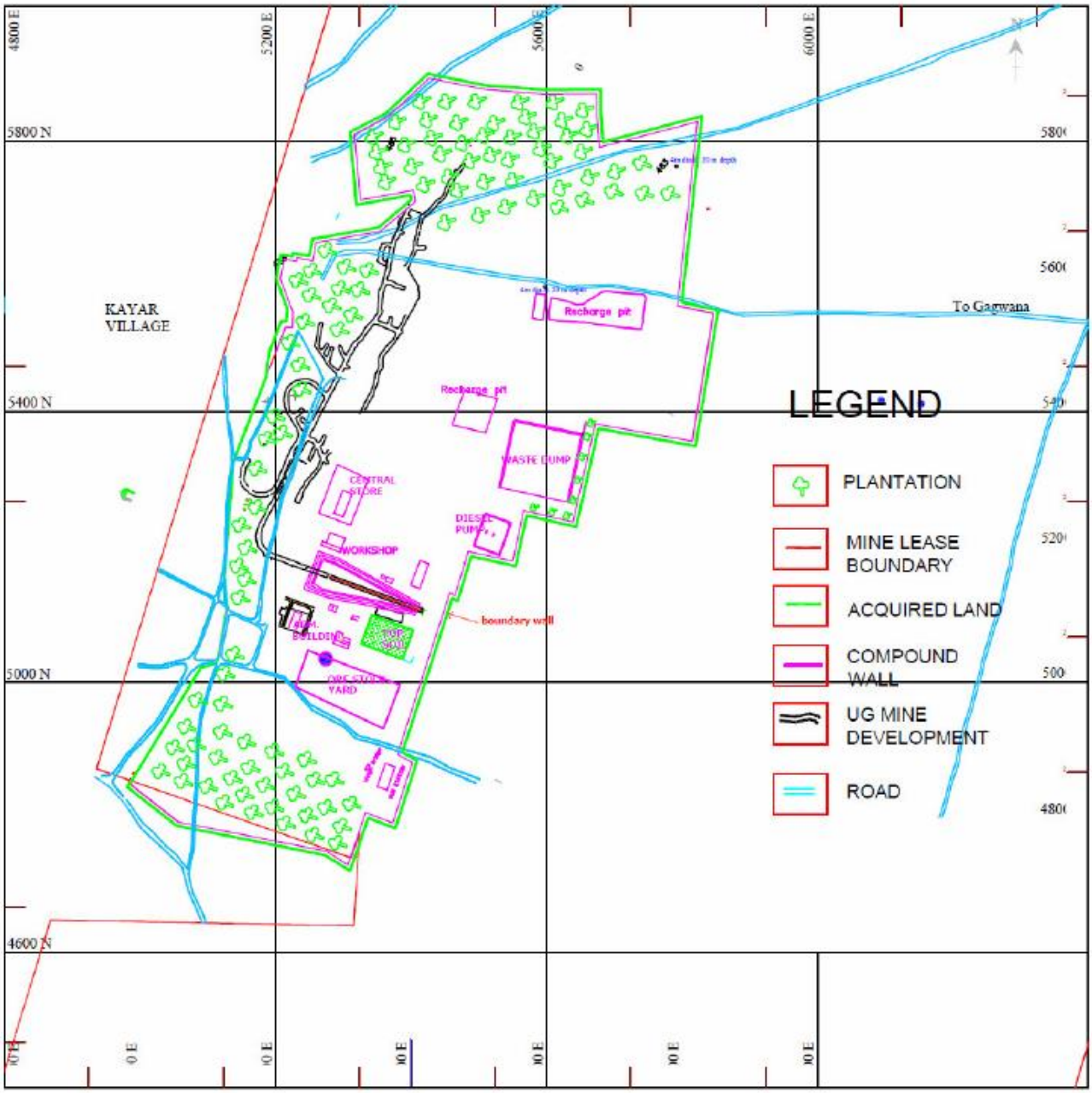

Figure 2.4: Surface Plan

2.4 JUSTIFICATION FOR SELECTING PROPOSED PROJECT SITE

- The Kayad Lead Zinc Mine is located in District & Tehsil of Ajmer ,Rajastahan.
- The reason for expansion of Kayad Lead-Zinc Ore Underground Mine from 1.0 million TPA (ROM) to 1.2 million TPA (ROM) (20% increase) is that the ore produced at the Kayad Mine is sent to Rampura Agucha Mines for beneficiation in the existing mills of 6.5 MTPA capacities. Production from opencast mine at Rampura Agucha is now on a decreasing trend due to increasing pit depth. In order to increase the indigenous production of concentrates for captive smelters it is necessary to utilize the milling capacity of Rampura Agucha mine mill to full extent.
- The estimated insitu ore reserves & resources as on 01.10.2017is 9.74Mt (1.17% Pb and 7.23% Zn).
- Environment Clearance was granted by MoEF&CC, New Delhi for Enhancement in Production Capacity of Kayad Lead -Zinc Ore underground mine from 0.35 million TPA (ROM) to 1.0 million TPA (ROM) vide letter no. J-11015/47/2012-IA II(M) dated 23.09.2014. Presently Valid Consent to Operate is available from Rajasthan State Pollution Control Board (RSPCB), Jaipur for carrying Mining activities vide letter no.F(Mines)/Ajmer(Ajmer)/1(1)/2009-2010/7897-7901dated 04.03.2015 and valid upto 31.01.2018.
- The mine is approachable by nearest airport, Kishangarh Airport at about 14.6 km and nearest railway station is Ladpura about 5.5 km and NH 8 Jaipur-Ajmer is at about 2 km towards SE.
- Kayad deposit is hosted by mid proterozoic Delhi Fold Belt of Metasediments (2000 my-750 my).
- Kayad Mine is well equipped with infrastructures like Administrative office, Work Shop, Vocational training Center, Rescue room, Canteen, Rest Room, Washrooms, Ambulance, First-aid facilities, Refuge Chamber etc.

2.5 LAND FORM, LAND USE AND LAND OWNERSHIP

2.5.1 Land Form

The area is undulating with altitude varying from 480 to 506 mRL. The highest point is a small hillock 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 seasonal "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 watercourse other than seasonal "Kala Nala" in the area.

2.5.2 Land Use& Ownership

Total Mine lease area is 480.45 ha, out of which 48.50 ha has been acquired within mining lease. There shall be no requirement to acquire land beyond the existing acquired land. The mine area in operational use will suffice the requirement. Breakup of land use of lease area is shown as under:

Table No.2.2: Land Use

Particulars	Present Land use (ha)	Proposed Land use (Ha)
a) Area to be excavated	0.73	0.73
b) Storage of top soil	0.24	0.24
c) Overburden / Dump	1.0	1.0
d) Mineral storage	1.4	1.4
e) Infrastructure (workshop, buildings, Parking etc.)	2.4	2.4
f) Road	0.88	0.88
g) Green Belt	21	24.8
h) Water storage tank	0.06	0.06
i) Surface water bodies/ponds	1.3	1.3
j) 1 MT Magazine	0.01	0.01
k) Bulk Emulsion plant	0.35	0.35
l) Open spaces	19.13	15.33
Total (A-L)	**48.5**	**48.5**
Land use (Ownership & Occupancy Status)		
i) Private Land	445.82	
ii) Charagah	11.10	

iii) Govt. Land	23.53
GRAND TOTAL/Lease Area	**480.45**

Topography - The area is undulating with altitude varying from 480 to 506 mRL. The highest point is a small hillock 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 seasonal "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 watercourse other than seasonal "Kala Nala" in the area. A number of dug well with water table varying between 20 to 30 m are present.

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.

Drainage pattern-The Prominent "kala Nala " (outside the ML) Flowing From South – west to north – east joins Phool Sagar reservoir located west of kayad village about 1.5 Km away upstream from the project site. The drainage is seasonal and mostly of dendritic pattern and there is no prominent watercourse other than "Kalan Nala" in the area. A number of dug well with water table varying between 20 to 30 m are present. The Surface drainage of the acquired lease area of the mine is away from the catchment area of the kala nala and the Phool Sagar Reservoir thus having no interaction with the same. There is no nala or drainage passing through the acquired lease area thus having no impact on the surface drainage pattern due to present and proposed expansion.

Vegetation- The area is mostly covered by 1 m to 15 m thick sandy loam. The trees found in the area are neem, babool, etc.Sporadically there is a growth of thorny bushes and cactus.

Climate-Ajmer has a hot, semi-arid climate with over 450 mm of rain every year, but most of the rain occurs in the monsoon months, between June and September. Temperatures

remain relatively high throughout the year, with the summer months of April to early July having an average daily temperature of about 30 °C (86 °F).. The winter months of November to February are mild and temperate with average temperatures ranging from 15–18 °C (59–64 °F) with little or no humidity. There are, however, occasional cold weather fronts that cause temperatures to fall to near freezing levels.

2.6 GEOLOGY

Kayad deposit is hosted by mid 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 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.

Table No.2.3: Summarized Geological Succession

Group	Sub Group	Formation	Litho units
Ajabgarh Group	Arauli	**Ajmer Formation**	Carbonaceous Phyllite, Garnetiferous, Chlorite schist
	Barkhol		Carbonaceous Phyllite and Quartzite
	Thanagazi		Phyllite , Felsic volcanic rocks
	Sariska		Quartzite, Phyllite and Marble
	Kushalgarh		Siliceous Schist, Marble bands and dolomite rich bands.

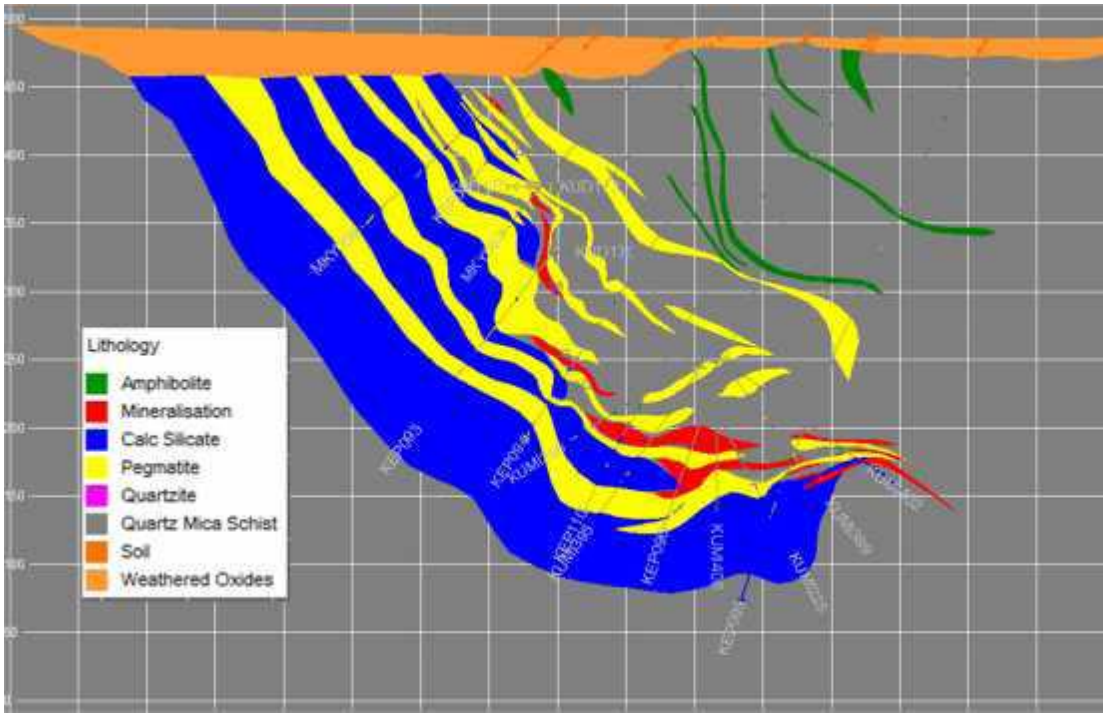

Figure 2.5: Typical Geological Section showing different lithology

Structure

The general strike of litho units exposed in the Kayad and its surrounding area is NNE-SSW to NE-SW parallel to regional trend of central axis of main "Delhi Synclinorium". An open fold structure with shallow north easterly plunging hinge has been revealed after the detailed studies of the recent oriented core drilling over the deposit. The contact of quartz mica schist and calc silicate is a folded one. Hinge of the fold strikes in N25E-S25W direction. While one limb is dipping about 60^0-70^0 due SE, the other one is flatter with dips ranging from 10^0 to 40^0 due SE.

The primary bedding is well preserved in the form of color and compositional banding represented by bands of ferruginous, siliceous and carbonates material in the calc-silicate exposed on the mound east of Kayad village. Foliation in the schist is parallel to axial plane of F2 fold and is dominant secondary structure recorded in the area. The foliations are often seen crenulated in the schist due to later deformation and shearing.

Joints are seen in the quartzite, quartz mica schist, Calc-silicate and rarely in the migmatites and gneisses. The common trends are E-W with vertical dips and NNE-SSW having steep dips of 70 to 80 degrees due east or west.

Mineralization

In the mineralised zone grains of sphalarite, galena and pyrrhotite show effect of shearing in the form of brecciation and mylonitisation. Number of small sympathetic to tangential shears and fracture planes of varying width is encountered in the boreholes. In general these shear planes depending upon their spatial orientation are either at high angle to the core axis or are parallel to sub parallel in nature.

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2.7 ORE BODY AND ITS BEHAVIOR

Geology of the lease area

Kayad is a mostly flat soil covered area except a mound of Calc silicate rock (with Amphibolites and Pegmatite intrusions) situated to the west of the deposit. Few isolated out crops of hard and resistant Migmatites are also seen further west of leasehold in the ground. In general, Meta-sedimentary formations from East to West are the host Quartz Mica Schist (QMS), Calc silicate rock (CSR) and Quartzite.

Lead zinc mineralisation occurs mainly at the interface of Quartz Mica Schist and CalcSilcate with the earlier rock seeming to be the main host rock.

Shape and size of the mineral/ore deposit

There are three major lenses – the Main lens, K1 lens and S1 lens and two minor lens namely S2 & NEML. The main host rock 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. The main lens has been explored to variable depths and maximum upto 50 mRL while K1 and S1 goesupto 375 & 150 mRL respectively.

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 approx 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 2011-12 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.

S2 lens is a low grade resource lying at distance of 600m from the southern margin of main lens. The average width is 2-5m with strike length of 650m at a depth between 200mRL to -150mRL.The Mineralization occurs in calc silicate rock and is disseminated in nature.

NEML lens is at a distance of 500m from eastern margin of main lens. The average width is 3-7m with strike length of 350m and lies at a depth between 0mRL to -280mRL. The Mineralization occurs predominantly in quartz mica schist along with calc silicate rock. The physical parameters of these lenses have been tabulated below in table no 2.4.

Table No. 2.4: Description of Ore body Lenses

Lens	Strike Length (m)		Avg- width (m)	Depth from (mRL)	Depth to (mRL)
Main Lens	Steeper Portion	900	5 – 15	450	230
	Shallow Portion	800	15 – 35	225	50
K1 Lens		250	4	470	375
South (S1) Lens		150	3	450	150
South (S2) Lens		650	2 – 5	200	-150
NEML Lens		350	3-7	0	-233

Disposition

The disposition of various lenses is shown in the perspective view below

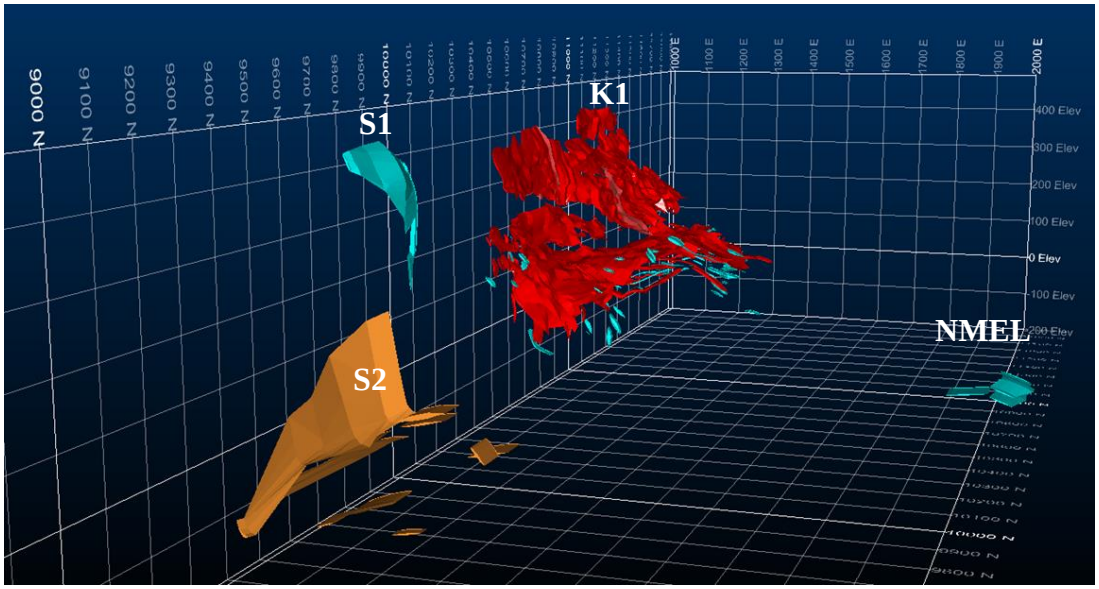

Figure 2.6: Disposition of various lenses

Litho-units

1. **Quartz Mica Schist**: This rock unit is seen mostly in drill core and is rarely exposed in the area. The rock is dark gray to grayish black, fine to medium grained showing schistose texture. It is composed of biotite, muscovite, quartz and feldspar with garnet, rutile, zircon occuring as accessory minerals.

2. **CalcSilcate:** This is grayish white in color, sometimes showing color and compositional banding of white layers of carbonates and greenish gray to dark brown layers of mafic minerals.

3. **Quartzite:** It is found in the western parts of lease. The rock is light gray, hard and compact. It is predominantly composed of quartz.

4. **Pegmatite:** This is an intrusive rock composed mostly of quartz and feldspar, coarse to medium grained. This has intruded and dissected the mineralization in the depth.

5. **Amphibolite:** It is mostly seen in the drill core having concordant relationship with the enclosing rocks. The rock is green in colour, fine to medium grained, massive to foliated in nature. It is mostly composed of hornblende, quartz and feldspar with or without garnets.

Structural Features

The general strike of litho units exposed in the Kayad and its surrounding area is NNE-SSW to NE-SW parallel to regional trend of central axis of main "Delhi Synclinorium". An open fold structure with shallow north easterly plunging hinge has been revealed after the detailed studies of the recent oriented core drilling over the deposit. The contact of quartz mica schist and calc silicate is a folded one. Hinge of the fold strikes in N25E-S25W direction. While one limb is dipping about 60^0-70^0 due SE, the other one is flatter with dips ranging from 10^0 to 40^0 due SE.

The primary bedding is well preserved in the form of color and compositional banding represented by bands of ferruginous, siliceous and carbonates material in the calc-silicate exposed on the mound east of Kayad village. Foliation in the schist is parallel to axial plane of F2 fold and is dominant secondary structure recorded in the area. The foliations are often seen crenulated in the schist due to later deformation and shearing.

Joints are seen in the quartzite, quartz mica schist, Calc-silicate and rarely in the migmatites and gneisses. The common trends are E-W with vertical dips and NNE-SSW having steep dips of 70 to 80 degrees due east or west.

Based on the drilling data and mapping of limited surface outcrops of lithounits it is observed that a major shear zone trending N-S to NNE-SSW is passing through the area near the contact of calc-silicate and quartz mica schist along which major pegmatite bodies have probably been emplaced. This zone is 40 to 100m wide and quartz mica schist show mylonitisation, brecciation and retrograde alteration of muscovite to sericite.

Exploration:

(a) Surface Exploration

In an effort to enhance the reserve & resource base, comprehensive surface exploration is under progress & drilling has been done in phases for up gradation and addition purpose. Over a period of time several high potential targets with in the lease have been identified and are being further explored.

Significant drilling has been done year on year for these targets and the exploration has been done both far and near to the existing main lens. A detailed exploration strategy has been planned and under progress to enhance the resource potential of the area. The location of the potential areas is shown in Fig. bellow:

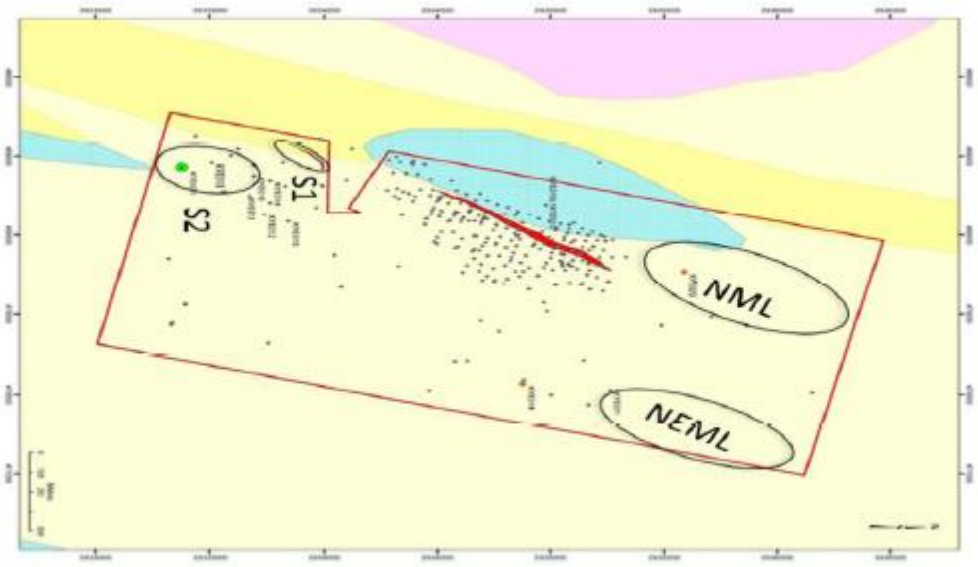

Figure 2.7: The plan showing various exploration targets

North East of main lens (NEML)

In the year 2014-15, around 10590 m drilling was done in 18 Bore holes to fill the gaps in the main lens to upgrade the resources mainly in northern area. Separate potential target lying 500 m east of the main lens in NE was explored

Around 5689 m in 7 bore holes were drilled to establish the resources in depth which were based on the targets generated as a result of multi-disciplinary exploration strategy adopted involving geophysics and geology. 5 bore holes out of 7 were positive and intersected mineralised zones.

To further prove the continuity and nature of the mineralization 3919 m drilling was done in 4 boreholes in the year of 2017-18. The bore holes have intersected the mineralization between - 120 mRL to ‑ 233 mRL. The length of the intersection varies from 1.25 m to 5.5 m with an average grade of 5 to 7 % TMC with mineralization hosted in quartz mica schist and calc silicate.

The above drilling of 9608 m in 11 boreholes has resulted in enhancement of resource by ~0.86 Mt in NEML lens. It is further planned to conduct Bore hole EM Geophysical survey to establish the mineralization continuity in a 200 m radius which will generate additional drilling targets.

North of main lens (NML)

To explore the possibility of northern continuity of the main lens, the drilling was done at 50 x 50 m drill spacing. So far 2203 m drilling in 4 bore holes at a distance of 150 m north of the main lens has been completed.

Continuity of main ore body has been proved by one of the bore holes which has intersected the mineralization at 285 mRL with 3.45 m @ 16 % TMC. One of the additional borehole has intersected 0.40 m @ 10% TMC which depicts pinching and swelling nature of the main lens in strike. These intersections have added 0.01 Mt resources in main lens.

Considering the pinching and swelling nature of the ore zone further drilling is to be taken up to close the gap between the main lens and the intersection.

South of main lens (S2 lens)

In year 2015-16 drilling program was planned to explore the potential in southern part of mining lease at a distance of 800m away from the main lens and to minimize the drilling gaps. This satellite lens is termed S2 lens. 7 bore holes were drilled comprising of 4950 m of drilling which targeted additional resources in S2 lens. All the bore holes had positive intersection with mineralization hosted in calc silicate at varying depth from 230 mRL to -30 mRL. The ore zone is westerly dipping with plunge towards south.

Drilling was done in 2016-17 to further explore continuity of S2 lens in dip/strike. 7 bore holes were drilled covering 4382 m. All the bore holes intersected mineralisation establishing continuity in strike extension further south. These intersections are of an average grade of 3-5% TMC between 230 mRL to -150 mRL. Drilling is under progress to further delineate the S2 lens.

Around 3482 m drilling has been done in year of 2017-18 with 6 boreholes to explore strike/dip continuity of S2 lens. 5 holes out of 6 have been intersected mineralization which has established 650m strike length of S2 lens at depth between 200Mrl to -150Mrl.

These positive intersections have established the mineral resource of ~1 Mt with 1.5 % Zn & 2.5 % Pb and 14ppm Ag.

Available drilling information has indicated an extension of S2 lens in south and east. The planned exploration is under progress to enhance resources and upgrade the resource category.

Others: S1 AND K1

S1 and K1 lens will also further explored to upgrade resource into reserve category and add to the resource potential.

Geophysical technique is also planned on ground as well for down hole (Ground EM/Gravity) along with down hole EM survey between sections S -12 to S 42 which will be followed by drilling in eastern/middle part of lease to establish ore potential.

Simultaneously strike and dip continuity of main ore body will also establish beyond section S 24 in north. This will significantly increase the life of the mine.

(b) Underground Exploration

In the beginning of the project, development of ore drives were mainly guided on the basis of level projections prepared from the surface boreholes spaced at 50 to 100 m. In the upper levels (425, 400, 375) ore body was found to be more or less regular as per projection. But below 350 mRL (350 and 325) ore body deviated significantly from the projection which has rendered level development useless at some locations, this has necessitated reviewing of mine development strategy and need for further exploration from underground to facilitate stope planning and lower level development in ore.

Accordingly the mine development data was integrated with available exploration data and reviewed and a detail exploration strategy has been formulated for precise delineation of ore geometry for minimizing the deviation in ore drive development, better stope planning and reduce dilution. The Original exploration strategy was planned in two phases. In continuation of the same, a third phase is now under progress in light of the positive outcome and recorrelation of the ore body. The details has been explained below -

The scheme is envisaged to be completed in three phases -

Phase-1 comprise of 20061 m of underground diamond drilling at 25X12.5m grid and 1250 m of level development in hanging wall for exploratory Drill drive at 325mRL to facilitate drilling. Phase-1 work started in April 2014 and completed in March 15 with 20061 m of underground drilling in 531 holes. Underground horizontal holes from ore drive were drilled at 12.5m strike spacing on either side. Length of individual holes varies from 15 to 50 m.

These holes have helped in precise delineation of ore body in the level. Inclined holes were drilled from hanging wall drive on standard sections spaced at 25m strike interval. Multiple holes were drilled from each section in fan shape manner to define the ore body between 325-225m levels at regular interval of 12.5m along dip direction. The above work has established 2.1 million tons of proved reserves up to 225 Mrl

Phase-2 involves total 35000 m of underground diamond drilling at 25X12.5m grid and 1210 m of level development for exploratory drive in hanging wall at 250mRL out of which 21890 m drilling has been completed up to March 2016. The exploratory drilling has been done in a fan shaped pattern covering the whole strike length of the ore body. The exploratory drilling was mainly for block 2 and partially for Block 3. Around 10248 m drilling was completed up to January 2017 to cover the remaining exploration gaps in Block 3

Phase 3: The exploratory drilling completed in the phase 2 has generated additional targets and opened a scope for further drilling in eastern part of main lens due to positive intersections. As the bore holes from the existing drive were going parallel to the ore body, it was planned to move the drilling location further east. Therefore an additional exploratory drive in Hang wall is planned which is 110 m towards east from the existing drive to intersect the ore body at steep angle.

The exploratory drive will cover ~ 450 m length of the ore body along the strike. Total 10000 m drilling is planned from this exploratory drive which will be done in fan shaped manner to cover the lateral expansion and prove the eastern continuity of the block-III Ore body. Exploration for K1 & S1 lens is also planned to upgrade it to prove category in phase 3. The same will be taken up from Surface exploration.

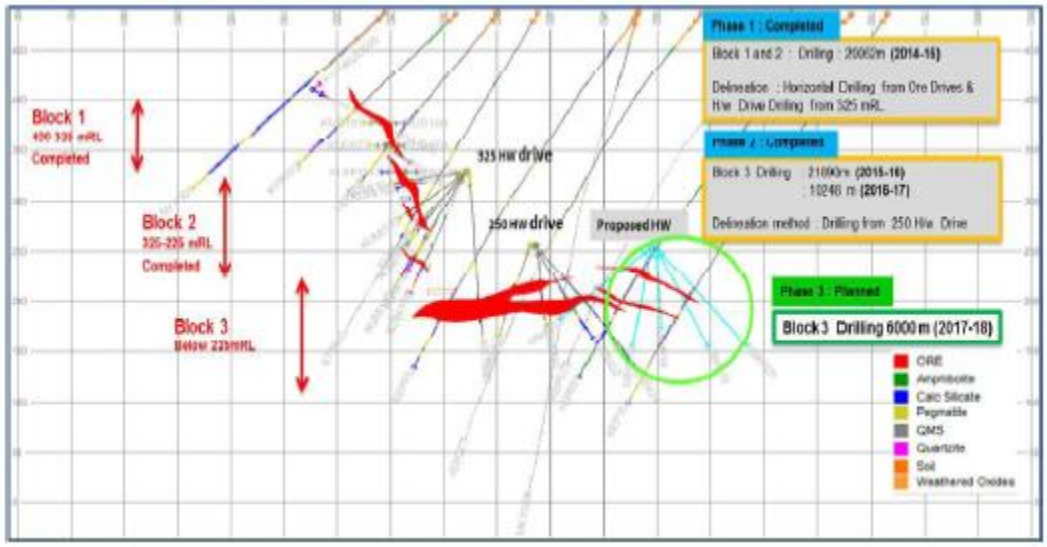

Figure 2.8: Phase wise UG exploration

2.8 RESERVES & RESOURCE AS PER UNFC CLASSIFICATION

Depending on the stage of exploration, geological resource generation includes sequential upgradation from G3 to G1 levels to decipher mineable block for extraction. Regarding feasibility & viability parameters, indicated & inferred category of mineral resource being less than 100m extension of confirmed block bear fair degree of confidence for their mining. Categorization based on geological confidence, feasibility & viability described in as under.

Table No. 2.5:Reserve and Resources as per UNFC

Level of Exploration	Depth (mRL/level)	Area (ha)	Resources in million tonnes	Zn %	Pb %	Ag (ppm)
G1- Detailed Exploration	50	156	7.03	7.97	1.16	30
G2- General Exploration	-80	114.85	0.50	7.58	1.22	19
G3- Prospecting	-280	209.6	2.21	4.8	1.2	17
G4- Reconnaissance		-	-	-	-	-
TOTAL		**480.45**	**9.74**	**7.23**	**1.17**	**26**

The estimated ore reserves and resources as on 30.09.2017 of Kayad mine stands at 9.74 Mt (1.17% Pb, 7.23% Zn). The reserves are in the tune of 7.03 Mt. For 1.2 Mt per annum of production, the life of the mine as per existing reserve comes to approximately 6 years. Apart from this potential of 2.21Mt of resources has been established by exploration and further increase in resource is envisaged through ongoing exploration. The additional resources once upgraded to reserves will further add 2 to 3 years of mine life.

Base Data Generation for Reserves and Resources & Ore body Model.

The underground exploration is being done on 25mX12.5 m horizontal & vertical grids and all exploration data is collected on these grids to decipher geological parameters in 3D. All data is electronically translated and is being used to create ore body model & mine designing using DATAMINE software.

Basis of Estimation of mineral resources

The ore body shapes are interpreted based on correlation of geological structures and ore intersections on transverse sections and level plans. The reserves/resources are being computed using DATAMINE software.

Based on fresh R&R estimation as on 01.10.2017, the total tonnage is estimated to be 9.74 Mt. and the UNFC classifications given below:

Table No. 2.6: Status of Reserve & Resources as on 01.10.2017

Category	UNFC code	*(Million Tonnes)*	Zn%	Pb%	Ag g/t
A. Mineral Reserve					
1. Proved Mineral Reserve	111	2.00	7.30	1.00	28
2. Probable Mineral Reserve	121 and 122	5.03	8.24	1.22	30
Total Reserve		**7.03**	**7.97**	**1.16**	**30**
B. Mineral Resources					
3.. Measured Mineral Resources	331	-	-	-	-
4. Indicated Mineral Resources	332	0.50	7.58	1.22	19
5. Inferred Mineral Resource	333	2.21	4.80	1.20	17
Total Resources		**2.71**	**5.31**	**1.20**	**17**
Total (Reserve & Resources)(A+B)		**9.74**	**7.23**	**1.17**	**26**

Proved Mineral Reserves (111): 2.0 Mt reserves are economically mineable part of measured mineral resource, for which primary development and exploration at 25m interval is completed.

Probable Mineral Reserves (121 and 122): 3.4 Mt reserves are economically mineable part of Indicated mineral resource, for which development is partly completed or is under progress and exploration at 25m interval is fairly completed. The Probable reserves will be converted into Proved category once the development is fully completed. The part of ore production during next five years will come from these reserves.

Measured and Indicated Mineral Resource (331 +332): 1.3 Mt resources are estimated with fair level of confidence based on 25-50 m spaced exploration and geological evidence. More than 23000 m drilling has been done which has covered major exploration gaps in block 1 and block 2 and has resulted in up gradation in measured resources

Inferred Mineral Resource (333): 0.4 Mt resources are estimated with low level of confidence based on 50-75m spaced exploration and geological evidences. Further exploration is under progress to address the variation in ore body, random intrusion of pegmatite and pinching and swelling nature of ore body.

A mineral resource has been estimated as per UNFC and is given below:

Table No. 2.7: Mineral Resources as per UNFC classification

Level of Exploration	Resources in million tonnes	Zn %	Pb %	Ag (ppm)
G1- Detailed Exploration	7.03	7.97	1.16	30
G2- General Exploration	0.50	7.58	1.22	19
G3- Prospecting	2.21	4.8	1.2	17
G4- Reconnaissance	**-**	**-**	**-**	**-**
TOTAL	9.74	7.23	1.17	26

2.9 MINING

2.9.1 Open Cast Mining

No open cast operation / mining are being done.

2.9.2 Underground Mining

2.9.2.1 Mode of entry (Decline)

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 ore body, 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.

Decline access is best suited for the shallow depth of Kayad deposit, proposed high mechanization and for the planned production capacity of 1.2 Million tones.

2.9.2.2 Description of Mining Methods

A. Longitudinal Long Hole Open Stoping (LHOS):

For Longitudinal Long hole open stoping method, the stope size planned is 25m height, 25 – 50m length (along strike) depending upon the geometry of the ore body and geotechnical Consideration.

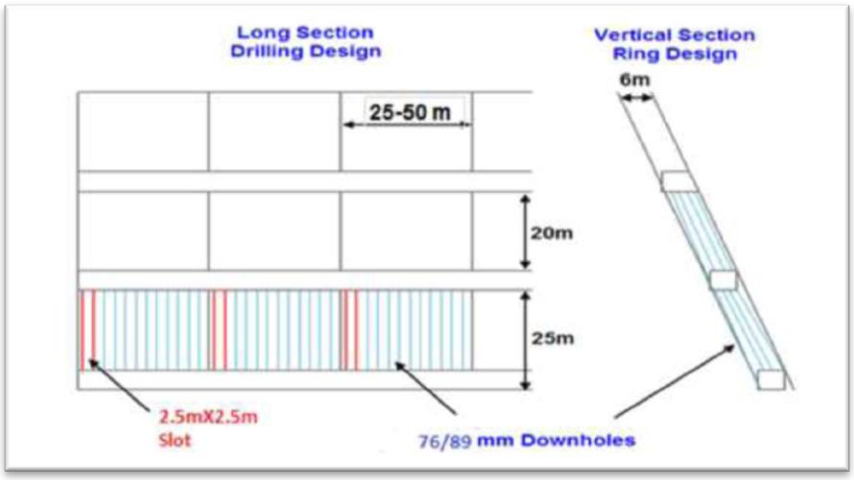

Figure 2.9: Typical Longitudinal LHOS

B. Transverse Long Hole Open Stoping (LHOS):

The stopes are planned across the strike in transverse direction with individual stopes of 10-25m 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.

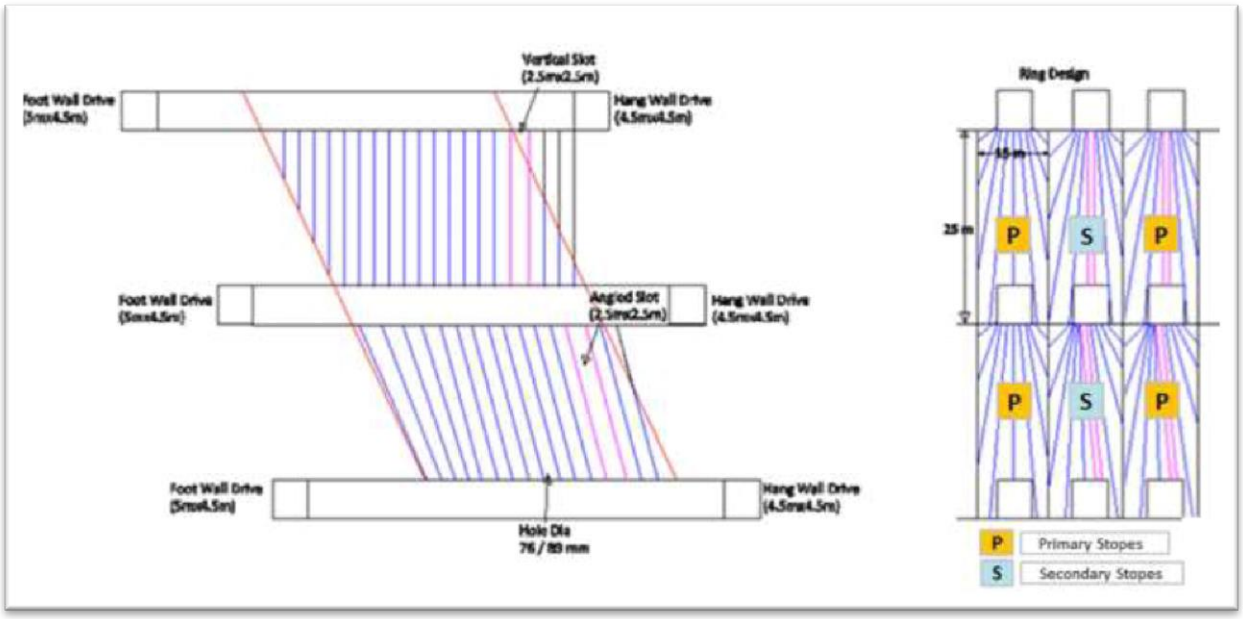

Figure 2.10: Typical Transverse stope

3.9.2.3 Conceptual Mine Plan

Planned production from Kayad mine had been increased to 1.0Mt per annum as per approved modified mine plan vide Letter no. 584(5)(3)(406)/11-AJM, dated 07.05.2013 by The Controller of Mines, IBM - Ajmer (Details in Table and EC terms dated 23.09.14 *(A6)*. The mine has now reached to a sustained level of production at the designed rate 1.0Mt per annum. Before embarking on to the details of mining, it is necessary to discuss briefly the conceptual plan, hereunder.

The ore body at Kayad comprises of discontinuous veins, fracture fillings and occasional disseminations of the sulphides. The true width of ore body is varying from 5 m (in the steeper portion) to 50 m (in the shallow areas).

From the ore reserves and mineral resources summary as on 01.10.2017 estimated reserves and resources of Kayad mine stands at 9.74 Mt (1.17% Pb, 7.23% Zn). For a 1.2 Mt per annum of production, the life of the mine as per existing reserve comes to approximately 6 years. Apart from this potential of 2.21Mt of resources is established by exploration which is still continued. Considering past exploration results, the additional resources will be converted to reserves to enhance the life of mine.

Presently, the mine is being worked at 180 mRL and by the end of the 4th year of the Modified Mining plan the mine workings are expected to reach 50mRL. Exploratory drilling is being carried out from surface and underground, for proving the further depth extension of ore body below 50 mRL. With exploration effort the reserve and resource of Kayad deposit is expected to increase in due course of time.

Based on the current reserve and resource of Kayad deposit it is, technically feasible to achieve ore production rate of 1.2Mt per annum as per the mining plan.

Kayad deeper level exploration is under progress and there are positive intersections of High Grade Ore up to (-) 128 mRL in North along 400m away from present working. Similarly the Deeper level exploration in southern extension has indicated presence of mineralization at the depth of (-) 125 mRL along 200 m away from the existing working.

2.9.3 Development and stopping method

The upper, steep dipping section of the ore body 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 ore body is accessed via footwall drives developed north and south from the decline accesses,

along the strike extent of the ore body. 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 and Long Hole Open Transverse stoping is proposed for the shallow (almost flat) portion of ore body below 225 mRL. In Block III wherever ore body is steeper Longitudinal Open Stoping Method is proposed. All the mining is planned with back filling with Rock fill (RF) and Cemented rock fill (CRF). Other Mining Methods such as Drift and fill method may be considered wherever ore body configuration requires.

The blasted muck from stope is then withdrawn at extraction level through LHDs and then directly loaded in to mine trucks for hauling through ramps from underground to surface stock yard. From stock yard, ore is dispatched to Rampura Agucha Mine for further processing.

Underground Layout

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. shown in **table no.-2.8**

The decline is 5.50 m x 5.00 m (WxH) cross section with arched roof throughout its length with gradient of 1 in 7. The main levels (having same dimensions as decline) are at 400mRL, 375 mRL, 350 mRL, 325 mRL, 300 mRL, 275 mRL, 250 mRL, 225 mRL, 200 mRL, 175 mRL, 150 mRL, 125 mRL, 100 mRL, 75 mRL and 50 mRL. 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.

Proposed Mine Development Schedule for Next Four Years

Block III is currently being developed and ore production is from stopes between 180mRL and 200mRL. Development is also planned for the extraction of S1 and K1A lenses in Block I. The bulk of ore production during next four years will be from block III and from some ore body extension in extremities and also Block II pillar mining. 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. Year-wise mine development schedule during next Four years is depicted in LVS in Plate No. 6. If the ore body 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 Particulars of level wise development envisaged during next Four years are depicted in the following table.

Table No.2.8: Four Year Level wise Mine Development plan.

Unit: In meter

	Level RL	Name	2017-18	2018-19	2019-20	2020-21	Total
K1A	**375 - 450**	Decline		240	240		480
		Ore Drives		250	500	50	800
		Waste X/C		540	450	200	1190
		Raises		50	50	50	150
S1	**300-375**	Decline		300	300	300	900
		Ore Drives		350	550	200	1100
		Waste X/C		800	600	500	1900
		Raises		50	50	50	150
	150-225	Decline	160	0	0	0	160
		Ore Drives	1,800	1,750	1500	850	5900
		Waste X/C	3,200	1670	450	800	6120
		Raises	150	150	150	150	600
	50-150	Decline	750	600	500	0	1850
		Ore Drives	1,240	750	410	1000	1000

Block III		Waste X/C	2,500	150	650	1350	4650
		Raises	200	100	100	0	400
	Contingent development		500	750	1000	1000	3250
	Total	Decline	910	1140	1040	300	3390
		Ore Drives	3040	3100	2960	2100	11200
		Waste X/C	5700	3160	2150	2850	13860
		Raises	350	350	350	250	1300
		Grand Total	**10,500**	**8,500**	**7,500**	**6,500**	**33,000**

Proposed Ore Production Schedule for Next Four Years

Ore Production in Block II (225-300) will be completed by the year 2017-18. Block III is currently being developed to commence ore production which will be sustained during next Four years. To maximize the ore recovery production is also planned above 375mRL in main lense and from S1and K1A lense in Block I after required technical studies .The proposed Ore Production is tentative and may need to be revised to some extent depending on the ore body configuration and technical reason on account of ore body complexities.

