Chapter-1
Introduction

Notes Scanner

1.0 INTRODUCTION

1.1 Purpose of the Report

Rajpura Dariba (RD) Lead-Zinc deposit was opened in year 1982. The present capacity is 0.63 MTPA of ore production and mine beneficiation plant of capacity 0.9 MTPA. The proposal is to set up Lead-Zinc Integrated complex within the existing mine lease area. The integrated complex will consist of Zinc smelter of 2 x 0.25 MTPA capacity, Lead smelter of 1 x 0.125 MTPA capacity, Captive Power Plant of 3 x 85 MW capacity along with enhancement of ore production capacity from 0.63 MTPA to 0.9 MTPA and beneficiation capacity from 0.9 to 1.2 MTPA. The renewal of mine lease due on 30.05.2010.

As per EIA Notification, meeting was held in MoEF during 24th September 2008 for determining Terms of Reference (TOR) for the preparation of EIA/EMP report for the proposed Lead-Zinc Integrated complex as well as expansions in the capacity of mine and beneficiation. Copy of the *Terms of Reference* (TOR) prescribed by MoEF vide letter No J-11011/380/2008-IA II (I), dated 3rd November, 2008 is enclosed as **Annexure-I**. in compliance with the TOR the Public Hearing was conducted on 12th February 2009 and the details are discussed in Chapter-8.

Hindustan Zinc (HZL) has retained the services of M/s. Vimta Labs Limited, Hyderabad to undertake EIA studies as per *Terms of Reference* (TOR) prescribed by the MoEF for assessing the impact of the proposed Lead-Zinc Integrated complex and expansion of Lead-Zinc underground mine project production and capacity enhancement of beneficiation plant activities and renewal of mine lease on various environmental parameters in the study area and to prepare an Environment Management Plan for negating the adverse impacts of the project to obtain Environment Clearance from Ministry of Environment and Forests (MoEF) Government of India, New Delhi and the Consent For Establishment (CFE) from Rajasthan State Pollution Control Board (RPCB) for the project. This EIA report is prepared in the lines of EIA Notification dated 14th September, 2006. The public hearing was conducted on 12th February, 2009.

1.2 Identification of Project & Project Proponent

1.2.1 Identification of Project

The Mining Lease of Rajpura Dariba Lead-Zinc deposit, ML-2/89, extending over an area of 1142.2 ha in Rajsamand District of Rajasthan has been sanctioned to Hindustan Zinc Limited (HZL). The Government of Rajasthan granted mining lease of Rajpura Dariba Lead-Zinc deposit to Hindustan Zinc Limited (HZL) vide letter No. F-3(2)/Khanij/68 dated 31.03.1970 for a period of twenty years with effect from 31.03.1970. I[st] renewal was granted vide order No. P/2/36/khan/Gr-2/90 dated 17.09.1992. Validity of the mining lease is up to 29th May 2010 and the lease is due for renewal thereafter.

Rajpura Dariba is an underground mine with beneficiation facilities. The commencement of ore beneficiation took place at RD mines in the year 1982.

Rajpura Dariba deposit was discovered by the Geological Survey of India (GSI) during the course of regional exploration extending from 1970 to 1975. It was further investigated by Hindustan Zinc Limited (HZL) in detail from 1976 to 1980 by surface exploration drilling within mining lease ML -2/89.

Looking into the cost of production of smelters, and in-house study, it was found that the project is feasible for setting up of new smelters of total capacity 2 x 0.25 MTPA zinc and a 1 x 0.125 MTPA lead plant and with 3 x 85 MW captive power plant at Rajpura Dariba along with enhancement of existing mining operation at RD mine by raising ore capacity from 0.63 MTPA to 0.9 MTPA and beneficiation capacity from 0.9 MTPA to 1.2 MTPA. At this site, benefit of existing infrastructure, sufficient land, availability of adequate road along with water supply from a source captive to HZL are available resulting in significant time and cost savings.

1.2.2 Project Proponent

Hindustan Zinc Limited today is one of the top six global companies. Hindustan Zinc Limited (HZL) is the only integrated Lead & Zinc manufacturer in India and owns captive Lead and Zinc mines that supply complete requirement of Lead and Zinc concentrate for its smelters. HZL operates mechanized open cast mine at Rampura Agucha as well as underground Mines at Rajpura Dariba and Zawar Mines in the state of Rajasthan with state of the art technology. HZL is having Lead-Zinc mining, smelting and marketing operation, with a capacity of 7.13 MTPA ore production and matching beneficiation facilities. The smelting capacity stands at 0.681 MTPA for Zinc and 95,000 TPA for Lead metal and associated by-products i.e. Cadmium, Silver, Sulphuric acid etc.

Hindustan Zinc Limited - the leading producer of Zinc in India - was incorporated in January 1966 as a public sector company. Starting with a 1,50,000 TPA lead-zinc mine and a 3600 TPA lead smelter, it has grown to a multi-unit company having lead-zinc mines at 4 locations in Rajasthan (Rampura Agucha, Zawar, Rajpura Dariba and Sindesar Kurd mines) and 3 smelters (Chanderia Lead Zinc Smelter, Debari Zinc smelter and Vizag Zinc smelter) with a capacity of 7.2 million TPA ore production and 6,81,000 TPA zinc and 95,000 TPA lead metal production within a span of 40 years. The Government of India has disinvested HZL in April 2002.

The fiscal and financial performance of the company for the past five years has shown remarkable upsurge. The company has come a long way with technology update, research and development activities, up keeping of environmental safety and ecological balance besides exploring new business opportunities.

1.3 Brief Description of Project

1.3.1 Nature of the Project

Considering the concentrate availability, zinc market, operating and capital costs etc the in-house study was concluded and the best capacity where the maximum return accrued was 2 x 0.25 MTPA. Considering the Roaster and its subsequent unit operations capacities, it is decided to put up two zinc smelters of capacity

0.25 MTPA. There will be a Lead plant of 0.125 TPA capacity. Power generation of 255 MW (3 x 85) is proposed to meet the demand of the new smelter as well as other nearby locations of Hindustan Zinc. Based on the pre-feasibility study, it has been envisaged to enhance the ore production capacity from 0.631 MTPA to 0.9 MTPA with matching enhancement in the beneficiation capacity from 0.9 MTPA to 1.2 MTPA.

The proposed expansion project is classified as "**CATEGORY-1A"** by Ministry of Environment & Forests, New Delhi as per the EIA Notification dtd 14th September 2006.

1.3.2 Size of the Project

The proposed Lead-Zinc Integrated complex with smelters and CPP will include the following:

- New Zinc smelter – 2 x 0.25 MTPA
- New Lead smelter – 1 x 0.125 MTPA
- New Captive Power Plant – 3x85 MW
- Enhancement of ore production – 0.63 MTPA to 0.9 MTPA
- Enhancement of beneficiation capacity – 0.9 MTPA to 1.2 MTPA

The Rajpura Dariba Mine is developed through shaft. The RD mines consist of well established township with all the amenities such as school, hospital, community centre, guest house, etc. The integrated facility consists of beneficiation plant, garage, pump-house and workshop.

1.3.3 Anticipated Life of Project and Cost of the Project

The projected life of the mine is 18 years and the smelter and CPP is 20 years. Total cost of the proposed project is estimated to be Rs. 3,852 Crores.

1.3.4 Location of the Project

The deposit lies between latitude 24^0 55' 41" and 24^0 57' 51" N and longitude 74^0 07' 03" and 74^0 08' 48" E. Rajpura-Dariba mine is located at the southern extremity of Rajpura-Dariba-Bethumni metallogenic belt in Rajsamand district, Rajasthan, at a distance of 76 km NNE of Udaipur. The nearest railway station is Fatehnagar, about 18 km, on Chittorgarh-Udaipur railway line. The deposit is well connected by a metalled road from Udaipur, Chittorgarh, Bhilwara and Dist. headquarter Rajsamand. The deposit falls in Survey of India Toposheet No. 45/L1.

Geographical location of the Rajpura Dariba project is shown in **Figure-1.1**.

1.3.5 Importance to the Country & Region

Exploiting this Lead-Zinc deposit is critically important for the country's long-term economic growth. The Rajpura Dariba deposit has high metal content. By enhancing the mining of the deposit, HZL will provide the country with increased Government earnings and revenues, transform the region's economy from

predominantly agricultural to significantly industrial, and accelerate the pace of industrial development in the region.

1.3.6 Supply and Demand Details

The identified zinc and lead resources of the HZL lease hold areas are estimated at 232mt. Out of this, 80mt containing 2.25% lead and 11.36% zinc fall under category of reserves. The bulk of the lead-zinc deposits occur in Rajasthan and are under lease/exploitation by HZL. A major multi-metal world-class deposit of zinc, lead and associated metals is in Rampura-Agucha belt in Bhilwara District of Rajasthan, which has estimated ore reserves of 63.56mt containing 12.97% zinc and 1.94% lead.

- ***Lead Metal***

Of the global lead metal production of 755000 MT in 2007-08, India's share stands at 59000 MT. With the commissioning of Ausmelt lead plant at Chanderia (HZL) with an annual capacity of 50,000 TPA the supply demand deficit is bridged partially. The capacity expansion plans of HZL are in the line. India is poor in lead resources with no viable lead mines and thus limited availability of lead concentrates.

- ***Zinc Metal***

The production of primary Zinc metal production in the country has increased from level of 175000 MT in 1999-2000 to 681000 MT in the year 2007-08. In a report that compares India's economic growth with China, London-based analyst Matt Fernley (research firm USB Ltd) said India's appetite for materials, such as cement, mined copper and zinc, is exceeding its supply.

1.4 Status of Regulatory Clearances

The Government of Rajasthan granted mining lease of Rajpura Dariba Lead-Zinc deposit to Hindustan Zinc Limited (HZL) vide letter no. F-3(2)/Khanij/68 dated 31.03.1970 for a period of twenty years with effect from 29.05.1970. Ist renewal was granted vide order no. P/2/36/khan/Gr-2/90 dated 17.09.1992 for a period of 20 years. Validity of the mining lease is upto 29th May 2010, and will be renewed thereafter.

The Mine Plan including environment management plan has been approved by Indian Bureau of Mines vide letter no. 682(23) (140)/90 –MCCM (N)-Udp dated 26-03-1991 under rule 11 of MCDR, 1988 and the current Scheme of Mining (2005-06 to 2009-10) has been approved vide letter no. 682(23) MS-310/2005-Udp dated 19-08-2005 under rule 12 of MCDR, 1988. The existing Mine Plan & Scheme of Mining is valid up to 2009-2010.

1.5 Scope of the Study

In line with the TOR prescribed by Expert Appraisal Committee of MoEF, the zone comprising of 10-km radius around the proposed lead-zinc Integrated complex and mine lease area is considered as the study area. The study area map is shown in **Figure-1.2**.