In order to maximize ore recovery it is also planned to mine the Pillars between two mining blocks based on Geotechnical studies done by CIMFR, Nagpur. Year-wise Ore Production schedule during next four years is depicted. Particulars of level wise Production envisaged during next four years are depicted in table below.

Table No.2.9: Year wise production plan for next 4 years

Lens		Level	Northing	Stope	2017-18	2018-19	2019-20	2020-21	Total
S1 Lens		300mRL to 435mRL	N9640 to N9815	S1,S2,S3,S4,S5, S6,S7	0	0	25000	135000	**160000**
Block I	**K1A Lens**	400mRL to 450mRL	N10490 To N10710	S1,S2,S3,S4 N1,N2,.N3,N4, N5	0	0	50000	80000	**130000**
	375 & above	375mRL to 425mRL	N9960 To N10740	S1,S2,S3,S4,S5, S6,S7,S8,S9,S10,S11,S12,S13,S14,S15,S16,N1,N2.N3,N4,N5, N6,N7,N8,N9,N10,N11,N12,N13,N14,N15	0	50000	50000	17000	**117000**
Block II	**Pillar**	300mRL to 325mRL	N9960 To N10740	S1,S2,S3,S4,S5, S6,S7,S8,S9 N1,N2.N3,N4,N5,N6,N7,N8,N9, N10,N11,N12,N13,N14,N15,N16	90000	0	0	0	**90000**
	Main Lens	225mRL to 300mRL	N9930 To N10800	S1,S2,S3,S4,S5, S6,S7,S8,S9,S10,S11,S12,S13,S14,S15,S16,S17,S18 N1,N2.N3,N4,N5,N6,N7,N8,N9, N10,N11, N12,N13,N14,N15,N16,N17,N18	14000	0	0	0	**14000**
Block III	**Main Lens**	150mRL To 225mRL	N10000 To N10770	N260-N305, N320-N350, N365-N395, N410-N440, N455-N485, N500-N530, N545-N575, N590-N620, N635-N665, N680-N730, N745-N760, S50-S95, S105-S140,S155-S185,S50S95,S105-S140, S155S185,S200-S245	941000	1038000	955000	780000	**3714000**

	Main Lens	50mRL to 150mRL	N10000 to N10255	S50-S95, S110-S140,S155-S185, S200-S245	0	57000	85000	173000	**315000**
				Total Stoping Ore	1045000	1145000	1165000	1185000	4540000
				Total Development Ore	155000	55000	35000	15000	**260000**
				Total Production	**1200000**	**1200000**	**1200000**	**1200000**	**4800000**

Note: *The tonnage for individual year from particular level and lens shall be as per the Table no. 30.The tonnage from the stope is tentative and may vary ± 20% due to sequential mining operation*

Table No. 2.10: Mine Development Ore (Mt) during next 4 years

Level	***2017-18***	***2018-19***	***2019-20***	***2020-21***	**Total**
S1 Lens		2500	2500	2500	7500
K1A Lens		2500	2500	2500	10000
50-150	0	15000	20000	5000	47500
150-225	155,000	35,000	10000	5000	205000
Total	**155,000**	**55,000**	**35,000**	**15,000**	**270,000**

2.9.5 System of drilling and blasting

Production drilling shall be done using Electro Hydraulic Simba drilling m/c for drilling 76 – 89 mm dia. Holes. Holes shall be drilled in upward/downward direction/ fan shape according to the geometry and configuration of the ore body. The drilling and blasting parameters for Longitudinal and Transverse stopes are shown in following table:

Table No.2.11: System of Drilling and Blasting

Drilling pattern in ore	Burn cut
Drilling pattern in Rock	Burn cut
Drilling pattern in Stopes	Ring/Parallel hole drilling
Ring Burden for 76mm dia. Holes	2.2 m
Ring Burden for 89mm dia. Holes	2.7 m
Ring Spacing for 76mm dia. Holes	2.2 m
Ring Spacing for 89mm dia. Holes	2.7 m
Maximum number of holes blasted in a round.	65 holes
Charge per round (Kg)	250Kg to 1000Kg
Charge per hole (kg)	Charge per hole (kg) 35Kg to 200Kg
Drill Factor for 76mm dia. Holes	6 t/m
Drill Factor for 89mm dia. Holes	9 t/m
Type of explosive	Emulsion Explosive
Powder factor (Norms)	
Rock development-	0.8 to 1.05 kg/t
Ore development-	0.8 to 1.05 kg/t
Stope-	0.30 to 0.50 kg/t
Powder Factor (Actual)	
Rock development-	0.8 to 1.05 kg/t
Ore development-	0.8 to 1.05 kg/t
Stope	0.30 to 0.50 kg/t

2.9.6 Method and sequence of stoping

From the ore reserves and mineral resources summary as on 01.10.2017 estimated reserves and resources of Kayad mine stands at 9.7 Mt (1.17% Pb, 7.23% Zn). For a 1.2 Mt per annum of production, the life of the mine as per existing reserve comes to approximately 6 years. Apart from this potential of 2.71 Mt of resources is established by exploration which is still continued. The additional resources are expected to add to further 2 to 3 years of mine life.

Block I Mining (Between 465 mRL to 325 mRL):

The ore block in Main Lens between 325 mRL and 375 mRL has been mined out. It is proposed to continue mining above 375mRL after carrying out necessary technical studies for maximizing the ore recovery. It is also proposed to mine K1A lens and S1 Lens located in the North and South sides respectively of this mining block.

Block II Mining (Between 325 mRL to 225 mRL):

The ore between 225 mRL and 300mRL has been mined out except for access pillars. Pillar recovery in Block II mining is currently being carried out between 300 and 325 mRL using the Longitudinal Open Stoping Method.

Block III Mining (Below 225 mRL):

As per the geological information available presently the orebody is flattening below 225 mRL.In certain part of Block III ore body is steeper also. Therefore it is proposed to adopt a combination of longitudinal and transverse stoping methods in this block for maximizing ore recovery. In transverse long hole stoping method in the central part of the block III, it is proposed to carry out mining in primary and secondary sequence.

Primary stope will be mined out and backfilled and subsequently mining of secondary stopes shall be carried out. longitudinal open stopes, in the northern and southern the mining sequence will be in the retreating manner from the extremities.

Other mining methods like drift and fill will also be examined to adopt to the ore body configuration so as to maximize ore extraction.

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 hangwall 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 next Four years is given in Table No.29 and Table No.30 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. In Block III wherever ore body is steeper Longitudinal Open Stoping Method is proposed. All the mining is planned with back filling with Rock fill (RF) and Cemented rock fill (CRF).Other Mining Methods such as Drift and fill method may be considered wherever orebody configuration requires.

2.9.7 Filling System

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 LHD's 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 rock fill.

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.

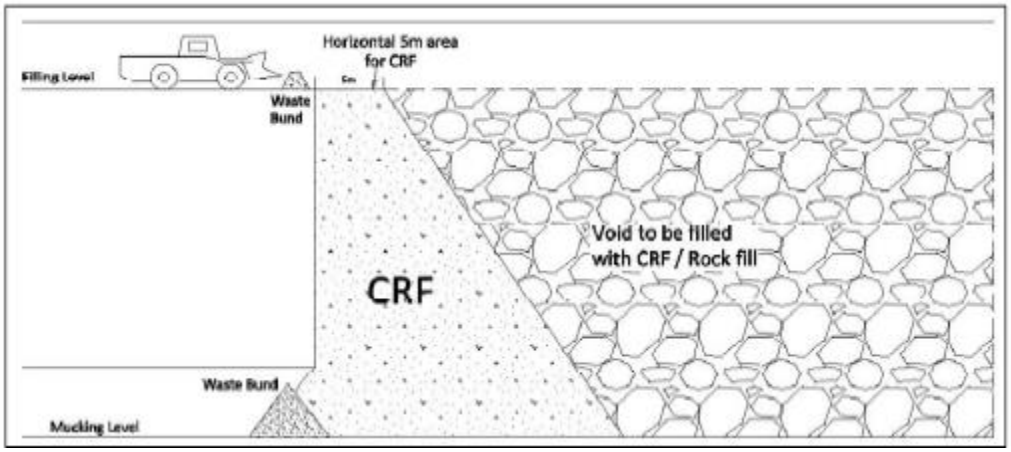

Figure 2.11: Diagram showing backfilling process.

CRF Reticulation:

Major ore production in upcoming years will be from Block-III which is below 200 mRL Almost 75% of total backfilling will be done with cemented rock fill (CRF) below 200 mRL Currently the cement slurry discharge is at 400 mRL and two millers are being used to deliver the cement slurry for CRF backfilling.

Due to a an increased rate of filling as a result of transverse stoping method and increased production rate, CRF cement slurry will be 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 will be installed at the bottom of the hole to reduce the pressure of slurry coming from surface. The slurry will be delivered directly into mixing crosscut drive where an LHD will mix waste rock with the cement slurry. Also there will be an arrangement of filling miller at 200 mRL so that the miller can deliver the cement slurry below 200 mRL wherever required.

2.9.8 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 persons capacity and light moving vehicles for transportation from surface to underground. Manholes, at every 20m are provided in ramp.

Surface Transportation:

The ore from underground is stacked at Surface stockpiles. From surface stockpiles, the ore is transported to Rampura Agucha Mine for by dumpers of 25t/30t capacity further processing. Rock breaker is also deployed at surface stockpiles for breaking large sized boulders.

2.9.9 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 393mRL to the main decline. The shaft serves as second outlet and intake. A winder of 60 HP with cage for 6 persons capacity has been installed.

2.9.10 Subsidence Management

Table No. 2.12: Subsidence Management

1	Whether surface areas being monitored are marked on plan?	Marked in surface plan
	Details of surface features in the subsidence basin	NA
2	Whether monitoring points have been marked on plan as well as on ground?	Marked in ground
	Depth of the workings from surface (m) where subsidence is being measured.	Vary from 293 to 465m
3	Maximum subsidence observed at monitoring points (mm)	No subsidence
4	At what frequency subsidence monitoring is done?	Monthly
5	Whether results of monitoring are being properly recorded?	Recorded
6	Angle of draw observed on dip and strike side.	NA
7	Whether critical, sub-critical or super-critical area extracted?	NA

2.10 PROGRASSIVE MINE CLOSURE PLAN

Existing area is open and flat (486 mRL) 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 No.2.13 Land use pattern within Study area. (Area in Hectares)

Name of the Village	Radius in km from	Total Area	Forest	Irrigated Arable	Un-irrigated	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
Kankarda-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 %	--	**100.00**	**8.78**	**45.70**	**26.06**	**13.82**	**5.63**

The study area has no National park, Wildlife Sanctuaries, Biosphere Reserve etc. The details of land use pattern are given below:

Table No. 2.14: Land use pattern with in Lease area

S.No.	Description	Pre-Mining	Operational
1	Un-irrigated, village road and canals	23.53	14.89
2	Charagah	11.10	11.1
3	Residential, Poultry and agriculture	440.82	402.31
4	Barren	0.00	0

5	Forest	0.00	0
6	Mining Operation for industrial use (Portal, OB, Ore storage etc)	0.00	6.19
7	Road black top all weather	0.00	0.88
8	Water bodies(Kayad nala , rainwater harvesting pond	5.00	5
9	Green Belt	0.00	21
10	Open land in mining	43.99	19.13
		480.45	**480.45**

Table No. 2.15: Land use pattern with in acquired area.

S. No.	Description	Present Land use (Ha)	Land use Proposed under Plan Period (Ha)
1	Area to be excavated	0.73	0.73
2	Storage of top soil	0.24	0.24
3	Overburden / Dump	1	1
4	Mineral storage	1.4	1.4
5	Infrastructure (workshop, buildings etc.)	2.4	2.4
6	Road	0.88	0.88
7	Green Belt	21	24.8
8	Water storage tank	0.06	0.06
9	Surface water bodies/ponds	1.3	1.3
10	1 MT Magazine	0.01	0.01
11	Bulk Emulsion plant & ANFO	0.35	0.35
12	Open spaces	19.13	15.33
TOTAL		**48.5**	**48.5**

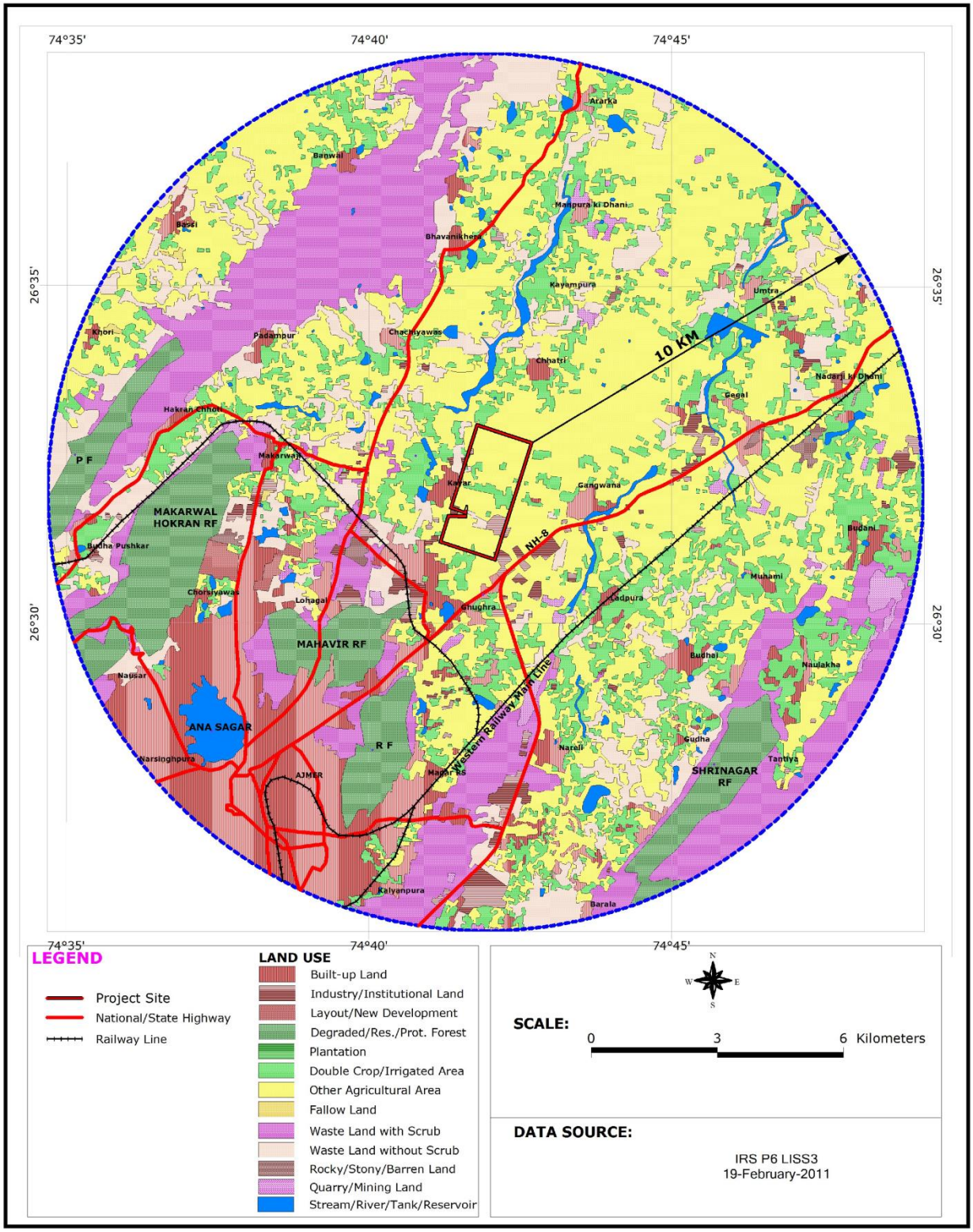

Figure 2.12: Land Use Map

Mine Ventilation

Three main mechanical ventilators having a capacity of 150m^3/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 (170m^3/s), North Intake raise (70m^3/s), South Intake raise (90m^3/s) and Secondary Outlet (20m^3/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 ISM,Dhanbad.

The main decline splits into two, South decline and North decline at 412mRL. The North and South section intake air is connected up to 180mRL and 175mRL 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 air requirements in working areas.

The development headings are ventilated by auxiliary ventilation fans of 22kW (15m^3/s), 75 KW(20m^3/s), 132KW(35m^3/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.

2.11 EXTENT OF MECHANIZATION

The mine development is being carried out using combination of drill jumbo and LHD. In stopes, for production drilling Electro hydraulic Simba and ITH drill machines are being used. For mucking diesel LHDs are being deployed. The ore is mainly transported to surface through ramp by diesel LPDT's (Low Profile Dump Trucks). The ore after breaking on surface is loaded into dumpers and transported to Rampura Agucha beneficiation plant. To achieve ore production rate of 1.20 Mt per annum the number of machineries has been

envisaged. The status of existing mine equipment and additional requirement is illustrated in table below:

Table No.2.16: List of Mining Machineries in Use

S. No.	Type of Machinery & Name	Make	Current	Requirement
1	LHD 17T	Sandvik	7	10
2	LHD 10T	Atlas Copco/ Sandvik	1	1
3	LPDT 60T	Atlas Copco	3	6
4	LPDT 50T	Atlas Copco/Sandvik	4	4
5	LPDT 30T	Atlas Copco /Sandvik	4	7
6	Single boom Drill Jumbo	Atlas Copco	1	1
7	Double boom Drill Jumbo	Atlas Copco	5	7
8	Production Drills	Atlas Copco/Sandvik	5	6
9	SCISSOR'S LIFT	Normet	4	4
10	MULTIMEC	Normet	1	1
11	Personnel Carrier	Normet	2	2
12	Rock Bolter	Sandvik	2	2
13	Scalar	Normet	1	1
14	Road grader	Caterpillar	1	1
15	Compressors	Ingersoll Rand	2	2
16	Miller Cassette	Normet	2	3
17	Cable Bolter	Sandvik	0	1
18	Light Motor Vehicle	Mahindra/Normet	7	10
19	Cable Handler	Normet	0	1

2.12 MINE DRAINAGE

(a) Minimum and maximum depth of water table based on observations from nearby well and water bodies

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 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 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 metamorphic rocks, during post monsoon period ranges within very wide limit from 3 to 30 metre 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 pre monsoon period. The fluctuations due to rainfall and ground water withdrawal are significant as the rocks have very low fracture porosity and hydraulic conductivity.

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(b) Indicate maximum and minimum depth of workings

Maximum depth of working current is 175mRL and minimum depth is 400mRL.

(c) Quantity and quality of water likely to be encountered, the pumping arrangements and places where the mine water is finally proposed to be discharged.

Minor seepage is observed in the mine. Only re-circulated water which is used for drilling and dust suppression is routed through raises/boreholes to sumps at various blocks & pumped to surface storage tank through incline and re-circulated for mining activities to minimize the fresh water addition. Presently sump of 1000cum capacity at 412 mRL in North section and

275mRL in both section are available. Water from 412mRL and 275mRL sump will be directly discharged to surface through boreholes equipped with pumping installation & dewatering pipe lines to surface. Additional level sumps are being developed at each working level in order to meet the water handling requirements of the mine. The existing anticipated maximum intersecting water is to be 147 m^3/day. The suspended particles in the collected water get settled in the settlers. The decanted water is pumped to surface storage tank by multistage pumps through dewatering pipe lines. Submersible pumps are used for periodic cleaning of the sludge from the sumps. The water from surface storage tank is re-circulated for use (except drinking) in the mine maintaining zero discharge. The quality of water in core and buffer zone has been discussed in chapter 3 of this report.

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 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. Rainfall is restricted to monsoon period between July and September and average annual rainfall between 2001 and 2010 was 245.50 mm.

All surface runoff from the OB dump, Mineral storage area shall be collected through proper garland drains and routed through desilt pits to remove suspended particles. The desilted runoff water shall be collected in large surface storge ponds for reuse in mining operations and green belt development and this pond is also used as recharge pit.

Detailed hydrogeological study for groundwater intersection for proposed expansion is attached as **annexure XI.**

2.13 STACKING OF MINERAL REJECT/SUB GRADE MATERIAL AND DISPOSAL OF WASTE

a. The nature and quantity of top soil, overburden / waste and Mineral reject disposed off.

The muck generated from the development heading would be Quartz mica Schist, calc silicate and Pegmatite. Waste generated from the mine development is brought to the surface waste dump area. The waste generated from underground mine development will also be disposed-off in mined out stopes. LHD /LPDT will be used for waste disposal into mined out stopes. No sub grade minerals will be produced. If any sub grade mineral will be encountered then it will be stacked separately from waste dump site for use in future depending upon economic viability.

The location of the waste dump is indicated within lease boundary.

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

Table No. 2.17: Waste generation during next 4 years

Year	Approx. quantity of Waste generation (t)
2017-18	5,00,000
2018-19	4,00,000
2019-20	3,50,000
2020-21	2,00,000
Total	**14,50,000**

b. The proposed dumping ground within the lease area be proved for presence or absence of mineral and be outside the UPL unless simultaneous backfilling is proposed or purely temporary dumping for a short period is proposed in mineralized area with technical constraints & justification.

No pre-concentration of the mineral is exercised at site. Ore from the stopes and development headings and waste from other development headings are handled separately from its place of origin and then dumped in the respective areas – ore to the surface stockpile and waste at belowground as cemented rock fill or at the surface waste dump as may be applicable at the instant. The ore stockpile and waste dump area has been indicated in the Surface Plan.

The waste dump area has a bottom floor at 486 mRL for a maximum height of 20m in two lifts. retaining wall and a garland drain along the periphery of base of the waste dump is constructed as a protective measure. This drain discharges the water into a pit of size 40.0 m (L) * 20.0 m(W)* 1.5 m (D) constructed at the low-lying area near the waste dump where the water is allowed to de-silt and the run-of water from this pit is taken for recycling for mining purposes. The waste dump is of temporary as end of mine life all waste generated will be backfilled in mine.

c. Manner of disposal of waste, configuration and sequence of year wise build-up of dumps along with proposals for protective measures.

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 itself from January ‘15. Currently all the CRF for stopes comprises of waste generated out of the current mining operations and waste from surface waste dump that is transported to belowground for the purpose.

Table No.2.18: Estimated backfilling requirement during next 4 years

Year	Backfill Requirement Est(t)
2017-18	750,000
2018-19	825,000
2019-20	825,000
2020-21	850,000
Total	**3,250,000**

To meet the requirement of waste for filling purposes, the following strategy, under economic considerations, is proposed -

1) The waste will be obtained from Rampura Agucha mines or some other suitable source from nearby areas meeting the backfill requirement.

2) Alternatively it is also proposed to examine the option of backfill material from mining lease area by carrying out necessary excavation. The excavation will be limited to approximately 30m depth and no deep hole blasting will be done. The rock will be excavated by rock breaker or other suitable equipment and transported by trucks to the underground for backfilling. This proposed area will be kept sufficiently away from the existing structures and any underground mining workings. The excavated area will be subsequently utilized as water reservoir. The approximate tonnage generated will be 3.0 MT which will be sufficient for the backfilling throughout the anticipated mine life.

2.14 USE OF KAYAD MINERAL AND MINERAL REJECT AT RA MINE

Kayad Lead Zinc Mine of M/s Hindustan Zinc Limited is a captive mine as the final product after mining & ore beneficiation is sent to captive smelters in the form of concentrate.

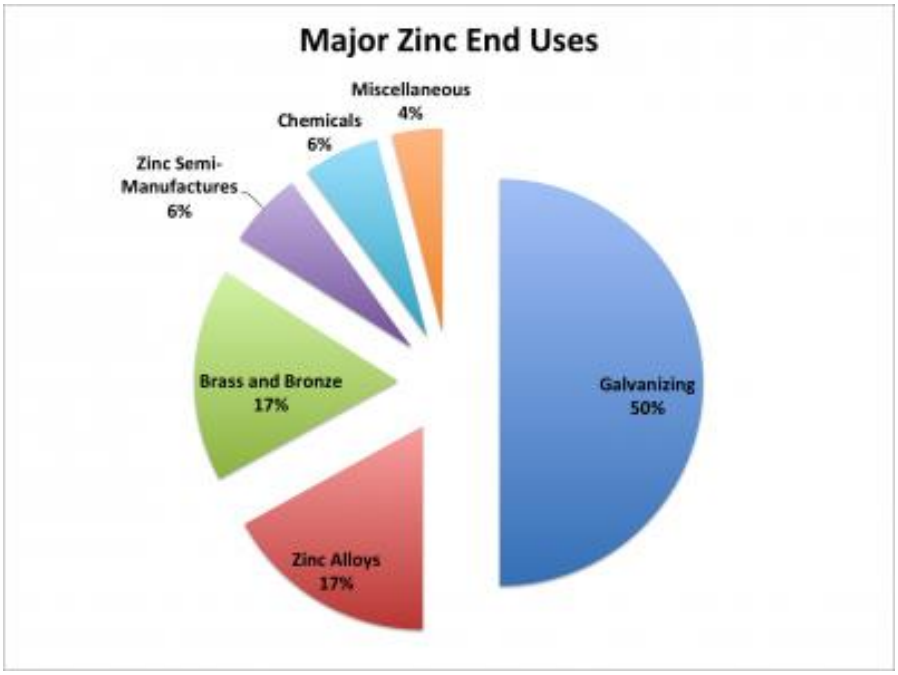
ROM production consists of economic extraction of Lead & Zinc sulphide mineral in the form of Sphalerite and Galena. The mineral is not directly usable. The minerals from the mines are concentrated to 51.0% zinc and 53.0% lead through chemical & froth flotation process at the Integrated Beneficiation Plant (Mill).

The Lead & Zinc concentrates are sent to following smelters of the company to produce lead & zinc metal and therefore the mine holds a "Captive" mine Status.

- Lead Zinc Smelter, Chanderiya (Rajasthan)
- Dariba Smelter Complex, Dariba (Rajasthan)

a) End-use of industry specifically in terms of physical and chemical composition

About 12 million tons of zinc is produced annually worldwide. Half of this amount is used for galvanizing to protect steel from corrosion. Approximately 17% goes into the production of zinc base alloys, mainly to supply the die casting industry and 17% to produce brass and bronze. Significant amounts are also utilized in zinc semi-manufactures applications including roofing, gutters and down-pipes. The remainder is consumed in chemical compounds such as zinc oxide and zinc sulfate. These first-use suppliers then convert zinc into in a broad range of products. Main application areas include: construction, transport, consumer goods and electrical appliances and general engineering



The main use of zinc and lead metal are as follows:

A. Zinc metal is mainly used in galvanizing, die casting, batteries, and paints and for making alloys.

B. Lead metal is mainly used in batteries, cable sheath, acid proof lining, and ammunition and for making alloys.

b) Intermediate industries involved in up gradation of mineral before its end-use

The ROM from Kayad is sent to Rampura Agucha mine where combined Lead-Zinc ore is separated & enriched into concentrate by beneficiation at concentrate plant itself. ML is granted for captive purpose use only.

c) Requirements for other industries, captive consumption, export, associated industrial use etc.

Once the ore from Kayad is treated for making concentrates of Lead and Zinc, the respective concentrates are dispatched to company's smelters for recovery & refining of Lead, Zinc metal. There is no issue regarding the quality of the concentrates produced. Hindustan Zinc

Limited is having its smelters based on both hydro and pyro metallurgy, where concentrates produced from HZL's other mining operations are suitably blended to get maximum metal values out of the concentrates.

d) Processes adopted to upgrade the ROM to suit the user requirements

The transported ROM from Kayad to Rampura Agucha mine is of the varying size ranging from fines to 500 mm This is stacked at a separate ROM stock pile designated for Kayad ore. The ROM is than put into Primary Crushers for generating size less than 120 mm. The coarse ore stockpile is of 7000-7500t (depending upon fragmentation) live capacity. This ore is wet ground to 78-80% (-) 105micron size in 3500tpd SAG mill(6.1m dia. by 3.35m long) & Ball mill(4.57m dia. by 7.6m long) in close circuit with single stage hydro cyclone classifiers. After adding flotation chemicals in conditioners, the pulp is initially passed in a series of cells for flotation of galena. Tails from the lead circuit, after addition of further flotation chemicals are pumped through another series of cells for flotation of Sphalerite. Lead and zinc concentrates are taken to separate thickeners for settling. High-density pulp from thickeners is then sent to pressure filters for dewatering and then conveyed to separate stockpiles for onward despatch to smelters.

Tailing Disposal at RA Mine

Currently, the tails from plant is being pumped to exiting tailing dam of Rampura Agucha Lead Zinc Mine. It is a continuous process of raising the tailing dam dyke height in order to cater this expanded capacity. It is also proposed to utilize the tailings in the stope backfill.

2.16 UTILITIES REQUIRED

2.16.1 Site Services

Workshops:

At Kayad mine, one major HEMM workshop exist where maintenance of major mining equipment like LHD, LPDT, drill jumbos etc. is carried out. Workshops are equipped with Automatic washing systems for LPDT and LHD. Mechanized bay lubrication system, high capacity EOT cranes, hydraulic press for tyre assembly and dismantling, under-chasis washing system and Nitrogen filling system.

Substations & Diesel Generator Set:
The power(5MW) is supplied by AVVNL distributed to mine via surface sub-station (33KV) located within the mine boundary. In case of any power shortage or failure the captive stand by DG (1MVA) sets will provide power.

Central Store:
The Inventory of spares and consumables for mine requirement is maintained at the central store located in mine premises.

Fuel Station:
At site there exist one licensed diesel pump of 140 kL capacity. The diesel pumps are electronic with RFID tag system that senses the equipment and activates the diesel pump. It reads the diesel filled into the equipment and maintains the electronic log-book.

Compressed Air:
There are two air compressors of 1000cfm and one air compressors of 500 cfm has been installed for supplying compressed air to mine for operation of pneumatic machines.

2.16.2 Water

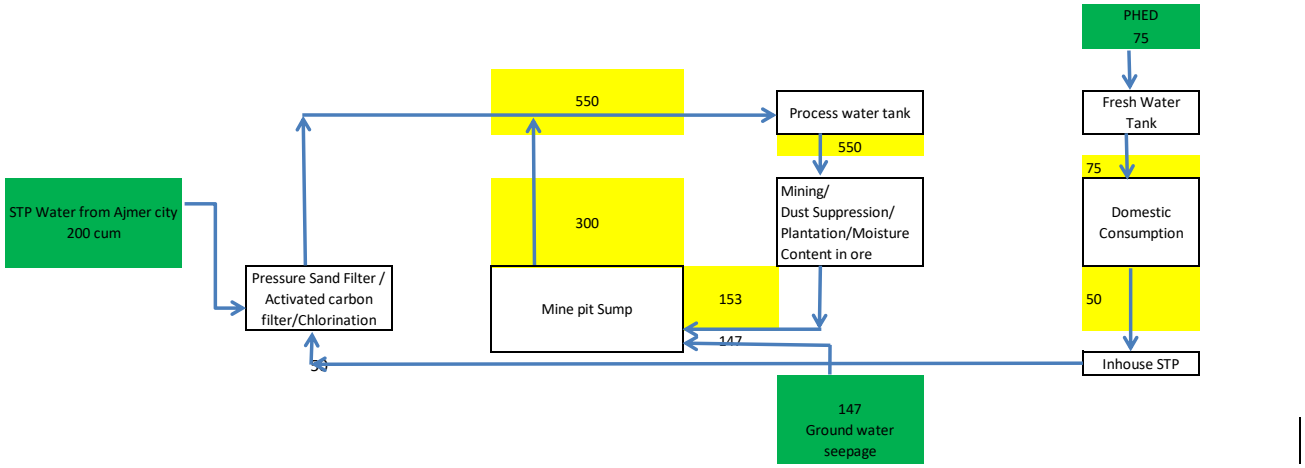
Drinking water management

No increase in water demand for the proposed expansion. Freshwater is being sourced from PHED for domestic Consumption. The drinking water facilities are being developed. Potable water is being/will be made available for all the employees.

Waste Water management

Mine water generated in the mining activity is suitably treated and reused in wet drilling operations, dust suppression, Cemented rock fill in underground operation and in sprinkling on surface roads for dust suppression and Plantation. NOC from CGWA for dewatering of groundwater intersection is available for 147 KLD. Detailed hydrogeological study for groundwater intersection for proposed expansion is attached as **annexure XI**. Zero discharge is being/will be maintained from mining premises.

Water Balance Diagram (all are in KLD)



2.16.3 Power requirement& supply/ source

No additional power is required for the proposed expansion. The power (5MW) is supplied by AVVNL.

2.16.4 Man power requirement

The existing operation has direct employment of about 629 persons and the proposed project will be managed by the existing resources but there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

2.16.5 Health checkup

The periodical medical checkup is done for all Mine workers as per mine regulation. The mission of the HZL is to continually improve safety and health standards, practices and performance of the mine worker. HZL has appointed DuPont as safety consultant to improve the overall safety in the mines.

2.16.6 Lease Terms

The mining lease of Kayad lead-zinc deposit extending over an area of 480.45 Ha in Ajmer district of State of Rajasthan was sanctioned as ML no. 16/92 for a period of 20 years to M/S Hindustan Zinc Limited vide 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 owing to The Mines and Mineral (Development & Regulation) Amendment Act, 2015. The current approved modified Mining plan is for the period 2016-17 to 2020-21 and the Modified Mining plan being submitted is also for the period 2017-18 to 2020-21.

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CHAPTER-3

DESCRIPTION OF THE ENVIRONMENT

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3.1 INTRODUCTION

The anthropogenic activities related to mining activities cause impacts on environmental components in and around the project site. However, the intensity of environmental impacts vary from project to projects, depends upon several factors like; Physical, Chemical, & other, etc. involved in the project, processing capacity (scale / size of the project), type and extent of pollution control measures, project location surrounding geomorphology etc. To assess environmental impacts from proposed project (specific), it is essential to monitor the environmental quality prevailing in the surrounding area prior to implementation of the proposed project. The environmental status (baseline status) within the study area is used for prediction of anticipated environmental impact assessment study. The impacts from an existing mining project on its surrounding environment are due to the nature of pollutants, their quantities discharged to the environment, existing environmental quality, assimilative capacity of the surrounding environment and topography.

A regional background to the baseline data is being presented at the very onset, which will help in better appreciation of micro-level field data, generated on several environmental and ecological attributes of the study area. The baseline status of the project environment is described section wise for better understanding of the broad-spectrum conditions. The baseline environment quality represents the background environmental scenario of various environmental components such as air, noise, land, ecological and socio-economic status of the study area.

3.2 BASELINE DATA GENERATION:

Field monitoring studies for collection of primary data to evaluate the base line status of the project site were carried out covering March, April & May' 2017 representing the primary data.

Environmental data has been collected in relation to given mine for:-

a. Land
b. Water
c. Air
d. Noise
e. Biological
f. Socio-economic

3.3 LAND ENVIRONMENT:

3.3.1 Topography

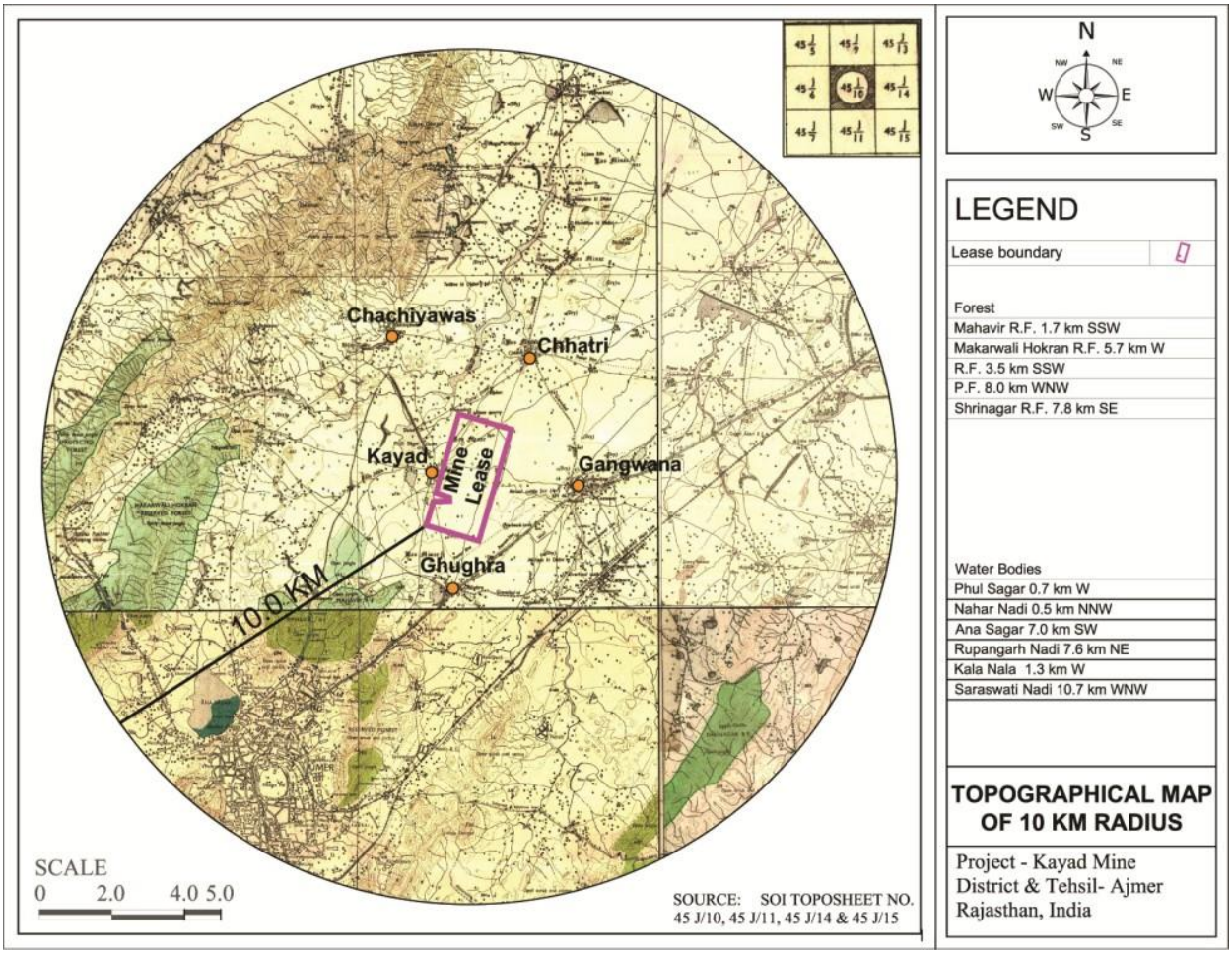
(a) Regional Topography

The district has no natural division. Its boundaries are territorial and composed of four sub-divisions namely Ajmer, Beawar, Kekri, and Kishangarh. Ajmer sub-division forms the Northern part of district and is more or less triangular in shap, Beawar sub-division is an irregular terrain lying the sourth-west of district. The track is generally hilly. Kekri sub-division forms the south Eastern portion of the district and consists of two narrow strips of land separated from each other.

(b) Study Area Topography

The area is undulating with altitude varying from 480 to 506 mRL. The highest point is a small hillock 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 seasonal "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 watercourse other than seasonal "Kala Nala" in the area. A number of dug well with water table varying between 20 to 30 m are present.

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.



Source: Survey of India toposheet

Figure 3.1: Topography Map of Study Area

3.3.2 GEOLOGY:

Regional Geology

The geological setting of the Ajmer district is represented by Bhilwara and Delhi Super Groups, which have been further divided into several Groups and Formations. The rocks of Bhilwara Super Group occur from Arain block in northeast through Bhinay up to Kekri block area, underlying the plains and comprised of metasedimentary sequences with associated magmatic complex and igneous rocks. The Aravalli range running in NNE-SSW direction is occupied by the rocks of Delhi Super Group in the southern part which comprises of calcareous, argillaceous and arenaceous metasedimentary sequences with associated volcanic and igneous rocks.

Geology of Mine Lease Area

Kayad deposit is hosted by mid 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 considered to be time equivalent of Aravallis by Fareeduddin et al - 1995.

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.

Table No. 3.1: Summarized Geological Succession

Group	Sub Group	Formation	Litho units
Ajabgarh Group	Arauli	**Ajmer Formation**	Carbonaceous Phyllite, Garnetiferous, Chlorite schist
	Barkhol		Carbonaceous Phyllite and Quartzite
	Thanagazi		Phyllite , Felsic volcanic rocks
	Sariska		Quartzite, Phyllite and Marble
	Kushalgarh		Siliceous Schist, Marble bands and dolomite rich bands.

3.3.3 LAND USE:

Material and methods: - The details of study area, collection of relevant satellite images, ground-truth observation, and the use of software and analytical tools used in the current study.

Geographical location of the study area: - The project is for environmental clearance for expansion of Lead – Zinc ore production from underground mine from 1.0million TPA (ROM) to 1.2million TPA (ROM) (20% increase). The Kayad Lead Zinc Mine is located in District & Tehsil of Ajmer Tehsil of District Ajmer. Kayad Mine deposit extends over a lease area of 480.45ha in Ajmer District of Rajasthan has been sanctioned to Hindustan Zinc Limited (HZL), Vide ML No. 16/92

The survey of India Open Series Map (OSM) 45 J/10,45 J/14 & 45 J/15 was used for geo referencing the study area.

Materials: - The equipment used during the present investigation includes ground truth hand held GARMIN 12 GPS receiver for ground truth collection, besides the visual observation and analysis.

Garmin 12 GPS receiver: - Global Positioning System is based on a constellation of 24 satellites orbiting the Earth at a very high altitude of 20,200 km, which allows anyone with a GPS receiver to determine the precise 3-D location. It offers advantages of accuracy, speed, versatility and economy while in use as an aid for position based data collection. GPS owes its popularity to the dependable high accuracy with which position and time can be determined. The termination of selective availability from first May 2000 has instantly increased the accuracy of stand-alone mode GPS to at least five fold and things are going to get even better in the near future. The GPS was conceived as a ranging system from known positions of satellites in space to unknown positions on land, sea and space. GPS uses pseudo ranges derived from the broadcast satellites. The pseudo ranges were derived either from measuring the travel time of the (coded) signal and multiplying it by its velocity or by measuring the phase of the signal. The antenna detects the electromagnetic waves arriving from the satellites, converts the wave energy into an electric current, amplifies the signal strength and sends the signals to the receiver electronics. The GARMIN 12 GPS Receiver in stand-alone mode was used to collect the information regarding the geographical location of the ground truth sites during the present investigation.

Satellite data: - The Indian Remote Sensing satelliteIRS-1C/1D/P6 LISS III was used for present analysis. One scene of IRS P6 LISS III covered the entire study area.

Topographical maps of the study area: -The Survey of India Open Series Map (OSM) 45 J/10,45 J/14 & 45 J/15, on 1:50,000 scale covering Ajmer District of Rajasthan, was used as reference map for geo-referencing of the remote sensing data. These maps helped to select the ground truth collection sites.

Ancillary data: - Information derived from the remotely sensed data can only be verified using field data. Field data is used to improve the information extraction, to calibrate either data or the information and to assess the accuracy of the derived information. Field data used in the study was of different types such as maps of Survey of India, data collected in the field sampling, and information derived from statistical data from revenue department.

Computer hardware and software: - HP Core i3 PC with ERDAS IMAGINE 8.5 image analysis software was used for processing and analysis of the remote sensing data. Arc GIS version 10.2 was used for making land use maps.

Spatial observations: - Spatial measurements were made with the help of hand held GPS to get the spatial coordinated along with type of land use.

The raw LISS III spectral information's was collected in the three bands as detailed below:

Band 2: Green region, 520-570 nm

Band 3: Red region, 620-680 nm and

Band 4: Near infrared region, 770-860 nm

Data & Methodology:-

For the present land use study LISS-III sensor data of IRS-P6 satellite has been used which has a spatial resolution of 5.8 m, which is good enough for Level-II classification. National Remote Sensing Centre (NRSC), Hyderabad classification scheme has been followed for present land use study. First of all the .tiff file is imported to .img format, geometric corrections were performed and data prepared for further process was done.

Unsupervised classification method has been adopted followed by visual interpretation technique for 10 km radius and a total of 7 classes have been obtained.

Digital image analysis: - The various steps involved in the digital image analysis of remote sensing data area follows.

For digital image processing and analysis, preliminary work like collection of maps, reports, remote sensing images, collection and study of collateral and ground truth data were done first. Among all, ground truth data collection is very important for subsequent digital analysis. The HP P-4 dual core PC with ERDAS IMAGINE 8.5 software was used for processing and analysis of remote sensing data. The toposheets of the study area on1:50,000 scales were scanned and were geometrically corrected in the DATA PREPARATION panel of ERDAS IMAGINE 8.5. The IRS P6 LISS III Image of the study area was loaded into the ERDAS IMAGINE using the IMPORT option. Later, geometric correction of the image was done with the help of the geometrically corrected SOI Toposheets and Ground Control Points (GCPs) collected with the GPS receiver. The raw image data when viewed on the display showed the difficulty in distinguishing all features. Preliminary interpretation of the satellite data was conducted and GCPs, which were distributed randomly throughout the image with minimum root mean square (RMS) error of less than 0.5 were selected. Polynomial transformation of 1st order was used because the correction program runs faster with it and it also avoids geometric distortion in areas of very few GCPs. After completing geometric correction of the image, study area boundary overlay was done. The study area boundary was digitized from SOI toposheets using AOI tools polygon and vector options, saved as AOI layers. This AOI layer was used as administrative boundary mask and the subsets of the respective blocks was prepared using subset image option of data preparation panel. The unsupervised classification was used to prepare the LULC map of the study area. The LULC map around the 10 Km radius of proposed Expansion.

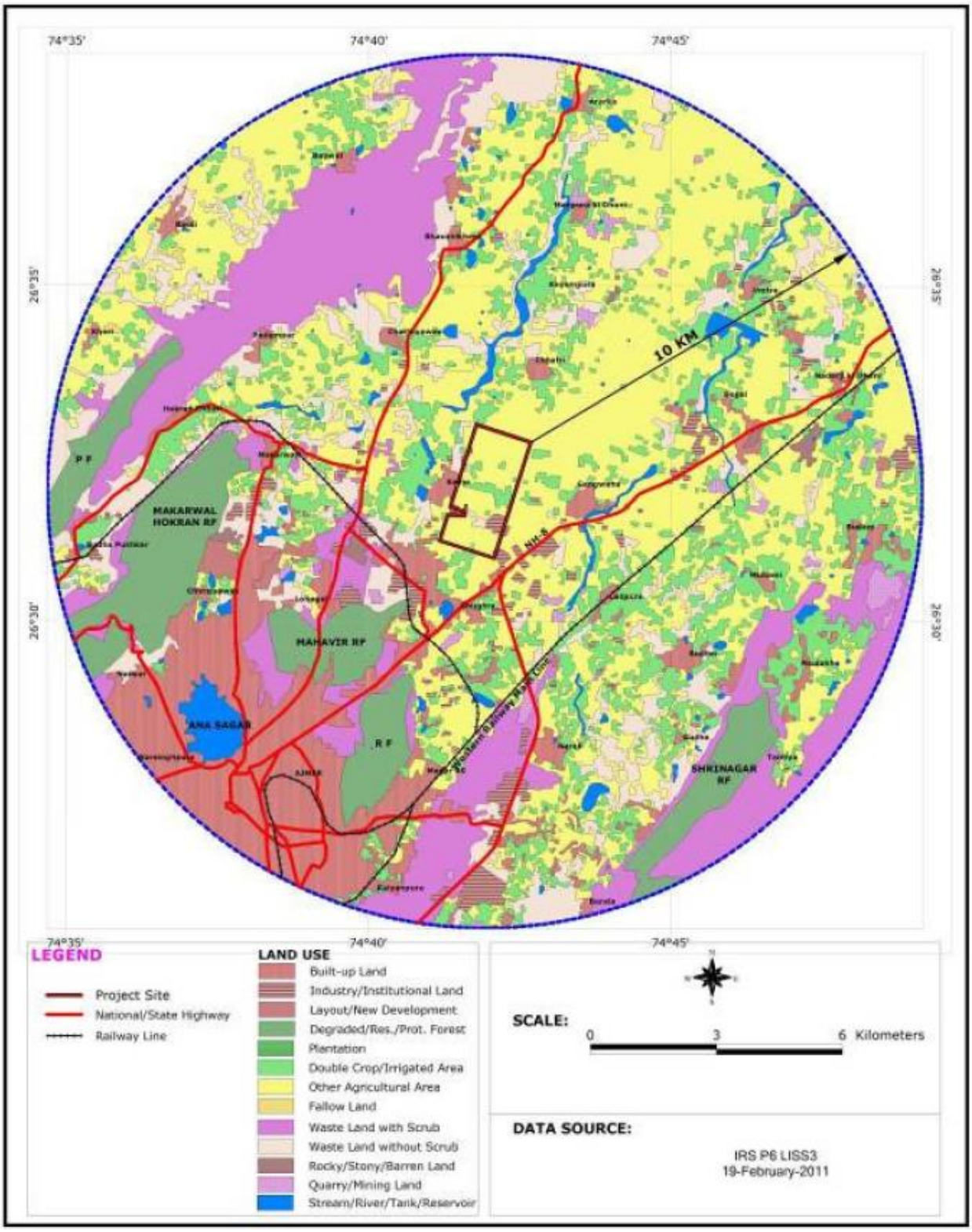


Figure 3.2: Landuse/ Landcover Map of Study area

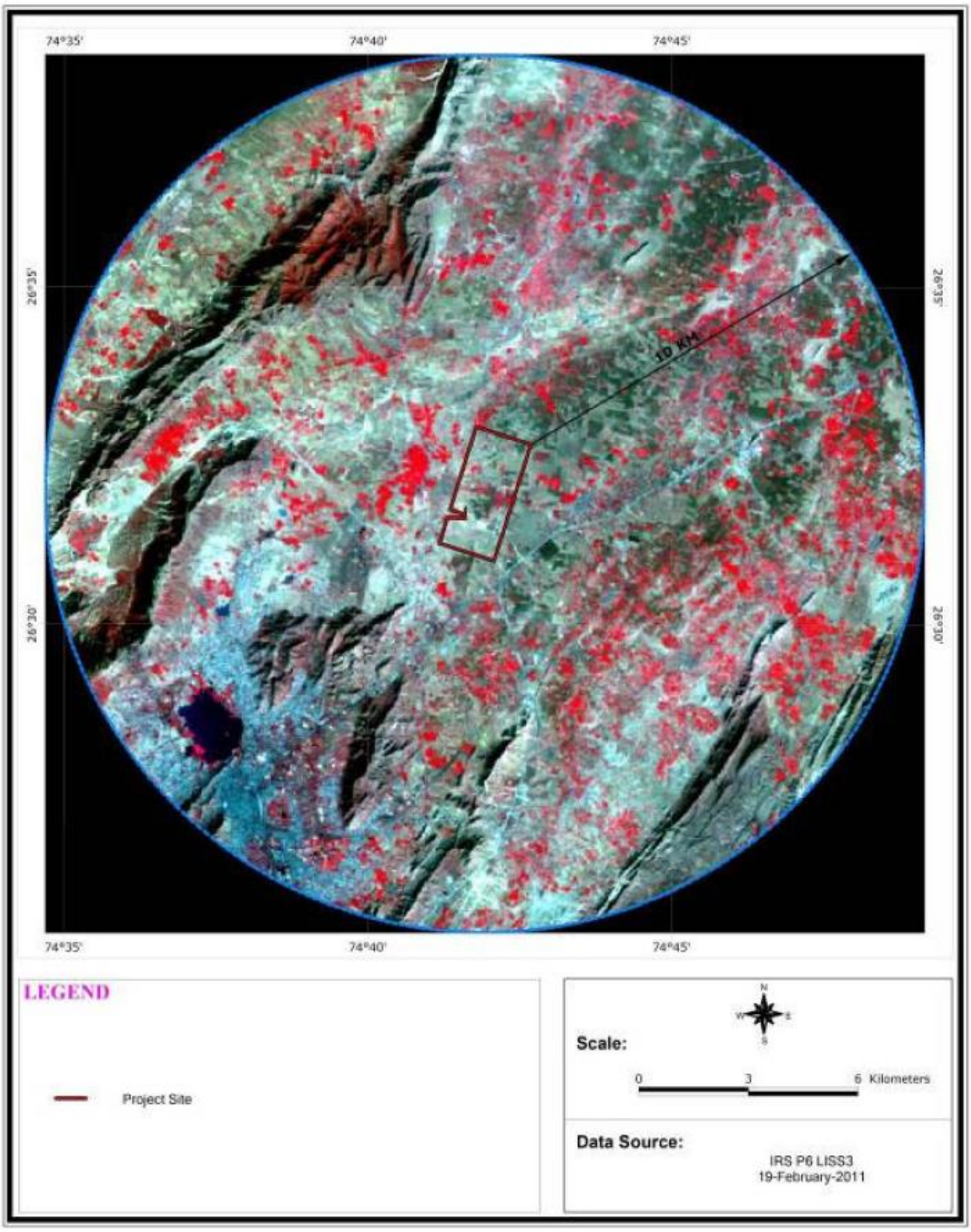


Figure 3.3: Thematic Map of Study Area (IRS-P6:LISS3)

Table No. 3.2: Land use pattern in the study area

S.no	Classes	Area (HA)	Area (%)
1.	Forest Land	2908.16	9.26
2.	Land under cultivation		
	a) irrigated Land	2652.15	8.45
	b) unirrigated Land	16902.48	53.84
3.	Cultivable waste land	3489.30	11.12
4.	Area not available for cultivation	5443.39	17.33
	Total	**31395.58**	**100**

3.3.4 SOIL CHARACTERSTICS

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.

The sample was collected by driving an auger into the soil up to the depth of 90 cms. The present studies on the soil quality establish the baseline characteristics and identifies the incremental concentrations if any, due to the expansion project. The objective of the sampling is:-

- To determine the baseline soil characteristics of the study area;
- To determine the impact of proposed activity on soil characteristics and;
- To determine the impact on soil, more importantly from agriculture production point of view.

The soil sample is collected from three different depths viz: 30cm, 60cm and 90cm. The sample was than packed in polythene plastic bags and sealed. The sample from three different depths is homogenized and then is analyzed.

a. Data Generation Methodology

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the plant area representing various land use conditions. The physical, chemical and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil up to a depth of 90 cm.

The present study of the soil profile establishes the baseline characteristics and this will help in future identification of the incremental concentrations if any, due to the operation of the plant. The sampling locations have been identified with the following objectives:

- To determine the baseline soil characteristics of the study area;
- To determine the impact of industrialization on soil characteristics; and
- To determine the impact on soils more importantly from agricultural productivity point of view.

Six locations in and around the proposed project were selected for soil sampling. The details of the monitoring locations are given in above Table no. 3.1. 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. This is in line with IS: 2720 and IS: 9497 and Hand book of Method in Environmental Studies by S.K. Maiti. The homogenized samples were analyzed for physical and chemical characteristics.

The soil samples were collected in March 2107 representing Summer season. The samples have been analyzed as per the established scientific methods for physico-chemical parameters. The methodology adopted for each parameter is described in Table no-3.2

Table No 3.3: Analytical Techniques for Soil Analysis

Parameters	Test Method
pH	IS 2720 (Part 26) 1987
Electrical Conductivity (at 25° C)	IS: 14767-2000, Reaff 2006
Calcium Carbonate	IS 2720 (Part 23) 1976, Reaff 2006
Moisture	Hand book of Method in Environmental studies by S.K. Maiti
Calcium as Ca^{2+}	Standard Book of Practical Agricultural Chemistry
Magnesium as Mg^{2+}	Standard Book of Practical Agricultural Chemistry

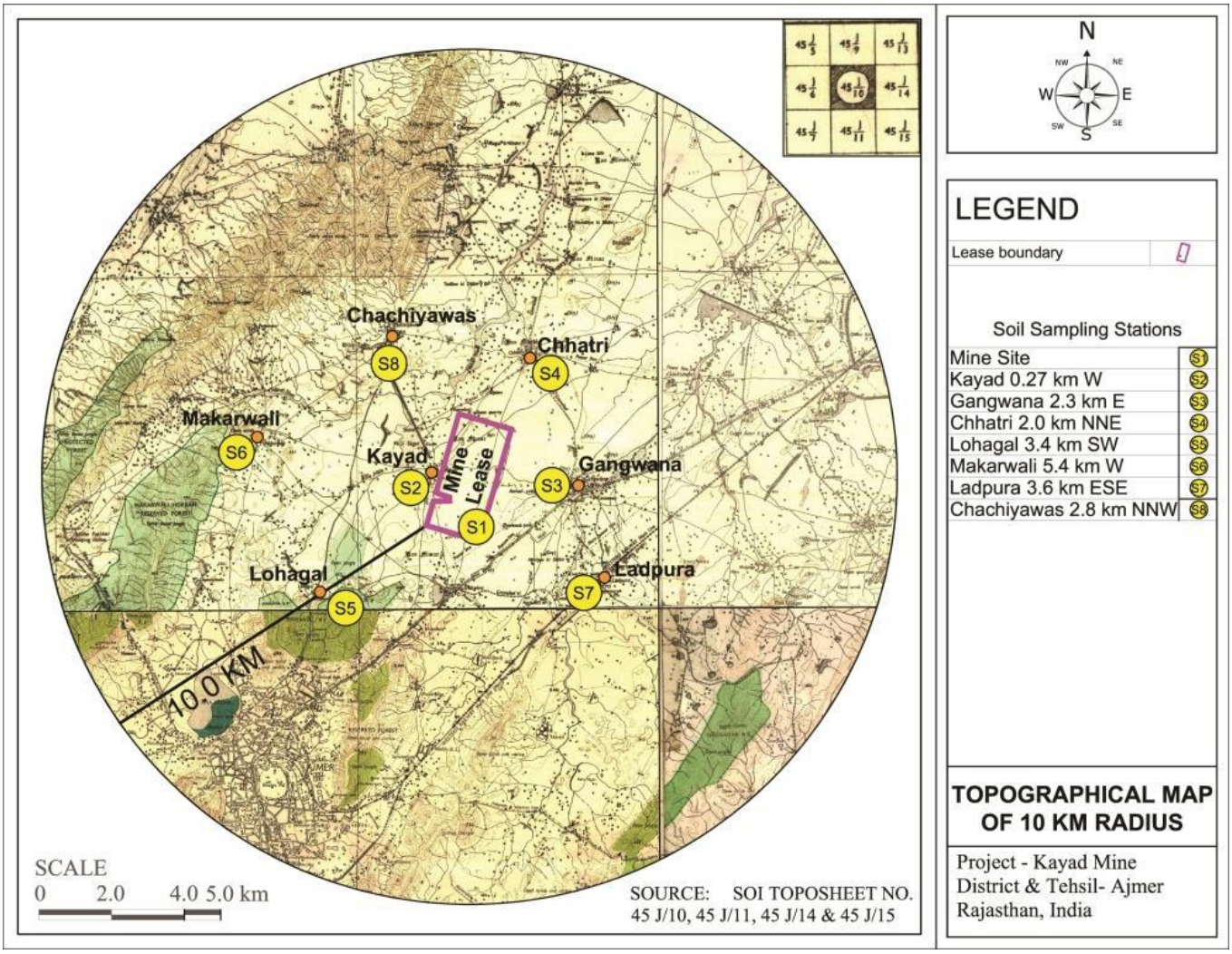
Specific gravity	Hand book of Method in Environmental studies by S.K. Maiti
Bulk density	IS: 918 – 1985, Reaff 2006
Chloride as Cl	Handbook of Goyan, R.K and Trivedi
Porosity	Hand book of Method in Environmental studies by S.K. Maiti
Organic Matter	IS 2720 (Part 22) 1972 (Reaff 2006)
Organic Carbon	IS 2720 (Part 22) 1972
Available Phosphorous as P	IS 10158 - 1982 Reaff 2003
Sulphate as SO^4	IS 2720 (Part 27) 1977
Sodium as Na	IS: 9497-1980 (Reaff, 2005)
Potassium as K	IS: 9497-1980 (Reaff, 2005) SOP No. 93/100
Sodium Absorption Ratio	Hand book of Method in Environmental studies by S.K. Maiti
Available Nitrogen	Standard Book of Practical Agricultural Chemistry

Soil quality analysis (Study Area):

The soil study was carried out to analyze the soil characteristics of the study area. For studying soil quality of the region 8 samples (including site) were collected, description of the same as follows:

Table No. 3.4: Details of Soil Sampling Locations

S.N.	Sampling Location	Station Code	Distance w.r.t ML Area	Direction w.r.t ML Area	Details of surroundings
1.	Mine Area	S1	-	-	Represent the Project site
2.	Kayad	S2	0.27 km	WNW	Agricultural Land
3.	Gagwana	S3	2.3 km ;	E	Agricultural Land
4.	Chhatri	S4	2.0 km ;	NEE	Agricultural Land
5.	Lohagal	S5	3.4 km:	SW	Agricultural Land
6.	Makarwali	S6	5.4 km ;	WNW	Agricultural Land
7.	Ladpura	S7	3.6 km ;	SE	Agricultural Land
8.	Chachiyawas	S8	2.8 km ;	NNW	Agricultural Land



Source: Survey of India toposheet

Figure: 3.4: Soil Sampling Locations of the Study Area

Table No.: 3.5: Results of soil analysis

	PARAMETERS		Unit	Mine area	Kayad	Gagwana	Chhatri	Lohagal	Makarwali	Ladpura	Chachiyawas	Detection Limits
				S1	S2	S3	S4	S5	S6	S7	S8	
1	Particle size distribution	Sand	(%)	78.5	78.3	77.6	80.2	80.5	77.4	83.2	81.4	
		Silt		14.4	14.3	15.6	14.6	12.8	15.2	10.1	11.4	
		Clay		7.1	7.4	6.8	5.2	6.7	7.4	6.7	7.2	
2	Texture		-	Sandy Loam	Sandy Loam	Sandy Loam	Loamy Sand	Sandy Loam	Sandy Loam	Loamy Sand	Loamy Sand	
3	pH (1:5 Solution)		-	7.34	7.68	7.78	6.98	7.21	7.4	7.62	7.56	
4	Electrical Conductivity		µS/cm.	112.4	121.4	135.2	275.3	185.3	164.3	188.4	172.8	
5	Cation Exchange capacity		meq%	1.24	1.23	1.48	1.4	1.31	1.58	1.48	1.28	
8	Water Holding Capacity		(%)	25.3	18.4	26.3	30.5	30.8	28.4	32.4	24.7	
9	Porosity		(%)	6.8	3.5	5.4	14.5	8.5	7.5	6.4	7.8	
10	Bulk Density		gm/cm^3	1.47	1.25	1.35	1.74	1.64	1.86	1.54	1.38	
11	Nitrite		mg/kg	0.54	0.67	0.74	0.7	0.66	0.84	0.6	0.52	0.2
12	Nitrate		mg/kg	3.18	3.45	2.82	2.34	2.64	2.32	1.51	1.75	
13	Phosphate		mg/kg	4.14	1.24	1.15	1.68	1.54	1.32	3.14	2.85	
14	Sodium (Na)		mg/kg	635.1	375.2	546.4	7312	548.3	653.1	754.2	545.4	
15	Calcium (Ca)		mg/kg	336.8	2631	2817	1247	2134	4543	1735	3325	
16	Magnesium (Mg)		mg/kg	512	456	442	6583	436	548	362	432	
17	Potassium (K)		mg/kg	268.30	165.14	352.3	223.30	314.3	364.48	334.14	458.32	
18	Lead (Pb)		mg/kg	20.14	24.14	16.3	23.34	21.54	23.48	33.14	36.65	
19	Iron (Fe)		mg/kg	4562	5435	6854	6756	5478	6785	4365	6785	

20	Arsenic (As)	mg/kg	BDL	BDL	BDL	0.63	0.70	BDL	0.68	0.52	0.2
21	Cadmium (Cd)	mg/kg	1.65	1.32	2.25	0.67	0.84	0.71	1.15	1.26	
22	Total Chromium (Cr)	mg/kg	7.4	4.3	6.2	11.2	9.4	7.5	6.4	8.2	
23	Copper (Cu)	mg/kg	13.5	13.4	10.2	21.3	16.3	21	14.4	17.3	
24	Nickel (Ni)	mg/kg	18.3	15.6	26.3	18.3	20.3	14.3	25.1	28.5	
25	Manganese (Mn)	mg/kg	184.3	165.4	175.2	32.3	165.2	178.2	168.1	145.2	
26	Zinc (Zn)	mg/kg	48.4	52.4	65.2	125.2	47.4	37.1	43.4	61.4	
27	Barium (Ba)	mg/kg	112.4	61.4	87.4	BDL	124.5	127.3	136.2	148.8	
28	Selenium (Se)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.25
29	Mercury (Hg)	mg/kg	BDL	BDL	BDL	4.1	BDL	BDL	BDL	BDL	0.25
30	% Moisture	%	3.8	3.2	4.8	0.72	4.1	2.6	6.3	7.9	
31	Total Alkalinity	%	0.45	0.55	0.63	14.2	0.78	0.69	0.58	0.78	
33	Available Nitrogen	%	6.7	3.1	8.4	45.3	16.2	9.5	7.1	9.8	
34	Available phosphorous	mg/kg	38.8	12.2	44.3	3.65	49.3	30.3	36.8	39.4	
36	Organic Matter	%	1.45	1.43	2.32	BDL	2.64	2.54	1.64	2.54	
37	Boron	mg/kg	BDL	BDL	BDL	3	BDL	BDL	BDL	BDL	1
38	Chloride	%	2.3	4.8	3.6	51	3.8	2.8	3.6	2.4	
39	Sulphate	mg/kg	48	74	81	8.80	51	42	56	68	
40	Carbonate	%	2.2	7.2	3.4	80.2	7.23	4.6	3.14	4.14	

b. Results & Conclusion

The soil analysis results are presented in **Table No. 3.5.** The result obtained is compared with the standard soil classification given in Agriculture Soil Limits. 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.

Table No.: 3.6: Standard Soil pH Classification

pH	Classification	Sample
<4.5	Extremely acidic	-
4.51- 5.00	Very strong acidic	-
5.01- 5.50	Strongly acidic	-
5.51- 6.00	Moderately acidic	-
6.01- 6.50	Slightly acidic	-
6.51- 7.30	Neutral	**S4**
7.31- 7.80	Slightly alkaline	**S1,S2,S3,S5,S6,S7,S8**
7.81- 8.50	Moderately alkaline	-
8.51- 9.00	Strongly alkaline	-
> 9.00	Very strongly alkaline	-

Source: Agriculture Handbook, 2011

3.4 AIR ENVIRONMENT

Climatology and Meteorology:

The atmosphere is the medium in which air pollution transported away from the source. Meteorology influences the way air pollution is dispersed, including wind direction and wind speed, type of terrain and heating effects. Atmospheric stability affects pollution released from ground level and elevated sources differently.

In unstable conditions, ground level pollution is readily dispersed thereby reducing ground level concentrations. Elevated emissions, however, such as those released from a chimney, are returned more readily to ground level, leading to higher ground level concentrations. Stable conditions mean less atmospheric mixing and therefore higher concentrations around ground level sources, but better dispersal rates, and therefore lower ground level concentrations, for elevated plumes.

The climate of the study area is semi-arid type where seasons can be classified as[1]:

- Summer : March – May;
- Monsoon : June – September;

- Post monsoon : October – December;
- Winter : January – February.

3.4.1 SITE SPECIFIC METEOROLOGICAL DATA

The meteorological parameters were recorded on hourly basis during the study period and comprises of parameters like wind speed, wind direction (from 0 to 360 degrees),temperature, relative humidity, atmospheric pressure, rainfall and cloud cover. The maximum, minimum, and average values for all the parameters except wind speed and direction are presented in table no.3.7

Table No.3.7: Summary of the meteorological data

Month	Temperature(°C)		Relative Humidity (%)		Rainfall (mm)
	Max	Min	Max	Min	
March	40.1	12.3	56	22	nil
April	43.4	15.0	64	31	nil
May	46.7	20.6	68	40	nil

3.4.2 WIND ROSE DIAGRAM

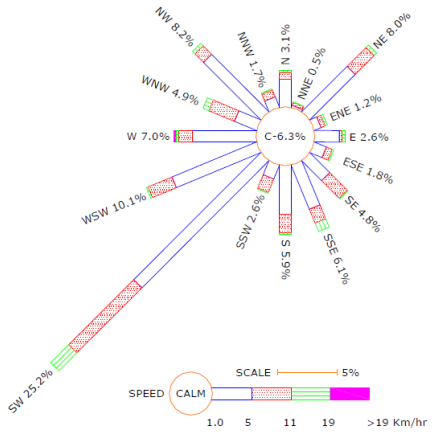


Figure 3.5: Site Specific 24 Hours Wind rose

The predominant wind direction observed during the study period was 25.2% in SW followed by WSW for 10.1% is representing in site specific wind rose.

3.4.3 AMBIENT AIR QUALITY

The prime objective of the baseline air monitoring is to evaluate the existing air quality of the area. This will also be useful for assessing the conformity to standards of the ambient air quality during the operation of the mine.

This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques and frequency of sampling. The monitoring was carried out during summer session (March-May'2017).

3.4.3.1 METHODOLOGY ADOPTED FOR AIR QUALITY SURVEY

A) SELECTION OF SAMPLING LOCATIONS

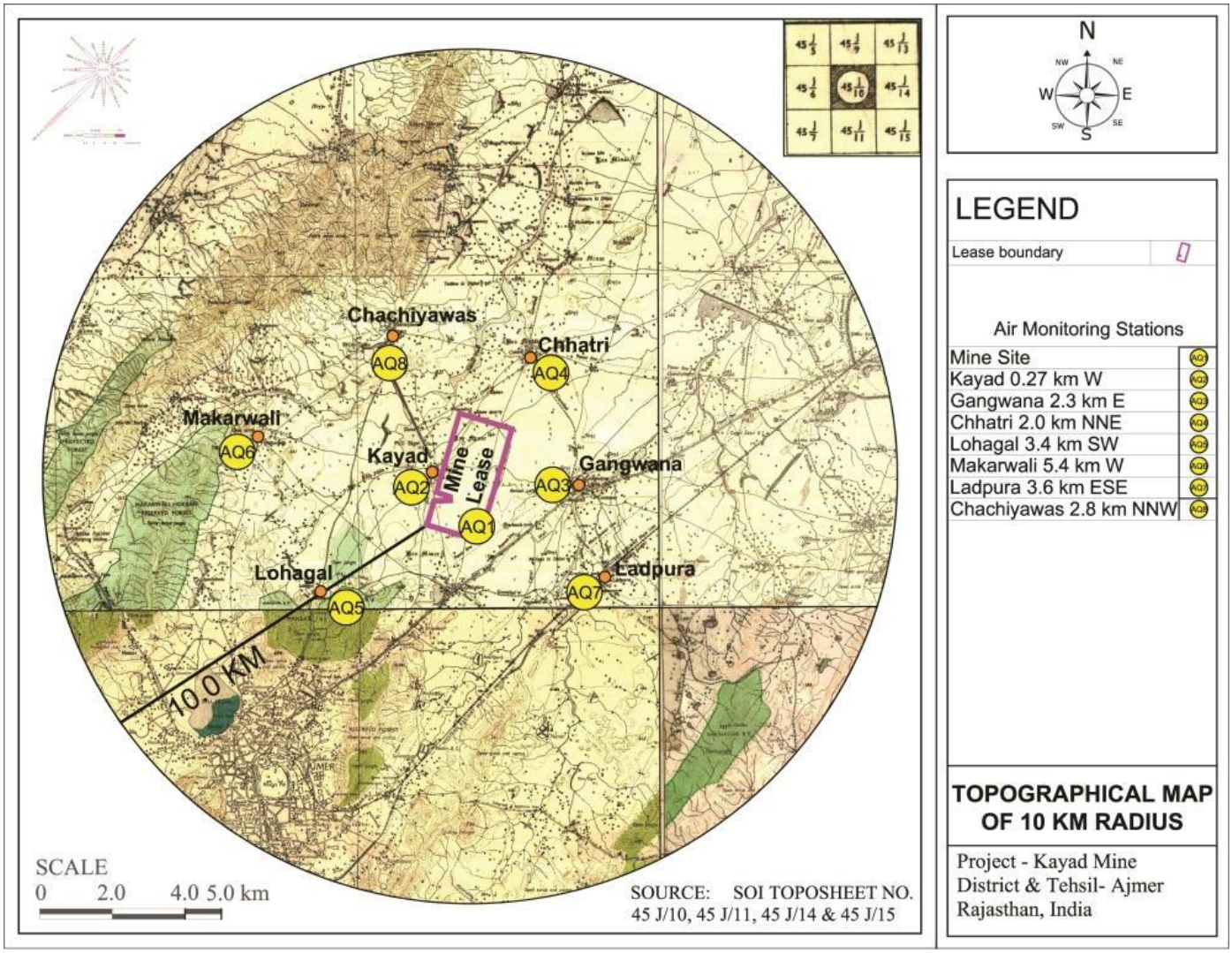
The baseline status of the air quality in the study area has been assessed though a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance programme has been based on the following considerations:-

- Meteorological conditions on synoptic scale;
- Topography of the study area;
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

Ambient Air Quality Monitoring (AAQM) stations were set up at eight locations with due considerations to above mentioned points. Table 3.8 gives the details of environmental setting around each monitoring stations and their distances with reference to the existing mining lease.

Table No.3.8: AMBIENT AIR QUALITY MONITORING STATIONS

S.No.	Sampling Location	Station Code	Distance w.r.t mine lease area	Direction w.r.t mine lease area	Details of surroundings
1	Mine Area	AQ 1	--	within ML	Represent the Project site
2	Kayad	AQ 2	0.27 km	W	Rural setting with Vehicular traffic and mixed land use
3	Gagwana	AQ 3	2.3 km	E	Rural setting with residential land use associated with vehicular movements on NH-08.
4	Chattri	AQ 4	2.0 km	NE	Rural setting with residential land uses.
5	Lohagal	AQ 5	3.4 km	SW	Rural setting with residential land uses
6	Makarwali	AQ 6	5.4 km	WNW	Rural setting with residential land uses
7	Ladpura	AQ 7	3.6 km	SE	Rural setting with residential land uses
8	Chachiyawas	AQ 8	2.8 km	NNW	Rural setting with residential land uses



Source: Survey of India toposheets

Figure 3.6: Map Showing Ambient Air Quality Sampling Locations in the Study Area

B) FREQUENCY AND PARAMETERS FOR SAMPLING

The ambient air quality monitoring has been carried out with a frequency of two days per week at fourteen locations covering one complete season (Summer season). The ambient air quality along with their frequency of sampling is given below:-

Table No.3.9: Monitored Parameters, Code of Practise & Detection Limits

S.No.	Parameter	Code of Practice	Detection Limit
1	Particulate matter (PM_{10}) ($\mu g/m^3$)	IS 5182 (Part 23):2006 & CPCB guidelines	4 $\mu g/m^3$
2	Particulate matter ($PM_{2.5}$) ($\mu g/m^3$)	IS 5182 (Part 23):2006 & CPCB guidelines	4 $\mu g/m^3$
3	Sulphur dioxide ($\mu g/m^3$)	IS 5182 (Part 2): 2001 & CPCB guidelines	3 $\mu g/m^3$
4	Oxides of Nitrogen ($\mu g/m^3$)	IS 5182 (Part 6): 2006 & CPCB guidelines	3 $\mu g/m^3$
5	Carbon monoxide ($\mu g/m^3$)	IS: 5182 (Part-X) & CPCB guidelines	0.01 mg/m^3
6	Ozone ($\mu g/m^3$)	IS-5182 (Part-IX):1974 & CPCB Guidelines	1 $\mu g/m^3$
7	Ammonia (NH_3)	Indophenol Blue Method	10 $\mu g/m^3$
8	Benzene (C_6H_6)	IS : 5182 (P-09)1974 – 2009	1 $\mu g/m^3$
9	Banzo-a-pyrene (BAP)	IS : 5182 (P-11)- 2006	0.1 ng/m^3
10	Arsenic (As)	IS : 5182 (P-12)2004 – 2009	1 ng/m^3
11	Nickel (Ni)	IS : 5182 (P-22)2004 – 2009	1 ng/m^3
12	Lead (Pb)	IS : 5182 (P-22)2004 – 2009	0.01 $\mu g/m^3$
13	Free Silica		1 $\mu g/m^3$

3.4.3.2 BASELINE DATA

The ambient air quality data were collected to find the existing regional emissions. The data are stated in Table no. 3.10.

Table No.3.10: Ambient Air Quality Status

S. No.	Pollutant	Locations	Minimum ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Average ($\mu g/m^3$)	98th Percentile	CPCB Standards ($\mu g/m^3$)
1.	SO_2	AQ 1	10.50	16.80	13.55	16.71	80.0
		AQ 2	8.40	15.30	11.99	15.07	
		AQ 3	7.80	12.60	10.08	12.42	
		AQ 4	5.80	10.40	8.14	10.22	
		AQ 5	6.80	15.00	9.86	14.91	
		AQ 6	6.20	14.40	9.15	13.66	
		AQ 7	6.20	10.20	8.26	10.02	
		AQ 8	6.50	11.50	8.07	10.81	
2.	NO_2	AQ 1	16.70	26.20	21.44	25.83	80.0
		AQ 2	13.50	21.70	17.89	21.01	
		AQ 3	12.40	18.80	15.88	18.62	
		AQ 4	10.60	18.60	14.54	18.55	
		AQ 5	10.60	22.20	16.18	21.51	
		AQ 6	10.60	26.40	16.44	26.31	
		AQ 7	10.20	22.70	16.03	21.78	
		AQ 8	11.60	26.40	15.95	23.64	
3.	PM_{10}	AQ 1	75.10	90.70	83.12	90.56	100.0
		AQ 2	68.50	81.30	74.33	80.75	
		AQ 3	65.50	77.20	71.24	76.83	
		AQ 4	52.00	68.50	60.18	68.18	
		AQ 5	54.40	73.00	62.35	72.82	
		AQ 6	51.70	66.70	58.27	65.32	
		AQ 7	52.00	69.20	60.73	68.97	
		AQ 8	51.30	70.00	60.96	69.54	
4.	$PM_{2.5}$	AQ 1	35.80	44.20	39.50	43.88	60.0
		AQ 2	31.60	40.50	36.96	40.36	
		AQ 3	28.80	39.00	32.90	38.82	
		AQ 4	21.60	39.80	28.89	37.87	
		AQ 5	20.40	40.50	32.16	39.72	
		AQ 6	20.40	33.50	27.30	33.22	
		AQ 7	22.20	36.40	28.35	35.76	
		AQ 8	20.30	36.10	27.99	35.87	

5.	**CO**	AQ 1	115.00	517.50	249.17	517.5	**2000.0**
		AQ 2	115.00	345.00	184.01	323.15	
		AQ 3	115.00	575.00	203.86	454.25	
		AQ 4	115.00	345.00	172.50	345.00	
		AQ 5	115.00	460.00	204.44	420.90	
		AQ 6	115.00	345.00	204.44	345.00	
		AQ 7	115.00	345.00	180.71	315.10	
		AQ 8	115.00	345.00	184.00	312.80	
6.	**NH_3**	AQ 1	12.60	24.70	17.40	23.36	
		AQ 2	11.20	17.50	14.15	17.26	
		AQ 3	10.40	14.60	11.70	14.51	
		AQ 4	9.30	18.50	12.59	17.46	
		AQ 5	8.50	20.00	12.92	19.36	
		AQ 6	8.30	18.40	12.65	18.14	
		AQ 7	9.20	14.00	11.29	13.95	
		AQ 8	8.30	14.80	11.78	14.75	**400**
7.	**O_3**	AQ 1	12.60	24.50	17.56	23.63	
		AQ 2	12.60	19.50	16.47	19.18	
		AQ 3	8.20	16.80	13.20	16.66	
		AQ 4	6.50	14.40	09.14	13.11	
		AQ 5	6.80	14.80	9.53	14.66	
		AQ 6	5.80	15.50	8.94	15.04	
		AQ 7	5.20	15.40	9.00	15.12	
		AQ 8	6.20	14.40	9.80	14.31	**180**
8.	**Pb**	AQ 1	0.08	0.30	0.18	0.30	
		AQ 2	BDL	0.22	0.12	0.22	
		AQ 3	BDL	0.23	0.11	0.22	**1**
		AQ 4	BDL	0.06	0.04	0.06	
		AQ 5	0.02	0.12	0.05	0.10	
		AQ 6	0.02	0.18	0.05	0.16	
		AQ 7	0.02	0.06	0.04	0.06	
		AQ 8	0.02	0.04	0.03	0.04	
9.	**C_6H_6**	AQ 1	BDL	BDL	BDL	BDL	
		AQ 2	BDL	BDL	BDL	BDL	
		AQ 3	BDL	BDL	BDL	BDL	
		AQ 4	BDL	BDL	BDL	BDL	
		AQ 5	BDL	BDL	BDL	BDL	
		AQ 6	BDL	BDL	BDL	BDL	**5**
		AQ 7	BDL	BDL	BDL	BDL	

		AQ 8	BDL	BDL	BDL	BDL	
S. No.	**Pollutant**	**Locations**	**Minimum (ng/m^3)**	**Maximum (ng/m^3)**	**Average (ng/m^3)**	**98th Percentile**	**CPCB Standards (ng/m^3)**
10.	**Ni**	AQ 1	BDL	2.20	1.52	2.18	
		AQ 2	1.10	1.60	1.38	1.60	
		AQ 3	1.20	2.60	1.73	2.54	
		AQ 4	BDL	1.80	1.34	1.77	
		AQ 5	1.10	2.88	2.12	2.83	
		AQ 6	1.10	2.88	2.04	2.82	
		AQ 7	1.20	2.50	1.78	2.48	
		AQ 8	1.20	2.80	1.83	2.74	**20**
11.	**As**	AQ 1	BDL	BDL	BDL	BDL	
		AQ 2	BDL	BDL	BDL	BDL	
		AQ 3	BDL	BDL	BDL	BDL	
		AQ 4	BDL	BDL	BDL	BDL	**6**
		AQ 5	BDL	BDL	BDL	BDL	
		AQ 6	BDL	BDL	BDL	BDL	
		AQ 7	BDL	BDL	BDL	BDL	
		AQ 8	BDL	BDL	BDL	BDL	
12.	**BAP**	AQ 1	BDL	BDL	BDL	BDL	
		AQ 2	BDL	BDL	BDL	BDL	
		AQ 3	BDL	BDL	BDL	BDL	
		AQ 4	BDL	BDL	BDL	BDL	
		AQ 5	BDL	BDL	BDL	BDL	
		AQ 6	BDL	BDL	BDL	BDL	**1**
		AQ 7	BDL	BDL	BDL	BDL	
		AQ 8	BDL	BDL	BDL	BDL	

Presentation of Results:-

The analysis results for the study period are presented in above monitoring tables. Various statistical parameters like 98th percentile, average, maximum and minimum values have been computed from the observed raw data for all the ambient air monitoring stations. These are compared with the standards prescribed by Central Pollution Control Board

(CPCB) for rural and residential zone and it is observed that all values are within the prescribed limit.

3.4.3.4 EXISTING TRAFFIC SCENARIO

Traffic scenario at the existing access road and traffic after the proposed expansion, based on the anticipated increased traffic was compared with volume capacity ratio as per IRC 106-1990 for two lane paved shoulder road.

The same is given below in table 3.11.

Table No.3.11: Existing Traffic Scenario

Description	T1:At Kayad Vishramsthal	T2: At RA Mine Road (NH-8)
Total Traffic (PCU)/24 Hours (To & Fro)	1307	21181
Average Traffic flow/Hr	54	883
Max.Traffic Flow (PCU)/Hr	109	993
Min.Traffic Flow (PCU)/Hr	14	813
Maximum Traffic Flow Hours	07-08 AM	09-10 AM
Minimum Traffic Flow Hours	1-2 AM	4-5 AM
Road width(in m)	10	24(NH-8 Four Lane)
Road Condition	Paved Road	Paved Road

Capacity as per IRC-106; 1990 for guideline,

V= Volume in PCU's/hr & C= Capacity in PCU's/ hr

Table No.3.12: Traffic Scenario Post expansion

Road (After expansion)	Peak hour traffic (volume PCU/ hr) [V]		Capacity as per IRC 1990 Guidelines for Urban roads (PCU/hr) [C]		Proposed [V]/[C]	Level of Service (LOS)
	Baseline	Additional	Total			
T1:At Kayad Vishramsthal	109	3	112	1500	0.07	A
T2: At RA Mine Road	883	3	886	3600	0.25	8

(NH-8)						

Capacity as per IRC-106; 1990 for guideline,

V= Volume in PCU's/hr & C= Capacity in PCU's/ hr

Table No.3.13: IRC V/C and performance class

V/C	LOS	Performance
0.0 - 0.2	A	Excellent
0.2 - 0.4	B	Very Good
0.4 - 0.6	C	Average
0.6 - 0.8	D	Poor
0.8 - 1.0	E	Very Poor
1.0 & above	F	Worst

The peak traffic level of existing road and after expansion for the both the access road was found to be in the category of excellent to very good due to current very low traffic. Post expansion will have minimal impact on the current traffic as most of the traffic will be restricted between Ajmer and Kayad Mine.

3.5 WATER ENVIRONMENT

3.5.1 DRAINAGE:

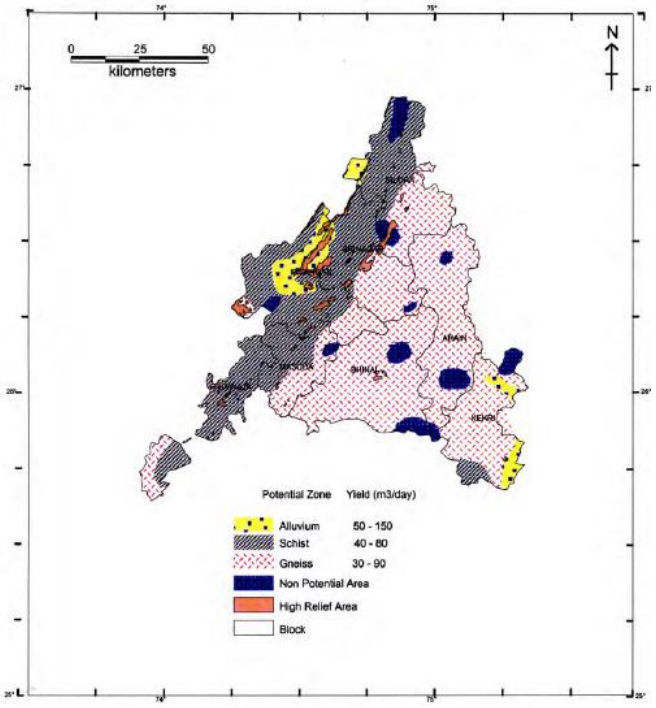
Ground water movement is controlled mainly by the hydraulic conductivity of the crystallinemetamorphics and hydraulic gradient. The ground water movement mainly takes place through the fractures and joints of the crystalline rocks. A review of the topography and drainage pattern in the major part of the buffer zone reveals that the general slope of the area is towards northeast and is 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 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 significant as the rocks have very low fracture porosity and hydraulic conductivity.