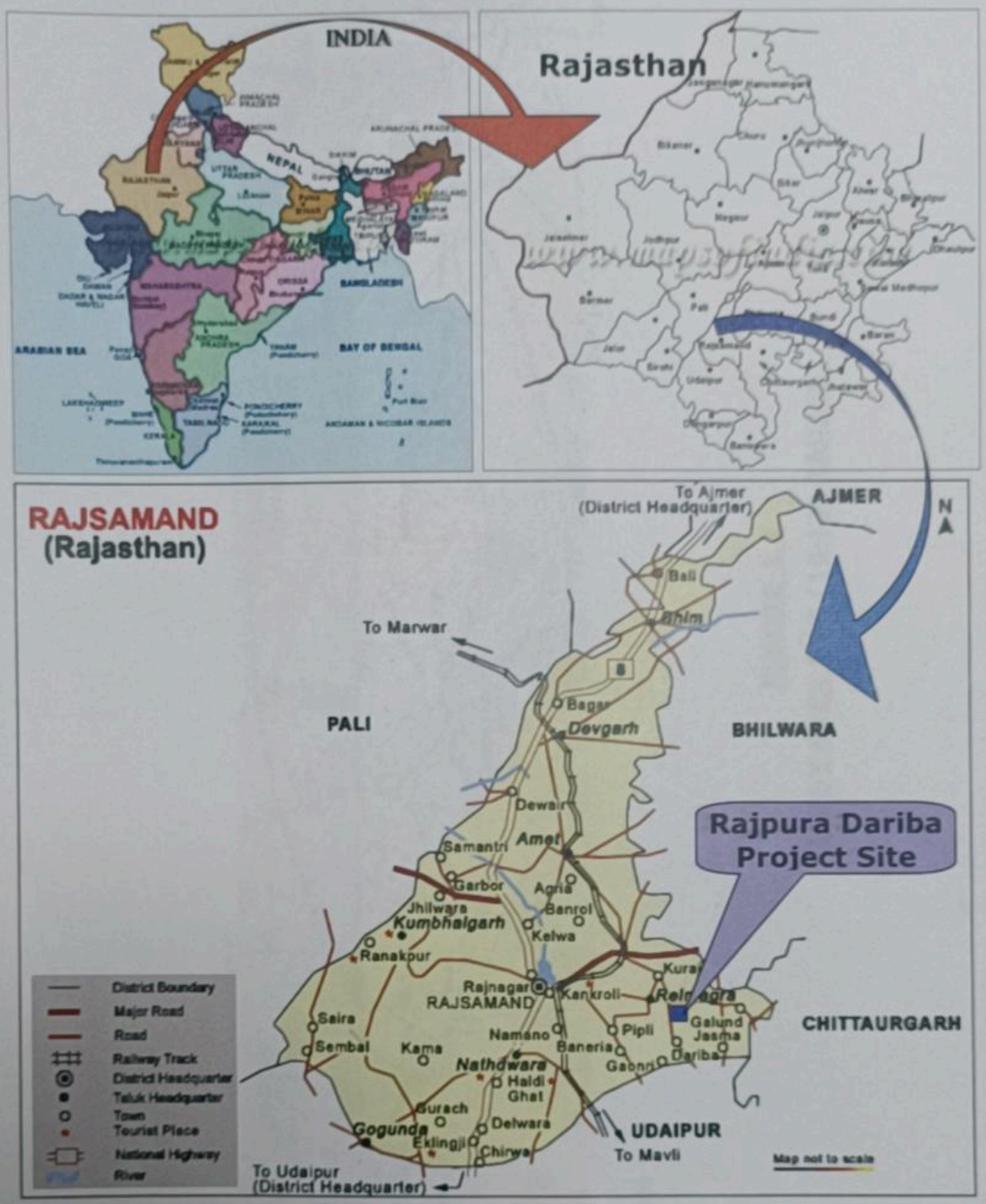

FIGURE-1.1
GEOGRAPHICAL LOCATION OF THE PROJECT

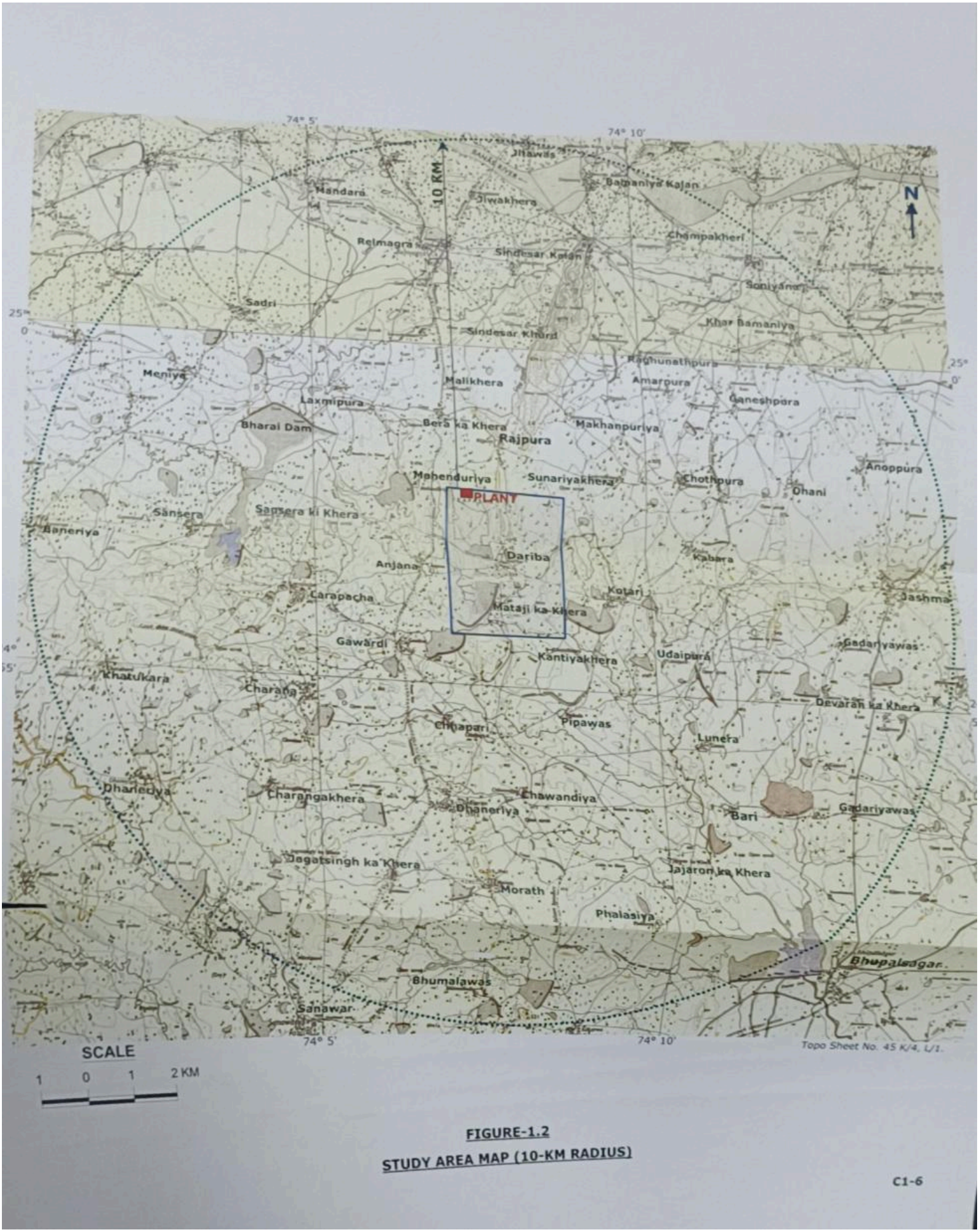

FIGURE-1.2

STUDY AREA MAP (10-KM RADIUS)

C1-6

Notes Scanner

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 *1st December 2007to 30th May 2008 and 1st October to 31st November 2008 covering Winter, Pre-monsoon and Post-Monsoon seasons 2007-2008*. The scope also includes all the conditions outlined in the TOR issued by MoEF vide letter No J-11011/380/2008-IA II (I), dated 3rd November, 2008. The list of TOR conditions and their compliances in the EIA report is given in **Table-1.1.**

TABLE-1.1
LIST OF TOR CONDITIONS AND THEIR REFERENCE IN EIA REPORT

ToR for Zinc & Lead Smelter and CPP

Sr. No.	ToR Points	Reference in the EIA Report	
		Chapter #	Page #
1	Revised form-1 along with the earlier questionnaire for including and mining sectors should be submitted while submitting EIA/EMP.	Submitted along with Finaal CEIA	
2	Present land use should be prepared based on satellite imagery.	Chapter-3	Section-3.8.3 C3-71 to C3-92
3	Location of national parks/wildlife sanctuary within 10 km radius should specifically be mentioned	No National Parks/Wildlife Sanctuary exist in 10-km Radius.	
4	Permission and recommendations of the State Forest Department regarding impact of proposed Smelter Plants along with Captive Power Plant and Mine on surrounding reserve forests.	There are no reserved forests in 10-km radius of the proposed Smelter Plants along with Captive Power Plant and Mine on surrounding reserve forests.	
5	Major Projects located in 30 km radius and probable impact on these industries.	Sindesar Khurd mines of HZL (3.0 km, NNE) is the only other industry in 30-km radius	
6	Sources of coal, status of environmental clearance and approval from the State Govt. etc should be covered.	Coal is imported/from Indian market. However, for long term linkage request has been made to Ministry of Coal, copy of same has been attached as **Annexure-II**	
7	A chapter on the best available technology for the Zinc and Lead smelter along with the reasons for the selection of the same should be included.	Chapter-7	C7-1 to C7-5
8	Process details of the technology for Smelter Plants along with Captive Power Plant should be incorporated. Air pollution control measures proposed for the smelter plant and CPP should be included.	Chapter-2 Chapter-4	Section.2.6, C2-13 C2-55 Section-4.3.7 C4-26 – C4-48
9	Site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall should be collected.	Chapter-3	Section-3.1.1 C3-1–C3-5
10	Ambient air quality at 8 locations within the study area of 10 km (aerial) from project site and base line data for the lead in the ambient air should be included.	Chapter-3	Section-3.2 C3-13-C3-26
11	Action plan for monitoring Lead in ambient air and technological assessment for reducing Lead should be included.	Chapter-5	Section-5.4.1 & Section-5.9, C5-8–C5-9 and C5-20 – C5-24
12	Determination of atmospheric inversion level at the project site and assessment of ground level concentration of	Chapter-4	Section-4.3.7 C4-44–C4-45 & **Annexure-X**.

Sr. No.	ToR Points	Reference in the EIA Report	
		Chapter #	Page #
	pollutants from the stacks based on site-specific meteorological features should be incorporated.		
13	Air quality modeling for Smelter plants for specific pollutants and location of one ambient air quality monitoring station in downwind direction is necessary. Measures proposed for the control of SO_2 emissions should specifically be covered.	Chapter-4	Section-4.3.7 C4-38 – C4-49
14	Location of stacks for smelter plants and captive power plant should be included	Chapter-2 Figure-2.3.3 Chapter-4	C2-6 Section-4.3.7 C4-40
15	Impact of Lead emissions on surrounding environment and Lead balance should be provided.	Chapter-4	Section-4.3.7 C4-35 – C4-37
16	One year data for gaseous emissions for the existing plant should be incorporated.	The smelter and CPP are proposed and there does not existing any smelter or CPP at present	
17	One season data for air emissions for the winter season.	Chapter-3	Section-3.2 C3-13-C3-26
18	A note on secondary fugitive emission control, assessment, preventive methods, control and monitoring etc should be included.	Chapter-4 & 5	C4-30-C4-31 & Section - 5.9, C5-20 – C5-24
19	Impact of the transport of raw material and finished product on the transport system should be assessed and provided.	Chapter-4	Section-4.4 C4-96 – C4-96
20	Water balance data including quantity of effluent generated, recycled and reused and discharged should be included	Chapter-4	Section-4.3.9 C4-50 – C4-55
21	Surface water quality of nearby water bodies and other surface drains at eight locations must be determined and included.	Chapter-3	Section-3.4 C3-32 – C3-47
22	A chapter on hydrology study around the project site and tailing region may be included.	Chapter-3 Chapter-4	Section-3.5 C3-48 – C3-57 Section-4.4 C4-67 – C4-81
23	Ground water quantity monitoring minimum at eight locations and also near the solid waste disposal site should be included.	Chapter-3	Section-3.4 C3-30 – C3-47
24	'Permission' for the drawl of water for the Smelter Plant and CPP from the concerned Department should be included.	**Annexure-III**	
25	Geological features and Geo-hydrological status of the study area is a must and the ecological status (Terrestrial and	Chapter-2 & 3	Section-2.6.4 C2-57-C2-58, C2-59-C2-69 Section-3.5

Sr. No.	ToR Points	Reference in the EIA Report	
		Chapter #	Page #
	Aquatic) must be provided.		C3-48 – C3-57
26	Monitoring of water upstream and downstream of Jarosite pond secured landfill should be included.	Chapter-3 & 5	Section 3.4, C3-32 – C3-47 Section-5.9 C5-20 – C5-24
27	Solid waste generation, storage, utilization and disposal must be explained in detail. Action Plan for the disposal/utilization of solid waste and integrated Ash Management Plan for the utilization of fly ash as per Fly Ash Notification should be included. MOU signed with Cement industries for the disposal of fly ash should form part of the report.	Chapter-4	Section-4.3.4 C4-7 – C4-15
28	Design details of solid waste disposal area i.e. secured landfill (SLF) as per the CPCB guidelines with garland drains of at least for 10 years capacity. Land availability and earmarked for the SLF and possibility of reutilization of the solid waste should also be incorporated.	Chapter-4	Section-4.3.4 C4-10
29	Risk assessment and damage control should be included.	Chapter-6	C6-1 – C6-80
30	Occupational healths of the workers have to be detailed. Base line data for Lead and Cadmium in the workers and presence of Lead in ambient air and in bloods of human beings should be included.	Chapter-4	Section-4.8 C4-101 – C4-109 and **Annexure-XII**
31	Green belt development plan as per CPCB guidelines in 33 % area should be included.	Chapter-5	Section-5.5 C5-12 – C5-18
32	A scheme for rainwater harvesting should be included	Chapter-4	Section-4.3.11 C4-81 – C4-90
33	Socio-economic development activities to be taken up should be spelt out indicating the time frame and cost.	Chapter-4	Section-4.9.2 C4-110– C4-115
34	Action plan to comply with recommendations mentioned in the CREP guidelines should be incorporated.	Chapter-4	Section-4.7 C4-100 - C4-101
35	Detailed Environment management Plant (EMP) with specific reference to air pollution control system, water management, solid waste disposal, green belt development, monitoring frequency, responsibility and time bound implementation plan	Chapter-4 & 5	Section-4.3 C4-3 – C4-100 Section 5.1 to 5.5 C5-1-C5-18
36	EMP should include the concept of waste minimization, recycle / reuse / recover techniques, energy conservation, and natural resource conservation.	Chapter-5	Section 5.1 – 5.5 C5-1 – C5-18

ToR Points for Mines

Sr. No.	ToR Points	Reference in the EIA report	
		Chapter #	Page #
1	The study area should comprise of 10 km zone around the mine lease from lease periphery.	Chapter-1	Section-1.5 C1-4 – C1-7
2	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary and national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be included.	Chapter-3	Section-3.8.3 C3-71 – C3-93
3	Land use plan of the mine lease area should be prepared to encompass pre-operational, operational and post operational phases.	Chapter-4	Section-4.3.2 C4-4 – C4-6
4	Location of National Parks, Sanctuaries, Biosphere Reserves, Reserve Forest, Wildlife corridors, within 10 km of the mine lease should be clearly indicated. A location map duly authenticated by Chief Wildlife Warden should also be provided. Necessary clearance, if any, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above should be obtained from the State Wildlife Department/ Chief Wildlife Warden under the Wildlife (Protection) Act, 1972 and copy furnished	Chapter-1	Section-1.5 Figure-1.2, C1-6 There are no National Parks, Sanctuaries, Biosphere Reserves, Reserve Forest, Wildlife corridors, within 10 km of the mine lease. A letter to this effect from Chief Wildlife Warden is enclosed as **Annexure-V.**
5	A detailed biological study for the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, duly authenticated, separately for core and buffer zone should be furnished based on field survey clearly indicating the Schedule of the fauna present. In case of any scheduled-I fauna found in the study area, the necessary plan for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.	Chapter-3	Section-3.7 C3-48 – C3-55
6	Impact of change of land use particularly agriculture land and gaucher / grazing land, if any, should be included.	Chapter-4	Section-4.3.2 C4-4 – C4-6
7	Rehabilitation and resettlement plan	No R&R Issued Involved	

Sr. No.	ToR Points	Reference in the EIA report	
		Chapter #	Page #
	along with compensation details for the project affected people, if any should be included.		
8	Collection of one season (non-monsoon) primary base-line data on ambient air quality, water quality, noise level, soil and flora and fauna is necessary. Site-specific meteorological data should also be collected. The location of the monitoring stations should be justified.	Chapter-3	C3-2 – C3-70
9	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.	Chapter-4	Section-4.3.7 C4-38 – C3-49 and **Annexure-X**
10	The water requirement for the project, its availability and source to be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should also be indicated.	Chapter-4	Section-4.3.9 C4-49 – C4-55
11	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the project should be included.	Chapter-4	Section-4.3.9 C4-49 – C4-55 **Annexure-III**
12	Details of water conservation measures proposed to be adopted in the project should be included.	Chapter-4	Section-4.3.9 C4-49 – C4-55, C4-81 – C4-90
13	Impact of the project on the water quality both surface and groundwater should be assessed and necessary safeguard measures, if any required should be included.	Chapter-4	Section-4.3.9 C4-49 – C4-90
14	Details of rainwater harvesting proposed, if any, in the project area should be included.	Chapter-4	Section-4.3.9 C4-81 – C4-90
15	Information on site elevation, working depth, groundwater table should be provided both in AMSL and BGL. A schematic diagram may also be provided for the same. In case the working will intersect groundwater	Chapter-2 Chapter-4	Section-2.6.4 C2-71 – C2-88 Section-4.3.9 C4-61 – C3-66

Sr. No.	ToR Points	Reference in the EIA report	
		Chapter #	Page #
	table, a detailed hydro-geological study should be undertaken and report furnished.		
16	Quantity of solid waste generation to be estimated and details for its disposal and management should be included.	Chapter-4	Section-4.3.4 C4-7 – C4-15
17	The reclamation plan, post mine land use and progressive greenbelt development plan should be prepared in tabular form (prescribed format) and included.	Chapter-5	Section-5.5 C5-12-C5-18
18	Impact on local transport infrastructure due to the project. Projected increase in truck traffic as a result of the project in the present road network (including those outside the project area) and whether it is capable of handling the increased load. Arrangement for improving the infrastructure, if contemplated including action to be taken by other agencies such as State Government, if any, should be covered.	Chapter-4	Section-4.4 C4-96 – C4-98
19	Details of the infrastructure facilities to be provided for the mine workers should be included.	Chapter-2	Section-2.4.11 C2-12
20	Conceptual post mine land use and reclamation of mined out area (with plans and with adequate number of sections) should be included.	Chapter-2	Section-2.6.4 C2-76
21	Phase-wise plan of green belt development, plantation and compensatory afforestation clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be included.	Chapter-5	Section-5.5 C5-12 – C5-18
22	Occupational health impact of the project should be incorporated.	Chapter-4 .	Section-4.8 C4-101 – C4-109 and **Annexure-XII**
23	Measures of socio economic influence to the local community proposed to be provided by project proponent. As far as possible, quantitative dimension should be included.	Chapter-4	Section-4.9 C4-109 – C4-115
24	Detailed environmental management plan to mitigate the environmental impacts which, should inter-alia also include the impact due to change of land use, due to loss of agricultural land and grazing land, if any, besides other impacts of the projects should be provided.	Chapter-5	C5-1 – C5-18

Sr. No.	ToR Points	Reference in the EIA report	
		Chapter #	Page #
25	The issues raised and commitment made to the public during Public hearing / public consultation with time bound action plan to implement the same should be provided.	Chapter-8, C8-1 to C8-8 and **Annexure-XIII.**	
26	Any litigation pending against the project and /or any direction / order passed by any Court of Law against the project, if so, details thereof should be included.	No Litigations are pending against the project and a letter to this effect is enclosed as **Annexure-XIV.**	

Chapter-2
Project Description

Notes Scanner

2.0 PROJECT DESCRIPTION

The chapter describes the process, and sources of pollution of the proposed Lead-Zinc Integrated Complex and the proposed enhancement of the mine and beneficiation capacity.

2.1 Type of Project

The proposed Lead-Zinc Integrated complex with smelters and CPP will include the following:

- New Zinc smelter – 2 x 0.25 MTPA
- New Lead smelter – 1 x 0.125 MTPA
- New Captive Power Plant – 3x85 MW
- Enhancement of ore production – 0.63 MTPA to 0.9 MTPA
- Enhancement of beneficiation capacity – 0.9 MTPA to 1.2 MTPA

2.2 Need for the Project

The existing enhanced zinc smelting annual capacity of the HZL smelters at Debari, Chanderia & Vizag is 6.66 LT of zinc metal which requires about 13.8 LT of Zinc concentrate. At present the production capacity of zinc concentrate from Rampura Agucha mine, Zawar Group of mines and Rajpura Dariba Mines (Including Sindesar Khurd) is short of Zinc concentrate by about 3.5 LT. The Zawar Group of mines is depleting and will not be able to increase the capacity of concentrate production. The increased production of zinc concentrate will only be possible from capacity increase of Rampura Agucha mine, Sindesar Khurd mine and Rajpura Dariba mine to a limited extent from existing capacity. Therefore, the expansion of Rajpura Dariba deposit is justified for future requirement. To satisfy the demand of the Lead and Zinc in the country the installation of smelters is warranted.

2.3 Location of the Project

Proposed Lead-Zinc Integrated complex will be set up with in existing Rajpura Dariba Mine, Relmagra, Dist Rajsamand (Raj.). Rajpura-Dariba mine is located at the southern extremity of Rajpura-Dariba Bethumni metallogenic belt in Rajsamand district, Rajasthan, at a distance of 76 km NNE of Udaipur. The nearest railway station is Fatehnagar, about 18 km, on Chittorgarh-Udaipur railway line. The deposit is well connected by a metalled road from Udaipur, Chittorgarh, Bhilwara and District headquarters Rajsamand. The deposit falls in Survey of India Toposheet No. 45/L1. Lead – Zinc mineral deposit has been explored at this site.

Minerals and metals are site-specific reserves on the basis of economic and geological investigations by Central Govt. and State Govt. these reserves will be identified and extracted. Techno-economic considerations identifying the factors like raw material sources, its proximity and transportation, land and land development and basic infrastructure, cost, transportation of main product and

byproducts, availability of utilities like water, power and capital and operating cost have been evaluated for qualifying the new Hydrometallurgical Zinc Smelter and a Lead Smelter with CPP at Rajpura-Dariba.

The details of environmental setting are given in **Table-2.3.1**. Location map is shown in **Figure-2.3.1**. The mine lease map is shown in **Figure-2.3.2** and the layout is shown in **Figure-2.3.3.**

TABLE-2.3.1
ENVIRONMENTAL SETTING OF THE SITE

Sr. No.	Particulars	Details
1	Latitude	N 24°55'41" to 24°57'51"
2	Longitude	E 74°07'03" to 74°08'48"
3	Elevation above MSL	480 M-490 M
4	Nearest Highway	SH-12, 17.0-Km, N (Rajsamand to Bhilwara)
5	Nearest Railway Station	Fatehnagar, 18-Km, (SSW)
6	Nearest Airport	Dabok, Udaipur, 65-km (SW)
7	Nearest River	Banas, 12 Km (N)
8	Nearest Port	Kandla, 700-km (SW)
9	Nearest Village	Anjana, 0.6-Km (W), Kantiya Khera, 0.4-Km (S)
10	Nearest Town/City	Rajsamand, 50-Km (NW)
11	Hills/Valleys	Nil in 10-km radius
12	Monuments	Nil in 10-km radius
13	Archaeologically important places	Nil in 10-km radius
14	Reserved/Protected forest	Nil in 10-km radius
15	Protected areas as per Wildlife Protection Act, 1972 (Biospheres, Tiger Reserves, Elephant Reserves, National Parks, Wildlife Sanctuaries, Conservation Reserves, and Community Reserves)	Nil in 10-km radius
16	List of Industries	Sindesar Khurd mines (3.0-km, NNE) owned by HZL.
17	Seismicity	Seismic Zone III

2.4 Magnitude of Operation

2.4.1 Zinc Smelter

Considering the single largest Roaster available in the world, operating and capital costs etc the best capacity, where the maximum return accrued, shall be with one roaster of 123 m^2 hearth area which is equivalent to 0.17 MTPA zinc production.

The above size of the roaster has been successfully implemented for Brownfield expansions of AdZ Spain, Pasminco- Risdon- Hobart Smelter etc and also at Chanderiya Lead Zinc Smelter (CLZS) Hydro I and II which are among the 10 installations done by M/s Lurgi Metallurgie/ Outotec, Germany. Various plants in the world are operating successful operations of leaching, purification, electro-

winning and melting & casting plants of 0.25 MTPA capacity. To add to this HZL has commissioned 0.21 TPA plants at CLZS. The desired capacity expansion is therefore considered as two zinc smelters of capacity 0.25 TPA each. Since the individual roaster capacity is only 0.17 MTPA, part of the Calcine shall be sourced from the other roasters.

2.4.2 Lead Smelter

With huge gap between India's domestic demand and current primary lead production capacity, a 0.125 MTPA model is a natural / optimal size. Also ENFI / NFC's ShuiKoushan (SKS) technology's standard proven module of 0.125 MTPA is very successful in operation and has the flexibility of adding in modules of smaller/similar capacities.

With this capacity of smelting, it is estimated that the captive concentrates will be short of the overall requirements. The projection for concentrate sourcing is approximately 55-75% of the fresh feed requirement has to be in terms of procured concentrates / secondary etc.

2.4.3 Captive Power Plant

Captive Power Plant of 255 MW (3x85MW) capacity is proposed within the plant premises to meet the power demand for the proposed smelter. Out of three units planned two units will be constructed in the first phase along with Zinc smelter-1 and Lead smelter. Third unit will be constructed in phase-II along with Zinc smelter-2. The steam generators (320tph, 94bar/540^{0}C, bi-drum, top supported, tangential fired, natural circulation) of the proposed CPP will use pulverized coal as fuel. The annual production capacity of different units and the byproducts produced are given in **Table-2.4.1** and **Table-2.4.2.**

TABLE-2.4.1
ANNUAL PRODUCTION OF SMELTERS & CPP

Products	Quantity
Zinc Smelter	
SHG Zinc Cathode/Ingot (Special High Grade)	0.5 MTPA
Zinc (Continuous Galvanizing Grade) (out of 500, 000 TPA SHG Zinc)	0.08 MTPA
Lead Smelter	
Lead Cathode/Ingot	0.125 MTPA
Lead Alloy (Pb-Sb & Pb-Ca) (out of 125, 000 TPA Lead)	0.05 MTPA
CPP	
Power	255 MW