3.5.2 HYDROGEOLOGY OF DISTRICT

Ground water quality in Ajmer significantly influenced by semi-arid climate and hydro-geologically diversity-salinity, sodicity and fluoride are the major factors affecting the ground water quality. Ground water is the major source of irrigation in the district.

Alluvium area is restricted to riverbeds. Granite gneiss covers 4811 sq km (56.73%) and found in the eastern part falling in Kekri, Arain, Bhinay and parts of Masuda, Srinagar, Silora and Jawaja blocks. Quality of water varies from potable to brackish. Yield is generally poor and varies from 30 to 90 m^3/day. Schist is confined to 2,690 sq km (31.72%) in the western part of the district falling in parts of Pisangan, Srinagar, Silora, Masuda and Jawaja blocks. Open wells tapping schist yield 40 to 80 m^3/day whereas wells located along the intrusions of quartz vein and pegmatite yield 100 to 170 m^3/day.



(Source: District Ground water brochure: Ajmer District)

Figure 3.7: Hydro-geological Map of District Ajmer, Rajasthan

Limestone occurs between Bassi & Nand along Sasuti valley; confluence of Sasuti & Sagarmati Rivers in the north and Baktawarpura in the south. These do not form potential aquifer. Yield of wells at isolated location may goes up to 100 m^3/day. Depth of dug wells is below 50 m, generally restricted to weathered thickness. Nearly 90% wells are in the depth range of 10 to 25 mbgl. The yield of shallow wells varies from 20 to 30 m^3/day and it may go up to 150 m^3/day depending upon formation. Bore wells/ tube wells are generally 60 to 175 m deep. Depth to water level as recorded in 28 NHS (2006) ranges from 3.13 to 30.80 and 1.45 to 28.89 mbgl during pre-monsoon and post monsoon respectively. Block-wise depth to water level is as follows:

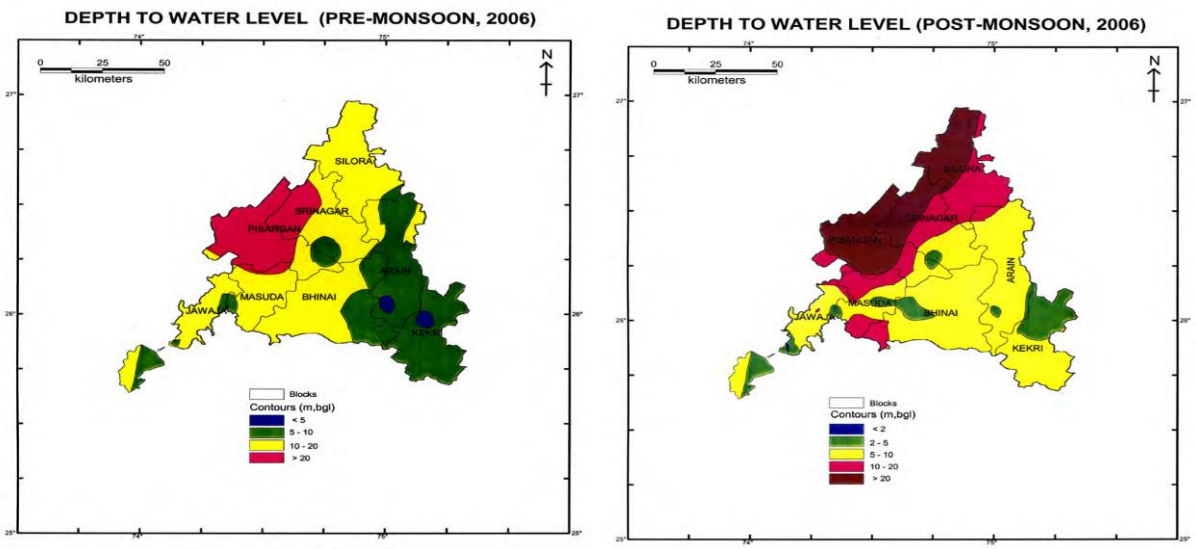


Figure 3.8 Depth to water level pre & post monsoon Ajmer, Rajasthan

During pre monsoon, shallow (<5 m) water levels were observed at isolated location in Kekri and Arain blocks. Post monsoon data shows depth to water level below 2m at isolated location in Jawaja block, 2 to 5m in Arain, Bhinai, Kekri, Masuda, Jawaja & Srinagar blocks. Western and northwestern part of the district has deeper water levels i.e. more than 20 mbgl. Water level between 10 & 20mbgl is in Silora, Srinagar, Pisangan, Masuda and Bhinai blocks. Rest of the area falls under 5 to 10m category. Broadly, water

table slopes follows drainage direction. Water table elevation & gradient ranges from 310 meter above mean sea level (mamsl) along southeastern part (Kekri block) to more than 660 mamsl in southwestern part (Jawaja block) & 1.0 (Kekri block) to 13.3m/km (Jawaja block) respectively.

Seasonal fluctuation of pre & post monsoon, 2006 indicates rise in most part of the district. Out of this, rise in water level more than 4m was observed in entire district except in Kekri, Pisangan and Silora. However, few locations in Arain, Bhinai & Silora blocks show decline at isolated locations.

Long term pre monsoon (1997-2006) water level data of Hydrograph Stations show declining trend in entire district. Srinagar block shows decline of more than 1 m during pre & post monsoon due to urban water supply and poor yielding aquifer.

Specific yield of schist is 2%, gneiss – 1.5% and and Alluvium-8% *(Reappraisal of ground water resources of Ajmer district, 2004)*. The transmissivity of aquifer tapping alluvium aquifer is about 40 m^2/day whereas in hard rock areas in the district it varies from 4.6 & 330 m^2/day.

Hydrogeology of study area

The area is located within Aravali ranges trending NE-SW. It is mainly on the eastern side of Ajmer hills and is undulating with altitude varying from 470 to 506 mRL. The area is mainly drained by Nahar river which originates in the eastern slopes of Ajmer hills and takes northeasterly course. There is a stream originating northwest of Kayar village known as Kala nala and flows northerly and is harnessed in a tank known as Phool sagar.

The area in general has alluvial soils of fluvial origin with varying depths from shallow to moderate with weathered rock in the sub-stratum.

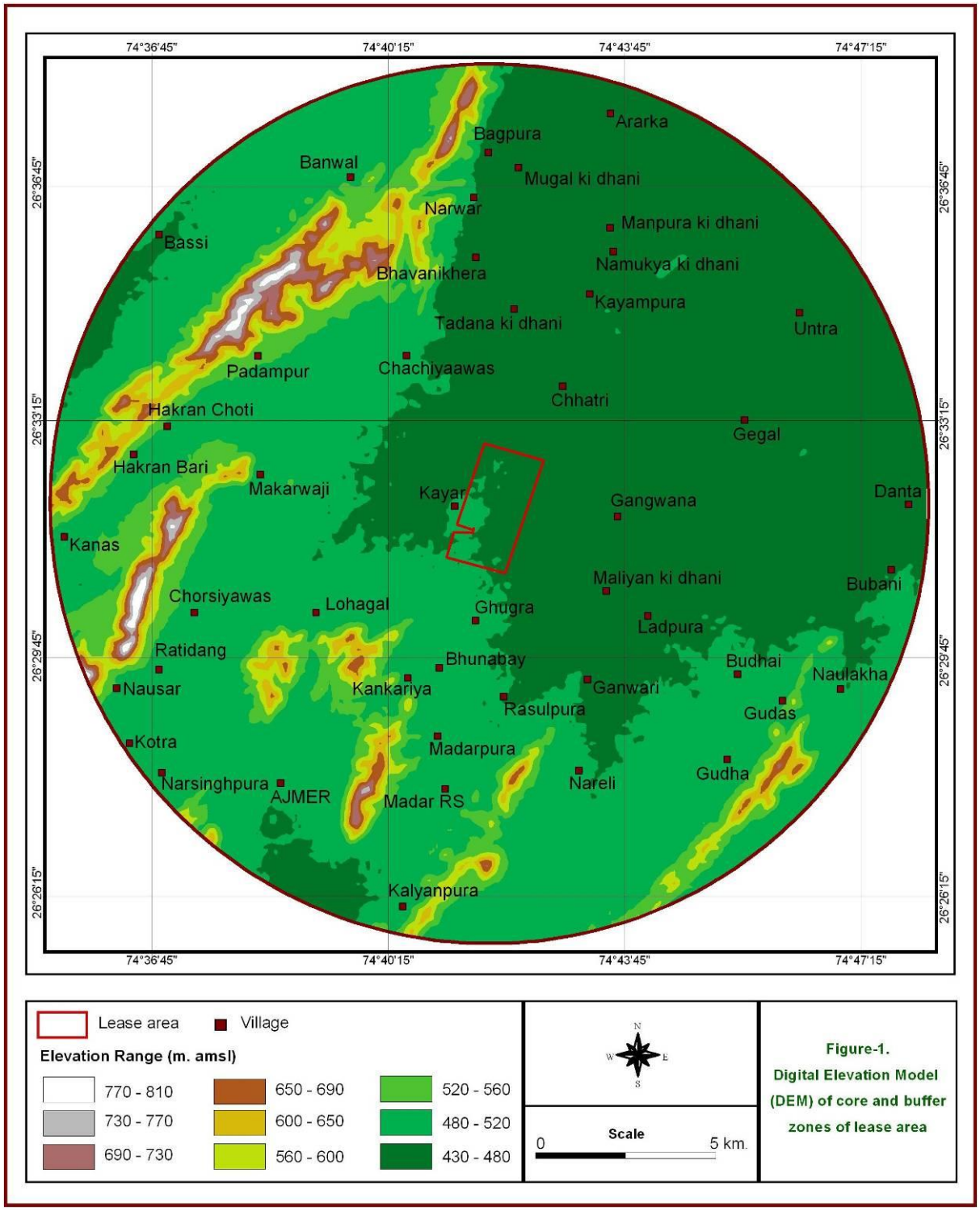


Figure-1. Digital Elevation Model (DEM) of core and buffer zones of lease area

Kayar area is drained by river Nahar which flows in northeastern direction and ultimately joins Roopangarh river which merges in Sambhar inland saline lake. Almost major part of buffer zone is drained by Nahar river, smaller area, between Choriyawas and northern Ajmer hills is drained in to Anasagar lake. The area west of Bhawanipura hills is drained in Luni river basin. The area drained by Nahar river has been placed by Irrigation Department in Shekhawati river basin

while on the western side lies in Luni river basin. There is drainage divide formed by Ajmer and Bhawaikhera hills.

There are few minor irrigation tanks constructed on Nahar river sub-basin and its tributaries. These tanks when completely filled provide irrigation to command area developed in nearby villages. However, for last few years, there was hardly any irrigation from these tanks and the area of buffer zone remained mostly uncommanded area.

Surface water reservoirs of Nahar river sub-basin

Four minor irrigation projects have been constructed in the Nahar river sub-basin. The details of these tanks are shown in the following table.

Table. Surface water reservoirs in Nahar river sub-basin

S. No.	Project Name	DSB No.	Catchment Area (km^2)			Live Storage Mm^3	CCA Ha.
			Total	Intercepted	Free		
1.	Phoolsagar	4	55.2	6.1	49.1	2.9	364
2.	Roopangarh	4	114	0.00	114	6.0	1342
3.	Ghugra tank	4	7.3	0.00	7.3	0.3	68.8
4.	Gangawana	4	13.8	0.00	13.8	0.4	161

DSB – Differential Sub- Basin

CCA- Culturable Command Area

Source – Irrigation department,1996.

Drainage pattern

Although there is a well defined drainage system having dendritic drainage pattern in the buffer zone, a major part of drainage has been harnessed by constructing minor irrigation projects and tanks. Whatever runoff is produced by the average annual rainfall of 281.63 mm in the buffer zone, major part goes as surface runoff after meeting the evapo-

transpiration losses and a part percolates to the zone of saturation.

3.5.3 RAINFALL & CLIMATE

Mean annual rainfall (1987-2006) of the district is 453.2 mm whereas normal rainfall (1901-70) is lower than average rainfall and placed at 433.8. Almost 95% of the total annual rainfall is received during the southwest monsoon, which enters the district in the last week of June and withdraws in the middle of September. Probability of average annual rainfall exceeding 300 mm is only 90%, However, there is 10% probability that the average rainfall exceed 600 mm. Drought analysis based on agriculture criteria indicates that the district is prone to mild and normal type of droughts. Severe and very severe type of drought is very rare and occurred only twice during 1987 & 2002.

January is the coldest month with mean maximum and minimum temperatures being lowest at 22.70º C & 7.60º C. Temperature in summer month, June, reaches up to 39.50º C. There is drop in temperature due to onset of monsoon and rises again in the month of September.

Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity 80%. The annual potential evapo-transpiration in the district is 1565.6 mm and is the highest in the month of May (243 mm).

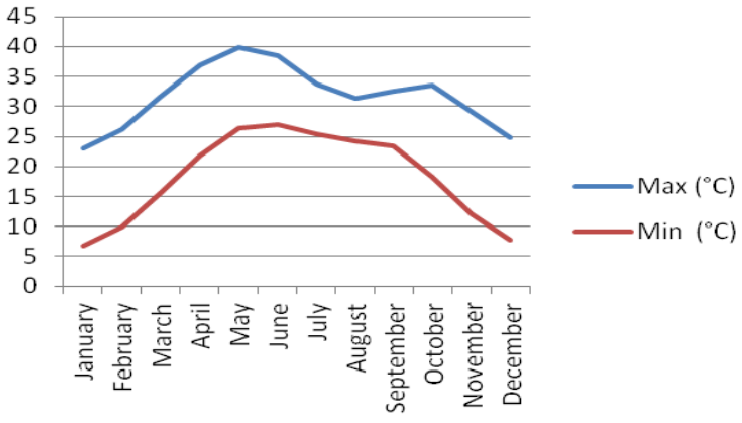


Figure 3.9 Average Maximum & Minimum Temperature

3.5.3 WATER QUALITY:

The baseline water quality in the study area was analysed for ground and surface water samples. The sampling locations were selected based on reconnaissance survey with the considerations of:

- presence of water resource;
- access to water resource; and
- Representative coverage of study area.

The quality of groundwater water was compared with IS: 10500 and surface water was compared with CPCB discharge standard for aquatic resources. Total of 5 groundwater locations and 2 surface water locations were identified. The details of the sampling locations identified in the study area for water quality monitoring are given in Table 3.14.

The water quality was assessed for physical, chemical and bacteriological parameters as per the Bureau of India Standards IS: 10500 specifications with additional parameters such as COD, BOD & DO etc.

Table No.3.14: Analytical Protocol followed for Water Quality Monitoring and Analysis

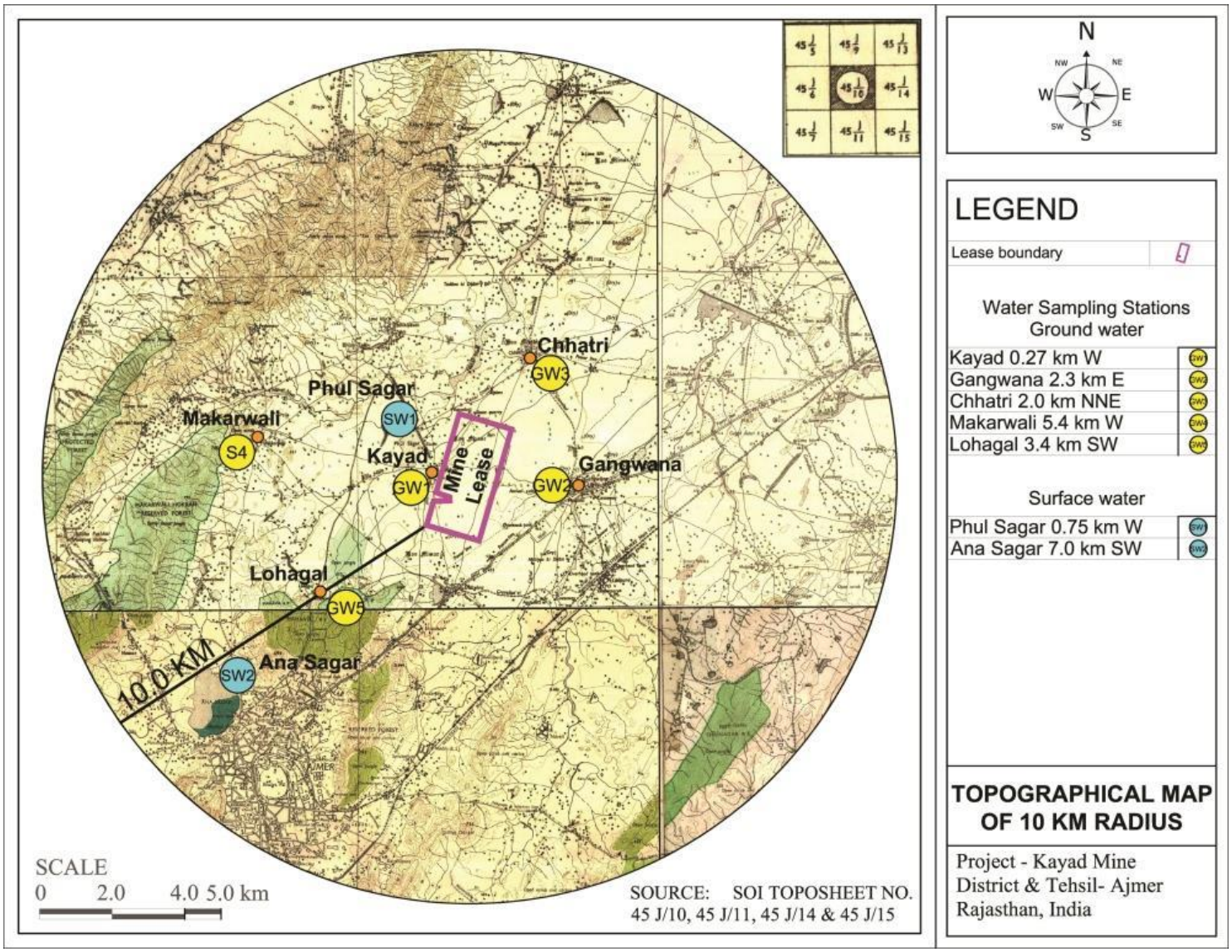
S. N	Parameter	Protocol Followed	Detection Limit
1.	True Colour, Hazen Unit	IS:3025 (Part-4)	1
2.	Odour	IS:3025 (Part-5)	-
3.	Taste	IS:3025 (Part-7&8)	-
4.	Turbidity, NTU	IS:3025 (Part-10)	1
5.	pH	IS:3025 (Part-11)	2
6.	Total Hardness (as $CaCO_3$), mg/l	IS:3025 (Part-21)	6.6
7.	Iron (as Fe), mg/l	IS:3025 (Part-53)	0.3
8.	Chlorides (as Cl), mg/l	IS:3025 (Part-32)	1
9.	Fluoride (as F), mg/l	IS:3025 (Part-23)	0.1
10	Total Dissolved solids, mg/l	IS:3025 (Part-16)	25
11	Magnesi0um (as Mg), mg/l	IS:3025 (Part-46)	10
12	Calcium (as Ca), mg/l	IS:3025 (Part-40	1
13.	Copper (as Cu), mg/l	IS:3025 (Part-42)	0.01
14.	Manganese as Mn, mg/l	IS:3025 (Part-35)	0.01
15.	Sulphate (as SO4), mg/l	IS:3025 (Part-24)	1
16.	Nitrate (as NO3), mg/l	IS:3025 (Part-34)	1
17.	Phenolic Compounds (as C_6H_5OH), mg/l	IS:3025 (Part-43)	0.001
18.	Mercury (as Hg), mg/l	IS:3025 (Part-48) Mercury Analyzer	0.001
19.	Cadmium (as Cd), mg/l	IS:3025 (Part-41)	0.002
20	Selenium (as Se), mg/l	IS:3025 (Part-56)/IS 15303	0.01

S. N	Parameter	Protocol Followed	Detection Limit
21.	Arsenic (as As), mg/l	IS:3025 (Part-37)	0.01
22.	Cyanide (as CN), mg/l	IS:3025 (Part-27)	0.002
23.	Lead (as Pb), mg/l	IS:3025 (Part-47)	0.01
24.	Zinc (as Zn), mg/l	IS:3025 (Part-49)	0.2
25.	Anionic D0etergents (MBAS), mg/l	Annex. K , IS 13428	0.1
26.	Chromium (as Cr+6), mg/l	IS:3025 (Part-52)	0.01
27.	Mineral Oil, mg/l	APHA 5520 C & IS 3025 (Part 39)	0.1
28.	Alkalinity (as CaCO3), mg/l	IS:3025 (Part-23)	0.5
29.	Aluminium (as Al), mg/l	IS:3025 (Part-55)	0.01
30.	Boron (as B), mg/l	IS:3025 (Part-29)	0.01
31.	Barium	Annex. F, IS 13428 / IS 15302	0.01
32.	Molybdenum (as Mo)	APHA Method	0.01
33.	Sulphide (as H_2S)	IS:3025 (Part-29)	0.05
34.	Nickel (as Ni)	IS:3025 (Part-54)	0.01
35.	TPH	ASTM D3921-96-2011	1
37.	MPN Coliform/ 100 ml	IS : 1622, 1981 (2003)	2
38..	Tests for detection of E.Coli	IS : 1622, 1981 (2003)	2
39.	Dissolved Oxygen, mg/l	APHA 4500 O-C	0.1
40.	Salinity, parts per thousand	APHA 2520 B	0.0155
41.	Chemical Oxygen Demand, mg/l	APHA 5220 B	4
42	Biochemical Oxygen Demand (at 20°C for 5 days), mg/l	IS:3024 (Part-44)	0.1

Table No.3.15: Water Sampling Locations in the study area

S. N.	Sampling Location	Station Code	Type of Sample	Distance w.r.t boundary of ML	Direction w.r.t lease area	Details of surroundings
Ground water sampling locations						
1	Kayad	GW1	Ground Water	0.27km	W	Representing groundwater quality with in a village located in close vicinity to the project site.
2	Gagwana	GW2	Ground Water	2.3 km ;	E	Representing groundwater quality with in a village located in close vicinity to the project site.

3	Chattri	GW3	Ground Water	2.0 km ;	NE	Representing groundwater quality with in a village located in close vicinity to the project site.
4	Makarwali	GW4	Ground Water	5.4 km	WNW	Representing groundwater quality with in a village located in close vicinity to the project site.
5	Lohagal	GW5	Ground Water	3.4 km ;	SW	Representing groundwater quality with in a village located in close vicinity to the project site.
Surface water sampling locations						
1	Phul Sagar	SW1	Surface Water	0.75 km ;	W	Representing surface water quality in W portion of the study area.
2	Ana Sagar Lake	SW2	Surface Water	7.0 km ;	SW	Representing surface water quality in SW portion of the study area which is Thickly Populated.



Source: Survey of India toposheet

Figure 3.10: Water sampling locations in the Study Area

Table No.3.16: Primary Water Quality Criteria for Designated-Best-Use-Classes

Designated-Best-Use	Category	Criteria Description
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20^{o}C 2mg/l or less
Outdoor bathing	B	Total Coliforms Organism MPN/100ml shall be 500 or

(Organized)		less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25^{o}C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Source: CPCB

Table No. 3.17: Results of GW & SW analysis

S.No	PARAMETERS	Unit	Kayad	Gagwana	Chattri	Makarwali	Lohagal	Phul Sagar	Ana Sagar Lake
			GROUND WATER					SURFACE WATER	
			GW1	GW2	GW3	GW4	GW5	SW1	SW2
1	pH value	-	6.97	7.86	7.63	7.82	7.45	7.56	7.74
2	Temperature	^{0}C	26.1	27.5	26.7	27.4	28.1	28.3	27.8
3	Turbidity	NTU	<1	2.3	2.0	2.8	3.4	3.2	3.4
4	Total Hardness (as CaCO3)	mg/L	421	354	292	367	371	68	85
5	Total Alkalinity (as $CaCO_3$)	mg/L	341	546	284	289	412	74	88
6	Chlorides (as Cl)	mg/L	235	435	268	302	384	25	18
7	Sulphate (as SO_4)	mg/L	47.3	72.4	56.2	63.3	75.2	38.2	28.3
8	Nitrite	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
9	Nitrate (as NO_3)	mg/L	14.3	18.3	16.8	21.4	17.8	22.3	25.7
10	Fluoride (as F)	mg/L	0.37	1.05	1.13	0.98	0.84	0.72	1.03
11	Sodium (Na)	mg/L	85.30	78.30	45.23	68.30	73.20	88.40	120.30
12	Potassium (K)	mg/L	6.14	4.56	5.05	7.35	5.23	8.12	6.46
13	Total Nitrogen	mg/L	1.74	2.32	1.28	2.84	2.56	4.18	3.47
14	Total Phosphorus	mg/L	0.74	0.53	0.82	0.63	0.73	5.31	7.43
15	DO	mg/L	4.1	3.2	3.7	2.8	3.6	3.6	3.9
16	BOD	mg/L	0.4	0.3	0.7	0.4	0.6	6.1	10.61
17	COD	mg/L	16	8	15	12	14	59	132

18	Phenolic Compounds (as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Iron (as Fe)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Arsenic(as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Chromium Hexavalnt (as $Cr+^{6}$)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27	Zinc (as Zn)	mg/L	0.06	0.03	BDL	BDL	0.03	BDL	BDL
28	Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Oil & grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Total Coliform	mg/L	<2	<2	<2	<2	<2	<2	22
31	Colour	mg/L	<1	<1	<1	<1	<1	<1	<1
32	Odour	mg/L	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
33	TDS	mg/L	1245	1564	912	1024	1456	357	364
34	RFC	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Boron	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
36	Sulphide	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
37	Cyanide	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Results & Discussions:

Physico-Chemical Parameters

Ground water

- pH of the groundwater samples were found in the range of 6.97 to 7.86 as against the drinking water norm of 6.5 to 8.5.
- The level of dissolved solids in the groundwater samples varied from 912 mg/l to 1564 mg/l. It was observed that at all locations TDS was above the Desirable limit, however within the permissible limit of 2000 mg/l.
- The chloride concentration ranged from 235 mg/l to 435 mg/l in the groundwater samples. Most of the groundwater samples had chloride concentration was found to be above Desirable limit (250 mg/l) except GW1 (Kayad), however these samples were found to have chloride within the permissible limit of 1000 mg/l.
- Alkalinity varied from 284 mg/l to 546 mg/l in the groundwater samples. Total alkalinity was found to be exceeded the Desirable limit (200 mg/l) in all the water samples, however all samples were observed to have alkalinity concentration within permissible limit of 600 mg/l.
- The fluoride level in the most of the groundwater samples was observed to be Below Desirable Limit and All locations the fluoride concentration is found within permissible limit of 1.5 mg/l
- The Sulphate and nitrate concentrations in the groundwater samples were observed to be in the range of 47.3 mg/l to 88.3 mg/l (for Sulphate) and from 13.7 to 21.4 (for nitrate).Sulphate and nitrate at every location were found within the acceptable concentration limit of 200 mg/l & 45 mg/l respectively.
- Level of Phenolic compounds and Heavy Metals was observed to be BDL in all the groundwater samples.

Surface water

SW1 Phul Sagar

Phul sagar is seasonal pond and most of the time it remains dry especially in summer season but during rainy season pond receive ample amount of water which last only for few months. The tank water has limited use in terms of human consumption. During monsoon and post-monsoon, when water body receives rain water and runoff, this water body can be utilised as outdoor bathing (Category B) and propagation of wildlife and fisheries (Category D). The monitoring result shows that pH value was 7.56. The COD and BOD level was 59 mg/l and 6.1 mg/l respectively and DO is 3.6mg/l. . The analyzed water quality of the Phul sagar sample indicates water was not suitable for outdoor bathing, i.e. Class 'B', however, it is fit for propagation of wildlife and fisheries, i.e. Class 'D'

SW-2 Ana Sagar Lake

Environmental threats to Anasagar include pollution, eutrophication, encroachment, siltation, weed infestation, unplanned, aquaculture practices etc. There are causing serious problems for the area and are proving detrimental to the growth of the system: it is noted that, while dissolved oxygen content was low indicating presence of pollutants was found to be high. Pollution is being caused from garbage, waste, sewage, detergents, fertilizers etc. from runoff processes.

The water is used for irrigation and is one of the surface water resources where water was available during the summer season. The monitoring result shows that pH value was 7.74. The DO and BOD level was 3.9 mg/l and 10.61 mg/l respectively. The Coliform contents were observed to be 22 organisms/100ml. The analyzed water quality of the sample indicates water was not suitable for irrigation purpose, i.e. Class 'E', however, it is fit for propagation of wildlife and fisheries, i.e. Class 'D'.

3.6 NOISE ENVIRONMENT

3.6.1 NOISE LEVEL SURVEY

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound, which is composed of many frequency components of various types of loudness distributed over the audible frequency range. The most common and universally accepted scale is the A weighted scale, which is measured as dB (A). This is more suitable for audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of human ear. The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise.

The main objective of noise monitoring in the study area is to establish the baseline noise level and assess the impact of the total noise expected to be generated during the project operations around the project site.

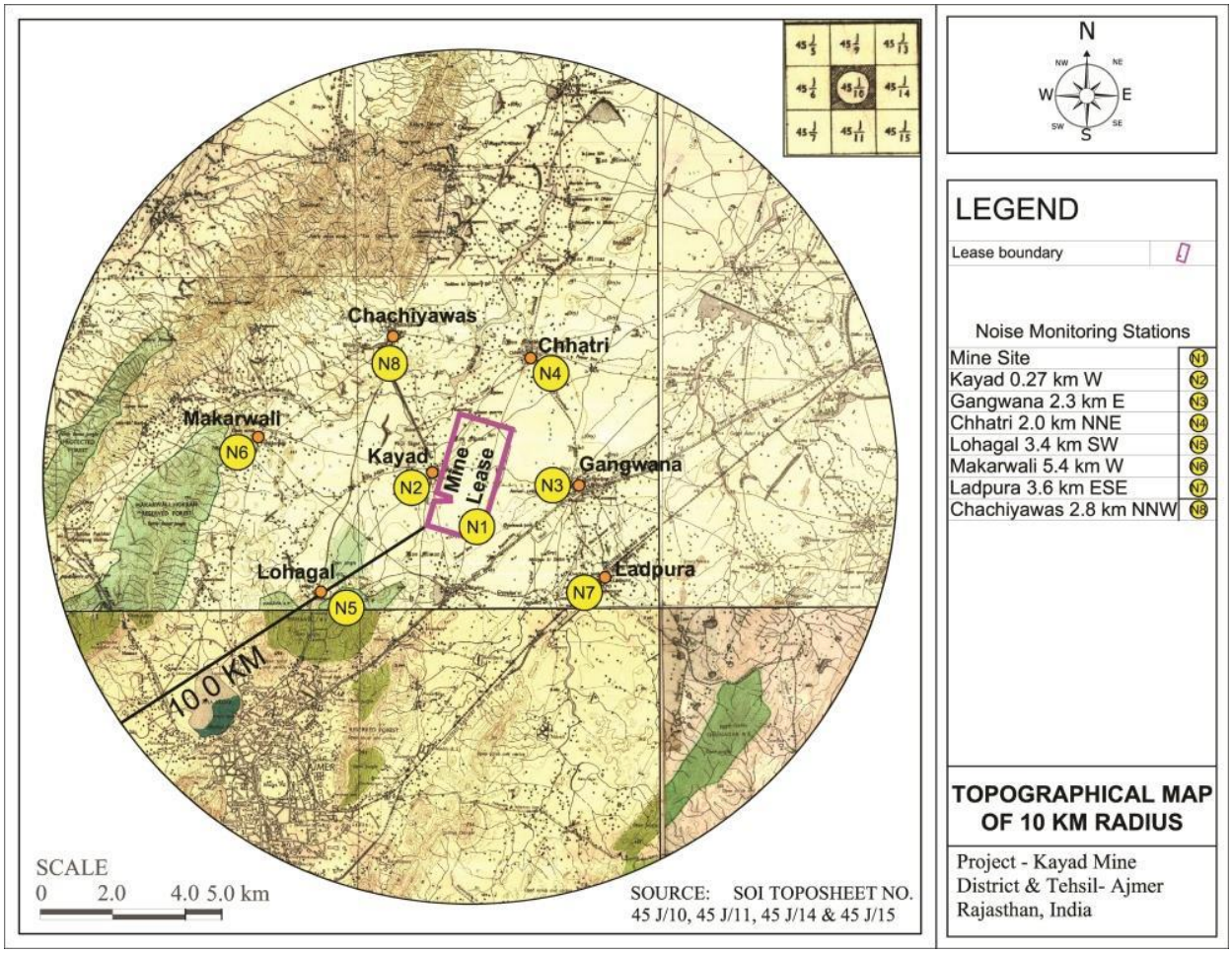
3.6.2 IDENTIFICATION OF SAMPLING LOCATIONS

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise at different generating sources has been identified based on the residential, industrial and commercial activities in the area.

The noise monitoring has been conducted for determination of noise levels at ten locations covering both core and buffer zone in the study area. The noise levels at each location were recorded for 24-hrs. The environment setting of each noise monitoring location is given in Table 3.18.

Table No.3.18: Details of Noise Monitoring Locations

S N.	Sampling Location	Station Code	Type of Activity	Distance (km) w.r.t border of ML	Direction w.r.t ML	Details of surroundings
1.	Mine Ambient area	N1	Mining	--	--	Represent the Project site
2	Kayad	N2	Residential	0.27 km	W	Represents residential area in W part of the study area in close vicinity to the Project site.
3	Gagwana	N3	Residential	2.3 km	E	Represents residential area in E part of the study area and vehicular movements on NH-08 in close vicinity to the Project site.
4	Chattri	N4	Residential	2.0 km	NNE	Predominantly rural residential zone surrounded by agricultural fields. Normal movement of Automobiles consisting of light vehicles.
5.	Lohagal	N 5	Residential	3.4 km	SW	Predominantly rural residential zone surrounded by agricultural fields. Rare traffic movements in the village.
6.	Makarwali	N6	Residential	5.4 km	W	Predominantly residential and commercial zone surrounded by agriculture fields.
7	Ladpura	N 7	Residential	3.6 km	SE	Predominantly rural residential zone surrounded by agricultural fields. Normal movement of Automobiles consisting of light vehicles.
8	Chachiyawas	N8	Residential	2.8 km	NNW	Predominantly rural residential zone surrounded by agricultural fields. Normal movement of Automobiles consisting of light vehicles.



Source: Survey of India Toposheet

Figure 3.11: Map Showing Noise and Traffic Sampling Locations in the Study Area

3.6.3 METHOD OF MONITORING

Instant Sound Level Meter measurements were recorded at eight locations. The readings were taken for every hour for 24 hrs. The day noise levels have been monitored during 6 AM to 10 PM and night levels during 10 PM to 6 AM at all the locations covered in the study area.

The details of the instrument used for the sampling is mentioned below:-

Instrument	Make	Model No.	Instrument Identification	Detection Limit
Integrated Sound Level measurement Instrument Standard Accessories	Lutron	Sl-4001	SAL/ NOISE/ INT/ 01	Lo 30-80 dB Hi 80 – 130 Db

Testing Method to be followed

Particular		Testing Method to be followed
A	Noise level in dB(A) for continuous 24 hours at 1 hour interval	Operational manual of Noise Level Meter, Meter No. DT-805 issued by Mextech

Measured noise level displayed as a function of time provides a useful scheme for describing the acoustical climate of a community. Noise levels recorded at each station are computed for equivalent noise levels. Equivalent noise level is a single number descriptor for describing time varying noise levels. The equivalent noise level is defined as mathematically

$$10 \text{ Log} 1/ T \sum (10^{Ln/10})$$

Where L = Sound pressure level a function of time dB (A)

T = Time interval of observations

Noise levels during the night time generally drop, therefore to compute equivalent noise levels for the night time, noise levels are decreased by 10 dB(A) as the night time highnoise levels are judged more annoying compared to the day time.

Noise levels at a particular station are represented as Day-Night equivalent (L_{dn}). Day – Night equivalent is the single number index designed to rate environmental noise on daily/ 24 hourly basis. Mathematically L_{dn} is given by

L_{eq} (day – night) = $10\log \{1/24 (15x10^{(Ld/10)} + 9 x 10^{(Ln + 10)/10)}\}$

Where :-

L_{eq} (day) = A weighed equivalent for day time period (6 am to 10 pm)

L_{eq} (night) = A weighed equivalent for night time period (10 pm to 6 am)

3.6.4 BASELINE DATA

The statistical analysis is done for measured noise level at eight locations in the study area. The parameters are analyzed for L_{eq}(Day), L_{eq} (night) and L_{eq} (day-night). The statistical analysis results are given in table 3.19.

Table No.3.19: Noise Levels in the Study Area during April 2017

Units – dB (A)

S. N.	Sampling Locations	Land use	Leq Day	Leq Night	Leq Day-Night	CPCB Limits Leq {dB(A)}	
						Day	Night
1.	N1	Industrial	62.1	42.0	61.3	***75***	***70***
2.	N2	Residential	53.2	42.6	53.0	***55***	***45***
3.	N3	Residential	54.9	44.8	53.6	***55***	***45***
4.	N4	Residential	52.3	41.8	51.6	***55***	***45***
5.	N5	Residential	52.6	41.2	52.1	***55***	***45***
6.	N6	Residential	51.6	41.8	50.7	***55***	***45***
7.	N7	Residential	52.1	41.6	51.7	***55***	***45***
8.	N8	Residential	53.3	42.0	52.6	***55***	***45***

The baseline noise monitoring in the study area was carried out at 8 locations during the study period. The day time and night time equivalent noise levels monitored at all the residential receptors were found within the prescribed norms. The noise levels within the ML were observed to be within the prescribed industrial noise limit during day and night time.

3.7 BIOLOGICAL ENVIRONMENT

3.7.1 Introduction

The survey was undertaken to determine the sensitivities/activities in the core zone area (Kayad Lead-Zinc Mine, M.L. No. ML -16/92 area 480.5 ha.) and buffer area of 10 km radius from the boundary of the mining lease area. The ground herbaceous flora was completely parched or only available near the moist areas.

3.7.2 Objective of the Study

The study was undertaken with the following objectives

Floral Status

- Identify floral species within the mine lease and area in 10 km radial distances around the core mine area ;
- Assessment of conservation status of species in conformation of the Indian Wildlife Protection Act (1972) and its amendments, IUCN red-list (2014) and endemic status of the flora in the area along with their use by local communities;
- Identification of major vegetation types of the study area;
- Identification of impacts to the vegetation in the study area due to proposed expansion of lead and zinc mining and beneficiation plant;

Faunal Status

- Identification of all faunal species (wild, avian, terrestrial and aquatic) within 10 km radial distances around the core mine area;
- Classification of these fauna based on their conservation status as per IUCN red-list (2014) and Indian Wildlife Protection Act (IWPA), 1972 and its amendments along with their endemic status;
- Identification of impacts to faunal species due to proposed expansion (such as possibility of travel to, foraging in, or breeding in the core mine area by these animals (which may be disrupted by the mining activities), as well as other potential impacts on these fauna);
- Preparation of detailed mitigation measures required, for the identified impacts on flora and fauna within the study area due to proposed expansion of lead and zinc mining.

1. Survey Limitation:

This survey records the flora and fauna evident on the days of the site visit and field survey. It does not record any flora or fauna that may appear at other times of the year, and as such, were not evident at the time of visit. The report represents ecological status of the area evident during the particular period of the study. This is an ecological report and as such no reliance should be given to comments relating to buildings, engineering, soils or other unrelated matters.

2. Approach of the study

To assess the ecological issues and document flora and fauna associated with the project following tasks were undertaken:

- Preliminary visit on the site
- Desktop review
- Core Site and Buffer area Survey

3. Methodology

i. Desk Study

The purpose of the desk study was to identify habitats and species of local conservation value which may not have been present or apparent during the survey visit (e.g. spring/monsoon plants). The desk study was also helpful in understanding the historical biodiversity and ecological status of the site. The desk study was carried out by referring the hard copy literature related to ecology and biodiversity of the region or of other related areas encompassing the proposed site. Literature survey was also undertaken by collecting and stating research papers and reports specific to the region.

ii. Habitat Survey:

To collect data on flora (Herbs, Shrubs and Trees) and fauna (Birds, Insects, Spiders, Reptiles, Mammals) various strategies were practiced. These strategies differed as per the habit and habitat of concerned group of species.

4. Flora:

The structure and composition of vegetation and forest cover was studied by using Phytosociological methods. Extensive field surveys were undertaken to analyze and estimate diversity, density, dominance and frequency of different members of plant population.

Observations were made in the forest area as well as in non-forest areas by laying plots and adopting quadrate method. The quadrate method includes laying down square sample plots or units for quantitative analysis of vegetation. The sample plot method given by Clements

(1898); Philips (1959); Muller and Ellenberg (1974) and Rau and Wooten (1988) EIA Hand Book (ch.7, pp.44) was followed. The Quadrate sizes of 1 m x 1m, 5m x 5m and 10m x 10m were taken for herbs, shrub and trees respectively.

Co-existence and competition both are affected directly by the number of individuals in the community. Therefore, it is essential to know the quantitative structure of the community. To characterize the community as whole, certain derived parameters are used i.e. Density, Frequency, Abundance, and Importance Value Index (IVI).

The Simpson Diversity Index gives a clear picture of community structure in quantitative terms.

To summarize the following parameters were used during the Floristic diversity and Phytosociological assessment:

i. Density, Frequency, Dominance, Abundance
ii. Importance Value Index (IVI)

5. Fauna and avifauna:

The assessment of wild fauna was mostly based on random sightings. For animals, other than directly sighted, secondary evidences were recorded through calls, dung boles, scats, and spoors, rub signs, signs of debarking, drag mark etc.

For birds, actual counts at each sampling site were made, by walk through in a chosen one kilometer stretch of the site and the number of birds were directly counted and listed. Species list was prepared along with taxonomic position of each species.

6. Sampling Stations:

Sampling locations were strategically selected to collect maximum data on vegetation pattern, faunal diversity and habitat diversity. In total, 18 samples were taken around 05 sampling locations demarcated as core zone (project area) and buffer zone (up to 10 km from leasehold) of Kayad Mine. The IVI value and Diversity richness of core and buffer areas were calculated based on Phytosociological study.

The areas that were visited and sampled during the survey were:

Sampling Location	Distance From Mine Centre (in Km)	Direction From Mine Centre
Mine lease Area (Core zone)	0.0	--
Near Village Gagwana (Buffer zone)	1.6	E
Near Village Gegal(Buffer zone)	6.0	ENE
Near Village Chhatri (Buffer zone)	1.7	NNE
Near Village Lohagal (Buffer zone)	2.7	SW

7. Observations:

Observations were made for all possible habitats and flora-fauna species in and around the site (except micro-organisms). All possible landscape features and areas in the site and buffer areas were visited to collect the required data. The observations recorded are site, time and season specific observations. However, the actual observation data was supported by the data obtained from secondary sources (reports, research papers, literature survey) to gather a wide and in-depth perspective.

The project being an expansion of mining project, the impact of the project can be multifold and therefore the ecological richness and sensitivity of the locations were examined critically. All the major habitats in the buffer area were visited and observation recorded.

1) Habitat and Forest Type Diversity:

The vegetation is one of the invaluable natural resources which changes spatio-temporally in its extent and distribution. Hence, reliable information on the extent and distribution of vegetation types is pre-requisite for natural resource management and planning. More recently, knowledge of the vegetation types is becoming increasingly critical to assess and monitor the potential vulnerability of natural ecosystems due to human induced global environment change. Based on vegetation assessment and forest types, 11 different forest types have been identified in and around the proposed project site as per Champion and Seth (1968).