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Power	255 MW

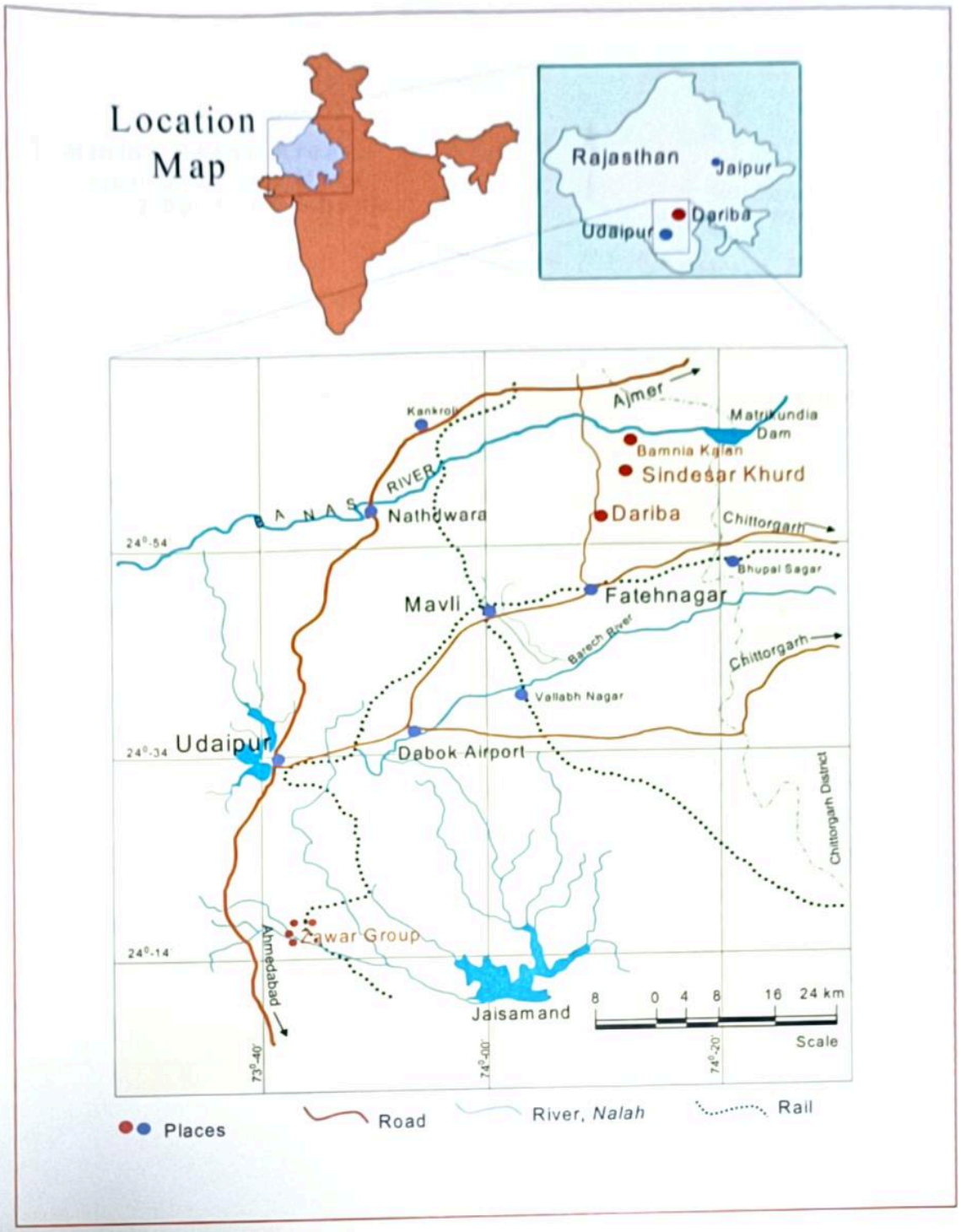


FIGURE-2.3.1
LOCATION MAP

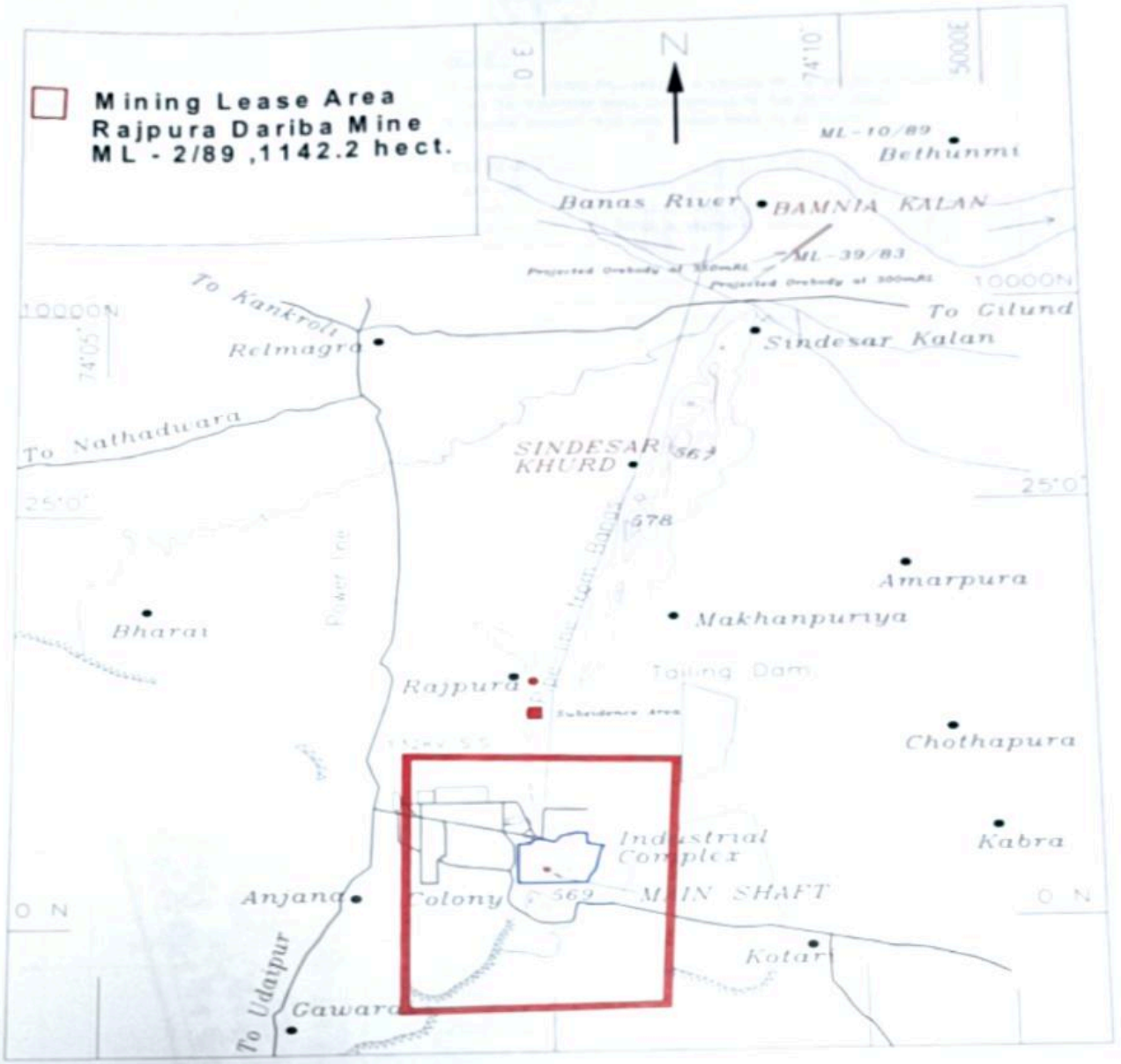


FIGURE-2.3.2
MINE LEASE MAP

Notes Scanner

TABLE-2.4.2
BYPRODUCTS FROM SMELTERS

By-Products	Quantity (TPA)
Sulphuric Acid	744,000
Lead - Silver Compound	80,000
Cadmium metal / Sponge (equivalent metal)	1,600
Calomel	44
Silver	400
Copper as Copper cement/sulphate/ matte/concentrate (equivalent metal)	1,900
Antimony as Antimony concentrate (equivalent metal)	850
Bismuth as Bismuth concentrate (equivalent metal)	16
Zinc Oxide compound	20,000
Lead concentrate (Oxide)	5,000
Anode Slime	4,000

The major design facilities of smelters and CPP are as given in **Table-2.4.3.**

TABLE-2.4.3
MAJOR DESIGN FACILITIES OF SMELTERS AND CPP

Sr. No.	Unit	No. /Capacity of each unit
1	Roasting Plant	2/954 TPD
2	Sulphuric Acid Plant [Zinc]	2/900 TPD
3	Calcine Leaching & Purification Plant	2/1350 TPD calcine treatment
4	Zinc electrolysis	2/750 TPD cath. Zinc
5	Casting Unit	4/24 tph [25 Kg Slab], 2/22 tph [1 T Jumbo]
6	CGG plant	2/10 TPH
7	Zinc Powder Plant	8/3000 TPA
8	Dross Milling Plant	2/10,000 TPA
9	Cadmium plant	2/800 TPA
10	Copper as Metal / Sulphate / Cement	2/500 TPA
11	Electrical Power Receiving & Distribution Station	2/120 MVA
12	Steam Turbine Power Generation Unit (Zinc Smelter)	2 x 4 MW
13	Captive power plant	3/ 85 MW
14	Lead Smelter-Bullion	1/140000 TPA
15	Sulphuric Acid Plant [Lead]	1/ 132000 TPA
16	Oxygen Plant [Lead]	1/8000 m3/h
17	Coal Pulverisation Plant [Lead]	1/ 10 TPH
18	Lead Refinery	2 / 62500 TPA
19	Copper Recovery Plant	1 / 900 TPA
20	Silver Recovery Plant	1 / 400 TPA
21	Antimony recovery System	1 / 900 TPA
22	Bismuth recovery System	1 / 16 TPA
23	Steam Turbine Power Generation Unit (Lead Smelter)	1 x 4 MW

2.4.4 Ore Production & Beneficiation

The present mine capacity is 0.63 MTPA of ore production. The proposed enhancement is intended for raising ore production capacity from 0.63 MTPA to 0.9 MTPA and beneficiation capacity from 0.9 to 1.2 MTPA. The details of the mine lease area are given in **Table-2.4.4.**

TABLE-2.4.4
DETAILS OF MINE LEASE AREA

Mining Lease	**ML: 2/89**
Validity	Up to 29th May 2010
Extent of Lease Area	1142.20 ha
Total acquired area	554.19 ha
Type of Lease Area	
Forest	NIL
Non-forest	1142.20 ha

Beneficiation plant of 3000 tpd ore treatment was commissioned at Rajpura Dariba Mine in 1982. The beneficiation process includes crushing, grinding and selective flotation of Lead and Zinc, thickening, filtration, mine back filling and tailing disposal.

The details of enhancement of ore production and beneficiation capacity are as given in **Table-2.4.5.**

TABLE-2.4.5
DETAILS OF ENHANCEMENT OF ORE PRODUCTION AND BENEFICIATION CAPACITY

Sr. No	**Description**	**Details**
1	Mine lease area	ML-2/89, 1142.20 Ha Validity 29-05-2010
2	Ore mineral	Sphalerite & Galena
3	Geological Reserves/Resource	24.68 MT (6.13% Zn, 1.7% Pb)
4	Present Mine Production	0.6 MTPA
5	Production after enhancement	0.9 MTPA
6	Strike length of deposit	900 m
7	Established Depth	500 m
8	Mode of Entry	By shafts
9	Method of Mining	Vertical Retreat Mining, Blast Hole Stoping by backfilling
10	Rated Ore Production	0.9 MTPA (Present capacity- 0.63 MTPA)
11	Present Beneficiation capacity	0.9 MTPA
12	Enhanced Beneficiation capacity	1.2 MTPA

2.4.5 Life and Cost of the Project

The details of life of the project, estimated cost are given in **Table-2.4.6.**

TABLE-2.4.6
DETAILS OF THE PROJECT

Sr. No.	Description	Details	
1	Life of the project	20 years (Smelters & CPP) 18 years (Mine)	
2	Power requirement	252 MW	
3	Water requirement	42050 m^3/day	
4	Manpower requirement	Smelters & CPP - 1450 Nos. Mine & Beneficiation - 150 Nos.	
5	Estimated Project Cost	Description	Amount (Rs Crores)
		Smelters & CPP	3777
		Mine & Beneficiation	75
		Total	**3,852**

2.4.6 Raw Materials

The major raw materials for the proposed project will be zinc, Lead concentrates, calcine and coal. The raw materials requirement is given in **Table 2.4.7**. the raw material source and mode of transportation is given in **Table-2.4.8**. Deficit, if any, shall be met through import. Other raw materials are aluminium metal for CGG zinc and coal/coke for Lead smelter and coal for power production. These materials will be sourced from the market, based on techno-economic feasibility.

The requirement of other consumables (fuels & process chemicals) required in the plant has been estimated and furnished in **Table-2.4.9.**

2.4.6.1 Coal Requirement

The total coal requirement for the power plant and smelter will be 1188000 MT, as mentioned in **Table-2.4.7**. It is proposed to import the required coal quantity. An application for long term coal linkage has been submitted to Ministry of Coal, Government of India. The same is enclosed as **Annexure-II**. The Coal Analysis report is given in **Table-2.4.10**.

TABLE-2.4.7
BASIC RAW MATERIAL- SMELTERS & CPP

Sr.No.	Item	Total Quantity/year (Tonnes)	Zinc Smelter-1 (Tonnes)	Zinc Smelter-2 (Tonnes)	Lead Smelter (Tonnes)	CPP (Tonnes)
1	Zinc concentrate	648,000	3,24,000	3,24,000	-	-
2	Calcine (ZnO)	280,000	1,40,000	1,40,000	-	-
3	Aluminium metal	160	80	80	-	-
4	Lead concentrate	260,000	-	-	260,000	-
5	Coal for lead smelter	26000	-	-	26000	-
6	Coke for lead smelter	27000	-	-	27000	-
7	Coal for power plant	1162000	-	-	-	1162000
8	Lead Silver Compound *	-	-	-	80000	-
9	Battery/Lead Scrap and secondary *	-	-	-	80000	-

* Used as an alternate to Lead Concentrate.

TABLE-2.4.8
BASIC RAW MATERIAL– SOURCE & TRANSPORTATION

Sr. No.	Item	Total Quantity/y (Tonnes)	Source of supply		Probable transportation	
			Imported%	Indigenous%	Imported	India
1	Zinc concentrate	648,000	-	-	-	-
2	Calcine (ZnO)	280,000	-	-	-	-
3	Aluminium metal	160	-	-	-	-
4	Lead concentrate	260,000	45.3	54.7	Kandla port	HZL mines-RAM, SK mine, Zawar mines
5	Lead silver compd for lead	80,000	-	100	-	CLZS & Dariba smelter complex
6	Lead secondaries	80,000	50.0	50	Kandla port	Mumbai
7	Coal for lead smelter	26,000	60.0	40	Navlakhi, Morbi near Mundra	Gotor, Kanika, Rajarh (MP)
8	Coke for lead smelter	27,000	-	100	Mundra port	Gandhidham
9	Coal for power plant	1,162,000	76.0	24	Kandla port	-

TABLE-2.4.9
CONSUMABLES PER ANNUM

Consumables	Unit	Quantity
Flocculants	Tons	133
Sodium Sulphate	Tons	19125
Lime	Tons	68500
SiO_2	Tons	5200
H_2FiS_6 (Silico Fluoric Acid)	Tons	500
LDO	KL	4060
LSHS	KL	4500
Sulphuric acid (internal)	Tons	27500
MnO_2 (internal)	Tons	6375
Caustic Soda Solution	M3	1500
Cement	Tons	13000
Ammonium Chloride	Tons	638
Coal	Tons	1188,000
Coke	Tons	27,000

TABLE-2.4.10
COAL ANALYSIS

No.	Particulars	Unit	Performance Coal	Range for Design
1	Moisture	%	10	5-15
2	Ash	%	35	15-35
3	Fixed Carbon	%	55	21-56
4	Volatile Matter	%	23	23-42
5	Gross Calorific value	k cal/ kg	6000	5000-6700
6	Sulphur	%	1.5	0.3-2.0

Source: Project Report

2.4.7 Water Requirement

Water requirement for industrial and township usage is met from HZL Captive dams. Consumption pattern of water for the enhancement of Ore production and Beneficiation capacity along with the smelters and CPP is given in **Table-2.4.11.**

TABLE-2.4.11
WATER REQUIREMENT

Plant	Consumption (m^3/day)
Zinc Smelter	11,000
Lead Smelter	7,250
Captive Power Plant	17,000
Domestic for smelter	1,000
RD Mine (existing)	4,600
RD Mine additional requirement due to expansion	1,200
Total	**42,050**

Water may be sourced from the dams through pipelines, the details are given in **Table-2.4.12.**

TABLE-2.4.12
SOURCES OF WATER

Source	Availability (m^3/day)
Matri-kundia dam	9000
Mansi Wakal dam	10,800
Gosunda dam	22,250
Total	**42,050**

An agreement has been signed between the Govt. of Rajasthan and HZL for supply of 117 mcft water from Matrikundia Dam. A Memorandum of Understanding (MoU) has been signed between Govt. of Rajasthan and HZL for implementation of Mansi Wakal Project Stage-I. Under this MoU, the water diverted from the Mansi Wakal Stage-I project, 30% of water available at off-take point of the common carrier system shall be made available to HZL. Govt. Of Rajasthan has allocated 1500 mcft water to HZL from Gosunda Dam vide letter no: F.2(28) Energy/86-IV dated Nov, 19, 1994. The allocation letters for the same are enclosed as **Annexure-III.**

2.4.8 Land requirement

Total land available at existing RD mines is 554.19-ha. Proposed mine expansion will not require any additional land. Proposed smelter and CPP will require 162 ha and will be constructed with in area of 554.19 ha.

No additional land will be acquired for proposed capacity enhancement in Mines and Beneficiation Plant.

2.4.9 Power Requirement

The power requirement for the Smelter and CPP project is 240 MW. The total power requirement for the smelters, CPP, mines, and beneficiation plant will be 252 MW. 255 MW coal based Captive Power Plant is envisaged for providing power to proposed smelters, CPP, mines and beneficiation plant. The power supply of 9 MW to the mine is received from Ajmer Vidyut Vitran Nigam Limited. Two 3.5 MW DG sets have been installed at the mine as standby. The additional power requirement for expansion of mines and beneficiation plant will be 3 MW.

Emergency Generator

The following D.G sets have been proposed for the new project.
1. 1X 1000 KVA emergency DG at CPP
2. 4X1250 KVA emergency DG at Zn smelter
3. 2X 630 KVA emergency DG at Zn smelter
4. 1X1600 KVA emergency DG for lead smelter.

2.4.10 Manpower

A workforce of 700 persons is employed on company roll and 425 numbers direct contractual labour are engaged to support various operations of the mine. Besides this large number of persons are supporting the other allied activities. The total manpower requirement for the Integrated complex is 1600 and the details are given in **Table-2.4.13.**

TABLE-2.4.13
MANPOWER REQUIREMENT

Unit	Manpower requirement
Smelters and CPP	1450
Mine & Beneficiation	150
Total	**1600**

2.4.11 Infrastructure

Rajpura Dariba Mine has all the infrastructure facilities including a Central Workshop for any major overhauling, maintenance and fabrication job. The power supply to the mine is received from Ajmer Vidyut Vitran Nigam Limited. Two 3.5 MW DG sets have been installed at the mine as standby. Water requirement for industrial and township usage is met from Matrikundia dam built on Banas river about 22km away. A workforce of 685 persons is employed on company roll and 425 numbers direct contractual labour are engaged to support various operations of the mine. The strength of executives is 90. Besides this large number of persons are supporting the other allied activities. The mine has a well-laid township having marketing, recreational and cultural facilities. A 16 bed hospital fully furnished with modern therapeutic equipment manned by specialised staff attends to the medical requirements of the employees and their families. A well equipped occupational health monitoring facility with X-Ray, audiometery, Lung function test, & blood lead level monitoring is available in the unit hospital. Two

primaries and one senior secondary Kendriya Vidyalaya cater to the educational needs of the wards of the employees and local population.