Table No. 3.20: Habitat and Forest Type of Project Site and in Adjoining Area	
No.	**Forest Type**
1	$5A/C_3$ – Southern Dry Mixed Deciduous Forest
2	$5B/E_3$ – Babul Forest
3	$5B/E8_b$ – Babul Savannah
4	5A/E8c – *Salvadora- Tamarix Scrub*
5	$6B/C_1$ – Desert Thorn Forest
6	$6B/DS_1$ – *Zizyphus* Scrub
7	$6B/DS_2$ – Tropical *Euphorbia* Scrub
8	$6B/E_1$- *Euphorbia* Scrub
9	$6B/E_2$ – *Acacia senegal* Forest
10	$6B/E_4$- *Salvadora* Scrub
11	$6B/DS_1$- *Cassia auriculata* Scrub

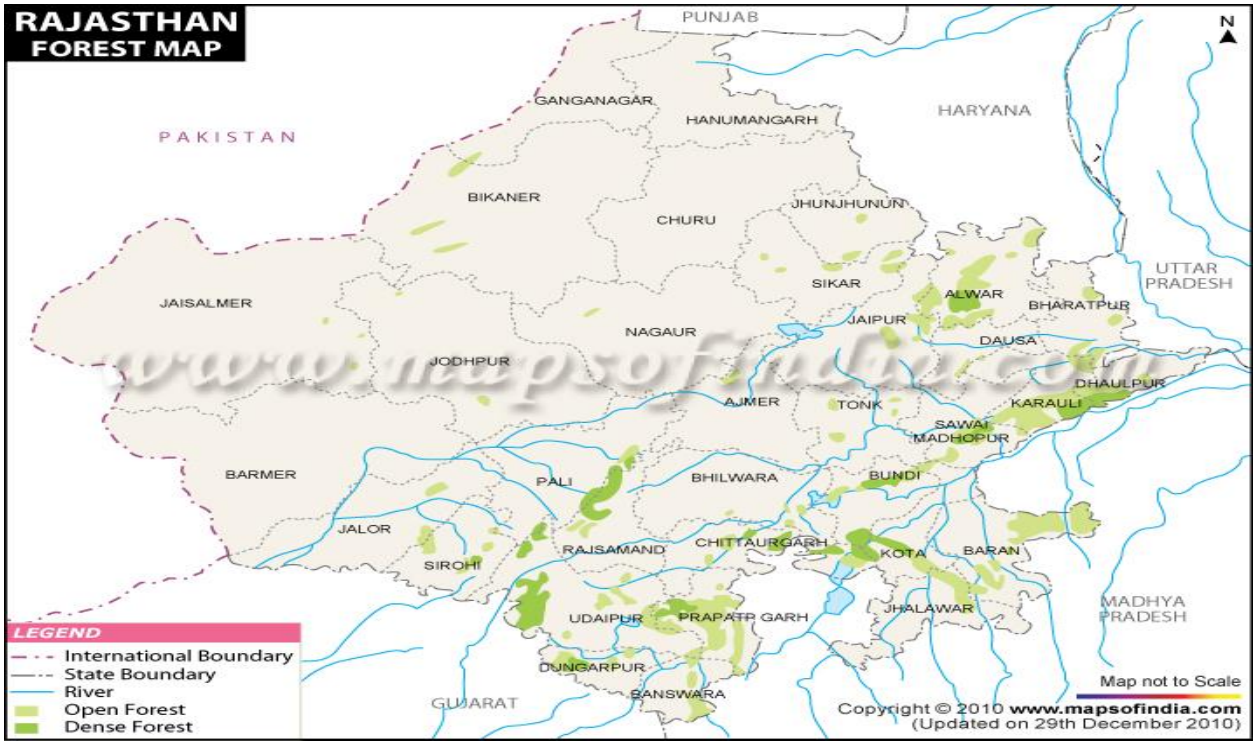
The floral wealth of Rajasthan is rich and varied. The western half is desert terrain, most of the area under forests is restricted to eastern and southern parts of the state. The forests are unevenly distributed in the various districts Most of the forests are over the hilly areas i.e. in Udaipur, Rajasamand, Kota, Baran Sawai Madhopur, Chittorgarh, Sirohi, Bundi, Alwar, Jhalawar and Banswara districts, which make up for about 50 % of the forests of the state. Dense natural forests are in protected patches, mostly confined to various national parks and wild-life sanctuaries. Most of the remaining forests of state are in various stages of plant growth. The forests of state can be divided into four broad forest types;

Tropical Thorn Forests:- Tropical thorn forests are found in arid and semi-arid regions of western Rajasthan . These extend from western Indo -Park border and gradually merge with the dry deciduous mixed forests of the Aravalli hills and the south-eastern plateau. The main species found in this kind of forests are Acacia nilotica , Acacia leucophloea, Prosopis cineraria, Capparis aphylla, Zizyphus spp., Flacourtia spp. etc. These forests are basically found in western part of Rajasthan namely Jodhpur, Pali, Jalore, Barmer, Nagaur, Churu, Bikaner etc.

Tropical Dry Deciduous Forests:- These forests are mostly found in small patches in few parts of the state. the northern and eastern slopes of aravalli ranges, mostly in Alwar, Bharatpur and Dholpur districts, are covered with this type of forests. Sporadic growth of certain species of dry deciduous forests is found along the dry river beds of Jalore, Nagaur, Ganaganagar and Bikaner, districts. The main species found in this kind of forests are *Anogeissus pendula, Anogeissus latifolia, Acacia catechu, Terminalia tomentosa, Terminalia balerica, Terminalia arjuna, Boswellia serrata, Dendrocalamus strictus, Lanea grandis.*

Central Indian Sub - tropical Hill Forests:- These forests which are most abundant in central India, as in Madhya Pradesh, parts of Gujarat and Maharashtra, are found in Sirohi district of Rajasthan also, mostly on the hills girding Mt. Abu. These forests have semi-evergreen and some evergreen species of trees. The vegetation of Mt. Abu consists of many plants which are similar to the sub - tropical region of Himalayas. Around Mt. Abu, they are well represented between 700 to 800 m altitudes.

Mixed Miscellaneous Forests:- These forests are mostly found in south eastern and eastern part of Rajasthan comprising Chittorgarh, Kota, Udaipur, Sirohi, Banswara, Dungarpur, Baran and Jhalawar districts.



There is no existence of any National Park, Sanctuary, Biosphere reserve, Wildlife corridor, Tiger / Elephant reserve in the 10 km periphery of the proposed project.

District forest cover:-

Table No .3.21

Name of district	Geog. Area in Sq .Km	Forest area (in Sq Km) till 2007	% forest area w.r.t Geog. area	Capital Forest area in Ha.
Ajmer	8481	613.10	7.32	0.03

Habitats are decisive factors and determine the diversity and distribution of flora and fauna in any given ecosystem. Therefore, it is vital to understand dynamics and diversity of habitats and ecosystems in and around the proposed project. Actual field observation coupled with Toposheet and Google earth images were used to characterize and distinguish landscape diversity in the study site and the buffer area. The overall examination was carried out by making actual visits at various pre-marked locations in the core site (lease area) and the region falling within the 10 km radius of the project location (Buffer area). The buffer

area was divided in to two parts (5km and 10km) to make the assessment and interpretation convenient.

The Core Site

The core site area is mining area in which project is proposed for Expansion of Lead-Zinc Ore Underground Mine from 1.0million TPA (ROM) to 1.2 million TPA(ROM) (20% Increase). The area is surrounded by other natural and populated habitats. No any reserve and protected forest was observed in the core zone.

The Buffer Site

Biodiversity discusses the existence of a variety of living species including algae to monocots of plant kingdom and protozoan's to mammals of animal kingdom and nature supports these living beings under a structural and functional unit called ecosystem. Biodiversity satisfies human needs in different ways either directly or indirectly. The direct way is increasing agricultural productivity, which supports existence of life on the earth. Indirect way include nutrient trapping, maintaining water cycles, production and protection of soil, absorption and breakdown of pollutants, provide recreational, aesthetic, scientific and spiritual values that helps to continue life on the earth. Present study has been carried out to inventorise the biodiversity existed in and around the study area and to evaluate the possible impacts on biodiversity during construction and operation phases of proposed Industrial Area. The baseline ecological surveys were carried out, based on various secondary sources (Forest Department Data, Scientific Studies etc.) which further validated from various primary surveys, and also through interviewing local people. Present biological studies were carried out in two zones: core zone (project area) and buffer zone (10 km surrounding the core area).

Buffer zone containing the mixed type of land use i.e. industrial, commercial and residential purposes. There is green belt area within & at the periphery of the Kayad Mine area. There will not be any discharge of effluent from the proposed project activity into any water body; hence there will not be any impact on aquatic ecology of the surrounding study area. Dust & gaseous will be generating due to AAQ & stack. Therefore no significant

major impact on terrestrial ecology is envisaged. The above tree species of study area, some of the species are found to be act as pollution tolerant namely Nerium indicum (Kanair) is absorbed SO_2 & NOx from Environment, Azadirachta indica (Neem), is tolerant to SO_2. Other species like Mangifera indica (Mango), Ficus Bengalensis (Vad) are tolerant to Dust. (As per CPCB guidelines March 2000) From the recorded shrub species in the area, Calotropis procera (Akdo) is found to be tolerant to SO_2emissions. Hibiscus rosa sinensis (Rose mallow /Jasud) is tolerant to dust.

Table No. 3.22: Floral species observed in the in the Core zone.

S. No	Local Name	Botanical Name	Family
	Trees		
1	Aam	*Magnifera Indica*	Anacardiaceae
2	Neem	*Azadirachta indica A. Luss*	Meliaceae
3	Ronj	*Acacia leucophloea*	Leguminosae
4	Desi Bawalia	*Acacia nilotica (Linn) Wild.*	Fabaceae
5	Pipal	*Ficus religiosa Linn.*	Moraceae
6	Bad	*Ficus benghalensis*	Moraceae
7	Kumttha	*Acacia senegal (Linn)Wild.*	Fabaceae
8	Araniya	*Clerodendron viscosum vent*	Verbebaceae
9	Khakhra	*Flacourtia indica*	Salicaceae
10	Harsiya	*Acacia arabica*	Fabaceae
11	Bael	*Aegle marmelos*	Rutaceae
12	Kikar	*Prosopis juliflora*	Fabaceae
13	Khejri	*Prosopis cineraria*	Fabaceae
14	Ber	*Zizyphus jujube*	Rhamnaceae
15	Dhak	*Butea monosperma*	Fabaceae
	SHRUBS		
1	Daturo	*Dhatura metel*	Solanaceae
2	Thor	*Euphorbia neriifolia*	Euphorbiaceae
	HERBS		

	/GRASS		
1	*Dhoob*	*Cynodon dactylon*	Poaceae
2	Akda	*Calotropis procera*	Asclepiadaceae

Table No. 3.23 Floral species observed in the Buffer zone.

S. No	Local Name	Botanical Name	Family
	Trees		
1	Aam	*Magnifera Indica*	Anacardiaceae
2	Neem	*Azadirachta indica A. Luss*	Meliaceae
3	Ronj	*Acacia leucophloea*	Leguminosae
4	Desi Bawalia	*Acacia nilotica (Linn) Wild.*	Fabaceae
5	Pipal	*Ficus religiosa Linn.*	Moraceae
6	Bad	*Ficus benghalensis*	Moraceae
7	Kumttha	*Acacia senegal (Linn)Wild.*	Fabaceae
8	Araniya	*Clerodendron viscosum vent*	Verbebaceae
9	Khakhra	*Flacourtia indica*	*Salicaceae*
10	Kanair	*Nerium Indicum*	Apocynaceae
11	Amaltas	*Cassia fistula*	Fabaceae
12	Ashok	*Saraca asoca*	Fabaceae
13	Ber	*Zizyphus jujube*	Rhamnaceae
14	Harsiya	*Acacia arabica*	Fabaceae
15	Gulmohar	*Delonix regia*	Fabaceae
16	Ratanjot	*Jatropha curcus*	*Euphorbiaceae*
17	Amala	*Phyllanthus emblica*	Phyllanthaceae
18	Siras	*Albizia lebbeck*	Fabaceae
19	Bael	*Aegle marmelos*	Rutaceae
20	Kikar	*Prosopis juliflora*	Fabaceae
21	Khejri	*Prosopis cineraria*	Fabaceae
22	Ber	*Zizyphus jujube*	Rhamnaceae
23	karonda	*Carissa congesta wt*	Apocynaceae

24	Har singar	*Bougainvillea*	Nyctaginaceae
25	Dhak	*Butea monosperma*	Fabaceae
	SHRUBS		
1	Daturo	*Dhatura metel*	Solanaceae
2	Thor	*Euphorbia neriifolia*	Euphorbiaceae
3	Marigold	*Tagetes minuta*	Asteraceae
	HERBS /GRASS		
1	*Dhoob*	*Cynodon dactylon*	Poaceae
2	Akda	*Calotropis procera*	Asclepiadaceae

Table No.3.24 List of Crops, Vegetables, Fruits

S. No	Local Name	Botanical Name	Family
	Crop		
1	Wheat	*Triticum Aestivum*	Poaceae
2	Maize	*Zea mays*	Poaceae
3	Cottan	*Gossypium barbadense*	Malvaceae
4	Mung	*Vigna radiata*	Fabaceae
5	Jowar	*Sorghum spp*	Poaceae
	Vegetables		
1	Brinjal	Solanum melongena	Solanaceae
2	Tomato	*Solanum lycopersicum*	Solanaceae
3	Cauliflower	*Brassica oleracea*	Brassicaceae
4	Palak	*Spinacia oleracea*	amaranthaceae
5	Chilly	*Capsicum annum*	Solanaceae
6	Mustard	*Brassica nigra*	Brassicaceae
	Fruits		
1	Lemon	*Citrus limon*	Rutaceae
2	Guava	*Psidium guajava*	Myrtaceae
3	Annar	*Punica granatum*	Lythraceae
4	Jamun	*Syzygium cumini*	Myrtaceae

Table No. 3.25 Details of Mammals, Birds, Reptiles & Amphibians observed in the Core Zone.

S. No	Common Name	Zoological Name	Order	Family	Schedule
A	**Mammals**				
1	Indian Hare	*Lepus nigricollis*	Lagomorpha	Leporidae	IV
2	Five striped palm squirrel	*Funambulus pennanti*	Rodentia	Sciuridae	IV
3	Common House rat	*Rattus rattus*	Rodentia	Muridae	IV
4	Indian field mouse	*Mus booduga*	Rodentia	Muridae	IV
B	**Birds**				
1	House sparrow	*Passer domesticus*	Passeriformes	Passeridae	IV
2	Common bulbul	*Pycnonotus barbatus*	Passeriformes	Pycnonotidae	IV
3	House crow	*Corvus splendens*	Passeriformes	Corvidae	V
4	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	IV
5	Rose-ringed Parakeet	*Psittacula Krameri*	Psittaciformes	Psittacidae	IV
6	Indian Ring Dove	*Streptopelia decaocto*	Columbiformes	Columbidae	IV
7	Pigeon	*Columba livia*	Columbiformes	Columbidae	IV
8	Jungle hen	*Gallus gallus*	Galliformes	Phasianidae	IV
C	**AMPHIBIAN**				
1	Common frog	*Rana temporaria*	Anura	Ranidae	
D	**REPTILES**				
1	Nevala	*Herpestes smithi*	Carnivora	Herpestidae	III

Table No.3.26 Details of Mammals, Birds, Reptiles & Amphibians observed in Buffer Zone.

S. No	Common Name	Zoological Name	Order	Family	Schedule
A	**Mammals**				
1	*Common Mangoose*	*Herpestes edwardsi*	Carnivora	Herpestidae	II
2	*Indian Hare*	*Lepus nigricollis*	Lagomorpha	Leporidae	IV
3	*Blue bull*	*Boselaphus tragocamelus*	Artiodactyla	Bovidae	III
4	Five striped palm squirrel	*Funambulus pennanti*	Rodentia	Sciuridae	IV
5	Common House rat	*Rattus rattus*	Rodentia	Muridae	IV
6	Indian field mouse	*Mus booduga*	Rodentia	Muridae	IV
7	Common langur	*Presbytis entellus*	Primates	Cercopithecidae	**II**
B	**Birds**				
1	House sparrow	*Passer domesticus*	Passeriformes	Passeridae	IV
2	Common bulbul	*Pycnonotus barbatus*	Passeriformes	Pycnonotidae	IV
3	House crow	*Corvus splendens*	Passeriformes	Corvidae	V
4	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	IV
5	Rose-ringed Parakeet	*Psittacula Krameri*	Psittaciformes	Psittacidae	IV
6	Indian Ring Dove	*Streptopelia decaocto*	Columbiformes	Columbidae	IV
7	Pigeon	*Columba livia*	Columbiformes	Columbidae	IV
8	Jungle hen	*Gallus gallus*	Galliformes	Phasianidae	IV
9	Bulbul	*Pycnonotus cafer (Linn)*	Passeriformes	Pycnonotidae	IV
10.	Pavo cristatus	Peacock	Galliformes	Phasianidae	I
C	**AMPHIBIAN**				
1	Common frog	*Rana temporaria*	Anura	Ranidae	
D	**REPTILES**				
1	Nevala	*Herpestes smithi*	Carnivora	Herpestidae	III

SUMMARY

Detailed ecological studies were conducted to assess the present biological resources in and around the proposed Kayad – mine lease area. plant species were observed during study period are *Cassia occidentalis, Datura metal, Jatropha sp, Parthenium hysteriphorus, Tridax procumbens* and *Physalis minima* are the herbaceous species and *Azadirachta indica, Peltoforrum ferrusinum, Carissa spinarum, Anogeissus pendula, Phoenix aculis* and Butea monosperma of perennial vegetation were also observed. Therophytes followed by phanerophytes dominate the region. Primary Faunal studies were conducted in five locations and no major wildlife exists in study area. Literature survey and data collected from forest department reveals that there are no wildlife sanctuaries, national parks and biospheres and no migratory paths in 10 km radius. As per Indian council of Agricultural institute classification, the study area falls under southern plains of Aravalli hills with average rainfall of about 450 mm and semiarid region

One schedule–I Faunal species i.e. Peacock have been reported from the study area they were found in the buffer area. Conservation plan for peafowl is elaborated in Environment Management Plan (Chapter -10) of this report.

3.8 SOCIO-ECONOMIC ENVIRONMENT

This section of the EIA report deals with Socio-Economic Impact Assessment of theProposed**"** Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM)"at ML No. 16/92, Village: Kayad, Tehsil: Ajmer, District Ajmer (Rajasthan) to be developed by M/s. Hindustan Zinc Limited. The broad objectives of the socio-economic impact assessment are as follows:

a) To study the socio-economic status of the people living in the study area of the Proposed "Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM)".
b) To assess the impact on socio-economic environment due to Proposed "Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM)".

c) To assess the impact of the project on State Gross Domestic Product (SGDP)

d) To evaluate the community development measures proposed to be taken up by the Project proponent, if any.

e) To suggest Community Development measures needs to be taken for the study area

3.8.1 Methodology

The methodology adopted for impact assessment is as follows:

a) The details of the activities and population structure have been obtained from Census 2011 and analyzed.

b) Primary data was collected by a door-to-door survey in urban area and household's living therein. The data collected during the above survey was analyzed to evaluate the prevailing socio-economic profile of the area.

c) Based on the above data, impacts due to construction operation on the community have been assessed and recommendations for further improvement have been made.

d)

3.8.2 Concept & Definition

a) Study Area: The study area, also known as impact area has been defined as the sum total of core area/project area and buffer area with a radius of 10 Kilometers from the periphery of the core area/project is. The study area includes all the land marks both natural and manmade falling herein.

b) Household: A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one member households, two member households or multi-member households.

c) Sex ratio: Sex ratio is the ratio of males to females in a population. It is expressed as number of females per 1000 males.

d) Literates: All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

e) Literacy rate: Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

f) Labour Force: The labour force is the number of people employed and unemployed in a geographical entity. The size of the labour force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labour force of a country consists of everyone of working age (around 14to 16) and below retirement (around-65) that are participating workers, that is people actively employed or seeking employment. People not counted under labour force are students, retired persons, stay-at home parents, people in prisons and discouraged workers.

g) Work: Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time or full time or unpaid work in a farm, family enterprise or in any other economic activity.

h) Worker: All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation or milk production even solely for domestic consumption are also treated as workers.

i) Main Workers: Those workers who had worked for the major part of the reference period(i.e. 6 months or more) are termed as Main Workers.

j) Marginal Workers: Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers

k) Work participation rate: The work participation rate is the ratio between the labour force and the overall size of their cohort (national population of the same age range). In

the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

3.8.3 Findings of the study:

Description of the Study Area:

The study area of the Proposed "**Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM)"at ML No. 16/92,** Village: Kayad, Tehsil: Ajmer, District Ajmer (Rajasthan) to be developed by M/s. Hindustan Zinc Limited. Detailed administrative setup is given in figure 3.1. The study area is involves villages,5 Villages are falling within 2 Km radius of project site and 52villagesare from 2 to 10 Km buffer zone, Total 57 villages& 3 Urban Area within study area.

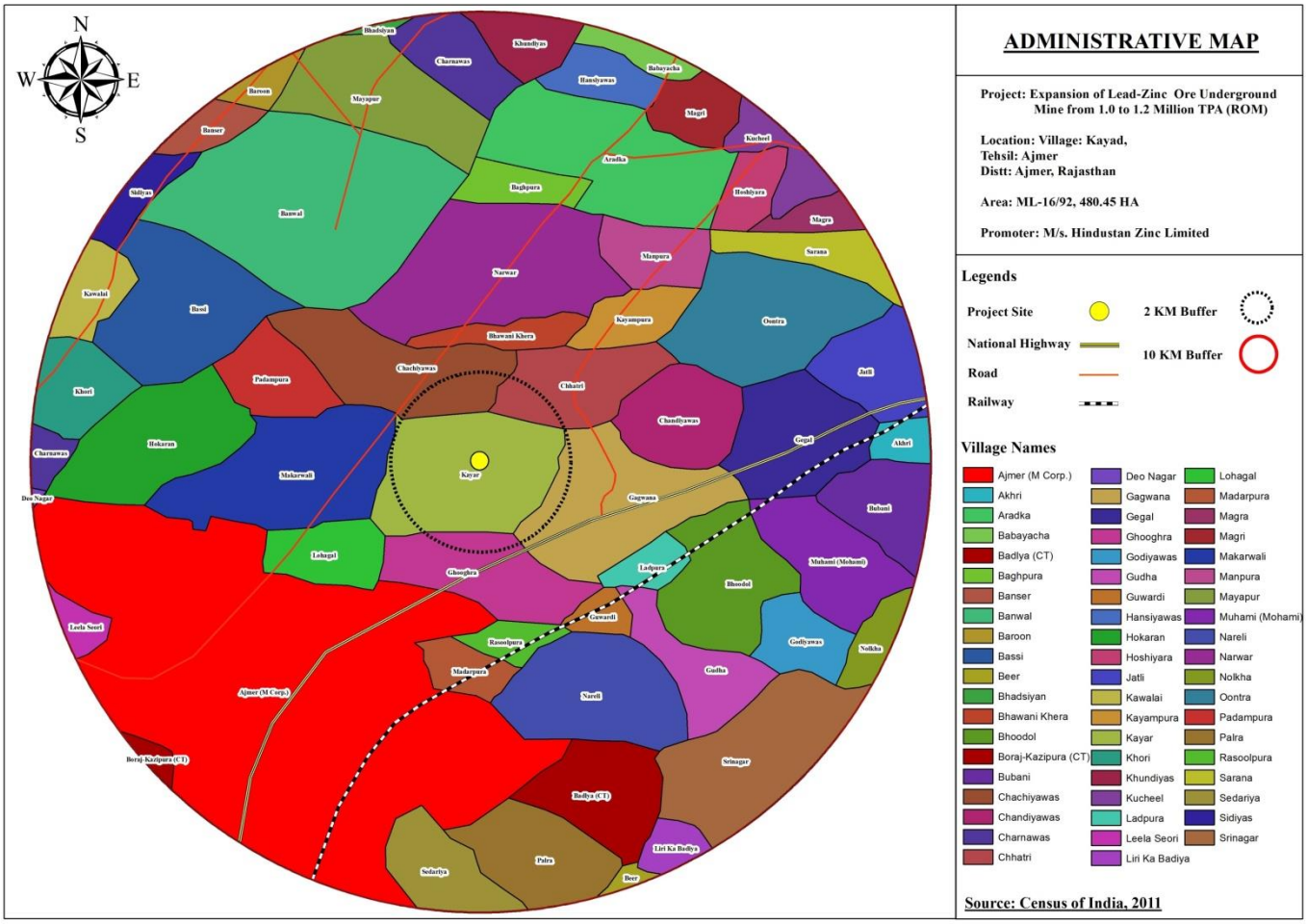


Figure 3.12: Thematic Map depicting Administrative Setup

Table No.3.27: Demographic Profile of the Villages in the study area

S/n	Demographic Feature	Study area		
		Core zone (Project area)	0-2 Km Buffer	2-10 Km Buffer
1	Total Population	0	20272	672199
2	Household	0	3660	133117
3	Children	0	3226	83021
4	Worker	0	7055	224124
5	Non Worker	0	13217	448075
6	Main Worker	0	5360	199742
7	Cultivator	0	904	12009

S/n	Demographic Feature	Study area		
		Core zone (Project area)	0-2 Km Buffer	2-10 Km Buffer
8	Agricultural labour	0	290	4990
9	Household worker	0	226	9019
10	Other Worker	0	3940	173724

Demographic composition:

According to Census 2011, Core zone doesn't have any human habitation however 2 Km buffer and 10km buffer have the total population of 20272 Individuals & 672199 Individuals respectively. The distribution of population is depicted in figure- 3.13. 51 percent of total population is male and 49 percent are female, this creates a gender gap of 2percent. The study area also involves rural villages of Ajmer District, Rajasthan as depicted in **Figure 3.13.**

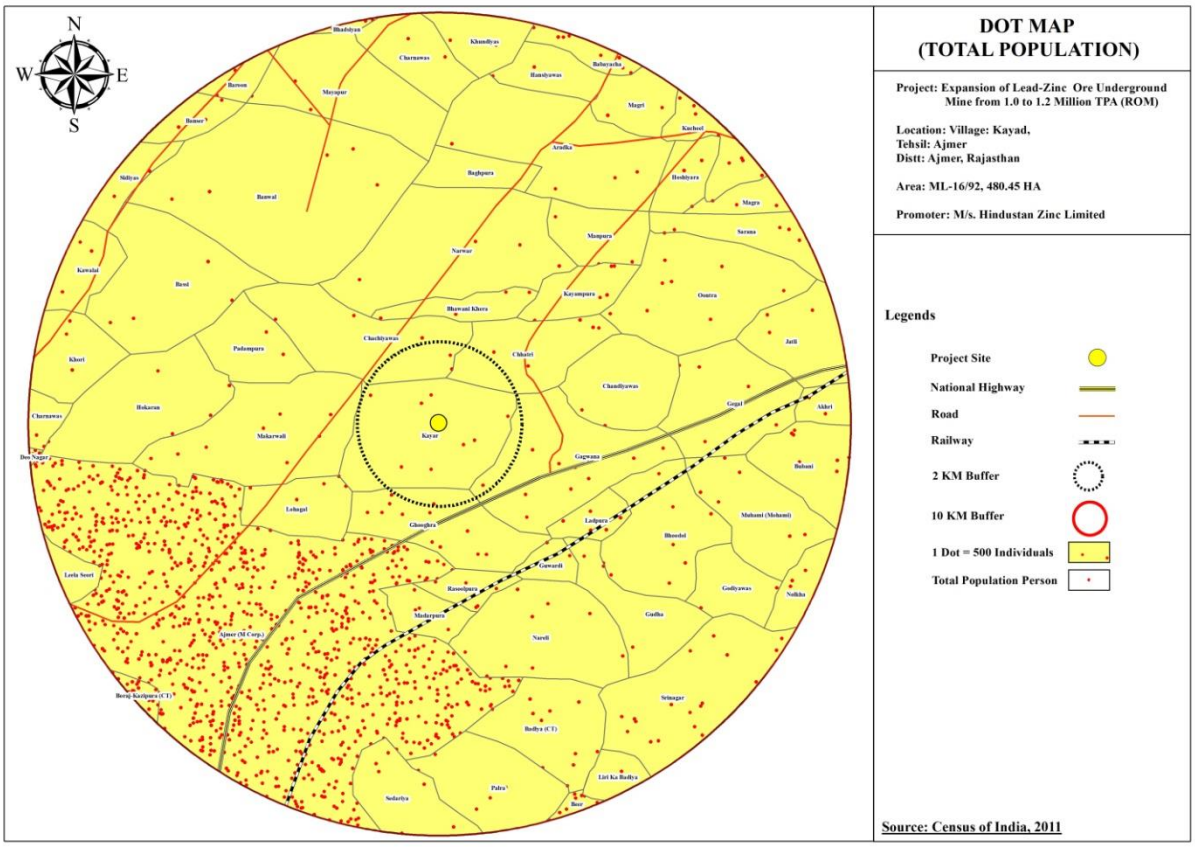


Figure 3.13: Thematic Map depicting Population distribution

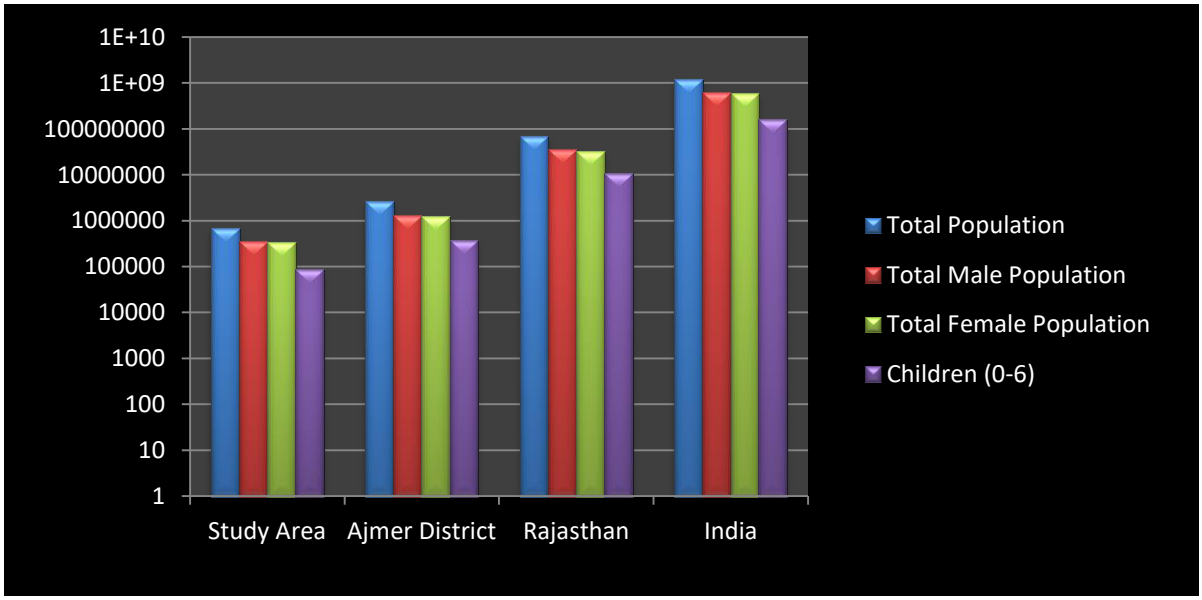


Figure 3.14: Total Population of Study Area, District, State and India

Sex Ratio: The sex ratio works out to 938 females per 1000 males for 2 Km buffer and 946 for 10 Km buffer.The sex ratio of Ajmer District is 951&Rajasthan State is 928. The sex ratio less than 928 females per thousand males were in 16villages.

The distribution of sex ratio is given in figure-3.14& 3.16. The details are given in table 3.28.

Table No.3.28 Male & Female of the Villages in the study area

S/n	Demographic Feature	Study area		
		Core zone (Project area)	0-2 Km Buffer	2-10 Km Buffer
1	Male	0	10460	345439
2	Female	0	9812	326760
3	Sex ratio	0	938	946

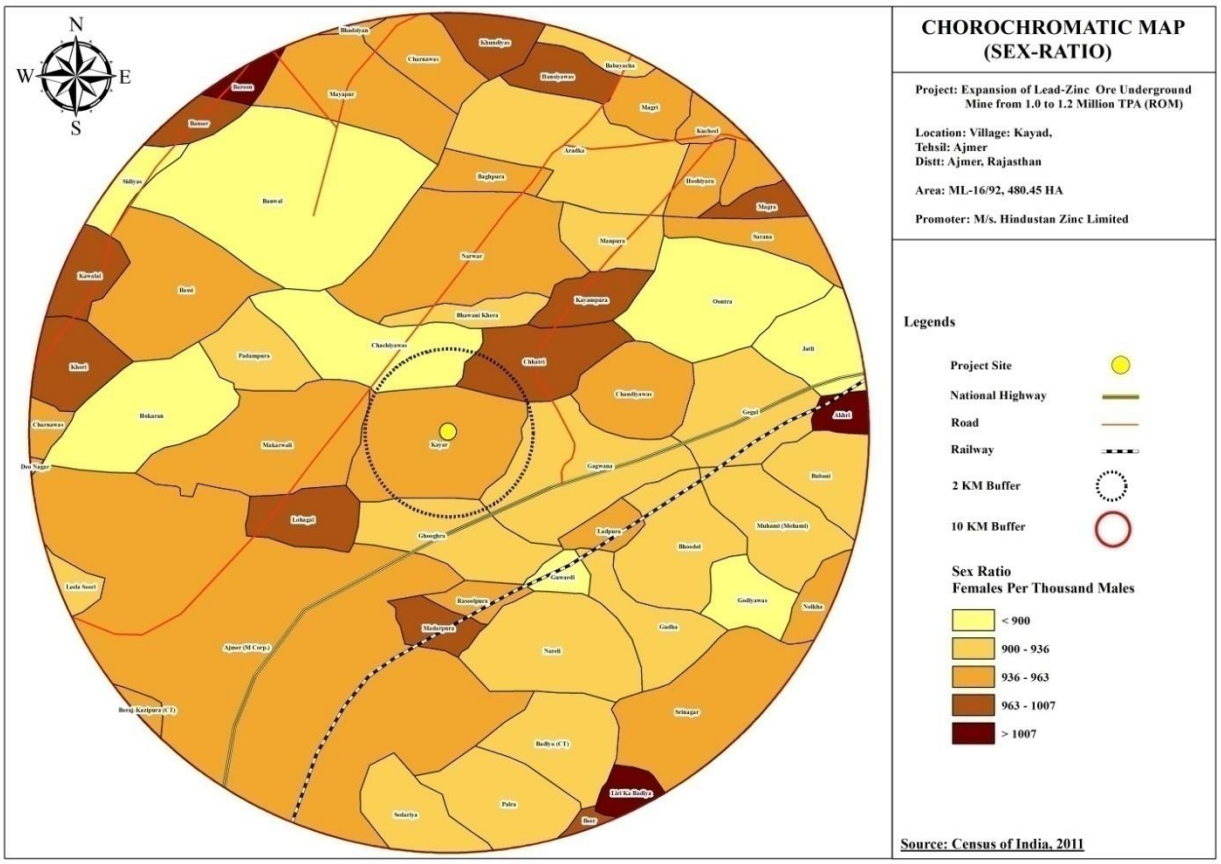


Figure 3.15 Thematic Map depicting Distribution of Sex-ratio

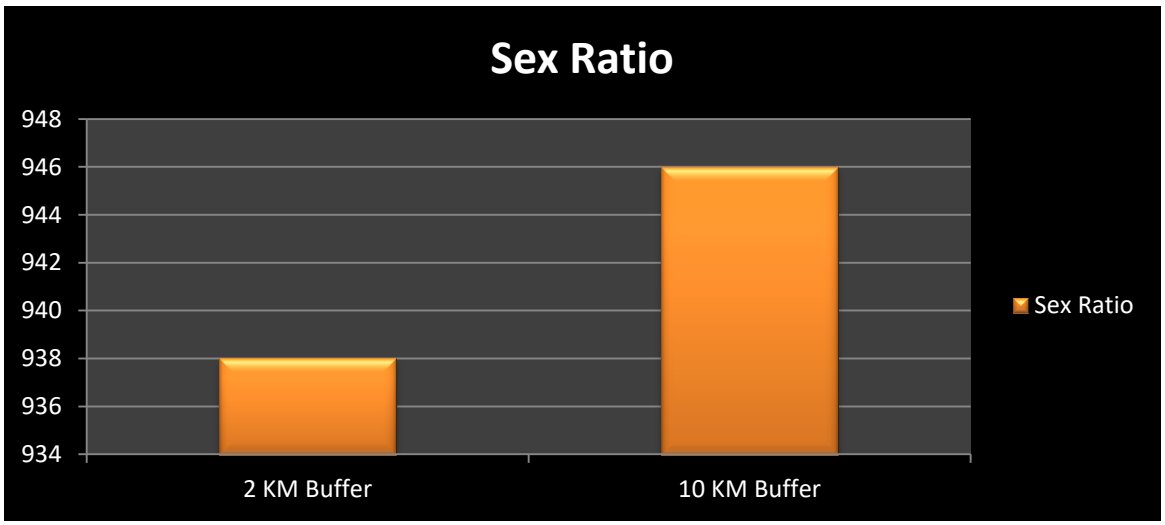


Figure 3.16 Chart Depicting Sex Ratio in 2 & 10 Km Buffer

Literates and literacy rate:

The illiteracy in the 2 Km and 10 Km buffer zone of study area are 42&28 percent respectively, while district Ajmer and state Rajasthan have illiteracy percentage as 41% and 34 % respectively. The literates 2 Km and 10 Km buffer zone of study area are 58&72percentage respectively. Literates are 59 % in district Ajmer while 66 % in Rajasthan. Distributions of Literates & Illiterates are given in Figure-3.17 & 3.18.