2.5 Technology and Process Description

2.5.1 Zinc Smelter

Considering various process options available such as Pyro-metallurgical ISF route & Hydrometallurgical route, HZL proposes a hydrometallurgical smelter at Dariba using conventional hydro-metallurgical route of roast-leach-electro-winning operations for the following reasons:

1. Higher recovery of zinc and other by-products
2. Production of Special high grade quality Zinc (SHG)

Also, there is no plant operating in the world following pyro-metallurgical route for more than 0.12 MTPA.

Conventional hydro-metallurgical route for zinc extraction is through "Roast-Leach-Electro-winning" operations. The raw material for the zinc smelter is zinc concentrate, which contains about 54% zinc in the form of zinc sulphide. The zinc concentrate containing zinc & other impurities is roasted to convert it into zinc oxide, which is leached in dilute sulphuric acid to produce a raw zinc sulphate solution. The impurities like copper, cadmium, nickel, cobalt etc also get dissolved in the solution as sulphates. The solution is filtered off to remove the insoluble impurities and the filtrate is purified by addition of zinc dust / powder and activators. The purified zinc sulphate solution is then electrolysed to obtain zinc cathodes, which are then melted and cast into zinc metal ingots. The filter cakes obtained during purification are sent to cadmium section. The leached solids obtained from leaching section are subjected to further treatment for zinc recovery and elimination of iron as jarosite. The lime and cement is mixed in the Jarosite to convert into stabilized non-leachable product called Jarofix.

Based on the above facts and figures the zinc plant on hydro-metallurgical route has been selected for the proposed new zinc smelter.

Salient Features

- Recovery of minor metals like Lead-Silver, Copper and Cadmium thereby reduction in waste generation;
- Efficient gas cooling and cleaning process to get optically clear gas.
- Double Conversion Double Absorption (DCDA) process with Cesium catalyst results in high SO_2 recovery (>99.8 %) and low SO_2 emission in acid plant
- Thermally autogenous process with power generation (8 MW) from waste heat
- High end automation and interlocking with pollution control equipments
- Pneumatic conveying system for calcine tanker unloading
- Online stack monitoring for SO_x; and

- Jarosite cake, a solid waste, will be stabilized by adding lime and cement (10% by weight) to produce Jarofix technology licensed from CE Zinc, Canada

2.5.2 Lead Smelter

Based on HZL's prior experience and recent assessment of technology the following process technology options were evaluated.

1. Ausmelt Technology (Single Furnace Philosophy) - Australia
2. Ausmelt Technology (Twin furnace philosophy) - Australia
3. SKS Technology – China

Based on the evaluations done, SKS Technology route has been selected for the following reasons

1. ENFI / NFC technology offer is including minor metal & precious metal recovery facilities like Cu, Sb , Bi , Ag etc
2. ENFI / NFC china offering a total turnkey solution from Technology to EPC to Process Guarantees

Salient Features

- Pyro-route for smelting & hydro-route for lead refining
- High Lead, Zinc and Silver Recovery
- Recovery of minor metals- Silver, Copper, Antimony and Bismuth
- Process capability to accept Lead Silver compound (a by-product of Zinc Smelter) and other Lead Secondary
- Effective dust collection and Hygiene systems
- Online stack monitoring for SOx

2.5.3 Captive Power Plant

Based on our proven and satisfactory experience, pulverised coal fired Boiler with steam turbine generator has been selected

Salient Features

- High efficiency ESPs with 8 nos. of fields
- Covered coal conveyors with water sprinkling system using waste water
- Bag filters at each coal transfer point, coal bunkers and fly ash silos to restrict emission
- Low NOx burners
- Online stack monitoring for SOx, NOx and PM

Salient Features of the Smelters and CPP

- Integrated Utility plant
- Integrated Effluent treatment plant followed with two stage RO Plant
- RO based DM plant thereby reducing effluent generation
- Transportation of raw material and finished products in 40 MT bulkers
- Cement concrete internal roads
- Industrial sweepers
- Truck / Tyre wash stations

2.5.4 Enhancement of Ore Production

The process adopted for the enhancement of the mine will be the same technology being used in the existing the mine, Vertical Retreat Mining (VRM) & Blast Hole Stoping (BHS) with back filling.

2.5.5 Enhancement of Beneficiation Capacity

Similarly for the enhancement of the beneficiation capacity the process selected will be same as the existing operation at Rajpura Dariba facility.

2.6 Project Details

2.6.1 Zinc Smelter 0.25 Mtpa (2 Units Producing total 0.5 Mtpa Zinc)

Two smelters each of capacity 0.25 MTPA zinc are planned in RD smelter complex. The following paragraphs will explain the process details of single zinc smelter of capacity 0.25 MTPA and second zinc smelter will be identical to the first zinc smelter.

The proposed hydro-metallurgical smelters are designed to produce 0.5 MTPA of Special High Grade Zinc annually from Zinc concentrate/Cacine. The hydro-metallurgical route based on Roast – Leach – Electrowinning process is widely accepted process for manufacturing zinc metal.

- **Process Description**

The process selected for the proposed zinc plant is based on the conventional roast-leach-electro winning route. The schematic flow diagram is shown in **Figure-2.6.1**

- **Raw Material Storage**

The concentrate will be unloaded at unloading station and stored in proposed concentrate storage yard, which will be of 12000 T capacity. From the stockyard, a pay loader will feed the material into different hoppers. By means of discharge and transport belt conveyors including an over-belt magnetic separator, the materials will be transported to a transfer tower, from where concentrate will be

routed to the roasting plant. Similarly storage facilities for storing calcine will be made in the proposed concentrate storage yard

- *Roasting Plant*

The zinc concentrate, which is in zinc sulphide form along with other sulphides, is not leachable at normal temperature and acidity. It is therefore necessary to convert this sulphide material to acid leachable form. The purpose of Roasting is to convert the zinc sulphide to zinc oxide (Calcine) by burning with air in a fluo-solid Roaster thereby expelling the sulphur as SO_2 gas and subsequently recovering as sulphuric acid in acid plant.

The zinc concentrate to be treated is stored in a surge bin, with a holding capacity for more than one shift. The schematic flow diagram of Roaster and Acid plant is shown in **Figure-2.6.2**

The concentrate is discharged from the bin by means of a slow running rubber belt. The capacity of Roaster furnace is 954 Tonnes of concentrate per day (Dry) with a hearth area of 123 m^2.

The principal roasting reactions are as follows;

$2ZnS + 3O_2 = => 2\,ZnO + 2SO_2 + 223.6$ Kcal
$4FeS + 7O_2 = => 2Fe_2O_3 + 4SO_2 +$ Heat
$ZnO + Fe_2O_3 = => ZnOFe_2O_3$ (zinc ferrite)

In order to avoid any gas leakage, in particular through the charge openings, the furnace is maintained under a slight negative pressure. This draught is provided by the SO_2 gas blower and controlled by a louver type damper. The roasting gas at the furnace exit has a temperature of about 950 to 1000°C and a SO_2 content of approximately 9% (Vol.). In a waste heat boiler, the gas is cooled to about 350°C.

The waste heat boiler is of the forced circulation type. It is designed to produce superheated steam at ~40 bar / 400°C. The boiler design provides for tube lined walls and the use of evaporator bundles. All the bundles are suspended at the boiler roof. To avoid any air ingress, the roof is tight welded. A part of the flue dust may adhere on the tube surface; all the bundles are equipped with an effective rapping device, controlled by a timer to make this adhering calcine to fall. The rapping periods may be set as required to optimize operation.

Only de-aerated and treated feed water will be used for the boiler. This water is prepared in the de-mineralized water treatment plant. It is fed into the boiler drum by means of a boiler feed pump. From the drum, the circulating pump delivers the water into the evaporator bundles and wall tubes and the cooling coils of the roaster.

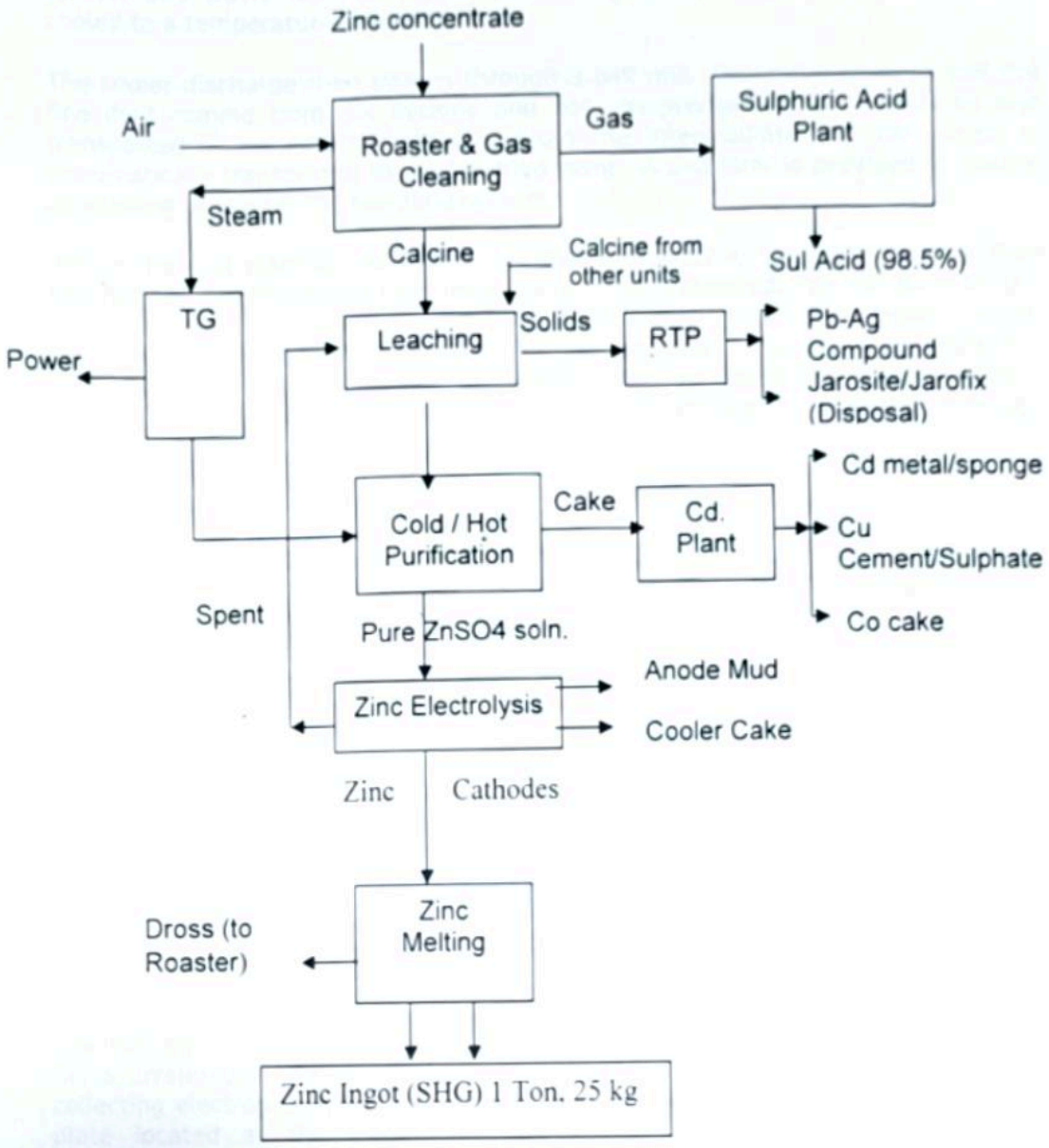


FIGURE-2.6.1
PROCESS FLOW SHEET-ZINC SMELTER

The calcine, collected in the waste heat boiler, drops into a longitudinal hopper arranged underneath the boiler and is discharged by a continuous air-cooled chain conveyor and water-cooled rotary valve. The calcine, collected from the roaster and waste heat boiler, passes through a rotating drum cooler, to be cooled to a temperature below 150^{0}C.

The cooler discharge then passes through a ball mill. The mill discharge and the fine dust coming from the cyclone and hot gas precipitator are combined and transported to an intermediate bin. From the intermediate bin the calcine is pneumatically transported to the leaching plant. A bag filter is provided to ensure de-dusting of the calcine handling system.

Before the first start-up, as well as for start-ups after long shutdowns, the fluid bed furnace and the waste heat boiler have to be preheated. For this purpose the roaster is equipped with a preheating unit for starting-up purposes, which consists of an oil tank with a pump, oil burners and oil lances. The necessary combustion air is taken from an air blower. Start-up gases are withdrawn by a start-up fan and vented via a start-up stack to the atmosphere provided after gas cleaning section.

- *Gas Cleaning*

The purpose of gas cleaning is to clean the gases of dust particles, saturated with water vapour, cooling and making it optically clear by removing the mist particles, thereby making it suitable for feed to the acid plant.

The gas cleaning section consists of the following units:

1. Hot gas cleaning
2. Wet gas cooling/condensing
3. Acid mist precipitator
4. Mercury removal system

1. Hot Gas Cleaning

The dust loaded SO_2 gases from the waste heat boiler are de-dusted in one single line three field hot ESP.

The hot gas electrostatic precipitator comprises of three separate electrostatic fields arranged in series. The dust particles are charged and separated on the collecting electrodes by the influence of the electrostatic fields. A gas distribution plate located at the electrostatic precipitator inlet ensures the even gas distribution over the sectional area of the electrostatic precipitator. The dust adhering to the collecting electrodes, discharge electrodes and gas distribution plate is removed at certain intervals by motorized rappers.

The removed dust drops into a longitudinal hopper arranged below the electrostatic precipitator casing and is discharged by a continuously operating dust conveyor and two rotary valves arranged in series. The collecting electrodes

consist of cold-rolled strips of steel plate. They are arranged in passages. The discharge electrodes of large cross section are rigidly fixed into pipe frames, which are vertically suspended between the collecting electrodes. This rigid frame design is highly efficient.

Both electrode system - collecting electrodes and discharge electrodes - are equipped with highly efficient motorized rapping systems. Hot purge air will be injected to prevent any condensation of Sulphuric acid mists on the surface of the supporting insulators of the discharge electrode systems.

The casing of the electrostatic precipitator will be fabricated from steel sheet and welded gas tight. It has to be fitted with particularly carefully designed heat insulation to avoid condensation of Sulphuric acid and corrosion. Each transformer rectifier is controlled by an automatic high voltage control system.

2. Wet Gas Cleaning

Washing Tower

After pre-cleaning in the hot-gas cleaning system, the gas is routed to the wet gas section equipped with a washing tower, which cools the gas adiabatically to a temperature of about 60^{0}C by means of circulating liquid. The washing tower also serves to wash out the bulk of the solids entering from the hot gas ESP's, as well as condensed volatile impurities. Excess liquid will be discharged to a stripper for SO2 removal.

Cooling Tower

The cooling of the SO2 gas is done in a packed gas-cooling tower. In counter current flow, cooling liquid (weak acid) is sprayed into the tower and flows downward through packing. By direct contact between the warm gases and the cooling liquid, heat is transferred. Flue gas cools down, gaseous water condenses and the cooling liquid is heated. The condensate leaving the cooling tower is collected in its sump from where it is delivered to the nozzles by means of a gas cooler flushing pump. The surplus of condensate is withdrawn by gravity from the sump to the washing tower weak acid circuit.

3. Acid Mist Precipitator

From the washing and cooling section, the gases are forwarded into two wet gas ESP's for mist elimination arranged in two stages. These ESP's are of the proven tubular type and are constructed mainly of plastic with high mechanical strength and a high chemical resistance. All parts in contact with the gas are of plastic or homogeneously lead-lined steel. The materials are selected according to the operating environment and stresses acting on the various components. The gases pass through the ESP tubes in a vertical direction, in the first stage flowing upwards and in the second stage flowing downwards. Spike design of discharge electrodes ensure that the mist particles are charged and separated on the tubes. The discharged condensate flows as a film along the tube surface to be collected

in the bottom section of the ESP from where it is drained. The condensate stream is combined with the wash acid in the washing tower.

4. Mercury Removal System (Calomel Process)

The mercury contained in zinc concentrate is transferred mainly into metallic mercury vapour during roasting. Some of the mercury may condense or re-combine with other components in the gas to form insoluble compounds. These particles or compounds may be separated in the conventional unit for gas cleaning and cooling before the gases enter the Sulphuric acid plant. But some amount of mercury vapour passes the conventional gas cooling and cleaning system as metallic vapour that must be removed from the gas before feeding to sulphuric acid plant.

Description of Mercury Removal System

The calomel process was originally developed for the purpose of removing mercury vapour from zinc concentrates roaster gases, after these gases have been treated in the conventional cleaning, washing and cooling plant.

The reactor for removal of mercury treats gases at a temperature of 38°C. The reactor is a counter current absorption tower made of glass fiber reinforced plastic. The tower is packed with plastic rings made of polypropylene. The $HgCl_2$ solution is sprayed over the packing by nozzles. The mercury vapour comes in contact with mercuric chloride solution and transforms to mercurous chloride. When mercury content in circulating water increases, some of the mercurous chloride is taken to a chlorination tank to convert mercurous chloride to mercuric chloride, which is used as make-up in circulating water. The mercurous chloride (calomel) is withdrawn periodically and stored for sale to interested buyers. The main reactions are as follows:

$HgCl_2$ (l) + Hg0 (gas) ==> Hg_2Cl_2 (s)
Hg_2Cl_2 (s) + Cl_2 (gas) ==> 2 $HgCl_2$ (l)

The towers are furnished with demisters in order to prevent drops leaving the tower with the purified gases. The clean gas then goes to sulphuric acid plant for production of H_2SO_4.

- **Sulphuric Acid Plant**

The SO_2 gas from the gas cleaning section is converted to sulphuric acid by first converting the SO_2 to SO_3 in converter in presence of V_2O_5 as catalyst. The converter has four layers of V_2O_5 catalyst. After 3rd mass, the gas is withdrawn and passed on to intermediate absorption tower where the SO_3 gas is absorbed to produce sulphuric acid. The residual SO_2 is further converted to SO_3 gas in 4th mass in order to achieve maximum conversion efficiency. The withdrawal of SO_3 gas after 3rd mass and converting it to H_2SO_4 accelerates conversion of SO_2 to SO_3 in fourth mass. Conversion of SO_2 to SO_3 in two stages and absorbing SO_3 in two stages is known as double conversion and double absorption (DCDA). In this

process, the conversion of SO_2 to SO_3 gas is very high (more than 99.7%) thus allowing very low SO_2 emission (less than 650 mg/Nm^3).

The Sulphuric acid plant mainly consists of 3 plant sections:

- The drying and absorption section
- The converter section with the gas-to-gas heat exchangers
- The product acid tank farm

1. Drying and Absorption Section

The drying and absorption section mainly consists of the drying tower, the intermediate absorber, the final absorber, the acid pumps, the acid pump tanks, the acid coolers and the acid piping.

The gas flow through the towers is counter-current to the acid flow, i.e. the gas flows from the bottom to the top of the tower. From the bottom of the tower(s) the acid flows to the pump tank and is pumped from there by the acid pumps (via the acid coolers) back to the spray system.

Acid transfer lines between the drying tower, the intermediate absorber and the final absorber and injection lines for dilution water at the intermediate absorber and final absorber allow control of the necessary acid concentration for each of the towers.

The Sulphuric acid is produced as +98% H_2SO_4 and the product acid is taken from the final absorber pump tank. The acid is then cooled in the product acid cooler and pumped to the existing acid storage tanks.

a. Converter System

In the converter, the SO_2 bearing gas is converted to SO_3 (sulphur trioxide) in the presence of Vanadium Pentoxide as catalyst, which is subsequently absorbed in acid towers to convert into sulphuric acid.

The converter system consists of a four-layer central tube converter. The intermediate absorption is following outlet of the 3rd layer. The converter itself is an insulated, vertical and cylindrical vessel divided in four sections called layers or trays with a central tube. The catalyst required for the conversion of SO_2 to SO_3 is arranged on these layers. The SO_2 gas flows up stream through layer 1 and down stream through layer 2, 3, 4.

Three gas-to-gas heat exchangers II, III and IV are designed as mixed cross flow/counter flow shell and tube heat exchangers. These heat exchangers mainly consist of inlet and out let chambers, the tube sheets, the tubes and baffles. Heat exchanger III ensures the optimum gas temperature for the intermediate absorber as well as for the inlet of layer 4.

Another heat exchanger I, inside the converter, arranged in the bottom of the central tube between layer 1 and 2, is designed as counter flow for pre heating SO_2 gas to the inlet temperature of layer 1.

b. SO_2 Gas Blower

The SO_2 gas blower is arranged downstream of the drying tower and routes the gas from the zinc roaster section via the gas cleaning plant through the Sulphuric acid plant. The blower will be provided with an electric motor.

c. Pre-heater

A pre-heater is needed to preheat the converter system from cold condition to operating temperature, whereas during normal operation of the plant the heat released within the process allows auto-thermal operation of the plant. In addition, lower or varying SO_2-concentrations can be compensated. The separate preheater preheats air or, in the start phases, SO_2-gas to the required temperature.

d. Process Criteria for the Acid Plant

For the production of the sulphuric acid, SO_2 containing gases from the zinc concentrate roasting are used. There are four main process criteria in the production of these kinds of gases by the contact/converter process. They are

- Gas drying;
- Water balance;
- Heat balance;
- Conversion of SO_2 to SO_3 at the required O_2/SO_2 ratio.

Gas Drying

Gas drying is an important process in this type of contact plant. Gas drying protects cooler parts of the plant, such as heat exchangers, against corrosion by acid condensation. It safeguards against the formation of acid mist, which can be very difficult to absorb at a latter stage of the process. It also protects the catalyst from acid condensation during plant shutdowns. Therefore, the life of the plant and also the tail gas purity largely depend on appropriate gas drying.

The substantial amount of heat, not just the heat of dilution of the sulphuric acid but also the heat of condensation of the water, is liberated in the gas drying stage. For that reason the circulated acid is generally cooled by indirect heat exchanger before being recycled to the dryer.

Water Balance

The water balance of contact sulphuric acid plants in general may simply be defined by the specific amount of process water required for achieving the desired product acid strength from the amount of SO_2 converted to SO_3.

In the case of acid gas plants (like roaster plants) the process water requirements are usually balanced nearly completely by the water vapour content of the SO_2 feed gases entering in the drying tower except for a small margin necessary for the automatic acid strength control.

Thus at a given SO_2 gas concentration and SO_2 conversion rate and at a fixed product acid strength, the only variable that can and has to be controlled or limited is water vapour content of the feed gasses entering the drying tower in order not to exceed the water balance of the whole system. This is done in the wet gas purification system by cooling the SO_2 gasses down to the dew point temperature corresponding to the maximum allowable water vapour content. For determination of the required dew point temperature, it is important not only to consider the negative pressure, for which the gas purification system is designed, but also the external barometric pressure, which depends largely on the elevation of the plant above sea level.

Absorption of SO_3

Sulphur trioxide formed by catalytic oxidation of sulphur dioxide is absorbed in sulphuric acid of at least 98% concentration, in which it reacts with existing or added water to form more sulphuric acid. The process gas leaving the converter system is cooled, first in a gas-to-gas heat exchanger to a temperature of about 160^0 C before entering the absorber. The gas entering the absorber is therefore not completely cold and it transfers heat to absorber acid as it passes through absorber, by the time it reaches the outlet it is virtually at the same temperature as the incoming absorber acid.

A substantial amount of heat is also generated in the absorber acid from the absorption of sulphur trioxide and the formation of sulphuric acid, and the acid temperature rises as a result by a margin, which depends on the acid circulation rate. The acid concentration is maintained constant by adding process water to the acid leaving the absorber and the acid cross flow from the dryer (to the intermediate absorber only) at a rate controlled by a concentration measuring device. The circulated acid is cooled by indirect cooling.

Heat Balance

The SO_2 gases leaving the wet gas cleaning system enter the acid plant at a temperature of 35^0-40^0 C (depending on the SO_2 concentration). After removing the residual water content in the dryer, the process gases must be heated up to the required converter inlet temperature of 440^0 C. This is achieved by indirect heat exchange with the available sensible gas heat released by SO_2 oxidation in the converter. The main objective of designing such a cold gas plant is to attain auto thermal operating conditions, which becomes primarily a question of the required gas heat exchanger surface, depending on the feed gas SO_2 concentration.

The reaction heat in a double catalysis plant based on roaster gases is released from;

- Catalytic oxidation
  $SO_2 + ½O_2 ==> SO_3 + 23.45$ Kcal (1)
- Sulphur trioxide absorption and sulphuric acid formation
  $SO_3 + H_2O = => H_2SO_4$ (2)
- Dilution to the acid production strength of 98.5% H_2SO_4
- Condensation heat for water content of the gases entering the drying tower system.

Conversion of SO_2 to SO_3

The catalytic oxidation of sulphur dioxide with atmospheric oxygen in the presence of a solid catalyst to form sulphur trioxide can be described as the classical example of an exothermal, reversible reaction

$SO_2 (g) + ½ O_2 (g) ==> SO_3 (g) + 23.45$ Kcal

The decisive factor for conversion is in each case also the O_2 concentration of the feed gas. Although, from stoichiometric aspects, a SO_2/O_2 ratio of 1:0.5 would be sufficient, it results already from the consideration of the chemical equilibrium that oxygen in excess will have a favourable influence on SO_3 formation.

In practice, the O_2 content of the gas entering the converter corresponds to 1.0 up to 1.8 times the SO_2 content, this being especially due to the influence of SO_2/O_2 ratio on the activity of the catalyst.

The heat of reaction liberated by SO_2 oxidation (1) leads to a temperature rise of the gas on its adiabatic passage through the catalyst layer so that the conversion is limited in accordance with the temperature equilibrium curve. With respect to obtaining a maximum SO_2 conversion efficiency to perform the catalytic SO_2 oxidation in several steps and to cool the gas to the most favourable temperature before it enters the next catalyst layer.

The theoretical basis of the double catalysis process is relatively simple and can be derived from the law of mass action. After a defined preliminary SO_2 conversion, after 3rd catalyst layer, the SO_3 formed at this stage is removed from the chemical equilibrium by intermediate absorption so that the equilibrium is shifted in favour of SO_3 formation.

On the basis of the corresponding temperature/conversion equilibrium it is possible to note already qualitatively that with the same number of contact layers as compared to the normal catalyst process, an essentially higher final SO_2 conversion is achievable which is more than 99.7% in practice.

A decisive advantage of the double catalysis process is the possibility of feeding gases of higher SO_2 concentration than with the normal catalysis process and this

means smaller gas volumes and consequently smaller equipment dimensions at comparable production capacities.

O_2/SO_2 Ratio

For the conversion of SO_2 to SO_3 the proportion of O_2 volume in the feed gas to the converter called SO_2/O_2 ratio, is an important factor for the conversion rate.

e. Product Acid Storage Tank

The total acid production received in the intermediate and the final absorber is pumped from the final absorber pump tank via the product acid cooler to the acid storage tanks.

- **Leaching**

As the concentrate will have high silver viable for its recovery, thus the plant shall have the provision of recovery of lead-silver using concentrate/ Calcine having high silver. Schematic flow sheet is shown in **Figure-2.6.3**.

The Calcine produced in the roaster and the calcine procured from the other smelters is stored in the silos. This calcine is conveyed to two hoppers situated where the leaching plant tanks are located. From there it is distributed throughout the different stages of the process by variable speed screw feeders and conveyors, which are regulated by pH meters that control the process variables.