Table No.3.29 Literate & Illiterate in the Villages of the study area

S/n	Demographic Feature	Study area		
		Core zone (Project area)	2 Km Buffer	10 Km Buffer
1	Literate	0	11756(58)	484195 (72)
2	Illiterate	0	8516 (42)	188004(28)

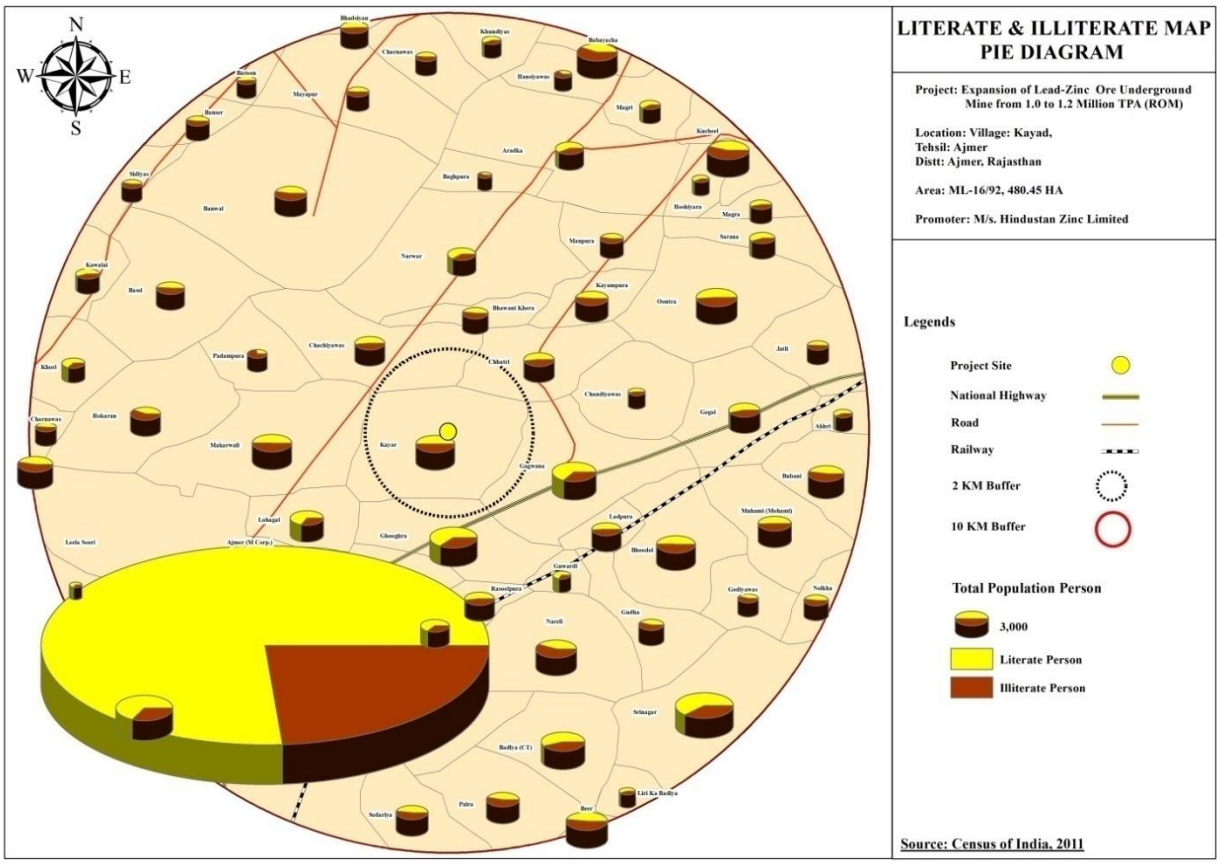


Figure 3.17: Thematic Map depicting Literate & Illiterate

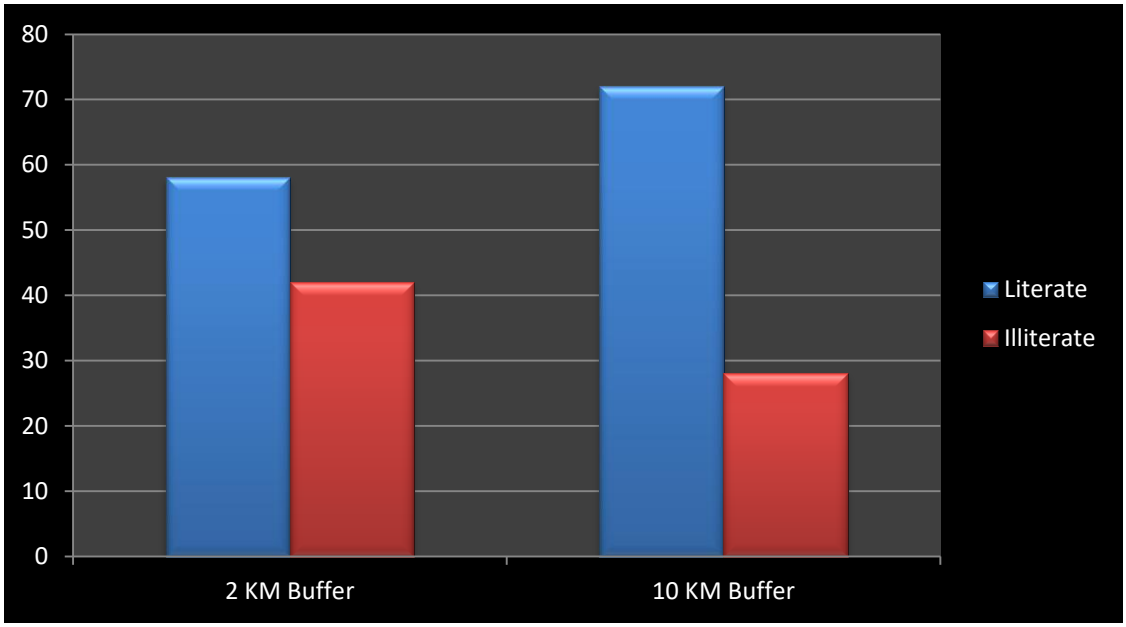


Figure 3.18: Literates & Illiterates in 2 & 10 Km Buffer

Table No.3.30: Demography of Study Area, District Ajmer, Rajasthan, India

S/n	Item	Number of Individuals	%	Number of Individuals	%	Number of Individuals	%	Number of Individuals	%
1	Name of area	**Study area**		**Ajmer District***		**Rajasthan***		**India***	
2	Type of Population	Rural & Urban							
3	Number of Household	136777		494832					
4	Total Population	692471		2583052		68548437		1.2×10^9	
5	Total Male Population	355899	51	1324085	51	35550997	52	6.2×10^8	52
6	Total Female Population	336572	49	1258967	49	32997440	48	5.9×10^8	48
7	Persons (0-6)	86247	12	381167	15	10649504	16	1.6×10^8	13
8	Total workers	231179	33	1053722	41				
9	Main workers	205102	89	827181	79				
10	Non workers	461292	67	1529330	59				

Source: Census of India 2011

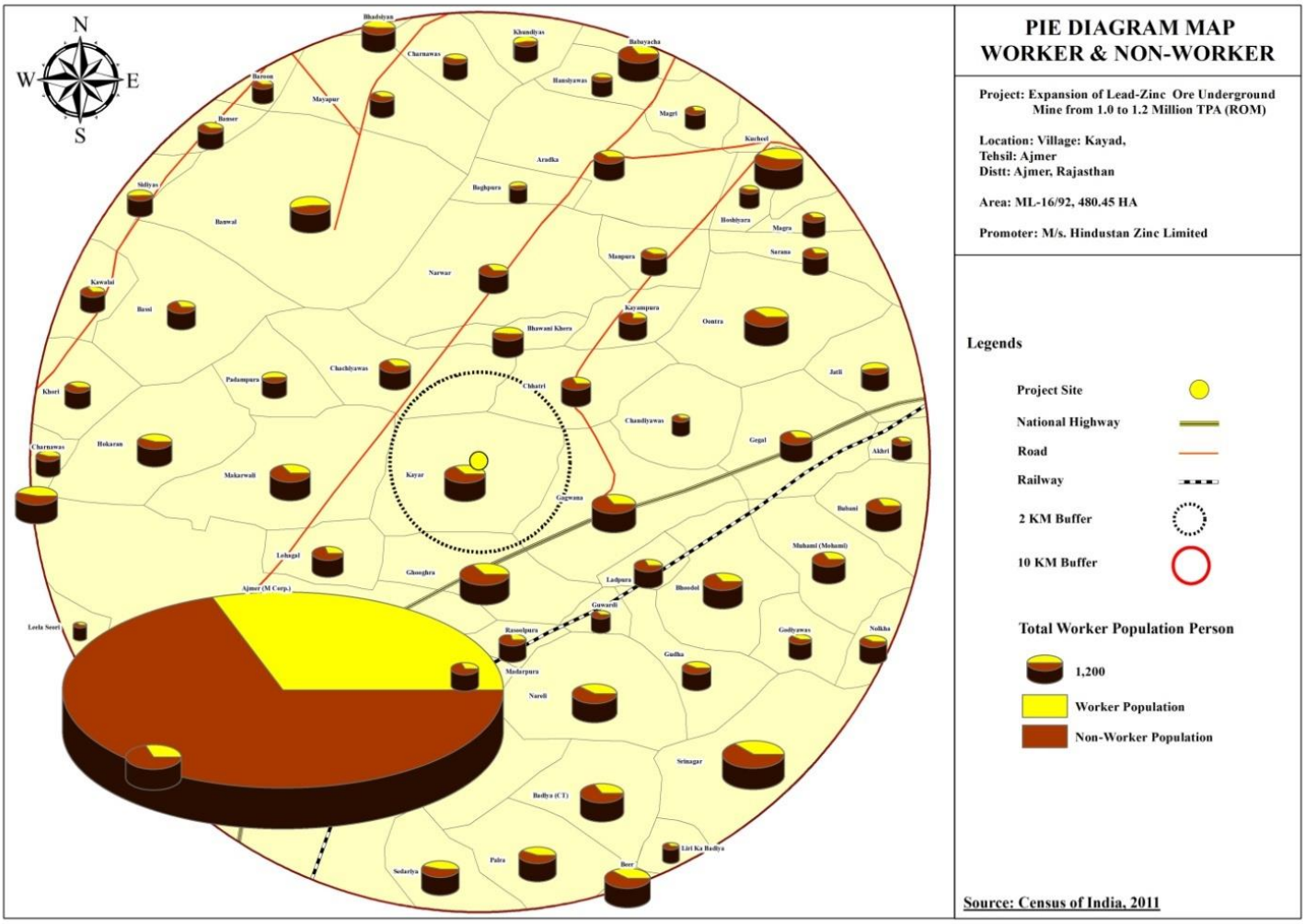


Figure 3.19: Thematic Map depicting Distribution of Worker & Non Worker

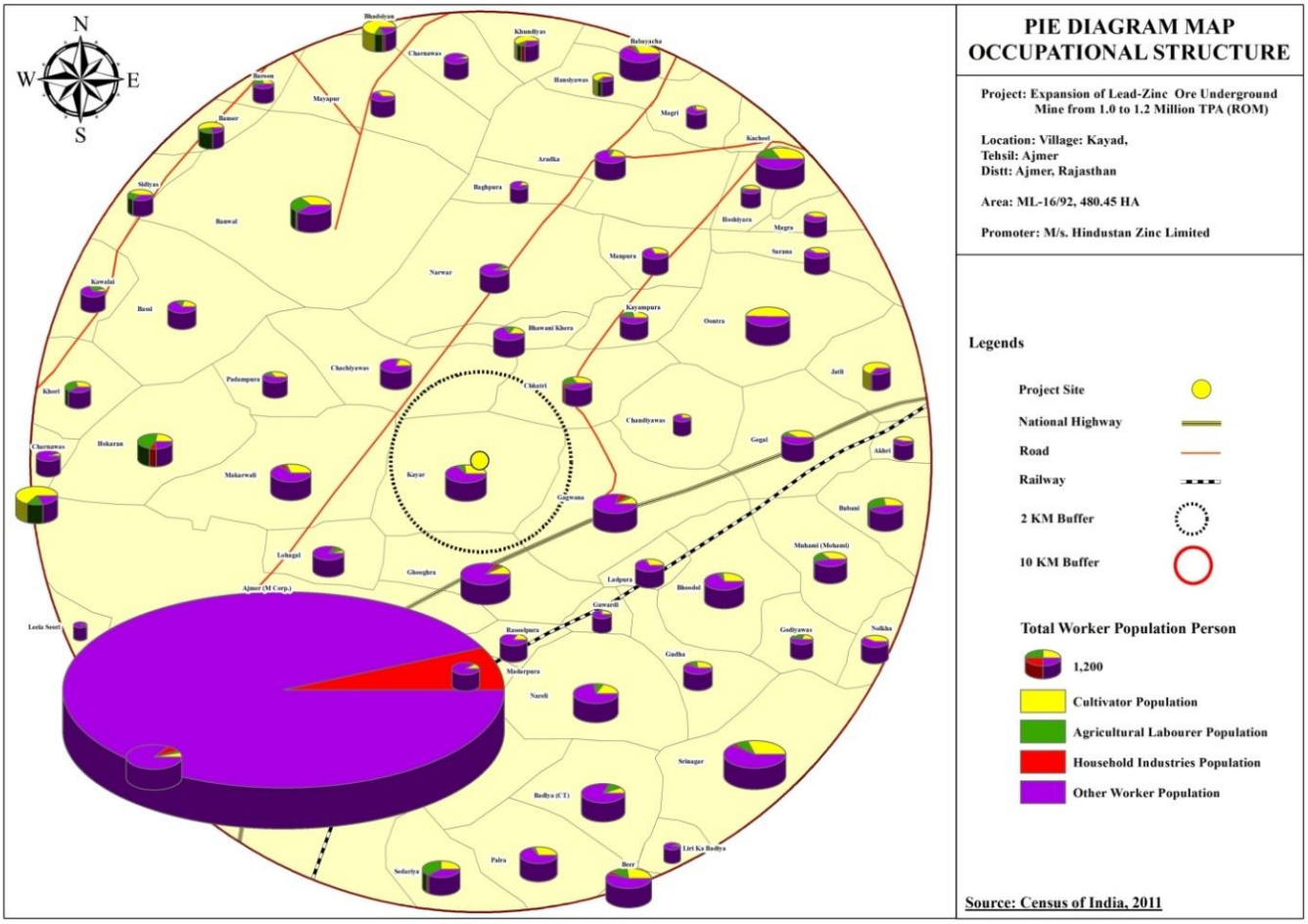


Figure 3.20: Thematic Map depicting Distribution of Occupational Structure

3.8.4 Social Infrastructure Available:

The Proposed **"Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM)"**at ML No. 16/92, Village: Kayad, Tehsil: Ajmer, District Ajmer (Rajasthan) to be developed by M/s. Hindustan Zinc Limited. The project site in district Ajmer.

Site surroundings and Connectivity details of the proposed project are given in **Table-3.31**.

Table No.3.31: Site Surroundings and Connectivity Details

S. No.	Connectivity & Site Surroundings		
	Description		**Distance and Direction from Mine site**
1.	Nearest Railway Station	Ladpura Railway Station	5.5 km aerial distance towards E
2.	Nearest Airport	Kishangarh Airport	14.6 km aerial distance towards NE
3.	Nearest Village	Chhatri Chachiyawas Makadwali Gagwana	2.0 km towards NNE 2.8 km towards NNW 5.4 km towards West 2.3 km towards East
4.	State Boundary	Rajasthan-MadhyaPradesh Border	173km towards South East.
5.	Nearest Highway	NH-8 NH-79	2.0 km towards East 8.40 km towards South West
6.	Water Bodies	Anasagar Lake	7.00 km South West
7.	Nearest School & College	GovtSen Sec SchoolKayad MDS University Kayad Sacred Heart Public School Sanskriti The School	1.10 km towards North 0.10 km towards North 1.05km towards South West 1.80 km towards South West
8.	Nearest Hospital	Janana Hospital Kothari Eye Hospital Government Hospital Ajmer Hospital	2.20 km towards West 6.30km towards South West 6.35 km towards South West 7.25 km towards South West
9.	Places of worship	Jama Masjid Kayad Peer Baba Masjid E Ibrahim EidgaahBadi Masjid	1.05km towards North East 0.90 km towards North East 1.60 km towards North East 2.05 km towards North

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CHAPTER - 4

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

CHAPTER-4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 GENERAL

The impacts due to mining operations commence from the exploration activities, extend through extraction and processing of minerals, may continue up to post closure of the operation, with the nature and extent of impacts varying throughout the stages of project development.

Identification of possible impacts specific to an activity is an important task since this helps in focusing attention upon relevant environmental parameters and relating them with the activities involved. The following parameters are of significance in the Environmental Impact Assessment and are being discussed in detail.

1. Land Environment
2. Water Environment
3. Air Environment
4. Noise Environment
5. Solid waste
6. Biological Environment
7. Socio-Economic

4.2 LAND ENVIRONMENT

Parameter	Impact	Management
Topography and drainage	The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 to 1.2million TPA (ROM) (20% increase). The mining activities due to proposed expansion will have very minimal impact on topography of the mine lease area due to underground workings and hence alteration of the surface topography is not expected.	Precautions will be taken by partial extraction, if required, to protect them from any damage from subsidence. Suitable drainage will be made to avoid and water logging in the center of subsidence. During extraction of panels, the ground subsidence will be monitored over at least one panel each in forestland to know the actual impact by an external

	As there will not be any expansion work at the existing establishment, change in topography is not envisaged. **Drainage** There is no perennial source of water like pond, river, stream or nallah running through the lease area. The acquired lease area which will have all mining related activities has its drainage towards the kayad nada (seasonal) located in the mine lease area, but outside the acquired area. The rainwater runoff from ore storage and over burden dumps are likely source of suspended solids, if allowed to escape to the natural drainage without any treatment, may affect the quality of rainwater runoff to the kayad nada. No major impact is envisaged, as the proposed expansion will be achieved by increasing the efficiency of the existing infrastructure of the mine.	agency. The facilities and entry points will be fenced and free access prevented for both man and animal. No adverse impact of the streamlets is anticipated as the peak flow will be of low magnitude and for very short duration under natural gradient. As underground mining is being carried out, any streams will not be affected and will continue to flow undisturbed by the mining. So, no diversion is required and there will not be any impact on the surface drainage system and surface water resources of the lease area and on any existing users
Land	Existing land use pattern indicating the area already degraded due to mining, roads, workshop, etc. The total land use in the lease area is 48.5 hectares. Since this is an underground mine, hence there is no significant effect of mining activity on the environment. Though infrastructural activities degraded land area earlier, No further land degradation in next 5 years proposal, because the voids created due to mining of ore, are back filled with classified mill tailing	No further land degradation in next 5 years proposal, because the voids created due to mining of ore, are back filled with classified mill tailing. Presently Gross area under green belt is around 21 hectares and under proposed expansion green belt will be further increased by 3.8 hectares which will make total green cover around 24.8 hectares, thus green cover of acquired area is more than 50%.

Soil	Since, Hindustan Zinc Limited is an underground mine, there will be no net loss of soil during the operation of mine. Contamination of soil quality, to some extent, is possible in the core zone near workshop for which adequate mitigating measures have been taken. In spite of these, no significant impact on soil quality has been observed.	The topography of the lease area is undulating surface and it is an underground mine. Hence, top soil will not be disturbed but at the places of dumps etc if it is encountered, it will be stacked and will be used for plantation purpose.

4.3 WATER ENVIRONMENT

Water plays a very important role in preserving life. It is also vital for the growth of flora, fauna and agriculture. Aquatic life fully depends on the quality and quantity of water. Rain cycle is an important activity of nature which fully depends on water, plantation, air, hills and other features. The mining activity in general is considered as creating negative impacts on this system. However, all mitigation measures have been envisaged to nullify these negative impacts, in this project, as detailed below:-

4.3.1Impact on Water Environment

4.3.1.1Impact due to Mining

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 which are as given below:-

S.No.	Anticipated Impacts	Mitigation/ Conservation Measures
1	Domestic wastewater and industrial waste water	➢ 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 channelize 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 vechile 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.
2	Ground Water	➢ Development of ground water recharge management system around the ML area; ➢ Implementation of recharge measures proposed in the hydrological and hydrogeological study; ➢ Monitoring of groundwater level and quality around area shall be 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 rain water descent into ML area and other surface activity area; ➢ Garland drains will be connected to siltation tank of appropriate size and will be de-silted at regular intervals. The water collected will be 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 will be designed keeping 50% safety margin over and above the peak sudden rainfall and maximum discharge in the area adjoining the mine site; ➢ Use of silt/sediment traps to reduce the sediment load from the disturbed area to the natural drainage; ➢ The waste dump will be provided with garland drains. The dump topsand sides of inactive areas will be progressively reclaimed with grasses and shrubs to prevent erosion. ➢ Rainwater harvesting measures undertaken for artificial recharge ground water basin will also help in restoring the water levels in the

		area.

4.4 AIR ENVIRONMENT

The proposed expansion of underground mining occurs in horizontal tunnels with access to the surface via large vertical shafts. The main activities carried out at underground ore mines that could lead to emissions to air, are as follows:

- Earthmoving associated with the development of the surface facilities
- Shaft/decline access and ventilation development
- Extracting, transporting, and dumping ore
- DG Set operations.

Table No.4.1Impact and Management of Air Environment

Impact	Management
This is an underground mine, dust producing activities are only a few. Ore from mine is to be loaded to covered trucks to transport to RA Mine . Material transfer points will be source of dust pollution. Material handling by heavy equipment will release considerable amount of dust if no action is taken for suppressing it at source, while the immediate effects will be poor visibility and intake of dust through inhalation can have health impacts.	➢The mine site has mechanical ventilator. Emanation of dust during working will be minimized by adoption of dust suppression systems (like water spraying) at working faces before and after blasting and during loading. Wet drilling will be adopted in drill machines. Dust generation will also be reduced by using sharp drill bits for drilling holes with flushing system. Greenbelt has been developed in and around the facilities which will be further increased upto 50% of the acquired area. It will act as dust barrier to the surroundings. ➢Dust masks will be provided as safety measure to the workers, engaged at dust generation points like drills, loading/ unloading points, material handling etc. ➢Blacktop paved road within the mine boundary and outside. ➢Low Profile Dumper Truck (LPDT) deployed with slow movement and low lift to reduce dust generation due to movement and handling of material. ➢Use of waste generated during development for back filling of voids created in stopes. ➢The ore carrying trucks to be covered with tarpaulin to reduce any possibility of dust generation.

4.5 NOISE ENVIRONMENT

Sources	Impact	Management
➢ Drilling and Blasting ➢ Operation of Machinery	**Physical structure** Vibration can cause varying degrees of damage in buildings and affect vibration sensitive machinery or equipment **Human** Effects on the body, psychological reactions, attitude, interference with communication and concentration, sleeping disturbance and inspiring fear. **Animals** Adversely affect wildlife by interfering with communication, masking the sounds of predators and prey, cause "stress" and result in temporary or permanent hearing damage. Exposure to noise impulses throughout the night-time sleep period resulted in poorer daytime task performance by animals *(Fletcher &Busnel, 1978).*	➢ All ventilations fans have been installed underground. ➢ Blasting is carried as per the recommendations of the CIMFR, Dhanbad and every blasting is monitored for vibration as per the DGMS rules and is found well within the permissible limits. ➢ Particle velocities of less than 5mm/s (2.0 in./s) show little probability of causing structural damage ➢ If there is at least 8 ms (millisecond) separation between detonations, the vibration effects of individual explosions are not cumulative. Particle velocity is still the best single ground motion description ➢ Controlled blasting is a technique for the purpose to reduce the amount of overbreak and to control the ground vibrations. ➢ In the management of noise and blast emissions is to implement a monitoring and audit program. ➢ Additional sound proof enclosures of fixed and mobile plant and mine ventilation fans. ➢ Providing bund walls for acoustical screening and acoustic treatment of dwellings. ➢ Altering the blast drilling pattern and delay layout. ➢ Blasting at times that suit local conditions.

		➢ D.G. Set has been enclosed in Acoustic Enclosure to mitigate the noise generated.

4.6 BIOLOGICAL ENVIRONMENT

Potential or likely impacts due to the proposed expansion of mining activity may be, loss of adjacent forest habitats and biodiversity, loss of vegetation cover and biodiversity, loss of aquatic ecosystem and biodiversity, effects of heavy transportation on habitats and faunal groups, Impact on water and land components, Changes in ambient air quality and degradation of vegetation, Impact of Noise on faunal groups, Accidental mortality of faunal groups, Impact to threatened floral species, Impact to threatened faunal species, Impact on Animal movement. Keeping all this in mind the following mitigations have been suggested under environmental management plan.

With the above understanding of the role of plant species as bio-filter to control air pollution, appropriate plant species (mainly tree species) have been suggested conceding the area/site requirements and needed performance of specific species.

Impact	Evaluation	Mitigation
Loss of adjacent forest habitats and biodiversity	The expansion is coming up in the same lease area. The increase in the production capacity may affect the surrounding habitats & biodiversity.	As the expansion is coming in the same mine lease area (core zone) is not consists of any critical / unique habitat or designated forest land vulnerable to the fragmentation or isolation. Therefore the proposed expansion project activities will not have any impacts like loss of true forest habitat, floral species and associated faunal diversity. However more than 42 % area of the existing acquired area is already covered under the green belt and it is likely to be increased

		upto 50% of acquired area in proposed expansion.

Impact	Evaluation	Mitigation
Loss of vegetation cover and biodiversity (core zone)	The expansion is coming up in the same lease area. So there will no impact on associated biodiversity of the core zone area.	There is no any clearing of existing sparse vegetation within the lease area so no major impact on floral composition and associated faunal species at local level. The mine area is already having 43 % green belt and now it is further suggested that approx 5000 trees (Local trees species like: *Cassia fistula, Delbergia sissoo, Delonix regia, Polyalthia longifolia etc*) will be planted in the mine area and nearby villages, to reduce the impact of expansion activities in the surroundings of the existing mine site.

Table No.4.2: List of plant species suggested to plant and improve green belt in and around the existing mine

S. No.	Species Name	Local Name	Species Characters
1.	*Acacia nilotica*	Desi Babul	*WT, ST*
2.	*Albizzia lebbek*	Shiris	*WT*
3.	*Annona squamosa*.	Sitafal	*CT, FT, ST*
4.	*Azadirachta indica*	Neem	*CT, MT*
5.	*Dalbergia sissoo*	Sisam	*WT, ST*
6.	*Pongamia pinnata*	Karanj	*MT, CT*
7.	*Emblica officinalis*	Ambla	*CT, ST, FT*
8.	*Ficus bengalensis*	Bad or Vad	*CT, LT, FT*
9.	*Ficus religiosa*	Piplal	*CT, LT, FT*
10.	*Holoptelea integrifolia*	Churel	*WT, LT*
11.	*Lawsonia inermis*	Mehndhi	*Sh*
12.	*Mangifera indica*	Aam	*CT, LT, FT*

13.	*Pithecellobium dulce*	Jungal Jalebi	*CT, MT*
14.	*Syzygium cumini*	Jamun	*WT, FT*
15.	*Tamarindus indica*	Emli	*CT,MT, FT*
16.	*Terminalia arjuna*	Arjun	*WT, LT*

Species Characters: SH=Shrub; WT sp= Wild Tree species; CT sp= Common Tree species; = Fruit Tree; ST = Small Tree; LT = Large Tree and MT = Medium Tree.

Overall 16 plants species have been suggested to grow in and around the mine lease area.

Impact	Evaluation	Mitigation
Changes in ambient air quality (dust & gases) and degradation of vegetation	Due to the proposed mining project transportation of material with the movement vehicles will increase and Dust concentration is expected to increase because of Heavy vehicle movements in the area.	Greenbelt development program with specific plant species which can act as bio-filters can further reduce the level of pollutant concentration and also will improve the overall ambient air quality in and around the project environment. Provision of spraying water can help to reduce dust emission on roads. Moreover, the following tabulated plant species suggested includes few shrubs and trees species of wild, common and species of ornamental values for effective dust control. The level of dust control efficiency of these species ranges from minimum of 6.12% by *Acacia nilotica* to maximum of 35.39% by *Holoptelea integrifolia*. The area of plantation suggested mainly focused along the road side where the vehicle pressure is likely to increase during the mining activities especially during sand transportation. In each location, a wider range plant species are suggested to maintain the floral diversity and improve the survival rate. Therefore, the species list includes predominately wild and few common tree species with high rate of dust control efficiency *(Cassia fistula- 23.03%, Azadirachta indica -25.54. Polyalthia longifolia- 29.84%, Terminalia arjuna-30.54% and Holoptelea integrifolia 35.39%).* The location 2 includes the stretches of all the roads

		passing through the village area which are under the influences of project related activities mainly vehicle pressure due to transporting sand. A list of 11 species has been recommended to develop avenue plantation along the road sides. This list includes mainly common species of aesthetic values with colorful flowers and also fruit trees to attracts birds

Table No. 4.3: List of Plant Species to Control Dust (Particulate matter) in and around the mine area

S. No.	Scientific Name	Common & Local Name	%of DC	Location		
				1	2	3
1.	*Annona squamosa*	Sitafal	12.09	*	*	
2.	*Magifera indica*	Aam	12.25			*
3.	*Thevetia peruviana (sh)*	PeeliKaner	12.56	*	*	*
4.	*Ipomea carnea (sh)*	Beshram/Behaya	14.87	*	*	*
5.	*Hibiscus rosa- sinensis(Sh)*	Gurhal, Jasund,	21.09	*	*	
6.	*Bougainvillieag lavra(St)*	--	21.35			
7.	*Ficus religiosa*	Peepal	12.94	*	*	*
8.	*Syzygium cumini*	Jamun	14.39			*
9.	*Citrus limon*	Nimboo	15.96			
10.	*Delbergia sissoo*	Shesham	17.02	*	*	
11.	*Delonix regia*	Gulmohar	18.05			*
12.	*Moringa oliei fera*	Sahajan	18.79			*
13.	*Aeglemarmelos*	Bel	18.9	*	*	
14.	*Pithecolobiumdule*	Jungle Jalebi	19.21	*	*	
15.	*Cassia fistula*	Amaltas	23.03	*	*	*
16.	*Butea monosperma*	Palas, Dhak	24.44	*	*	*
17.	*Azardirachta indica*	Neem	25.54	*	*	*
18.	*Polyalthia longifolia*	Ashoka	29.84	*	*	*
19.	*Terminalia catappa*	DesiBadam	30.12			*
20.	*Terminalia arjuna*	Arjun	30.54	*	*	

Locations: 1- both sides of the mining area, 2- Roads connecting mine lease, 3- Roads passing through nearest villages. S shrub, St – Straggler. %DC – Percent of Dust Control efficiency

Impact	Evaluation	Mitigation
Impact of Noise on faunal groups: **Increase in noise level in the project area may affect the faunal groups in term of their normal behaviors like; feeding, resting and breeding/nesting (especially avifauna).**	The main sources of noise in the mining activities will be of mining equipment and vehicular movement associated. The standard prescribed by the Occupational Safety and Health Administration (OSHA) is 90 db not more than 8 hrs. Exposures for the worker However, no such conditions and any standard limitations have been available for any animal group. However, intensive afforestation program with appropriate plant species can take care of this localized and short term disturbance in the long run.	1. Some of the plants species listed in above different table also perform vital role in control noise pollution due to their thick and fleshy leaves and vibrating nature (Sexena 1991). A total of seven species were identified as species which are able to absorb So_2 emission also. 2. Therefore those species listed below are suggested to grow in and around the villages and other public places like schools, hospitals, health Centre and temples of nearby villages. 3. In addition, following the afforestation programs suggested above in different locations in and around the mining sites, road sides, village and other area in different phases will further minimize the noise level and also provide habitat for many avifauna & other faunal groups and improve the overall faunal diversity of the surrounding area.

Table No. 4.4: List of plant species to control Noise pollution and absorb gas (SO_2 emission)

S. No.	Scientific Name	Common & Local Name	Performance		Location	
			CN	OGE	1	2
1.	*Aegle marmelos*	Bel	*			*
2.	*Azardirachta indica*	Neem	*	+	*+	*+
3.	*Diospyros melanoxylon*	Tendu	*		*	
4.	*Ficus bengalensis*	Banyan, Vad	*		*	*
5.	*Ficus religiosa*	Peepal	*	+	*+	*+
6.	*Polyalthia longifolia*	Ashoka	*	+	+	*+
7.	*Terminalia catappa*	DesiBadam	*		*	*
8.	*Terminalia arjuna*	Arjun	*	+	*+	+

*** CN –Control Noise level, OGE – Absorb Gas emission (+ So_2), Locations: 1- roads crossing villages, 2 – Public places (schools, hospitals, health centre and temples)**

4.7. SOCIO ECONOMIC IMPACT

S. No.	Existing variables/situations of Socio-economic Issues	Predict (adverse/ favorable) impacts (reasons for variations & bias of representative data).	Mitigation measures. In numbers.
1.	Habitation in the Core Zone There is no habitation in the core zone.	**Zero (0)** Loss of habitation. No displacent due to the proposed mine expansion project.	The nearest habitation is 200 m away from the mine boundary and all necessary measures are being taken to ensure safety.
2.	Loss/ gain of health & fitness in short term (>1) or long term (<1)	The nearest habitation in the west Direction may be effected due to adverse conditions of mining activities in the long run.	Regular health camps to trace the develeopments and control any ill-consequences due to any mining pollution. The Kayad Mine proposes to continue further expenditure on health care facilities and

			adoption of various health facilities.
4.	Health impacts – on mental, physical, and social well being.	The proposed expansion project will not adversely impact the mental, physical and social well being.	Expectations in Fair pay, employee care, social responsibility commitments etc. will be timely met. Greivance redressal mechanism is made to handle complaints from the study area.
5	Loss/gain of self esteem Less developed areas like The local residents have high self esteem due to the Hindustan zinc mine and associated economic growth in the region.	A rise in the self esteem due to incresing rate of economic growth in the region. Higher degree of self satisfation and contentment.	--
6.	Loss/gain of view by study area inhabitants	The project concerned is an underground mine.	Plantation will be done, Cleanliness will be maintained in and around the mine premises.
7.	Loss/gain of culture and religion: It is clearly stated in as per the Human Rights, that the obligation of States is to promote universal respect for, and observance of, culture & religion.	The proposed expansion project will follow universal respect for, and observance and protection of, human rights and fundamental freedoms for all.	The proposed project expansion will promote neither selective, nor relative, but universal respect through contribution in various festivities, equal observance and protection among employees and societies at large in all CSR activities.

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CHAPTER -5

ANALYSIS OF ALTERNATIVES

(TECHNOLOGY & SITE)

CHAPTER -5

ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

5.1. ANALYSIS OF ALTERNATIVE SITE

The site is selected based on the geological investigations and exploration carried out by Geological Survey of India (GSI). This is a mineral based site specific mining project. No increase in mining lease area or acquired lease area is proposed as part of the expansion. As it is an expansion project for mining, no alternative sites have been considered.

Kayad Mine extends over a lease area of 480.5 ha with The estimated insitu ore reserves& resources as on 01.10.2017is 9.74Mt (1.17% Pb and 7.23% Zn). The proposed expansion of mine is from 1.0to 1.2million TPA(RoM) of Lead-Zinc Ore Production (20% increase).. The proposed expansion will not require any acquisition of additional lease area. Thus, No alternate site analysis was required since it is a site specific project and no additional lease acquisition is envisaged.

5.2 ANALYSIS OF ALTERNATIVE TECHNOLOGY

MINING

5.2.1 Open Cast Mining

No open cast operation / mining are being done.

5.2.2 Underground Mining

5.2.2.1 Mode of entry (Decline)

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 ore body, 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.

Decline access is best suited for the shallow depth of Kayad deposit, proposed high mechanization and for the planned production capacity of 1.2 Million tonnes.

5.2.2.2 Description of Mining Methods

A. Longitudinal Long Hole Open Stoping (LHOS):

For Longitudinal Long hole open stoping method, the stope size planned is 25m height, 25 –50m length (along strike) depending upon the geometry of the ore body and geotechnical Consideration.

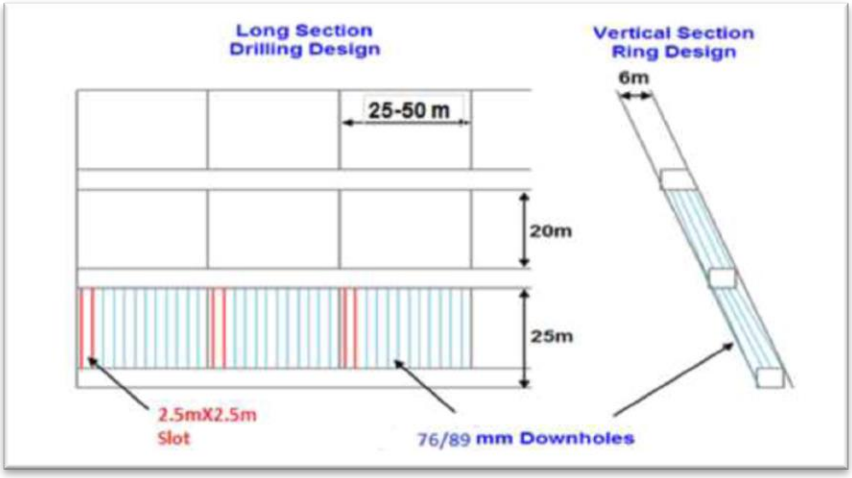

Figure 5.1: Typical Longitudinal LHOS

B. Transverse Long Hole Open Stoping (LHOS):

The stopes are planned across the strike in transverse direction with individual stopes of 10-25m 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 supportedroof and mucking through drives and cross cuts below solid roof which eliminates exposure to potential rock falls.

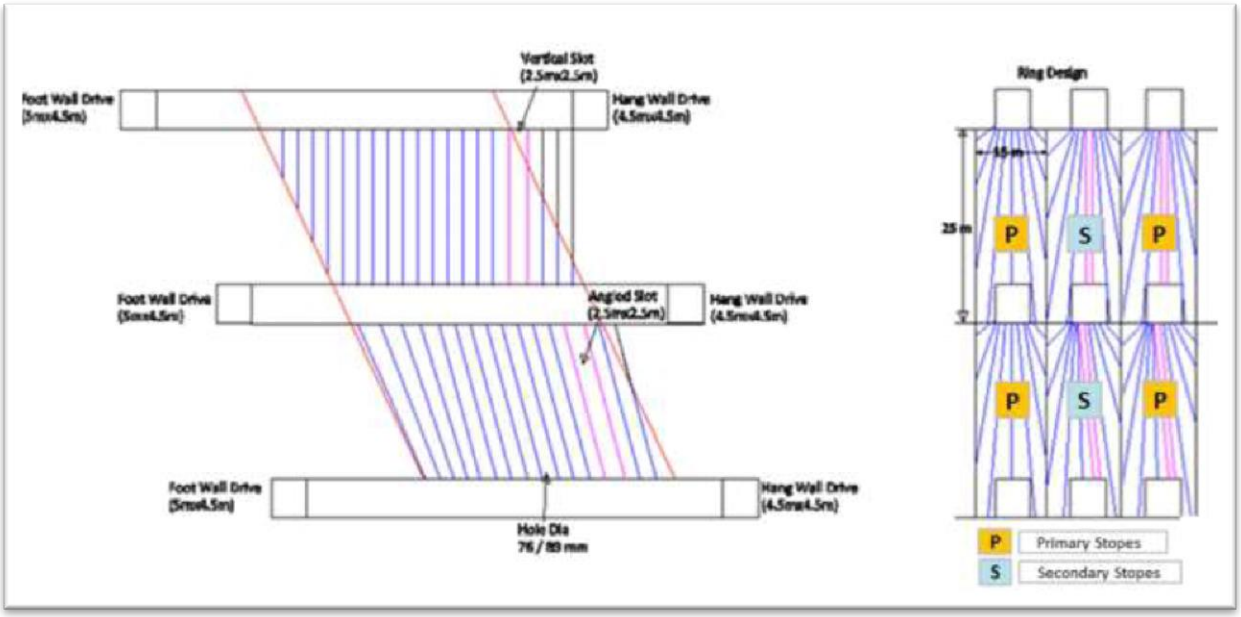

Figure 5.2: Typical Transverse stope

5.2.2.3 Conceptual Mine Plan

Planned production from Kayad mine had been increased to 1.0Mt per annum as per approved modified mine plan vide Letter no. 584(5)(3)(406)/11-AJM, dated 07.05.2013 by The Controller of Mines, IBM - Ajmer (Details in Table and EC terms dated 23.09.14 (A6). The mine has now reached to a sustained level of production at the designed rate 1.0Mt per annum. Before embarking on to the details of mining, it is necessary to discuss briefly the conceptual plan, hereunder.

The ore body at Kayad comprises of discontinuous veins, fracture fillings and occasional disseminations of the sulphides. The true width of ore body is varying from 5 m (in the steeper portion) to 50 m (in the shallow areas).

From the ore reserves and mineral resources summary as on 01.10.2017 estimated reserves and resources of Kayad mine stands at 9.74 Mt (1.17% Pb, 7.23% Zn). For a 1.2 Mt per annum of production, the life of the mine as per existing reserve comes to approximately 6 years. Apart from this potential of 2.21Mt of resources is established by exploration which

is still continued. Considering past exploration results, the additional resources will be converted to reserves to enhance the life of mien..

Presently, the mine is being worked at 180 mRL and by the end of the 4th year of the Modified Mining plan the mine workings are expected to reach 50mRL. Exploratory drilling is being carried out from surface and underground, for proving the further depth extension of ore body below 50 mRL. With exploration effort the reserve and resource of Kayad deposit is expected to increase in due course of time.

Based on the current reserve and resource of Kayad deposit it is, technically feasible to achieve ore production rate of 1.2Mt per annum as per the mining plan.

Kayad deeper level exploration is under progress and there are positive intersections of High Grade Ore up to (-) 128 mRL in North along 400m away from present working. Similarly the Deeper level exploration in southern extension has indicated presence of mineralization at the depth of (-) 125 mRL along 200 m away from the existing working

5.3 ALTERNATE SITES CONSIDERED

No alternate site was considered since it is a Brownfield underground expansion of existing underground mining project.

5.4 NO PROJECT SCENARIO

The scenario of no project was also considered and in the absence of the project, it will be difficult for HZL to cater to the current demand of Zinc and Lead. Thus, considering the closeness and the substantial availability of ore deposits at the project site, this is the best possible option for the project as well as for expansion of the site.

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CHAPTER- 6

ENVIRONMENTAL MONITORING PROGRAMME

CHAPTER- 6

ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION

Environmental monitoring can 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 will be 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 will be carried out at the site as per the norms of CPCB. Environmental Monitoring Programme will be 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 will be submitted every year to Regional office of MoEF on 1st of June & 1st of December. Quarterly compliance Report for conditions stipulated in Consent to Operate will be submitted to SPCB on regular basis.

Monitoring will ensure that commitments are being met with. This will take 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 may also require measurement of ambient environmental quality in the vicinity of a site using ecological/ biological, physical and chemical indicators. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints.

The preventive approach by management may also require monitoring of process inputs, for example, type and method used, resource consumption, equipment and pollution control performance etc.

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 will also be required to meet compliance with statutory and corporate requirements. Finally, monitoring results provide the basis for auditing.

6.2 ENVIRONMENTAL MONITORING CELL

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. With the knowledge of initial parameters, deviations in environmental conditions due to operation of the mine can be assessed and suitable mitigation steps will be taken in time to safeguard the environment. The following routine monitoring program will be implemented under the post – project monitoring as per CPCB guidelines.

Environmental monitoring schedules are prepared covering various phases of project advancement, such as constructional and regular operational phase.

6.2.1 Responsibilities of EMC

The responsibilities of the EMC include the following:

i. Environmental monitoring of the surrounding area.

ii. Commissioning of pollution control equipment.

iii. Specification and regulation of maintenance schedules for pollution control equipment.

iv. Ensuring that standards are maintained.

v. Developing and maintenance of green belt.

vi. Ensuring water use is minimized.

vii. Carrying out the Environmental Management Plan.

6.3. MEASUREMENT METHODOLOGIES

6.3.1 Instruments to be used

The following instruments will be used for data collection work in the monitoring schedule:

1. Respirable Dust Sampler,
2. Fine Particulate Matter Sampler (FPS),
4. Hygrometer
5. Sound Level Meter
6. Micro Meteorological Station Model Enviro
7. Water Level Indicator
8. Global Positioning System (GPS)

6.3.2 Monitoring Programme

The post project monitoring will include details of any major/ minor impact in the core zone and area within buffer zone for the following parameters: -

- Micro - Meteorological data
- Ambient Air Quality Monitoring
- Noise Level Monitoring
- Routine Medical Check-up – as per DGMS guidelines.

6.3.3 Monitoring schedule

The major attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:-

- Source emission and ambient air quality;
- Ground water levels and ground water quality;
- Water and waste water quality (water quality, effluent & sewage quality etc);
- Soil quality;
- Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels); and
- Ecological preservation and afforestation.

Details of the Environmental Monitoring schedule, which will be undertaken for various environmental components, are detailed below:

Table No. 6.1: Post Project Monitoring Schedule

S. No.	DESCRIPTION	FREQUENCY OF MONITORING
1	Meteorological Data	Daily
2	Ambient Air Quality at mine site	Fortnightly
3	Water Quality	Seasonal
4	Noise Level Monitoring	Seasonal
5	Soil Quality	Once in Six Months

6.4 ENVIRONMENT MONITORING PROGRAMME

The following routine monitoring programme as detailed under will be implemented at mine site. Besides to this monitoring, the compliances to all Environmental Clearance conditions and permissions from MoEF&CC will be monitored and reported periodically.

Table No. 6.2: Environmental Monitoring

S. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
I	**Air Pollution & Meteorology**				
	Air Quality				
	B	**Ambient Air Quality Monitoring**			
		1. At Mine area/Industrial area 2. At Residential area	Twice in a week	24 hr. continuously	PM_{10}, $PM_{2.5}$, SO_2, NO_x and CO.
	C Meteorology				
		Wind speed, direction, temperature, relative humidity, atmospheric pressure etc shall be monitored on hourly basis at one location.			
II	**Water and Wastewater Quality**				
	A	**Domestic**			
	1	Sewage effluents	Once in a month	composite	As per EPA Rules, 1986.
	B	**Recycled water**			
		mine water	Once in a month	composite	As per EPA Rules, 1986
		Surface Water Phul Sagar at the intake point	Seasonal	Grab	Parameters specified under IS:2296 (Class C)
		Ground Water Village and Piezo wells	Seasonal		IS:10500, 2012

S. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
III	**Noise Monitering**				
	1	At 6 locations near boundary	Once in a months	Day and Night	Noise levels in dB(A)
IV		**Soil Quality**			
		Soil samples around	Once in every six months	Grab	Physico-chemical parameters as per the parameters prescribed by MoEF/CPCB.

6.5 REPORTING SCHEDULES OF THE MONITORING DATA

It is proposed that voluntary reporting of environmental performance with reference to the EMP will be undertaken.

The Environmental Monitoring Cell will co-ordinate all monitoring programmes at site and data thus generated will be furnished as per statutory conditions.Environmental Monitoring will be conducted by MOEF&CC and NABEL approved lab.

The frequency of reporting will be on six monthly basis to the State PCB and to Regional Office of MoEF&CC, New Delhi. The Environmental statments will be prepared for the entire year of operations and will be regularly submitted to regulatory authorities.

6.6INFRASTRUCTURE FOR MONITORING OF ENVIRONMENTAL PROTECTION MEASURES

Following equipments and consumable items will be provided at the project site to implement the monitoring program as given in Table 6.3.

Table No. 6.3: Proposed Equipment for Environmental Monitoring

Name of Equipment	Purpose
Fine dust samplers/ Respirable dust samplers	AAQ monitoring
Automatic weather monitor	Meteorological data collection at site
Sound level meter	Noise levels
Micro balance	Chemical analysis
Refrigerator	Preserving samples
Oven	Heating
Thermometer/ Dry & wet bulb	Temperature/ relative humidity
pH meter	pH analysis

6.7 POST PLANTATION CARE

The post plantation care is an important aspect to be taken care of for better survival rate of plantation. The following care is being taken:-

(i) PROTECTION FROM GRAZING AND FIRE

Fencing will be provided around the area where mass plantation has been proposed. This will help in preventing cattle from entering in to such area and will protect unauthorized entry of out-side person and fire. Due care will be taken to protect plantation.

(ii) WATER IN DURING DRY SPELL

During dry spell, water is provided /sprinkled by water tankers.

(iii) MANURING

Initially fertilizer/ manure will be given to the pits before and after plantation. Thereafter, manuring will be continued on reduced scale till the plant attains survival. Provision of utilizing bio-manure will also be made within the lease area.

(iv) WEEDING AND SOIL WORKING

Man power will be engaged in mulching the soil frequently along with removal of weeds.

(v) Nursery to be developed for native species and include in the plantation program.

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CHAPTER- 7

ADDITIONAL STUDIES

CHAPTER- 7

ADDITIONAL STUDIES

7.1 RISK ANALYSIS AND DISASTER MANAGEMENT PLAN

Mining is an ancient occupation, long recognized as being arduous and liable to injury and disease. The lifecycle of mining consists of exploration, mine development, mine operation, decommissioning and land rehabilitation. Mining is a multi-disciplinary industry, drawing on several professions and trades. To ensure precision in clinical and epidemiological work, it is important to enquire about the details of tasks, as the term 'miner' is relatively non-specific. Mining is traditionally classified as metalliferous or coal, and as surface or underground. Metalliferous mining can also be classified according to the commodity being mined.

Unsafe conditions and practices in mines lead to a number of accidents and causes loss and injury to human lives, damages the property, interrupt production etc. Risk assessment is a systematic method of identifying and analysing the hazards associated with an activity and establishing a level of risk for each hazard. The hazards cannot be completely eliminated, and thus there is a need to define and estimate an accident risk level possible to be presented either in quantitative or qualitative way. Because of the existing hazards of mining as an activity and the complexity of mining machinery and equipment and the associated systems, procedures and methods, it is not possible to be naturally safe. Regardless of how well the machinery or methods are designed, there will always be potential for serious accidents. It is not possible for an external agency to ensure the safety of an organisation such as a mining company nor of the machinery or methods it uses. The principal responsibility for the safety of any particular mine and the manner in which it is operated rest with the management of that mine.

Hazard identification and risk analysis involves identification of undesirable events that leads to a hazard, the analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects.

7.2 NEED FOR RISK ASSESSMENT

Risk assessments will help the mine operators to identify high, medium and low risk levels. Risk assessments will help to prioritise risks and provide information on the probability of harm arising and severity of harm by understanding the hazard, combine assessments of probability and severity to produce an assessment of risk and it is used in the assessment of risk as an aid to decision making. In this way, mine owners and operators will be able to implement safety improvements. Different types of approaches for the safety in mines various tools and appropriate steps have to be taken to make mining workplace better and safer. A Hazard Identification and Risk (HIRA) analysis is a systematic way to identify and analyse hazards to determine their scope, impact and the vulnerability of the built environment to such hazards and its purpose is to ensure that there is a formal process for hazard identification, risk assessment and control to effectively manage hazards that may occur within the workplaces.

7.3 OBJECTIVE

Keeping the afore mentioned problems in mind, the project work has been planned with the following objectives

Review of literature on Hazard Identification and Risk Assessment

- Review of accidents in mines and their analysis.
- Study of risk assessment methodologies.
- Application of Hazard Identification and Risk analysis for improvement of workplace safety in mines.

7.4 HAZARDS IN UNDERGROUND WORKING

1. Fall of roof and sides
2. Collapse of pillar in mines
3. Air blast
4. Rock burst and bumps
5. Rope haulage

- Runaway of tubs due to breakage of rope, failure of attachment to rope, failure of

couplings and drawbars.

- Non functionality of safety devices.
- Travelling along haulage roadway
- Uncontrolled movement of tubs.
- Derailment of tubs.
- Poor construction of curves.

6. Electrical hazards
   - Electric shock and/or burn.
   - Ignition of firedamp
   - Fire arising from electric defects.
7. Fire hazard
8. Inundations
9. Ventilation
   - Failing of cooling system.
   - Oxygen deficiency (<19%)
   - Gas evolution
   - Presence of CO >50ppm
   - Presence of CO2 > 1%
   - Presence of H2S > 20ppm
   - Presence of NOX
   - Increase in temperature due to rock temperature and heats from machines

10. Illumination
    - Insufficient illumination system

7.5 METHODOLOGIES FOR RISK ANALYSIS

The objective of risk analysis is to produce outputs that can be used to evaluate the nature and distribution of risk and to develop appropriate strategies to manage risk. Events or issues with more significant consequences and likelihood are identified as higher risk and are selected for higher priority mitigation actions to lower the likelihood of the event happening and reduce the consequences if the event were to occur. Qualitative methods use

descriptive terms to identify and record consequences and likelihoods of the events and resultant risk. Quantitative methods identify likelihoods as frequencies or probabilities. They identify consequences in terms of relative scale (orders of magnitude) or in terms of specific values (for example estimate of cost, number of fatalities or number of individuals lost from a rare species). For both qualitative and quantitative methods it is important to invest time in developing appropriate rating scales for likelihood, consequence and resultant risk. The full range of risk situations likely to be encountered within the scope of the exercise should be considered when developing rating scales.

7.5.1 SEMI QUANTITATIVE METHODS

Semi-quantitative approaches to risk assessment are currently widely used to overcome some of the shortcomings associated with qualitative approaches. Semi-quantitative risk assessments provide a more detailed prioritised ranking of risks than the outcomes of qualitative risk assessments. Semi-quantitative risk assessment takes the qualitative approach a step further by attributing values or multipliers to the likelihood and consequence groupings. Semi-quantitative risk assessment methods may involve multiplication of frequency levels with a numerical ranking of consequence. Several combinations of scale are possible.

Risk Matrix

Consequences 1= Minor 6= Severe	1					
	2					
	3					
	4					
	5					
	6					
		Rare I	Unlikely (U)	Possible (P)	Likely (L)	Almost Certain (Ac)
Likelihood (L)						

From the above Risk Assessment Matrix, risks I are assigned a risk ranking that is used to determine their priority for management. The risk rankings are:

A	Critical Risk
B	High Risk

C	Moderate Risk
D	Low Risk

Table No.7.1: Risk and Hazard analysis for different phases of Project

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
1	Interaction with vehicles, machinery and equipment (Physical).	Refer Section 10 ESMP	1	L		2	U	
2	Interaction with onsite and offsite traffic	Implementation of traffic management plan	4	P		6	U	
3	Fugitive Dust Emission	Refer Section 10 ESMP	3	U		1	U	
4	Fatigue	Work rosters that include rest between shifts; training and awareness; and Health and well-being improvement program.	1	P		4	P	
5	Food Hygiene	Provision and supply of food to be undertaken in accordance with relevant food and hygiene legislation.	1	R		6	R	

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
6	Physical injuries from manual handling.	Documented standard operating procedure; education and training; education and awareness program; Job Hazard Analysis covering manual handling; and Effective pre-employment fitness for work screening and health and well-being improvement program.	1	R		2	L	
7	Leaks of oil, fuel or chemicals from vehicles during transport and/or at designated fuelling stations	Provision of auto-shut off nozzles; Follow SOP of fuelling procedures; Provision of impervious containment and bunding of stationary / fixed tanks; overfill protection; prompt reporting and clean-up; major equipment maintenance to be conducted in dedicated facilities; clean up equipment; and storage and handling in accordance with AS 1940	1	P		1	P	

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
8	Ventilation failure	The underground mining area will be provided with good ventilation as per the DGMS guidelines; Provision of backup ventilation provision, in case of failure of ventilation equipment's; Provision CO, NOx, O_2 and Methane level detectors;	NA	NA	NA	6	U	
9	Chemical release – liquid from leaks, ruptures, overflows, spillage or pooling.	Storm water is directed away from potentially contaminated areas; site drainage system designed to allow retention of spills on site; Hazard and Operability (HAZOP) reviews conducted during detailed design; Personnel trained in use, appropriate storage, handling and incident response; Material Safety Data Sheets (MSDS) available on site; appropriate personal protective equipment and adequate supply of spill materials; Chemical incidents included in Emergency Management Plan; and effective preventative maintenance.	3	U		4	U	

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
10	Natural Flooding and ground water interception and associated flooding	Site is not prone to flood; and Pumping will be done at regular interval; Provision of	5	U		5	U	
11	Noise and vibrations	explosive materials handled only by competent authorised personnel; induction and training of all staff on safety procedures during blasting; strict control of ignition sources; advise surrounding neighbours, where appropriate; personal protective equipment (PPE) provided; and storage of explosives and accessories in accordance with the Explosives Act	1	R		1	R	
12	Failure of waste dumps		6	U		6	U	
13	Failure of tailing storage dams		6	P		6	P	

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
14	Hazards due to poor illuminations	The work area will be kept well lighted. Lightening in different areas will be provided as per DGMS guidelines; Energy efficient light sources with minimum heat emission will be used in underground mining activities and mine office;	3	P		5	P	

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
15	Hazard due to Blasting associated activities	Protective devices will be provided to workers during handling explosives; lasting will be carefully planned and executed under supervision of a responsible officer to avoid any accident; xplosives will be handled as per guidelines of DGMS; Strict prohibition of smoking in fuel and hazardous chemical storage area; Signage in hazardous and risky areas; lasting sites will be checked post blast by qualified personnel for malfunctions and any unexploded blasting material prior to resumption of work in the area; Provision of storage of magazine at separate area at safe distance from ML area with necessary security arrangements; Provisions of fire fighting in the mine area and beneficiation plant with sufficient number of fire extinguishers at fuel storage area, mine office, electrical substation and other strategic locations to take care of any eventuality; Following Emergency	2	P		5	P	

S.N	Risk and Hazard	Control Measures	Environment and Land			Human Health		
			C	L	R	C	L	R
16	Storage of fuel and hazardous chemicals	pecific warning siren will be blown before each blasting activity to alert all the workers and local people residing in the surrounding areas; Material Safety Data Sheet (MSDS) for hazardous chemicals will be maintained and followed to ensure safety of workers; Eye wash and emergency shower system will be provided in hazardous chemical storage area; Signage in hazardous and risky areas;	5	P		5	P	

Note: C= Consequences, L = Likelihood and R = Risk

7.6 MITIGATION MEASURES FOR POSSIBLE RISK AND HAZARDS IDENTIFIED

1. Fire and Explosions

- Identify the sources of fire and fire hazards at regular intervals;
- Undertake regular training and awareness programmes on dos/ don't on in-case of fires; use of fire distinguishers; handling flammables;
- Develop well established emergency exit plan showing emergency exits,
- The boundaries of each explosion risk zone at the mining operation are clearly indicated by

signage at each boundary;

- Inflammable material shall not be stored in underground;
- Underground mining infrastructure's such as shaft, ventilation systems, Ramp, incline etc will be made of noncombustible materials;
- Proposed underground workshop, surface workshop, HSD filling station, compressor house and electrical sub-station shall be provided with adequate firefighting equipment's and the functioning status of the same shall be verified at periodic intervals as per the supplier requirement;
- Regular inspection/audit will be done to check the accumulation of greasy material cotton waste, old conveyor pieces, waste hose pipes, wooden scrap, wood cuttings etc. Regular removal of the same shall be ensured;
- A proper communication system shall be installed to warn underground worker about outbreak of fire;
- Electric apparatus, electric cables etc. shall be checked regularly;
- Adequate number of persons will be trained in firefighting;
- There is appropriate signage at the entrance to fuel storage areas advising:
    - Flammable materials are stored inside;
    - Access to experienced mine workers only;
    - No flames or naked lights;
    - No hot work;
    - Engines will shut down before firefighting;
    - Emergency procedures in the event of fire;
- Mock drills will be conducted periodically
- All fuel transfer systems are constructed with non-flammable materials, brass, or non-metallic components and have automatic sealing using fast fill couplings.

2. Failure of Ventilation systems

- Ventilation levels to be monitored as per statutory guidelines;
- Measures the quantity of air being delivered to every working place in the underground parts of the mining operation;
- Determines whether air is being recirculated in the underground parts of the mining operation and takes suitable action to stop any such recirculation;

- The mine management must ensure, in respect of any underground parts of a mining operation where a mine worker is doing work or may travel, that the air in that part is provided at an adequate quantity and velocity to ensure the mine worker will not be exposed to a concentration of dust that is likely to cause harm to the mine worker;
- The emergency supply of electricity to the underground parts of the mining operation, other machineries and equipment's that does not require power supply will be isolated as soon as reasonably practicable;
- The supply of electricity will not be restored until after the ventilation system has been safely restored and a competent person considers it is safe to restore the supply of electricity to the remaining machineries and equipment's.
- The mine operator will ensure regularly the air supplied to every underground place where mine workers are working meets the requirements of the applicable Regulations, and safe levels, in relation to:
    - Air velocity, quantity and composition.
    - Fire.
    - Methane or noxious gases.
    - Humidity.
    - Diesel emissions.
    - Radon.

3. Entrapment of miners

- To prevent premature collapse of any workings, effective supports will be erected based upon the geotechnical mapping;
- All workings will be systematically supported to safeguard against any possibility of premature collapse;
- Numerical modelling techniques will be used to determine the stable spans of stopes, safe locations of developments and stable pillars;
- The hang wall and crown pillar will be instrumented with multi point boreholes extensometer and stress meter for ground monitoring on regular basis;
- The rescue mode and methods are clearly identified and communicated and shall be continued and adequately extended in mine expansion;

4. Transportation, Storage and Handling of Hazardous substance

- Containers or systems in which hazardous materials are contained will be labelled.
- Storage and Disposal of hazardous substance containers is carried out as per Hazardous and Other Waste Management Rule(HoWMR) 2016;
- Requirements for storage, handling and disposal are determined before a chemical is purchased.
- All personnel handling these substances are trained in the associated procedures, including clean-up.
- Essential safety equipment will be made available at all times.

5. Fuel and Oil

- Ignition sources will be monitored and managed to avoid fire;
- Training will be provided in the safe operation of equipment and knowledge of emergency response procedures in the event of diesel leakage
- Equipment inspection and testing programs will be undertaken to ensure reliable performance of fuel tanks and bunds;
- Spill containment equipment (e.g. bunds) will be built to contain any spillage of liquids
- Clean storm water will be diverted away from the bunded fuel storage areas
- Sumps will be constructed to collect any spillage and allow recovery
- Standard operating procedures will be developed for operators
- Spill kits will be available at all fill/transfer points
- Appropriate firefighting facilities and suppression systems will be installed, maintained and available to extinguish fires
- An approved fire protection system is to be installed and maintained around new storage area

6. Irruption of Water

- The position of the workings below ground;
- Every borehole and shaft (with depth) drive, crosscut, winzes, raise, excavation and air passage connected therewith;
- The position of every dyke fault and other geological disturbance, with the amount and direction of throw;

- Levels taken in workings below ground at easily identifiable points sufficient in number to allow the construction of sections along all drives main headings and haulage roadways;
- Every source of water such as river, stream, water course, reservoir, water-logged workings on the surface, and also the outline of all water logged workings below ground lying within 60 meters of any part of the workings measured in any direction;
- Every reservoir, dam or other structure, either above or below ground, constructed to withstand a pressure of water or to control an inrush of water, along with reference to its design and other details of construction;
- Surface contour lines drawn at vertical intervals shall not exceed five meters; and
- Mine entries shall be developed above the highest flood level of the area.

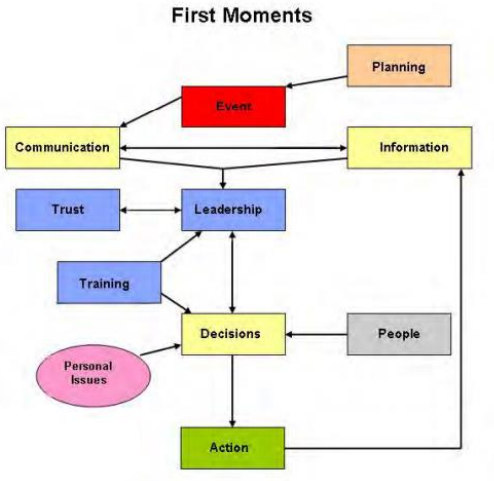
7. Working at height

- Perform the task on the ground if possible;
- Use a passive fall prevention device;
- Use a work positioning system to ensure employees work within a safe area;
- Install a fall arrest system to limit the risk of injuries in the event of a fall;
- Use a fixed or portable ladder incorporating a risk assessment, safe work procedures and training; and if you are not able to work on the ground or on a solid construction prior to working at height then;
- Establish emergency procedures and First Aid provision prior to undertaking the task;
- Review documented safe systems of work for contractors who are required to work at height; and
- Monitor the work at height practices of all employees and contractors to ensure they are working safely.

7.7 DISASTER MANAGEMENT PLAN

An underground mine is an inherently dangerous workplace. The safety of workers depends upon many interrelated factors, including knowledge of the dynamic, ever-changing environment, the ability to recognize and respond to hazards, training, experience, and communication. During an emergency, these factors can be crucial to response. When something goes awry in an underground mine, seconds count and the initial response can be critical to the outcome. Understanding the behaviors and issues

present in the initial moments of a response to mine emergency may enhance escape, facilitate rescue, and be helpful for training miners and decision-makers.



Framework of first moments in mine emergency escape

(a) Identification of potential emergencies

- Personal Injury
- Unplanned Explosion
- Fires, Including For Tyres And Explosives
- Strata or Ground Failure
- Entrapped or Missing Workers
- Inundation or Inrush
- Outburst
- Irrespirable or Noxious Atmospheres
- Hazardous Material Incident
- Explosives Incident
- Vehicle or Machinery Accidents
- Air Blast or Wind Blast
- Significant Ventilation Failure
- Mechanical or Electrical Equipment out of Control
- Natural Disasters, Such As Bushfires, Flooding, Earthquakes, Cyclones
- Medical Emergencies E.G. Stroke
- Spontaneous Combustion
- Structural Failure (Plant)

- Loss of Radiation Sources
- Intersection of Utilities (Gas Pipeline, Underground Water/Power).

(b) Mine Emergency Planning

All miners should be trained to understand and follow the mine emergency plan where they work. A response plan is only one piece of the continual, dynamic process of emergency response planning. Identifying threats and their associated risks will help establish planning process priorities. As a first critical step in emergency response planning, a thorough hazard analysis and risk assessment should be conducted. This will help in keeping emergency response plans simple and easy to use.

The Mine Safety Technology & Training Commission report (2006) recommends developing a comprehensive emergency response plan that is riskbased and mine specific. A risk-based plan is targeted for the most likely threats and assumes that preparing for them also prepares for unrecognized hazards.

Competencies required for successful escape include:

- Technical knowledge : understanding and proficiency in the use of emergency breathing apparatus (self-contained self-rescuers), lifelines, refuge chambers, etc.
- Mine specific knowledge : knowledge of the mine maps, the escapeways, the ventilation system, the mine emergency response plan, and familiarity with escape capsules.
- Escape conceptual knowledge : ability to think and adapt to changing conditions, to be resilient, to be able to problem solve and make decisions, and to understand the dynamic of human behavior in escape, including leadership and other psycho-social issues.

(c) Communication

Information about the situation affects the initial response and defines the first moments of an incident. NIOSH studies indicate that the effectiveness of a mine's communication

system is a key factor in the initial response. Research has suggested that effective communication will reduce confusion, increase confidence in decisions, stop rumors and incorrect information, and improve the likelihood of success.

(d) Training

Training is considered to be one of the most essential elements in the emergency response planning process. Training, in the form of drills, mock disasters, and even tabletop simulations, affords the opportunity for planners to identify and resolve problems, examine and evaluate the utility of developed procedures, refine plans, and train individuals who will be responding to emergency events.

(e) Decision-making

Decision-making directly relates to communications issues. In an emergency, decision-making relies on :

- The quality of the information received by everyone immediately following the incident
- The technical communication system in place in the mine.
- The process is iterative, meaning that one choice leads to another until the incident is resolved. Decision-making is also affected by the experience level of the people involved.

(f) Personal protective equipment for first aid and rescue

People entering the mine as part of first aid and rescue procedures should have the appropriate personal protective equipment (PPE).

Considerations for ensuring capacity to provide PPE include:

- Potential or actual atmospheric contaminants
- Potential or actual inundation or inrush
- availability of the appropriate equipment
- availability of persons trained in the equipment
- specific protocols for use of the equipment
- procedures for any specialist emergency response team who may enter the mine.

7.8 PROTECTIVE MEASURES TO BE TAKEN

(i) Measures taken to avoid mine gases are as follows:-

- The quantity of inflammable gas given out in each ventilation district will be determined at least once in a month and similarly borehole samples once in three months.
- The quantity of air sent into each district will be such as to keep the percentage of inflammable gases in the district return airway below a percentage of 0.75 to 1.25 at any place in the mine.
- The state of atmosphere near the stopping will be continuously monitored by flame safety lamps, air sampling and analysis.
- There should be strict adherence to latest safety manuals and statutory acts.
- Working will be ventilated by a suitable mechanical ventilator installed on the surface.
- The Manager will be assisted by a ventilation officer in each and every operative area.
- Adequate quantity of air will be coursed to well within meters of the working face, and
- Air samples will be frequently collected of the roof of the working face and analyzed timely for the presence of CH_4.

(ii) Measures to avoid fires in the underground mine are as under:-

- Check the workers, before the proceed underground, for matchbox, lighters and other contrabands,
- Do not allow burning of fire inside the mine and also within 15m of an incline/pit,
- Avoid welding of headgear pulley or the headgear frame unless adequate timely precautions are taken,
- Avoid welding in underground repair shops without adequate precautions.
- Restrict the storage of inflammable and combustible material like oil, grease, timber etc.
- Remove all wood cuttings as also oily and greasy cotton wastes out of the mine.
- Install the electrical cables and equipment with due care and maintain them properly with regular inspections.

- Use only approved safety lamps, which should be taken underground in locked condition.
- Machinery to be used underground should be meticulously assembled and properly operated so as to ascertain that during use it does not cause any dangerous sparks or for that matter generate any hot surface.
- Break blocks of underground machinery like haulage engines, locomotives, etc., should be adjusted periodically to avoid their overheating and
- Avoid at any cost accumulation of dangerous static electric charges on the equipment using air by earthing.

(iii) Measures to avoid Subsidence

- Long faces: Long faces or longer width of panel are to be preferred to reduce the number of rib-sides, where differential movements occur resulting in high subsidence.
- Rapid face Advantage: Temporary interruptions in face advance should be scrupulously avoided as the rapid face advance necessarily aims at diffusing the rib side conditions to control the subsidence.

(iv) Measures to avoid Inundation

- Working place approached within a distance of 60m of any other working (likely to contain accumulation of water) shall not be extended further unless it is examined physically and found to be free from accumulation of water.
- Whenever seepage of water is noticed at any place of working, such working shall be immediately stopped. The height of such working shall not extend 2.4m and at least one borehole near the center of working place shall be maintained with sufficient number of flank holes. The boreholes drilled above and below the workings at intervals of not more than 5m. Such boreholes constantly maintained 3m in advance of the working.

7.9 EMERGENCY PLAN

Emergency is any unplanned event that causes serious injuries or loss of life; causes

extensive property damage; shuts down or disrupts the mining operations; or threatens the operation's financial standing or public image.

Emergency preparedness is a well designed and executed plan that can eliminate or control hazards so they don't become a disaster; or if this isn't possible, it can turn a potential disaster into a well managed situation with minimal effect on the miners and property of the mining operation.

- **Emergency Management**

Emergency management is the collective arrangement of personnel to plan for, mitigate/control, respond to and recover from an emergency. It provides for a structured framework for completing all perceived activities in an emergency situation. Emergency management ensures a solid, complete and collaborative arrangement of personnel, resources and services. An emergency preparedness plan is not to be confused with an emergency response plan. Emergency response is just one of the key elements of the emergency preparedness plan. Emergency preparedness plans include risk management activities, prevention and/or control measures, response procedures and guidelines, and recovery efforts. Each of these components requires training, drills and periodic revisions.

- **A well-developed, implemented and maintained emergency preparedness plan can:**
  - Help mining companies fulfill their moral responsibility of protecting their miners, property and possibly the public and environment.
  - Ensure compliance with federal and state mining regulations.
  - Enhance a company's liability to recover more quickly from financial loss, regulatory fines, loss of market, and damages to property and equipment.
  - Reduce exposure to civil or criminal liability.
  - Provide employees, customers and suppliers with a sense of security.
  - Reduce insurance premiums.

- **Planning team**
  - General Mine Manager/Superintendent •
  - Mine Foreman •
  - Maintenance Manager/Supervisor •

- Labor Representative •
- Safety Manager/Director •
- Human Resources Manager •
- Engineering Manager/Supervisor •
- Security Director

7.10 INFRASTRUCTURE

Following infrastructure and operational system will be provided to meet any emergencies.

(a) Emergency Control Room

This will be situated in an area away from the places of fire and will be provided with the following facilities:-

1. Master plan of the mines.
2. First aid boxes.
3. Gas masks.
4. Telephone line with STD facility.
5. Emergency lighting system
6. Stretchers.
7. Transport facility.
8. Emergency control room will function as control base.
9. Lifebuoys

(b) Assembly Points

Assembly points are to be set up farthest from the location of likely hazardous events, where pre-designated persons from the works, contractors and visitors would assemble in case of emergency. Up-to-date list of pre-designated employees of various departments must be available at these points so that roll call could be taken. Pre-designated persons would take charge of these points and mark presence as the people come into it.

(c) Warning System and Control

The Control Centers will be located at an area of minimum risk or vulnerability in the premises concerned, taking into account the areas which might be affected by

fire/explosion, toxic releases, etc. For promptness and efficiency, the premises/storage sites may be divided into number of zones, which should be clearly marked on the site plan.

(d) Emergency Services

This includes the fire-fighting system, first aid center, hospital etc. Alternate sources of power supply for operating fire pumps, communication with local bodies, fire brigade etc., will also be clearly identified. Adequate number of external and internal telephone connections will be installed.

(e) Fire Protection System

The fire protection system for the proposed mine will consist of:-

a. Hydrant system for all the areas of the mine.

b. Portable hand appliances of suitable types/ capacities for extinguishing small fires in selected areas of the mine/storage areas.

7.11 OCCUPATIONAL HEALTH AND SAFETY

The main areas of concern for ensuring adequate occupational health and safety are:-

- All working places will have safe means of access, safe working platform and exit. Persons working in hazardous dust prone area will be provided with dust mask.
- Personal protective equipments like respirators, ear plug, noise muff, helmet etc. will be provided to the workers.
- Proper unit design and engineering controls in order to protect workers, including by control of process and fugitive emissions.
- Adequate arrangement of drinking water will be done.
- Education & training will be provided to the workforce about facilities, protective equipment, risk associated, potential health effects, etc.
- Display board will be provided showing the hazards associated and recommended precautionary measures.

❖ **MEDICAL SURVEILLANCE**

Following are the proposed Medical Surveillance will be conducted as per DGMS guidelines for all employees:-

- Pre-employment medical check-up.
  - * Pulmonary Function Test
  - * Complete Physical Examination
  - * Blood Test
  - * Urine Test
  - * Chest X ray
  - * Audiometry Test

- Form 27A Fitness Certificate will be obtained every year from certified surgeon.
- Form 17 Health Register of each employee will be obtained every year from certified surgeon.
- Individual medical record will be maintained.

❖ **OCCUPATIONAL HEALTH**

Occupational health needs attention during operation phases. However, the problem varies both in magnitude and variety in the above phases.

Operation and Maintenance

The problem of occupational health, in the operation and maintenance phase is primarily due to dust and noise which could affect the workers from respiratory and hearing problems. The necessary personal protective equipments will be given to all the workers. The working personnel will be given the following appropriate personnel protective equipments.

- Industrial Safety Helmet;
- Crash Helmets;
- Face shield with replacement acrylic vision;
- Zero power plain goggles with cut type filters on both ends;
- Zero power goggles with cut type filters on both sides and blue color glasses;
- Welders equipment for eye and face protection;
- Cylindrical type earplug;

- Ear muffs;
- Dust mask;
- Self contained breathing apparatus;
- Leather apron;
- Safety belt/ line man's safety belt;
- Leather hand gloves;
- Asbestos hand gloves;
- Acid/ Alkali proof rubberized hand gloves;
- Canvas cum leather hand gloves with leather palm;
- Lead hand glove;
- Electrically tested electrical resistance hand gloves; and
- Industrial safety shoes with steel toe.
- Lifebuoys

Full-fledged hospital facilities will be available round the clock for attending emergency arising out of accidents, if any. All working personnel will be medically examined at least once in every year and at the end of his term of employment. This is in addition to the pre-employment medical examination.

7.12 SAFETY PLAN

The planning stage in the continuous improvement cycle is made up of the following four elements:

1. Policy 2.
2. Legal and Other Requirements 3.
3. Hazard Identification and Risk Management
4. HSEQ Management Improvement Planning

Underground Mine safety Management Plan must include but may not limited to :

- Ventilation
- Spontaneous combustion
- Gas management
- Innudation

- Emergency evacuation
- Transportationm machinery
- Starata control

Safety of both men and materials during construction and operation phases is of concern. Safety plan has been prepared , will be further revised and same will be implemented in the proposed expension. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster is possible due to collapse of rock structures and fire/ explosion etc.

Keeping in view the safety requirement during construction, operation and maintenance phases a safety policy will be formulated with the following regulations:-

- To allocate sufficient resources to maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the construction, operation and maintenance of men, machinery and equipment;
- To ensure that adequate safety instructions are given to all employees;
- To provide wherever necessary protective equipment, safety appliances and clothing and to ensure their proper use;
- To inform employees about materials, equipment or processes used in their work which are known to be potentially hazardous to health or safety;
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and upto date knowledge;
- To provide appropriate facilities for first aid and prompt treatment of injuries and illness at work;
- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters;
- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving people injury or injury to health with a view to taking corrective, remedial and preventive action;
- To promote through the established machinery, joint consultation in health and

safety matters to ensure effective participation by all employees;

- To publish/ notify regulations, instructions and notices in the common language of employees;
- To prepare separate safety rules for each type of occupation/processes involved in at site; and
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

(a) SAFETY ORGANIZATION

A qualified and experienced safety officer has been appointed. The responsibilities of the safety officer include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions in accordance with the requirement of Factories Act / DGMS and their duties and responsibilities will be as defined thereof.

(b) SAFETY MEETING

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety group would be constituted in each area of work. The group would consist of 5-6 employees from that area. The group normally will meet for about an hour every week.

(c) SAFETY TRAINING

A full-fledged training center will be set up at the plant. Safety training will be provided by the Safety Officers with the assistance of faculty members called from Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors will also be provided safety training. To create safety awareness safety films will be shown to workers and leaflets will be distributed. Some precautions and remedial measures proposed to be adopted to prevent fires are:-

- Spread of fire in horizontal direction would be checked by providing fire stops;

- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods;
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and
- Proper fire watching by all concerned would be ensured.

(d) HEALTH AND SAFETY MONITORING PLAN

The health of all employees will be monitored once in a every year for early detection of any ailment due to exposure of dust, heat and noise.

7.13 REHABILITATION & RESETTLEMENT (R&R)

The proposed expansion will be through underground mining operations within existing mine, hence no resettlement or rehabilitation is envisaged.

7.15 CORPORATE SOCIAL RESPONSIBILITY (CSR)

Detail of Expenditure incurred on CSR from 2012-13 to 2017-18

Table no.7.2: Expenses under CSR

(All Values in Rs. Lakhs)

S.No	Focus Area	2012-13	2013-14	2014-15	2015-16	2016-17	Proposed 2017-18
1	Rural Infrastructure Development	5.00	22.95	62.72	74.43	52.00	116.00
2	Health Water and Sanitation	8.84	9.45	10.19	32.32	12.80	33.00
3	Education	5.89	8.64	8.00	51.32	50.50	15.00
4	Khushi Project	0.00	0.00	0.00	0.00	46.00	80.00
5	Nand Ghar Project	0.00	0.00	0.00	0.00	6.42	45.00
6	Livelihood (Samadhan Project) Women empowerment	3.00	6.28	4.81	6.69	31.44	150.00

7	Social Mobilization /Sports and Culture	15.00	18.93	20.51	4.50	8.54	25.00
8	Bio-Investment	1.00	1.50	0.58	14.04	5.00	10.00
	Total	**38.73**	**67.75**	**106.81**	**183.30**	**212.70**	**474.00**

Table no.7.2: Proposed CSR Budget till -2020

(All Values in Rs. Lakhs)

S.No	Focus Area	2018-19	2019-20	2020-21
1	Rural Infrastructure Development	116.00	120.00	125.00
2	Health Water and Sanitation	33.00	100.00	100.00
3	Education	50.00	50.00	50.00
4	Khushi Project	80.00	90.00	90.00
5	Nand Ghar Project	750.00	750.00	750.00
6	Livelihood (Samadhan Project) Women empowerment	150.00	150.00	150.00
7	Social Moblization /Sports and Culture	25.00	25.00	25.00
8	Bio-Investment	20.00	20.00	25.00
	Total	**1224.00**	**1305.00**	**1315.00**

***Note :Similar nature of activities will be carried out in coming years by the CSR cell of Hindustan Zinc Limited- Kayad Mine.**

Nandghar Inauguration at Khanpura Anaanwari

Stakeholder engagement on Road Safety

Nandghar at Khanpura, Ajmer

Support Local Students for Higher Studies

KHUSHI Education Project

SAKHI Project - Women Empowerment

SAMADHAN Project - Agriculture and livestock

SHIKSHA SAMBAL Project

Awards & Accolades

1. **5 Star** Rating from Ministry of Mines , New Delhi in 2016

2. Over All Performance Award in Mine Environment and Mineral Conservation week 2016 from IBM , Ajmer

3. Global Sustainability Award from Energy And Environment Foundation in 2017

CHAPTER 8:

PROJECT BENEFITS

CHAPTER- 8

PROJECT BENEFITS

8.1 INTRODUCTION

Zinc is a very versatile non-ferrous metal. Zinc's different applications rank it as the 4th most common metal in use after iron, aluminum and copper. In India, zinc demand growth continues to remain strong at around 7%, and is expected to leverage support from the automotive and the white goods sectors. Other major uses for Zinc include its utility in brass and bronze among many alloys; die casting, batteries, chemical compounds such as paints, ceramics, pharmaceuticals and fertilizers.

Over the medium term, growth in consumption is projected to average 7% a year which is also likely to remain stable till Year 2020. Global zinc demand continues to be driven mainly by galvanizing sector in the emerging economies of Asia and Africa. The reported increase in Chinese manufacturing activities and US automotive sales along with emerging signs of stability in Europe's manufacturing and services sector are expected to support zinc demand.

The mining and associated activities in the mineral bearing areas bring about gains in gross domestic product, i.e. there is though a small contribution by the proposed expansion project but will add to the gains in the G.D.P.

The existing capacity of the Mine is 0.9 MMTPA of Lead-Zinc Ore Production and the proposed capacity after expansion will be 1.08MMTPA of Lead-Zinc Ore Production.

Zinc is a very volatile metal and small movements in its demand may produce price fluctuations. The mining industry has witnessed continuous modernization and adoption of new technologies in recent years for the excavation of mineral like Zinc. The proposed expansion of mine will cater to the huge market demand presently, which can be analyzed by the demand and supply gap as shown below:-

The proposed expansion will bridge the gap between supply and demand of zinc not only in the region but also at national level. This will also generate much needed employment to the local people. Economy of the area will get a boost and there will be overall growth of the region in terms of education, health, training, transport,

automobile, industry. The standard of living accordingly will also get an upliftment on the positive side.

8.2 IMPROVEMENTS IN PHYSICAL AND SOCIAL INFRASTRUCTURE

The proposed project will enhance the socio-economic activities in the adjoining areas. This will result in following benefits:-

1. Improvements in physical infrastructure.
2. Improvements in social Infrastructure.
3. Increase in employment potential
4. Contribution to the exchequer.
5. Post-mining enhancement of green cover.

8.3 IMPROVEMENTS IN PHYSICAL INFRASTRUCTURE

This project will have numerous induced impacts on society such as growth in schools (as part of CSR), hospitals, and transport etc.

8.4 EMPLOYMENT POTENTIAL –SKILLED; SEMI-SKILLED AND UNSKILLED

The proposed debottlenecking will be managed by the existing resources.The existing project has already provided huge opportunity for development of the area and the proposed expansion project is also anticipated to provide additional indirect employment opportunities to number of people from the Ajmer tehsil and its surrounding area. The proposed expansion project will also bring in people for secondary employment like transporters, vendors, local canteen and tea stall operators etc. Sourcing of consumable will be carried out from local region which will also provide considerable opportunity for local economy.

8.5 IMPROVEMENTS IN SOCIAL INFRASTRUCTURE

The proposed expansion project will bring in people from different cultures for secondary employment like transporters, vendors, local canteen and tea stall operators etc. such as:

- Generate indirect employment opportunities;
- Real estate development;
- Increase in purchasing power;
- Development of ancillary small scale supporting electro mechanical services for automobile's, civil, electrical and mechanicals etc. as part of CSR.
- Agriculture marketing and increased demand for locally produced farm products for large number of employees existing in the project;
- Access to high quality health care facilities;
- Women empowerment;

8.6 VARIOUS TANGIBLE SOCIAL BENEFITS IN THE STUDY AREA

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 & cattle, medical checkup camps, building/strengthening of existing roads in the area. 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 endeavor to become self-reliant. Engaging the communities in their pursuits of sustainable and constructive development thereby facilitating social cohesion.

Fig.8.1: Meeting of SHG under Sakhi Project

Fig.8.2: Sapling distribution to villages.

Fig.8.3: Schools bags distribution to school children.

Fig.8.4: Furniture distribution to schools.

Fig.8.5: Drinker water tank installation in kayad Village. **Fig.8.6: Health Camp organize by HZL.**

Various activities listed above will be continued for the lifetime operation of the project and any other similar or different activities, which are required for the further improvement of the surrounding area, will be carried out in consultation with the villagers, district and state administration.

Details of the CSR Existing and proposed has been elaborated in **Chapter-7** of this Report.

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CHAPTER - 9

ENVIRONMENTAL COST-BENEFIT ANALYSIS

CHAPTER - 9

ENVIRONMENTAL COST-BENEFIT ANALYSIS

NOT RECOMMENED

CHAPTER – 10

ENVIRONMENTAL MANAGEMENT PLAN

CHAPTER – 10

ENVIRONMENTAL MANAGEMENT PLAN

10.1 INTRODUCTION

An Environmental Management Plan (EMP) is drawn up after an EIA study for the proposed expansion project.

An EMS (Environment Management System- ISO 14001) provides a systematic framework and approach to identify the hazards and minimize risk and identify the environmental aspects and eliminate the impacts.

10.1.1 METHODOLOGY

The system is depicted graphically as follows:-

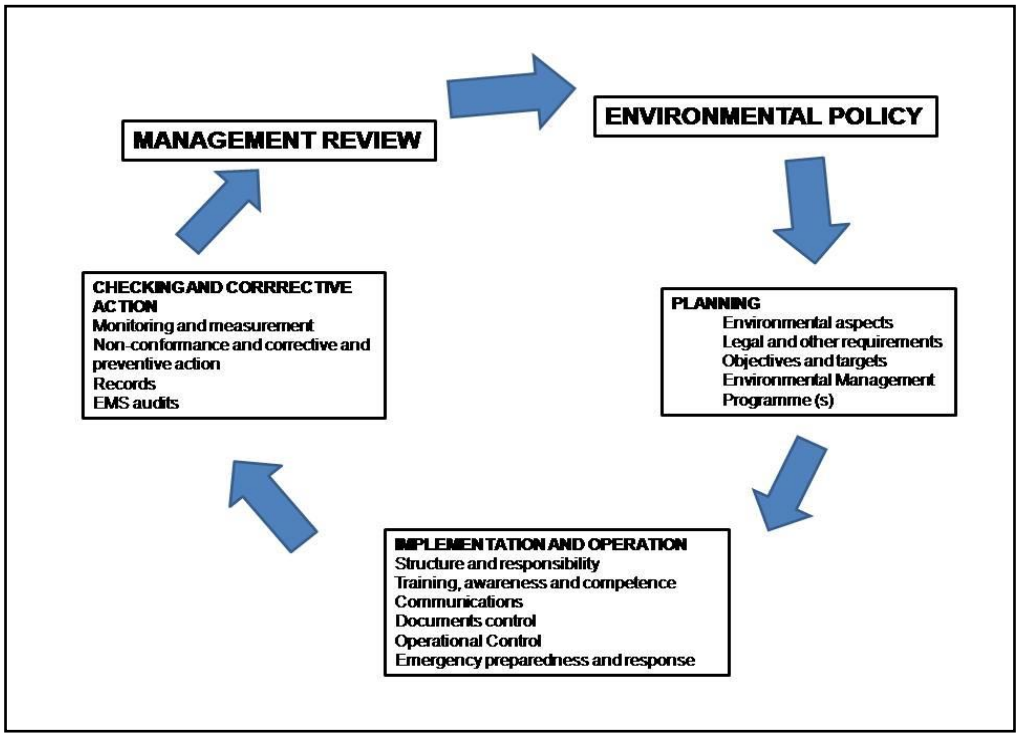

Figure 10.1: Environmental Management Methodology

10.1.2 Corporate Governance

Project proponent is responsible for the development and implementation of the EMP

and, where relevant, ensuring that the conditions in the and approved Environment Clearance are satisfied.

Roles and responsibilities of proponent/ stakeholder's will depend on the scale and scope of the EMP.

10.2 MANAGEMENT STRUCTURE

The Company is having a Head-Environment who has/will have overall responsibility for managing the project and for ensuring that the Environmental Management requirement is met.

The Head-Environment also has the authority to stop activities in contravention of the EMP must approve all decisions regarding environmental procedures and protocols.

The duties and responsibilities are being/will be well defined for implementation/ monitoring of both the persons enumerated as below:-

1) Maintenance , update and review of EMP;
2) Compilation and administration of Environmental Monitoring Plan to ensure that Environmental Management Measures are implemented and are effective;
3) Checking the records of environmental incidents (spills, impacts, legal transgressions etc.) as well as corrective and preventive actions taken;
4) Checking of the public complaints register maintained in which all complaints are recorded as well as action taken;
5) Communication of all modifications to the EMP to the relevant stake holders.
6) Conducting regular audits to ensure that the system for implementing the EMP is operating effectively;

10.3 ENVIRONMENTAL MONITORING COMMITTEE (EMC)

EMC's have become an effective mechanism for monitoring the implementation of the EMP. This will take care of the in-house implementation programme and statutory / legal holders like Regional Office of MoE&F, New Delhi and State Pollution Control Board.

The monitoring programme will comprise of three main aspects:-

1) Baseline measuring;
2) Impact (all performance);
3) Compliance Monitoring.

The monitoring should be implemented to ensure the prescribed mitigation measures are having the predicted and desired effect. Monitoring will be conducted periodically. It will also be ensured that the levels of specific environmental parameters are compliant with laws, regulations, standards or guidelines as applicable.

An implementation schedule must be prepared showing the sequence and timing (including frequency and duration) of the management action and monitoring activities or the EMP, where monitoring reports are produced, the timing of such report should be indicated. The schedule must be drawn up with the Project proponent, to ensure necessary links are made between the implementation schedule of the EMP and overall project schedule.

10.4 CRITICAL ACTIVITIES FOR EMP IMPLEMENTATION

1) Training and Environmental awareness;
2) Documentation and record keeping;
3) Reporting procedures;
4) Stakeholder/ project proponent engagement;
5) Auditing;
6) Responding to non-compliance;

10.5 MANAGEMENT OF VARIOUS FACTORS OF ENVIRONMENT

Environmental Management Plan (EMP) aims at the preservation of ecological system by considering in-built pollution abatement facilities at the existing site. Some of the major criteria governing the environmental measures will be adopted.

Sustainable development in the study area needs to be intervened with judicious utilization of non-renewable resources of the study area and within the limits of permissible capacity. The assimilative capacity of the study area is the maximum amount of pollution load that can be discharged in the environment without affecting

the designated use and is governed by dilution, dispersion and removal due to physico-chemical and biological processes. The EMP is required to ensure sustainable development in the study area of 10 km radius of the mining site; hence it needs to be an all encompassive plan for the existing activity. Government regulating agencies like Pollution Control Board working in the region and more importantly the people living in the study area need to extend their co-operation and contribution.

Environmental management for the existing mining activity is discussed for the environmental impact pertains to the operational phase. Even though reversible in nature - all the impacts will be visible only during operational phase. It is planned to take corrective measures to ensure that these effects are kept to bare minimum. The EMP will therefore, be initiated during planning stage itself.