The Leaching Plant shall have the following stages:

- Neutral Leaching (NL)
- Weak Acid Leaching (WAL)
- Hot Acid Leaching (HAL) / Strong Acid Leaching
- Jarosite (JAR) / Conversion
- Jarosite Acid Leaching (JAL)
- Jarosite Washing (JW)
- Pre-Neutralization (PN)
- Jarosite Filtration (JFT)
- Pb/Ag Filtration (Pb/Ag FT)
- Jarofix (JX)
- Magnesium Bleeding (MGB)

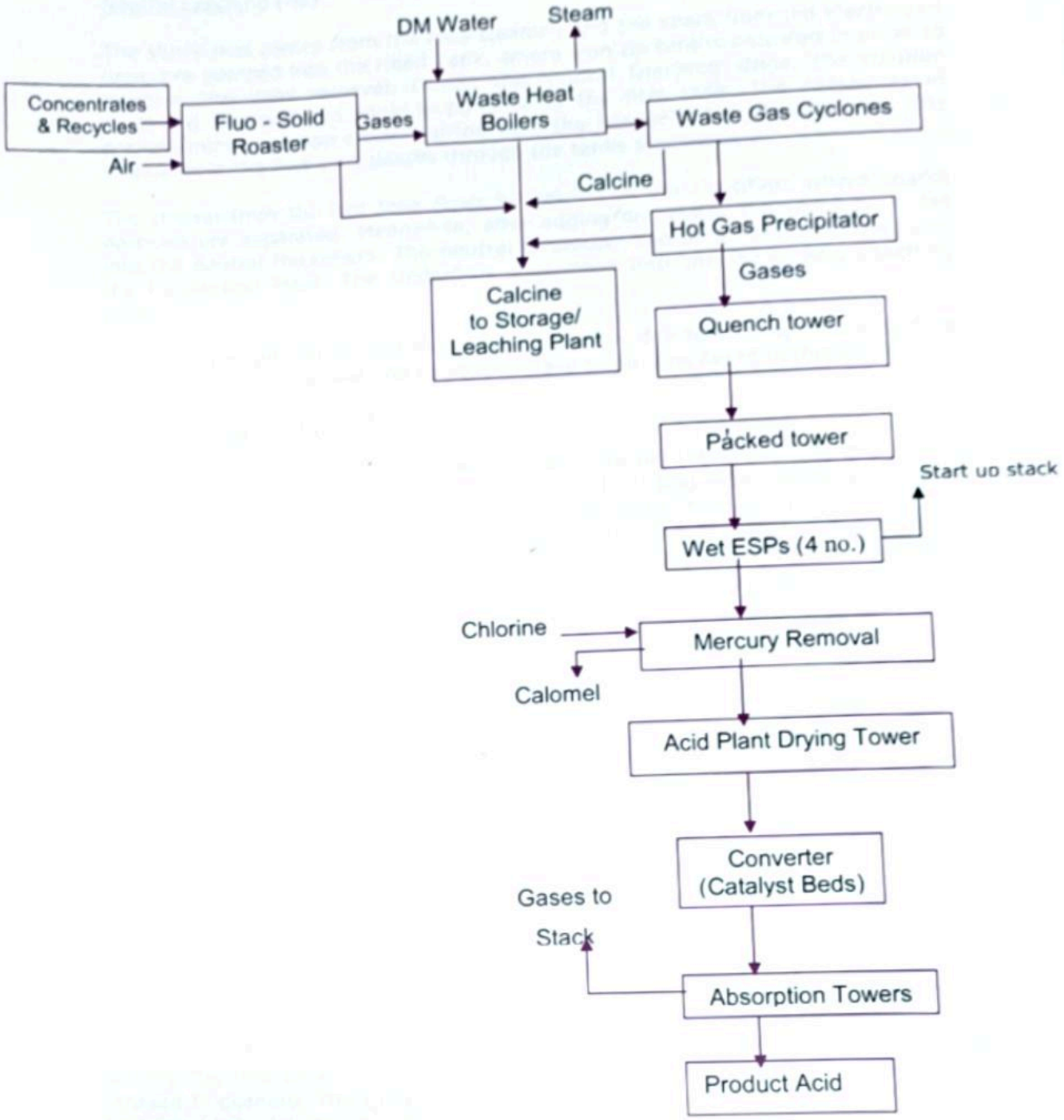


FIGURE-2.6.2
SCHEMATIC FLOW DIAGRAM OF ROASTER & ACID PLANT

Neutral Leaching (NL)

The slurry that comes from the cells cleaning and the spent from the Electrolysis area, are pumped into the Head Tank, where Iron content is adjusted in order to improve impurities removal. During the Neutral Leaching stage, the solution contained in the Head tank is pumped to the first tank. The control room predetermines the flow rates. Calcine from the hopper is fed into this tank. The stream from the first tank passes through the tanks successively.

The stream from the last tank flows by gravity to the classifiers where coarse particles are separated. Meanwhile, after adding flocculant, the Overflow is fed into the neutral thickeners. The neutral Overflow, free of solids, is pumped into the Purification Plant. The Underflow is pumped into the Weak Acid Leaching tanks.

In order to avoid setting and thickening problems, due to the high silica content in the Calcine, special working conditions have to be considered in this stage.

Weak Acid Leaching (WAL)

The Underflow from the Neutral Leaching and Pre-Neutralization thickener is fed into the first of a series of tanks, together with Strong Acid Leaching Overflow and spent electrolyte, when required. In these tanks, remaining zinc oxide and some zinc ferrite are leached. After leaving the last tank flocculant is added to the stream before it enters the Weak Acid Leaching thickener. The Underflow from the thickener is pumped to the Strong Acid Leaching stage while the Overflow is pumped to the Jarosite stage.

Strong Acid Leaching (SAL)

The Underflow from the Weak Acid Leaching thickener is fed into the first of a series of tanks, together with spent electrolyte and H2SO4; at the same time temperature is increased in order to facilitate ferrites leaching. The stream from the first tank passes through a series of tanks successively. After leaving the last tank flocculant is added to the stream before it enters in the Strong Acid Leaching thickener. The thickener Underflow is pumped to the Pb/Ag filters while the Overflow is pumped to the Weak Acid Leaching stage.

Jarosite (JAR)

The Overflow solutions from Weak Acid Leaching, Jarosite Acid Leaching and Jarosite Washing thickeners are fed into the first of a series of tanks, together with Calcine and SO_4Na_2. In these tanks, jarosite precipitation takes place. The stream from the first tank passes through a series of tanks successively. After leaving the last tank flocculant is added to the stream before it enters in the Jarosite thickeners. The Underflow from the thickeners is pumped to the Jarosite Acid Leaching while the Overflow is pumped to the Neutralization stage.

Jarosite Acid Leaching (JAL)

The Underflow from the Jarosite thickener is fed into the first of a series of tanks, together with spent electrolyte. In these tanks, zinc ferrite leaching is completed. After leaving the last tank flocculant is added to the stream before it enters the Jarosite Acid Leaching thickener. The Underflow from the thickener is pumped to the Jarosite washing stage while the Overflow is pumped to the Jarosite stage.

Jarosite Washing (JW)

The Jarosite Acid Leaching Underflow together with Horizontal Belt Filter filtrate feed the Jarosite washing thickener. The aim of this stage is to improve washing efficiency and, as a consequence, soluble zinc recovery. The Underflow from the thickener is pumped to the Filtration stage while the Overflow is pumped to the Jarosite stage.

Pre-Neutralization (PN)

The Overflow from the Jarosite thickeners is fed into the first of a series of tanks in the Neutralization stage. Calcine is also added at this point. Concurrently air/O_2 under low pressure is injected into all the tanks by lances in order to oxidize the Fe++ to Fe+++.

The stream from the last tank flows by gravity to a classifier where coarse particles are separated, while flocculant is added to the Overflow before it is fed into the Neutralization thickener. Part of the Overflow from the thickener is pumped to the Head Tank while the rest is sent to the third tank in the Neutral Leaching stage. The thickener' Underflow is pumped to the first tank of the Weak Acid Leaching stage. pH meters are controlling Calcine dosing in this stage.

Jarosite Filtration (JFT)

The Underflow from the Jarosite washing thickener is pumped into the Horizontal Belt Filter. Water is fed in various washing stages with the purpose of recovering soluble zinc. The primary filtrated solution is returned to the thickener while the cake is sent to a re-pulping tank and from there to the Jarofix stage. One portion of the washing filtrate is pumped to the Magnesium Bleeding tanks, while the other portion is recycled to the Jarosite washing thickener.

Pb/Ag Filtration (Pb/AgFT)

The Underflow from the Strong Acid Leaching thickener is pumped into the Filter Presses. Water is fed in various washing stages with the purpose of recovering soluble zinc. The filtrate is returned to the thickener while the cake is stored before feeding to the lead plants for recovery of silver and lead.

- **Jarofix Stage (JX)**

Jarosite cake from the filtration stage is pumped to the buffer tanks and then to a mixer where lime is dosed in order to neutralize the remaining acidity. After this operation, the slurry is mixed with cement and then discharged on trucks that transport the product to a land fill for disposal.

- ***Magnesium Bleeding (MGB)***

This stage is designed to remove Mg from the circuit to help to maintain the balance within the circuit of this element. To do this, the washing thickener Overflow is taken and lime slurry is added. Zinc is precipitated under the form of a mixture of hydroxide and basic zinc sulfate. At the same time gypsum is formed. Once the zinc precipitation has finished, the slurry is filtered to separate the solution (which is sent to the Effluent Treatment Plant) from the solid matter (which is mixed with spent electrolyte and recycled to the circuit).

- ***Purification Plant***

The neutral Overflow is pumped to the Purification Section where impurities are removed until levels drop to the point which facilitates the best possible results in the Electrolysis Section. The schematic flow diagram of the purification plant is shown in **Figure-2.6.4**.

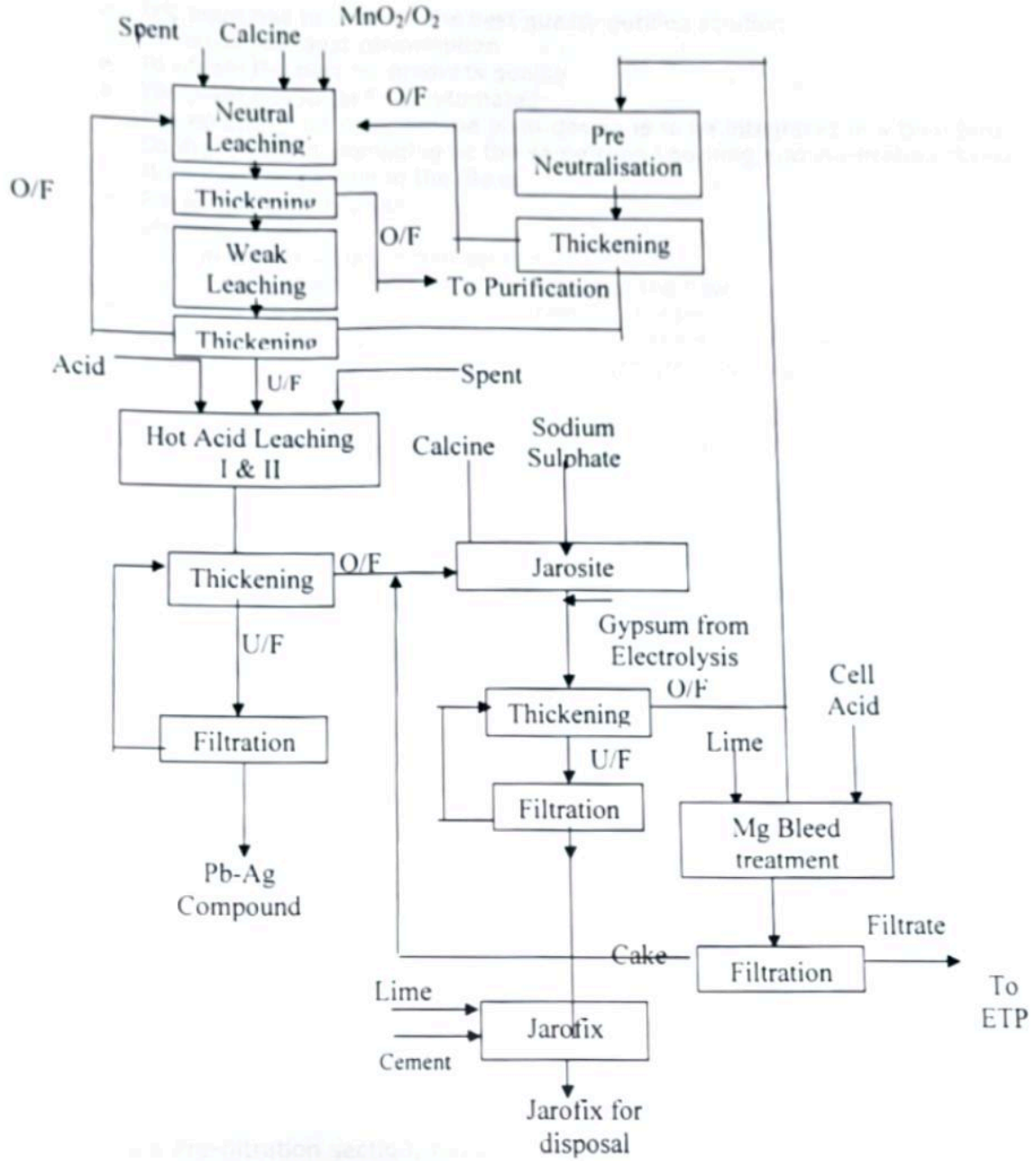


FIGURE-2.6.3
SCHEMATIC FLOW DIAGRAM OF LEACHING

Special considerations in the design of this plant are:

- The plant has to produce the best quality purified solution
- Minimum zinc dust consumption
- To obtain the best by-products quality
- The plant has to be fully automated
- The control philosophy for the plant design is to be integrated in a Distributed Control System, managing at the same time Leaching and Purification Plants. Main instrumentation in the file is:
- Frequency speed drives
- pH meters
- Flow meters, regulation and control
- Automatic reagents feeding as a function of the flow
- Temperature measurement, regulation and control
- Density meters, regulation and control (thickeners' Underflow)
- Torque measurement, regulation and control (thickeners)
- Zn, Cu, Co, Cd, on line analyzers

The Purification Section consists in the following stages:

- Pre-filtration
- Cu removal
- Hot purification/Cobalt Removal
- Polishing/Gypsum removal
- Copper Cement leaching
- Cadmium recovery

The neutral solution that is fed into the Purification Section shall comply with the following requirements:

Solid matter	<0.2 g/l
Zn	140 – 150 g/l
As	<0.200 mg/l
Sb	<0.200 mg/l
Ge	<0.100 mg/l
Fe	<10 mg/l
Mn	2 – 5 g/l
Mg	<10 g/l
Cl	<300 mg/l
F	<10 mg/l

Pre Filtration

In the Pre-filtration section, neutral over flow solution (containing app. 150 gpl of Zn as zinc sulphate) produced in the leaching plant at >65oC temperature is sent to pre filtration to remove any cake or mica etc.

Copper Removal

The pre filtered neutral solution is heated by steam in the spiral heat exchangers at 82°C. As the name suggests, in this stage the Copper present in the pre-filtrate solution is treated in copper removal tanks by the addition of Zinc dust. This solution is fed to copper removal filter presses, which filters clear filtrate and once after the filter chamber is filled with filter cake that is rich of heavy metals like Zinc, Copper, Cobalt and Nickel. To remove excess zinc dust and to separate Copper in the cake, spent electrolyte is circulated through the filter press. A Copper Analyzer is put in the return line of the leached electrolyte. When the analyzer starts detecting Copper from the leached electrolyte, spent electrolyte circulation will be stopped. Filter Cake now rich in Copper is re-pulped with dil. Sulphuric Acid in the slurry tanks and again filtered for final Clear Copper Sulphate Solution. Part of cake is sent to the copper cements leaching section.