Table No.10.1: Critical Activities for EMP Implementation for Various Factors

S. No.	Particulars	Proposed Activities
1.	Top Soil storage, preservation and utilization	The topography of the lease area is undulating and is an underground mine. If any top soil is generated the same will be utilized for plantation.
2.	Land reclamation and rehabilitation	This is an underground mine situated in a undulating terrain. Land will be disturbed only to a small extent. Mine has large potential and will therefore be continued to work for a long time. Exploration work being carried out may further enhance the reserves and there by the life of the mine will increase. Reclaimed area will be utilized for plantation, which will help in improving the vegetal cover of the region.
3.	Waste dump management	Additional waste generation due to development activities is envisaged . The development waste generated shall be disposed in underground voids backfilling.

4.	Afforestation programme with precautions proposed for survival and protection of plantations.	Plantation will be carried out in and nearby lease area. Proposed plantation programme is given as below:-

Species Name	Local Name
Acacia nilotica	Desi Babul
Albizzia lebbek	Shiris
Annona squamosa.	Sitafal
Azadirachta indica	Neem
Dalbergia sissoo	Sisam
Pongamia pinnata	Karanj
Emblica officinalis	Amla
Ficus bengalensis	Bad or Vad
Ficus religiosa	Piplal
Holoptelea integrifolia	Churel
Lawsonia inermis	Mehndhi
Mangifera indica	Aam
Pithecellobium dulce	Jungal Jalebi
Syzygium cumini	Jamun
Tamarindus indica	Emli
Terminalia arjuna	Arjun

About 21 ha (43.3%) of the total acquired area(48.5 ha) comes under mine has been already developed as green belt. Further additional 3.8 ha are proposed for greenbelt development and about 5000 trees will be planted for gap filling and greenery. Maintenance of plantation till the 90% survival of the plants.

5.	Air Environment	Following standards in ambient air quality of mining area for 24 hours will be achieved:-

Parameter	Standard Ambient Air
$PM_{2.5}$ ($\mu g/m^3$)	60.0
PM_{10} ($\mu g/m^3$)	100.0
NO_X ($\mu g/m^3$)	80
CO ($\mu g/m^3$)	2000
SO_2 ($\mu g/m^3$)	80

Operations of mining activities such as transportation, ore handling, will generate dust which usually gets air borne.

Dust is controlled by adopting following practices:-

- Wet drilling will be practiced.
- Effective water spraying arrangements in underground working places as well as at ore loading/ unloading at surface.
- Water spraying on haul roads within the mine premises.
- Plantation within the premises around waste and ore storage area
- Proper periodic maintenance of vehicles.
- Deployment of LPDT(slow speed and low lift).
- Trucks carrying ore will be covered with tarpaulin sheets.
- Underground workings of the mine are ventilated by adequate ventilation arrangements.
- Drilling and blasting are confined to underground only.

8.	Noise Control	➢ Duct fan operation, drilling & mucking operations are the sources of noise generation in underground workings. ➢ Majority of mining activities are restricted to underground only ➢ Ventilation fans are installed underground ➢ Noise generated by blasting is momentary and isolated in nature. ➢ Regular maintenance of equipment is done to reduce the noise levels. ➢ Compressors are installed in isolated area with acoustic enclosers ➢ Procurement of low noise mining equipment's ➢ Work zone Noise level monitoring will be carried out ➢ DG Generator provided with acoustic encloser ➢ Machine operations producing noise more than 85 dB (A) are being provided with PPE's. ➢ Plantation will be carried out all around the mine boundary to reduce the noise level exposure. ➢ Board has been displayed at defined locations of noisy areas to use PPE's.
9.	Ground Vibrations	**BLASTING HAZARDS** Blasting in mining areas may give rise to ground vibrations. However the magnitude of blast is not high. Proper precautions will be taken during blasting operations for controlling the ground vibrations.
9.1	Blast vibrations & Control measures	Controlled blasting technique will be adopted in this project in order to reduce blast vibrations. Further, charge per delay will be regulated to minimize blast vibrations. Proper hook-up will be adopted while firing the drill holes. The ground vibration levels kept much less than DGMS standards. In addition, the following guidelines will be adopted wherever required to check the ground vibrations:- ➢ The maximum charge per delay will be so as to limit the PPV values below DGMS standards.

10	Socio-Economic Environment	➢ A proper direction given to the villagers would help route the income and savings for growth. ➢ Vocational training camps for various stages. ➢ People will find indirect employment / income opportunities in the region. ➢ Regular health camps to trace the develeopments and control any ill-consequences due to any mining pollution. ➢ Greivance redressal mechanism is made to handle complaints from the study area. ➢ The proposed project expansion will promote among employees and societies at large in all CSR activities.
11.	Occupational Health and Safety	The following measures relating to Occupational health and safety has been and will be practiced:- ➢ Safety officer look after the safety aspect. ➢ Dedicated safety & Environmental committees in mine review the safety and environmental aspect of mining operations on monthly basis. ➢ Safety Committee comprises of Engineers, Geologists, Surveyor, Environmental Engineer, Medical officer, Training Officer, Occupational health In Charge, etc. ➢ Minutes of the Meeting of safety committee communicated to Directors/ officials and concerned regulatory authorities. ➢ Recommendations of safety committee are implemented. ➢ Provision of rest shelters for mine workers with amenities like canteen, drinking water etc. ➢ Provision to use of safety appliances, safety awards, display of posters, slogans etc. Celebration of safety week on annual basis. ➢ First – aid organization in mines including training and retraining of first – aider's. ➢ Use of personal dosimeters, dust samplers ➢ Regular monitoring of health through PMEs **Prevention of Injury.** ➢ Training in safety measure. ➢ Use of PPE's e.g. uniforms, helmet, earplugs, ear seals, earmuffs, safety goggles, respirators, hand gloves, rubber canvas shoes, gum boots etc. ➢ Regular monitoring of work environment.

12.	Environmental Protection Measures	➢ Rs. 14.5 Crores will be spent on additional environmental protection measures

CONSERVATION PLAN FOR PAVO CRISTATUS (INDIAN PEAFOWL)

Peacock or Indian peafowl (Pavo cristatus) is a familiar and universally known large pheasant. It is a National Bird of India, belongs to Schedule I of the Wildlife (Protection) Act 1972 was reported from the some villages of the study area. The male has a spectacular glossy green long tail feathers that may be more than 60 percent of the bird's total body length. These feathers have blue, golden green and copper colored ocelli (eyes). The long tail feathers are used for mating rituals like courtship displays. The feathers are arched into a magnificent fan shaped form across the back of the bird and almost touching the found on both sides. Females do not have these graceful tail feathers. They have the fan like crest with whitish face and throat, chestnut brown crown and hind neck, metallic green upper breast and mantle, white belly and brown back rump and tail. Their primaries are dark brown.

Study Approach

The study area has been reported as a habitat of Schedule I species Pavo cristatus commonly known as peacock, more effort was made to assess their status in term of movements and habitat use in and around the study area. At first, a detailed biological survey was carried out to understand the status distribution of the species in the study area.. The conclusion of the survey discussed the potential sightings &habitat use, and movement and food habits of peacock in the study area.

Habitat Use

All the direct sightings of the peacock were located near the human dominated areas. This species is well adapted to natural village environment setting. According to the villagers, peacock is present in both, village and forest areas. Day time they temporarily move towards the surrounding agriculture areas for feeding while during night time roosts on the trees present in the village.

Food Habits

Peafowls are omnivores, eating plant parts, flower petals, seed heads, insects and other arthropods, reptiles and amphibians. In the study area, dense tree canopy cover supports good

insect diversity which is very common food for peafowl.

A Peacock Habitat - Conclusion

Present survey of the peafowl in study area cleared that; peafowl is using both, village adjacent habitats. However, the following points can give an insight on the overall status of peafowl in the study area and thereby plan for better management strategies related to proposed expansion activities.

People of the surveyed villages were well aware of the habits and habitats of peafowl in the study area. Moreover, local people are against hunting and poaching of the Peacocks. In the study area peafowl uses agriculture (adjacent to village) as a feeding and breeding ground. Some of the peacocks are taking shelter in the village adjacent habitats while some prefer to rocky forest hills. It clearly indicates that, peafowl normally uses human associated and forest habitats.

From above study, it has been visualized that, the proposed expansion mine project will not have any significant impact on peacock in terms of their normal movements and other activities. However, it is necessity to take some management options like habitat improvement in the villages located in the vicinity of the project site. So, habitat improvement programme (plantation of local plant species) will be continued indifferent villages located in the close vicinity of the project area. Under this programme saplings will be distributed in the nearby villages with the consultation of the local forest department.

HABITAT IMPROVEMENT PROGRAMME AND AWARENESS

Habitat improvement programme will be undertaken through plantation of suitable tree species. Saplings of Madhuca indica (Mahua), Mangifera indica (Aam), Tamarindus indica (Emli), Tectona grandis (Sagaon), Terminalia arjuna (Arjun), Butea monosperma (Dhak), Aegle marmelos (Bel), Moringa oleifera (Sehjan) will be distributed in the nearest five villages Species recommended by local forest department will also be added in the present plantation programme.

In consultation of the forest department, following Conservation Measures will be adapted for Peacock conservation:

- Habitat improvement programme in the different villages will be undertaken for shelter and roosting of peacocks. This will be achieved by plantation of locally adapted species near villages in buffer area.

- School level awareness programmes will be conducted for conservation of peacocks by organizing competitions during "Wildlife Week" and "Van Mahotsav" celebrations.
- Awareness programme for "Peacock" conservation shall be continued
- During awareness programme following activities will be arranged at the various village level schools as mentioned above (year wise),
    - "Essay writing on Peacock"
    - "Drawing competition (Peacock picture)"

Further Suggestions/recommendations:

- To carry annual census research projects to ecology and habitat use by peacock.
- By making provision of veterinary care and cages for injured or sick deformed birds.

The peacock conservation plan has been approved by PCCF, Jaipur and implementation of conservation plan shall be continued after expansion project. Copy of the same is attached as **Annexure**.

10.6 CONCLUSION

Environmental Management plan will be dynamic, flexible and subject to periodic review. For project where the major environmental impacts are associated, EMP will require regular review. Senior management responsible for a project should conduct a review of EMP and its implementation to ensure that the EMP remains effective and appropriate.

Table no.:10.2. Breakup of Existing and Proposed EMP

S. No	Particulars	As per EC Rs. in cr.	Existing Rs. in cr.	Proposed Rs. in cr.	Total Rs. in cr.
1	Dust control/suppression systems	0.00	0.25	0.25	0.5
2	Surface water sprinkler	0.25	0.25	0.25	0.75
3	Mechanical road sweeper	0.00	0.00	0.7	0.7
4	Ventilation System	1.00	1.50	1.5	4
5	Rainwater harvesting	0.00	1.00	1.0	2

6	Plantation/Green belt development with drip irrigation system	2.55	0.25	0.75	3.55
7	Different Environmental Monitoring equipment	0.00	0.14	0.15	0.29
8	Automation in Environment Monitoring (CAAQMs)	0.00	0.00	2.5	2.5
9	Construction of Garland drain and silt settling tank and recycle system for waste dump management	0.20	0.00	0.01	0.21
10	Biodiversity cost	0.00	0.25	0.75	1
11	Installation of Oil grease trap system & Sewage treatment plant	0.05	1.00	1.00	2.05
12	Water hydrant system	0.00	0.00	1.00	1
13	Mobile Water tankers	0.25	0.00	0.00	0.25
	Grand Total (Rs. in cr.)	**4.30**	**4.64**	**9.86**	**18.8**

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CHAPTER -11
SUMMARY & CONCLUSION

CHAPTER -11

SUMMARY & CONCLUSION

11.1 INTRODUCTION

Hindustan Zinc Limited (HZL) is Asia's largest non-ferrous metal producer of Zinc and Lead and is Head office at Udaipur, Rajasthan. HZL is world's second largest integrated producer of Zinc with a global share of approximately 6.2%. HZL has its operations in exploration, mining, ore processing, smelting and refining of Zinc, Lead, Cadmium, Copper and Silver. It is also a major producer of sulphuric acid, as a by-product of lead-zinc metal processing. HZL also has interest in wind and thermal power generation.

The Kayad Lead Zinc Mine is located in Ajmer Tehsil of District Ajmer Rajasthan. Environment Clearance was granted by MoEFCC, New Delhi for Enhancement in Production Capacity of Kayad Lead -Zinc Ore underground mine from 0.35 million TPA (ROM) to 1.0 million TPA (ROM) vide letter no. J-11015/47/2012-IA II(M) dated 23.09.2014. Copy of the same is enclosed as **Annexure I**.

Valid Consent to Operate is available from Rajasthan State Pollution Control Board (RSPCB), Jaipur for carrying Mining activities vide letter no.F(Mines)/Ajmer(Ajmer)/1(1)/2009-2010/7897-7901dated 04.03.2015 and valid upto 31.01.2018.

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 MMTPA (ROM) to 1.2MMTPA (ROM). The Ore Produced at the Kayad Mine is sent to Rampura Agucha Mine for ore beneficiation in the existing mills having capacity of 6.5 MTPA capacity located in Hurda Tehsil , Bhilwara Dist of Rajasthan. The ore concentrate produced at Rampura Agucha Mine shall be processed at existing HZL Smelters.

The Kayad deposit is located in Ajmer Tehsil of District Ajmer.

The Ministry of Environment and Forests, Govt. of India, through its EIA Notification of 14.09.2006 and its subsequent amendment on dated 1st December' 2009 and 04.04.2011 under the Environment Protection Act, 1986, classified the projects under two categories – A (more than 50 hect.) and B (less than 50 hect. and ≥ 5.0). ***The proposed project is categorized under category 1 (a) - A category {Mining of Minerals}***

as the lease area is 480.45 ha *as per the Gazette Notification 14th Sep. 2006 and its subsequent amendment till date.*

The present proposal is for expansion of Lead – Zinc ore production from underground mine from 1.0 to 1.2 million TPA (ROM) (20% increase). Amendment in EC under clause 7 (ii) a of EIA notification 2006, & subsequent amendments is applied.

11.2 PROJECT SITE LOCATION AND DESCRIPTION

The Kayad Mine is 9 Km NNE of Ajmer city and is well connected by Motoarable road. Jaipur, the state capital is 127 km NE of Mine. Nearest Air port is Kishangarh at 20 KM , NE of 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 North Western Railway, 9 km SSE of Kayad. NH 79,Jaipur-Ajmer is at about half a km. from the lease area. The deposit falls in Survey of India Toposheet No. 45/J10. Kayad Deposit lies between Latitudes 26°31'41.47"N-26°31'37.04"N and Longitudes 74°41"30.73"E-74°41'30.45"E.

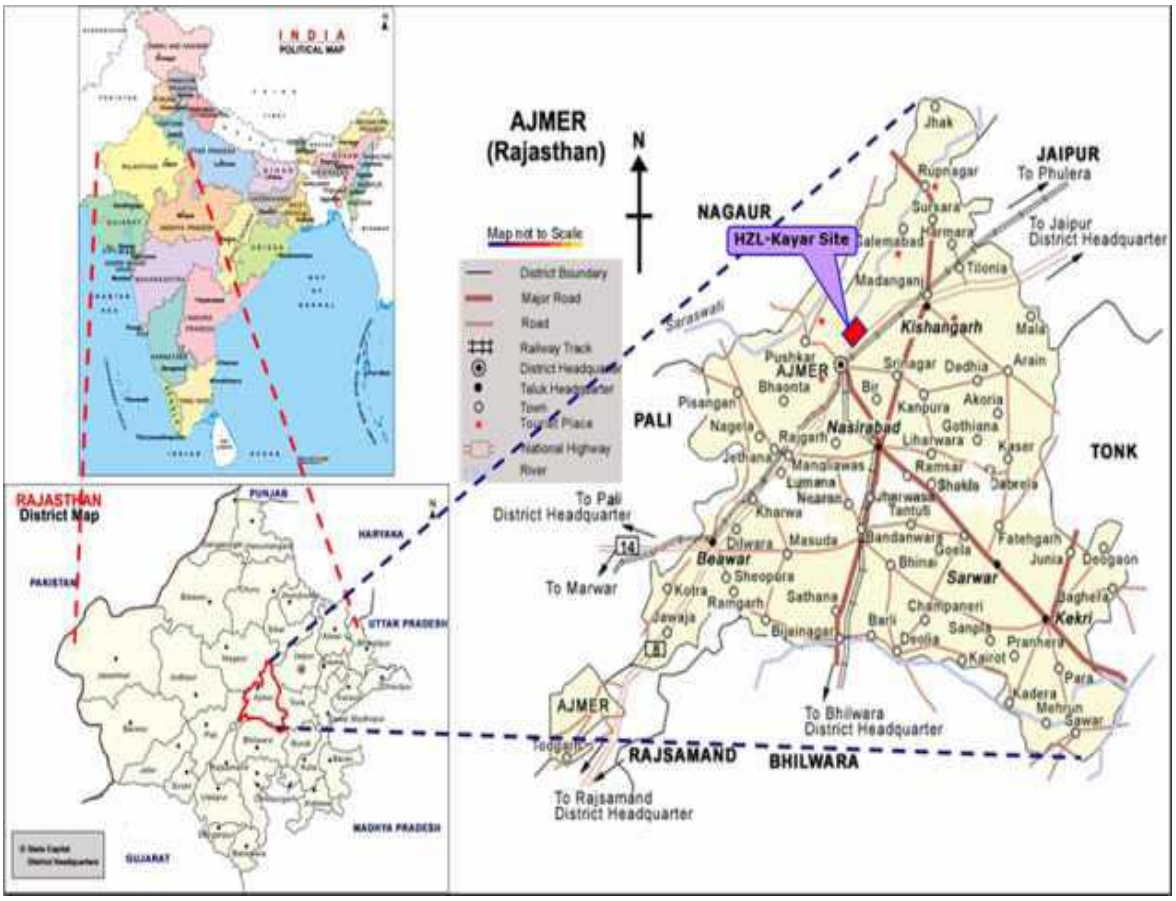

Figure: 11.1 Location Map

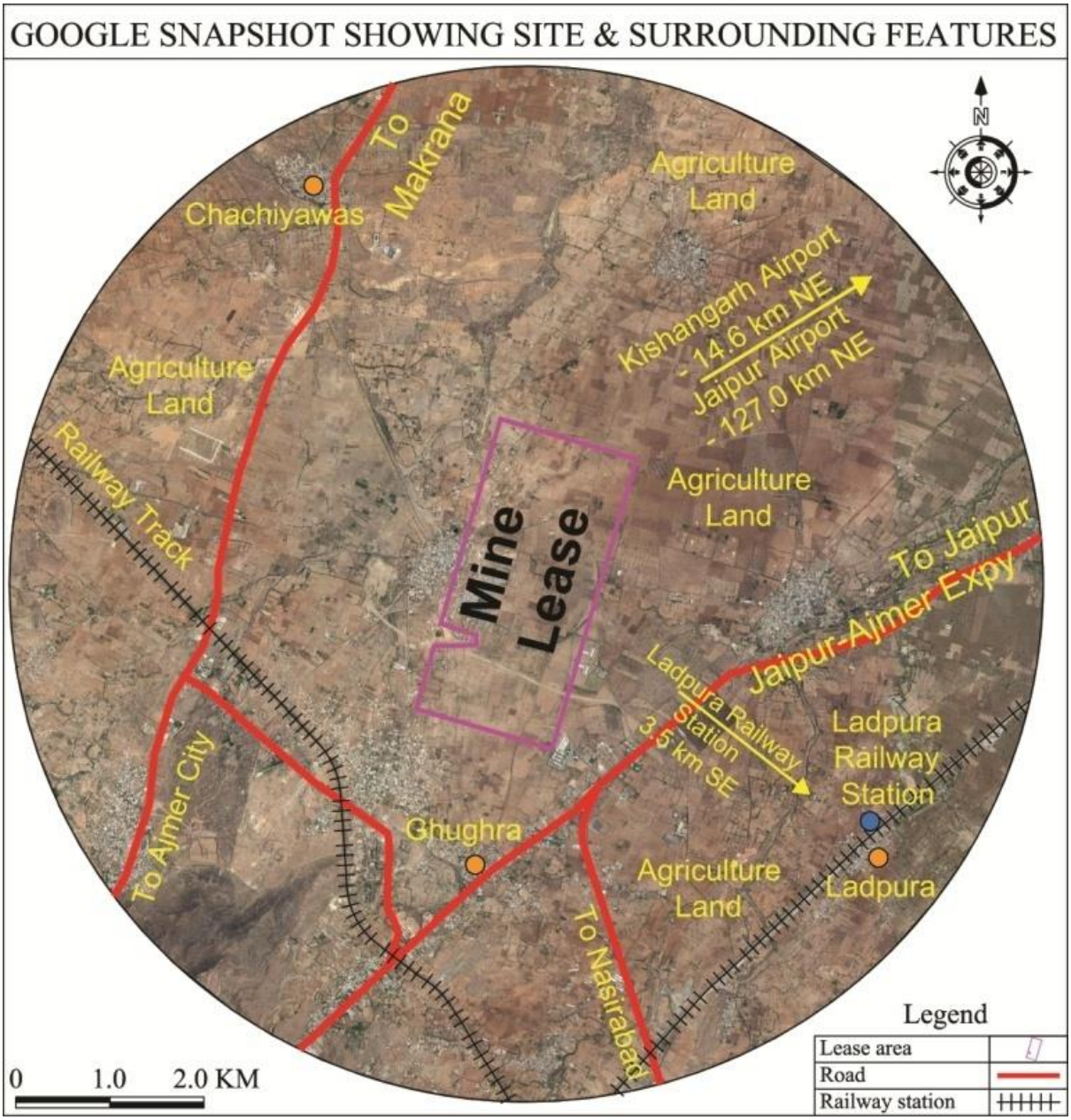

Figure: 11.2 Google Map

11.3 Protected Areas in Study Area

The Project site and surrounding area of 10 km radius from the mining lease boundary does not have any protected areas such as National Parks or Wildlife Sanctuaries. Reserve forests & protected forest are available in buffer zone.

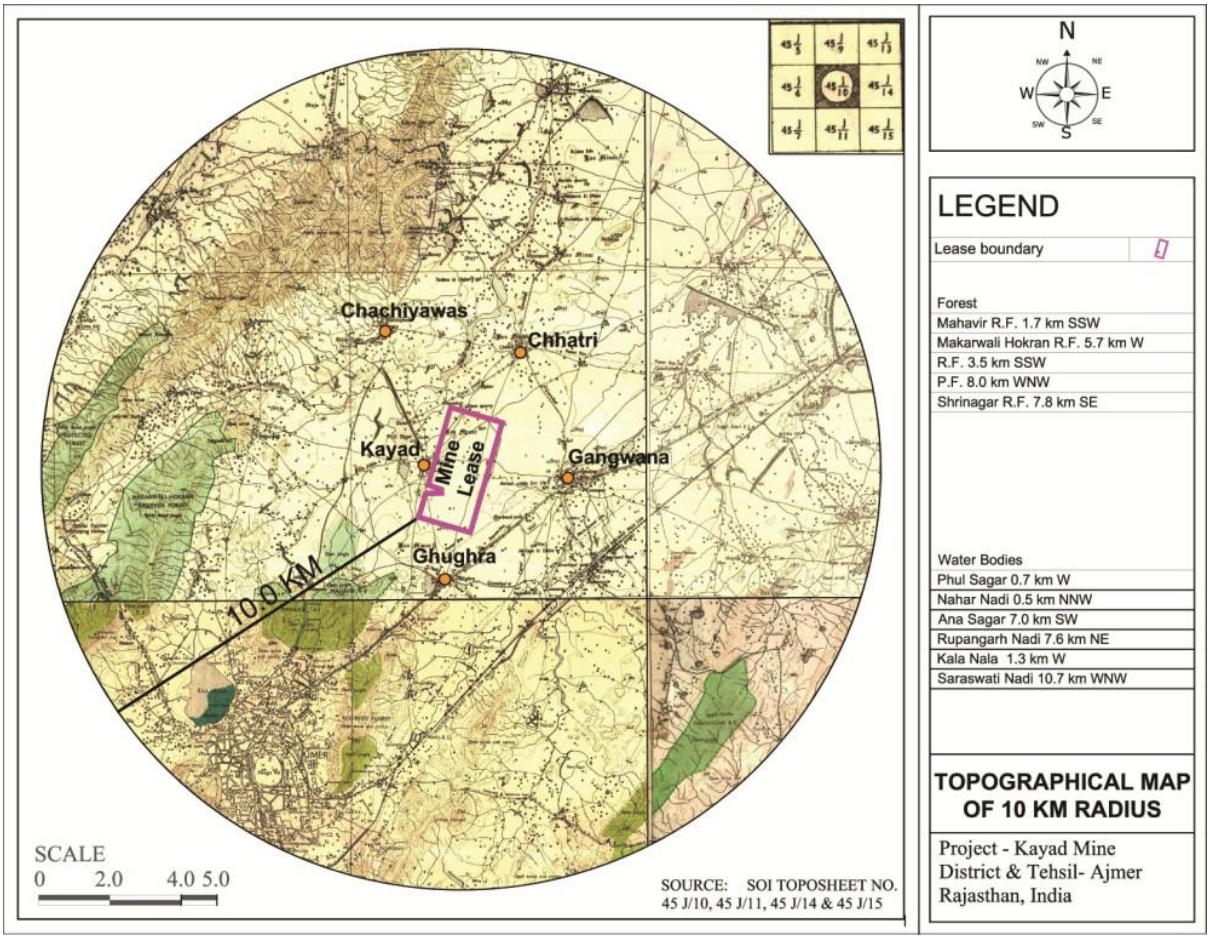

Figure: 11.3 Toposheet of Study Area

11.4 Project Description

Salient feature of the existing operational project and proposed expansion Project is given below in

Table No. 11.1: Salient Features of existing and proposed capacity enhancement

S. No.	Description	Existing	After Proposed Expansion
1.	Mine lease area	480.45 ha	No Change
2.	Land Requirement	48.5 ha	No Change
3.	Ore mineral	Lead ,Zinc and associated Mineral	
4.	Established Depth	About 437 m	About 437 m
5.	Reserves & Resources	5.97Mt,12.7 % Zn, 1.78% Pb as on 01.04.2016	9.74 million tons, 7.23% Zn, 1.17%Pb as on 01.10.2017

6.	Mode of Entry	By a ramp Decline	No change
7.	Method of Mining	LHOS, TOS, Drift and fill with waste rock	No change
8.	Ore Production	1.0 million TPA	1.2 million TPA (20% increase)
9.	Ore Beneficiation	Nil	Nil
10.	Waste Rock Generation (2017-18 to 2020-21)	5,95,000 MT	8,55,000 MT*
11.	Waste dump area	1.0 Ha	No change
12.	Power requirement & Source	5.0 MW, AVVNL & Emergency 1.0 MW DG set	No change
13.	Water requirement & Source	560 m^3/day, (PHED+ STP+ Mine Dewatering)	No change
14.	Manpower requirement (Nos.)	629	No Change
15	Project Cost	Rs. 350 crores	Rs. 521 Crores
16	Environment Protection Cost	Rs. 4.3 crores	Rs. 18.8 Crores

*In the proposed expansion of Kayad Mine, no additional waste will be dumped on the surface beyond the already approved waste quantity and hence no additional waste dump is envisaged. The increased waste generated will be disposed off into the underground voids

11.4 METHOD OF MINING

11.4.1 OPEN CAST MINING

No open cast operation / mining are being done.

11.4.2 UNDERGROUND MINING

11.4.2.1 Mode of entry (Decline)

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 ore body, 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.

Decline access is best suited for the shallow depth of Kayad deposit, proposed high mechanization and for the planned production capacity of 1.2 Million tones.

11.4.2.2Description of Mining Methods

A. Longitudinal Long Hole Open Stoping (LHOS):

For Longitudinal Long hole open stoping method, the stope size planned is 25m height, 25 –50m length (along strike) depending upon the geometry of the ore body and geotechnical Consideration.

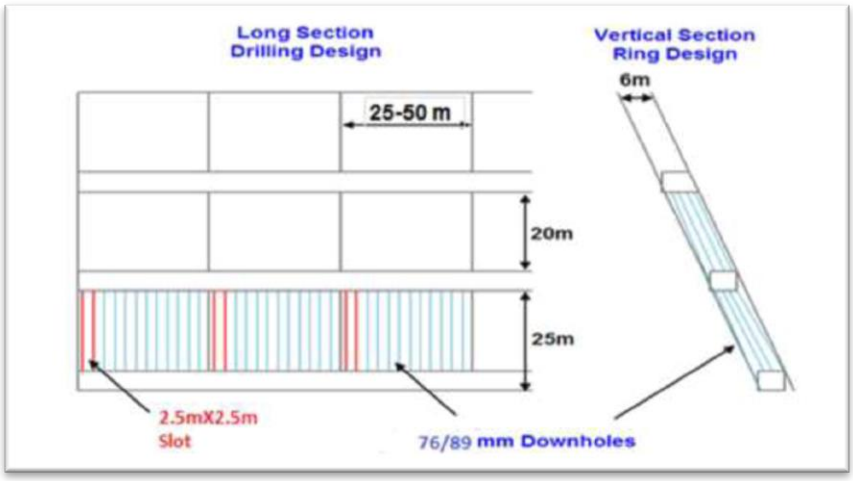

Figure 11.4: Typical Longitudinal LHOS

B. Transverse Long Hole Open Stoping (LHOS):

The stopes are planned across the strike in transverse direction with individual stopes of 10-25m 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 supportedroof and mucking through drives and cross cuts below solid roof which eliminates exposure to potential rock falls.

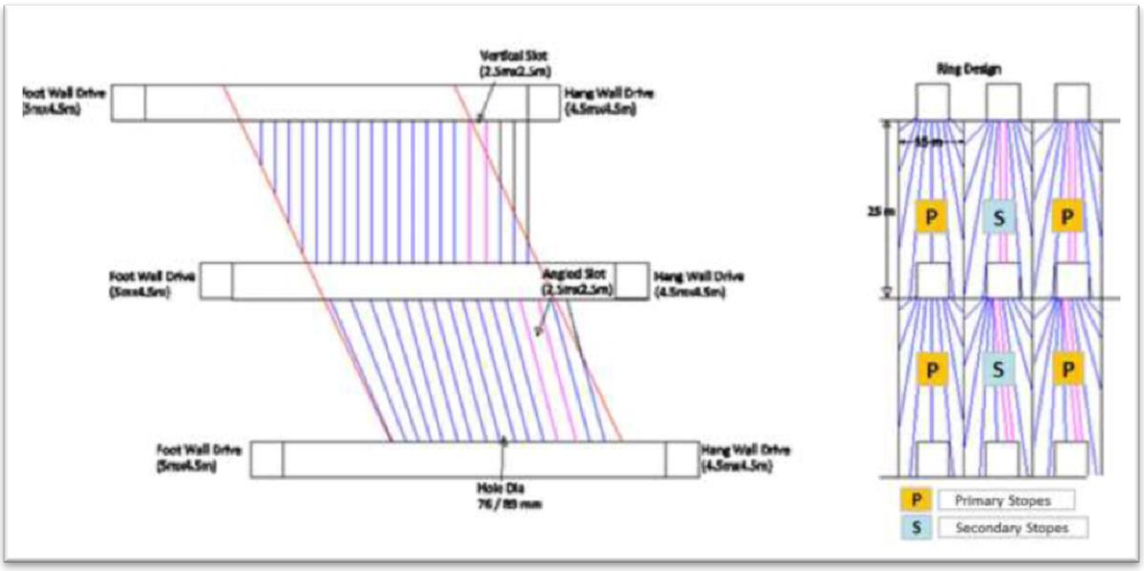

Figure 11.5: Typical Transverse stope

11.7 RESOURCE REQUIREMENT & SOURCES

Water requirement& its sources

No additional water is required for proposed expansion over existing 560 m3/day 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.

Power Requirement & its 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.

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.

Land requirement

Total Mine lease area is 480.45 ha, out of which 48.50 ha has been acquired within mining lease. There shall be no requirement to acquire land beyond the existing acquired land. The mine area in operational use will suffice the requirement. The proposed expansion of mine is from 1.0 to 1.2 MMTPA ROM of Lead-Zinc Ore Production **(20% increase).**

Manpower requirement

Existing trained manpower is sufficient to cater the need of industry. However, there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

11.8 MINE WASTE GENERATION AND MANAGEMENT

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 tonne. Thus as per proposed plan Waste generation during next 4 years will be 14,50,000 tonneas 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 off into the underground voids. If any additional waste required for backfilling will be utilized from Rampura Agucha Mine.

Tailing 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.

Used oil and other waste

Used oil generated shall be stored at earmarked area in drums and shall be sold to registered/ authorized recyclers; No additional used oil and Oil contaminated waste generation is envisaged .No change in other waste for the proposed expansion.

11.9 ENVIRONMENT BASELINE

As part of expansion plant, Environmental, Ecological and social baseline study was conducted during the period March to May 2017 representing the pre-monsoon/summer season. Brief findings of the same is given below

Site Meteorology

The predominant wind direction observed during the study period was 25.2% in SW followed by WSW for 10.1% is representing in site specific wind rose.

11.9.1 Soil Quality

The soil analysis results are presented in Table 3.5 for 8 locations during the study period. The result obtained is compared with the standard soil classification given in Agriculture Soil Limits. 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.

11.9.3 Ambient Air Quality

The analysis results for the study period are presented in table no.3.10 of EIA for 8 locations during the study period.Various statistical parameters like 98th percentile, average, maximum and minimum values have been computed from the observed data for all the AAQ monitoring stations. These are compared with the standards prescribed

by Central Pollution Control Board (CPCB) and it is observed that all values are within the prescribed limit.

11.9.4 Ambient Noise Level

The baseline noise monitoring in the study area was carried out at 8 locations during the study period. The day time and night time equivalent noise levels monitored at all the residential receptors were found within the prescribed norms. The noise levels within the ML were observed to be within the prescribed industrial noise limit during day and night time.

11.9.5 Ground& Surface Water quality

The baseline ground & surface water quality monitoring in the study area was carried out at 5 locations & 2 locations respectively during the study period.The ground and surface water samples were analyzed as per drinking water standards of IS: 10500, 2012. Few of the ground water samples show some values higher than the desirable limits but within permissible limits for drinking water standards. However, there is no evidence of any industrial contamination. Level of Phenolic compounds and Heavy Metals was observed to be BDL in all the groundwater samples.

11.10 ANTICIPATED IMPACTS

Anticipated key environment, ecological and social issues associated with proposed capacity enhancement are listed below in table

Components	Key Impacts
Land and soil Environment	• Impact on soil and land environment due debottlenecking process and associated activities; • Storage and handling of hazardous materials (e.g., fuel and lubricant) and waste generated from operation of construction equipment and machinery and their maintenance may lead to soil contamination due to leaks/ spillage; • Land Subsidence due to blasting;

Components	Key Impacts
Ambient Air Quality	• Dust emissions due to movement of machinery and vehicles; • Indoor fugitive dust emissions due to blasting, excavation and back filling activities etc; • Fugitive dust emission due to operation of primary and secondary crusher in underground and above ground, loading & unloading and transport of ore and concentrate;
Ambient Noise and vibration	• Noise generation due to movement of vehicles and heavy machineries; • Noise from debottlenecking activities; • Noise from additional ore handling, crushing of ore both underground and above ground, • Vibration due to blasting;
Water Environment	• No process related wastewater is anticipated to generated;
Ecology	• No change in surface infrastructure or surface related activities are anticipated to cause impact on surface ecology;
Visual Landscape	• No change in surface infrastructure or structure is anticipated.
Occupational health and safety	• Occupational health hazards due to dust and noise pollution; • Safety risk due to wrong handling of machinery,
Demographics	• No additional manpower or influx is anticipated;
Social and cultural fabric	• No Additional direct manpower due to capacity enhancement is anticipated however ample indirect employment opportunities will be created.
Economy and Employment	• Indirect impact on local economy through development of secondary facilities.
Land based Livelihood	• No land acquisition is associated with proposed activity and no impact is anticipated;
Community health and safety	• Transportation of concentrate components and associated increased vehicular movement will lead to traffic hazards for community residing close to the access roads;

11.10.1 ENVIRONMENTAL MANAGEMENT PLAN

Kayad Mine is currently implementing the Environmental and social management plan approved by MOEF&CC and regularly submitting the compliance report to RO of MoEF & CC. Also Vedanta Resources Plc has Sustainability Governance System for all its operations globally which provides an overarching umbrella for environment, health, safety and social management for all its assets and subsidiary companies.

Various impacts associated with proposed capacity enhancement activities are similar to the impact and mitigation measures of existing operational project. The project is continued to implement the various mitigation measures and comply with EC conditions and various conditions of other approvals obtained earlier.

A total sum of Rs. Rs. 18.8 Crores (Rs. 4.3 cr existing + Rs. 14.5 cr. proposed) will be spent on environmental protection measures

11.11 PROJECT BENEFITS

11.11.1 Financial Benefit

The proposed project shall generate foreign exchange to the country by exporting Zinc; additionally, it will also reduce import of phosphoric acid thus saving of foreign exchange. This will also generate revenue to the state Government as well as central government. The people around the region will get direct and indirect employment thus improves the financial status.

11.11.2 Employment generation due to project

The existing operation has direct employment of about 629 persons and the proposed project will be managed by the existing resources but there is an ample opportunity for increase in indirect employment due to mining related activities like transport, small workshops, garages, and due to development of local area.

11.11.3 Social Economic Development

The proposed expansion project will bring in people from different cultures for secondary employment like transporters, vendors, local canteen and tea stall operators etc. such as:

- Generate indirect employment opportunities;
- Real estate development;
- Increase in purchasing power;
- Development of ancillary small scale supporting electro mechanical services for automobile's, civil, electrical and mechanicals etc. as part of CSR.
- Agriculture marketing and increased demand for locally produced farm products for large number of employees existing in the project;
- Access to high quality health care facilities;
- Women empowerment;

11.11.4 National Economic Development

The present production capacities of Zinc in India are sufficient to meet the domestic requirements. However, the demand for zinc in India is expected to grow at a rate of 7.1%which makes it viable for the expansion of the zinc production capacities. Further the deficit in international market during the upcoming years provides opportunity for export.

11.11.5 Export Possibility

Indian exports majorly catered to South East Asian and African nations. In India, since, Hindustan Zinc is the largest producer of primary zinc, export of zinc is highly feasible and shall bring value addition.

11.11.6 Land value appreciation

The infrastructure development related to the proposed project is likely to cause appreciation of real estate prices in the nearby areas. Locals with land holdings in neighbouring areas are likely to benefit economically.

12. CONCLUSION

The proposed project is Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM) which is only 20% increase from existing capacity. Due to proposed project negligible or no impacts on the local environment, with proper mitigation measures and effective implementation of the environment management technologies and measures as suggested in the EIA-EMP Report and as recommended BY MoEF&CC, CPCB and SPCB. The negative impacts will be minimized to a great extent by judicious implementation of EMP.

This project will generate indirect employment to a considerable number of personal. This will improve the social and economic environment in the vicinity and also meets the raw material requirements of the expanded capacities of the company's existing plants. Besides meeting the company's requirement of its own downstream plants, the mining and processing of both these minerals(Lead and Zinc) are vital for the development of our country at large.

Thus, in view of considerable benefits from the project, the proposed expansion is most beneficial to the region as well as to the nation.

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CHAPTER- 12
DISCLOSURE OF CONSULTANT ENGAGED

Chapter 12
Disclosure of Consultant Engaged

Declaration by Experts contributing to the Project : ***"Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM) at Kayad Mine"***

Site Address : Kayad Lead Zinc Mine, ML-16/92, Hindustan Zinc Ltd , Tehsil- Ajmer, Distt-Ajmer (Rajasthan)- 305023 **Promoter : M/s Hindustan Zinc Limited**

I, hereby, certify that I was part of the EIA team in the following capacity that developed the above project for grant of Environmental Clearance.

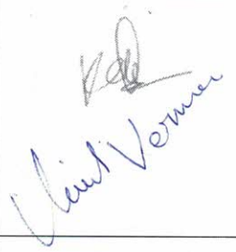
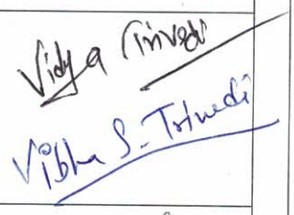
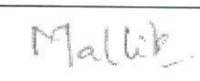
EIA coordinator : **Mining of minerals including Underground mining** [1 (a) (i)]
Name : **Mr. Mukesh Suroliya**
Signature and Date : 16.12.17

Period of involvement : February 2017-December2017

Contact information:
Address : **Gaurang Environmental Solutions**
#501 & 503, Soni's Paris Point, Near Collectorate Circle Bani Bark, Jaipur-302016.
Mobile No. : **9782074776**
E-mail : **gaurangenviro@gmail.com**

Functional area experts:

S. No.	Functional areas	Name of the expert/s	Involvement (period and task**)	Signature and date
1	AP*	• Ms. Ginni Barotia • Mr. Yogendra Krishna Yadav -FAA	• Selecting parameters for monitoring. • Suggesting measures of reducing emission. • Identifying and assessing quantum of emissions. • Identification of probable impacts of the different air emissions from the project • Identification of suitable control	

			device	
2	WP*	• Mr. Pradyumna Arvind Deshpande • Ms. Pooja Bunker-FAA	• Designing of water balance. • Identification of probable impacts of effluent/ waste water discharges in to the receiving environment/ water bodies.	
3	SHW*	• Mr. Pankaj Kumar	• Suggesting Methodologies for segregation and collection of Solid waste as per Applicable Rules. • Suggesting measures for handling waste.	
4	SE*	• Mr. Kapil Sharma • Mr. Vinod Kumar Verma-FAA	• Conducting baseline socio-economic survey. • Conduct social needs assessment studies. • Preparing need-based CSR plan.	
5	EB*	• Mr. Abhishek Gautam • Mr. Yogendra Krishna Yadav-FAA	• Survey of flora – fauna. • To identify ecologically important areas around project location. • To identify threatened species in the project area. • To identify impact of project on flora – fauna. • To recommend mitigations / greenbelt development.	
6	HG*	• Mr. Vidya Bhushan Trivedi • Mrs. Vibha Sharma Trivedi-FAA	• Analysis of surface hydrological data. • Computation of ground water recharge, flow rate and direction	
8	SC*	Mr. Pradyumna Arvind Deshpande	• Assessment of fertility/ productivity of soil, nutrient availability. • Controlling degradation of soil/soil conservation	
9	AQ*	• Mr. Mallikarjuna Murthy Guttula	• Analyzing micro meteorological data for use in modeling.	

			• Collecting and using secondary data on meteorology like cloud cover, inversion related data, mixing heights etc., for modeling • Application of relevant air quality models in prediction of dispersion of pollutants.	
10	NV*	Mr. Pawan Sut Sharma	• Probable impacts of noise and vibration on communities, buildings, structures etc. • Impacts of noise and vibration on fauna from projects in ecologically sensitive areas. • Control of noise emanating from project activities.	
11	LU*	• Mr. Kapil Sharma • Mr. Vinod Kumar Verma-FAA	• Generation and analysis of data related to land use pattern. • Assessment of land use and land cover.	
12	RH*	Ms. Ginni Barotia	• Assessment and mitigation of probable impacts. • Suggesting PPE for workers. • Measures for risk assessment. • Preparation of DMP.	

*One TM against each FAE may be shown

**Please attach additional sheet if required

Declaration by the Head of the accredited consultant organization/authorized person

I, **Vipul Khandelwal** hereby confirm that the above mentioned experts prepared the EIA/EMP report of ***"Expansion of Lead-Zinc Ore Underground Mine from 1.0 to 1.2 Million TPA (ROM) at Kayad Mine"*** **promoted by M/s Hindustan Zinc Limited** for Environmental Clearance. I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Signature:

Name	: **Mr. Vipul Khandelwal**
Designation	: **CEO/Proprietor**
Name of the EIA consultant organization	: **Gaurang Environmental Solutions Pvt. Ltd.**
NABET Certificate No. & Issue Date	: NABET/EIA/1720/IA0026: June 12, 2017