Hot Purification/Cobalt Removal

The Cu removal Overflow is pumped through heat exchangers to the first of a series of tanks. The temperature at the entrance of this tank is a constant 750C, and is regulated by controlling the supply of steam to the heat exchangers. In the first tank both a solution containing K, Sb, tartrate (premixed in the preparation tanks) and zinc dust are added. After leaving the last tank of the series, the mixture is pumped to the Filter Presses, where the solid matter containing the removed impurities, is retained.

The working cycle of the Filter Presses is between eight to twelve hours. Once the cycle has been completed the filter press is insulated from the circuit and the cake is discharged onto re-pulping tank, where it is recovered and then returned to the first tank of the Cadmium stage for further removal of Cadmium and Cobalt. The filter cloths are also washed to remove the solid particles adhering to them.

The pH of the solution, previously filtered through the Hot Purification stage, is adjusted by the controlled addition of spent, before the solution enters in the tank from where it is pumped up to the cooling towers.

Copper Cement Leaching

The cement separated in the Cu removal section are leached spent (at controlled pH), to allow the selective leaching of excess zinc dust. Finally the mixture is leached with dilute sulphuric acid to produce copper sulfate.

Cadmium Recovery

Cu-Cd cake generated from purification is treated in cadmium plant. The impurities are separated during cementation process and sponge generated is leached, purified and filtered. The Cd neutral solution obtained is fed to Cd cells. Sheets are stripped every 24 hours dried, melted, and casted into pencils.

Typical analysis of Cadmium:

Cd - 99.95 %
Pb - 250 ppm
Ni - 150 ppm
Zn - 10 ppm
Cu -100 ppm

- ***Electro-Winning***

The purified and cooled zinc sulphate solution is electrolyzed in cell house (electrolytic cells) using aluminum cathodes and lead anodes. The zinc metal gets deposited on the cathodes and the spent electrolyte containing sulphuric acid and depleted level of zinc is returned to leaching section. The zinc deposited on cathodes will be pulled out and stripped off with automatic pulling/stripping machines once in 48 hours cycle. The schematic flow diagram of the electrolysis, melting and casting section is shown in **Figure-2.6.5.**

For the proposed plant, large size cells have been selected for reducing floor area requirement. The current density, temperature etc. have been selected to optimize the area required, deposit quality and power consumption while rendering high operational efficiency.

This plant consists of the following sections:

1 Cooling, gypsum and basic salt separation
2 Cell house
3 Automatic handling and stripping of cathodes
4 Anode cleaning and flattening

1 Cooling and Basic Salt Separation (Gypsum Removal)

The purified solution from the hot purification section must be cooled down from 75oC to approx. 35oC prior to being fed to the electrolyte cycle. During this cooling operation, basic zinc salts as well as gypsum crystals together with some impurities are partly precipitated in line with the temperature-dependant solubility limits in aqueous zinc sulphate solutions.

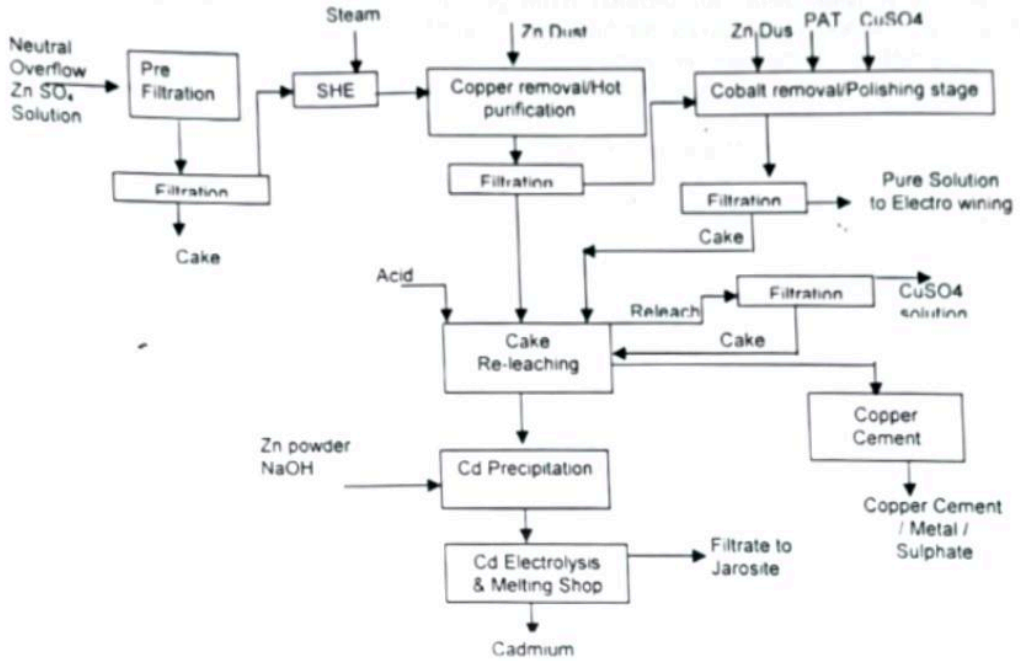


FIGURE-2.6.4
SCHEMATIC FLOW DIAGRAM OF PURIFICATION

Cooling is achieved in atmospheric cooling towers, where the solution is contacted with air in counter current flow. The cooled solution is collected in a launder system and flows to a settler where the solids, mainly basic zinc salts and gypsum crystals, will settle. The settler overflow is fed to the spent electrolyte. The settler underflow is recirculated to the Jarosite section where the zinc is recovered as $ZnSO_4$ solution and impurities go along with Jarosite cake. The cooler cake obtained while periodical cleaning of cooling tower is discarded.

2 Cell House

The purified solution, after having been treated for basic salt, is stored in the purified solution tank. The tank house will be designed according to the latest commercial technology using 3.5 m^2 cathodes as well as an automatic cathode transport system and full automatic stripping of the zinc deposits.

Spent electrolyte discharged from the tankhouse via the main collecting launder is collected in spent electrolyte storage tanks. From there a certain amount of spent electrolyte is pumped directly to the neutral leaching plant.

The major portion of the spent electrolyte is pumped to atmospheric cooling towers, where the spent electrolyte is cooled down to approximately 35°C. The cooling towers are of the same design as those for the neutral solution. The mixing of neutral leach solution and spent electrolyte takes place in the collecting launder under the influence of turbulence.

The electrolytic recovery of zinc is brought about by passing continuously electric current through the aqueous zinc sulphate electrolyte acidified with H_2SO_4 and the insoluble electrodes, causing the decomposition of the zinc sulphate and the water. The metallic zinc settles on the cathode and the oxygen on the anode, thereby recovering Sulphuric acid from the hydrogen of the water.

This process takes place in cells equipped with 115 anodes and 114 cathodes each. The tankhouse contains 132 cells. The electrodes of each cell are coupled in parallel by bus bar.

The electrolyte is supplied to the individual cells via distributing launder and pipes. Reagents, such as strontium carbonate, Arabic gum, and cresylic acid are added to improve deposit quality, increase current efficiency and suppress acid mist formation.

The direct current is fed from the rectifiers to the individual cells via bus bars mounted on isolators, which rest on special supports. The basic reaction in electrolysis is as follows;

$$ZnSO_4 + \text{electricity} \Longrightarrow Zn^{++} + SO_4^{--}$$

$$Zn^{++} + 2e^- \Longrightarrow Zn$$

3 Stripping of Cathodes

During the electrolysis process as already mentioned the zinc is deposited on aluminum cathodes, which in a cycle of 48 hours have to be taken out from the cells in order to remove the zinc deposit. The cathodes are automatically stripped in stripping machines.

The transport of the cathodes to the stripping machines is performed by a cathode and anode transport system provided with a special grab device, which is able to lift unstripped cathodes from the cell.

The cathodes are washed in a washing device prior to being distributed to the stripping unit of the stripping machine. The feeding of the inlet chain conveyors of each stripping machine with the cathodes is automatically regulated by the control system.

The stripped zinc sheets are stacked below the stripping machine, weighed and transported by forklift to the storage platform inside the melting and casting plant. The cathode transport system is also used for the anode cleaning operation.

- **Melting and Casting Plant**

The zinc sheets coming from the stripping machines are first stored on the storage platform in order to ensure that they are completely dry prior to feeding them into the melting furnaces.

1 Melting of Zinc Cathodes

The zinc sheets are fed into the induction furnaces by means of forklifts. The zinc sheets are melted down under a layer of ammonium chloride which serves the purpose to destroy the oxide film that may be formed during the melting operation, thus ensuring that the amount of zinc going into the dross is kept relatively low.

The molten zinc is pumped from the furnace's sump by graphite made vertical pumps through steel launders lined with heat resistant materials to the slab/jumbo casting machines.

2 Casting of Zinc Slabs

The zinc ingot production will be cast into standard 25 kg slabs / 1,000 kg zinc blocks. The molten zinc is pumped from the induction furnace through the launders to the casting machine. The casting machine is provided with automatic zinc pouring and skimming devices that ensure the proper filling of each casting mould with the required amount of molten zinc. The zinc slabs/blocks are cooled down inside the casting machine by water sprays.

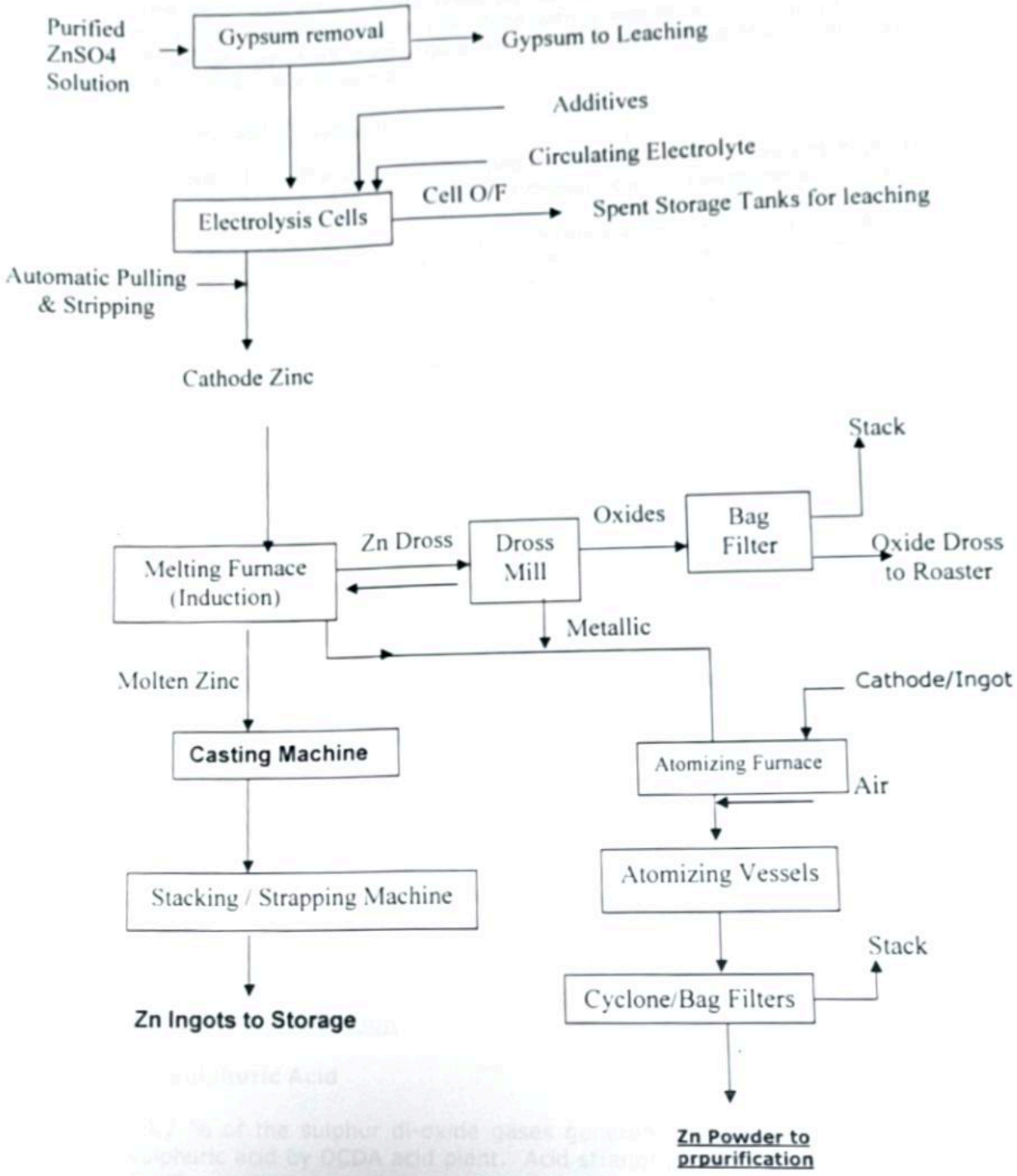


FIGURE-2.6.5
SCHEMATIC FLOW DIAGRAM OF ELECTROLYSIS, MELTING & CASTING

Afterwards, the slabs are automatically stacked in the stacking device and weighed on a scale. The bundles of zinc slabs with a weight of 1000 kg are collected on magazine conveyors from where they are transported to the storage section by forklift and finally strapped.

3 Dross Treatment Section

The dross from the zinc cathode melting furnaces, which contains approximately upto 90% of zinc, is firstly stored and cooled down in the transport containers.

The dross mills are discontinuously charged with dross produced at the main induction furnaces. During the grinding operation a suction fan continuously withdraws the fine dross particles mainly consisting of zinc oxides and ammonium chloride. The mixture of air and dust passes through a cyclone and afterwards the bag filter. The clean air is discharged to atmosphere; whist the fine dust is collected and conveyed to the raw-material storage. The metallic zinc is sent to the zinc dust plant for melting/ charging in the induction furnace.

- **Zinc Dust Plant**

The zinc dust plant consists mainly of three sections:

- atomizing furnace
- expansion chamber with a de-dusting bag house
- dust screening and storage

A portion of the molten zinc from the induction furnace is charged into the ladle of the gas/electric heated atomizing furnace. This furnace has at its lowest point a special plug which permits to drain about 1 to 2 tph of liquid zinc. A special designed compressed air jet nozzle atomizes these 5 to 8 liquid zinc streams by blowing them into the expansion chamber/cyclone.

In the expansion chamber/cyclone, which is under slightly negative pressure the solid zinc dust will precipitate and collect in a bin, which discharges onto vibration conveyors that extract the zinc dust, from the expansion chamber.

The main quantity of zinc dust, which is precipitated in the expansion chamber, is transported to the zinc dust screening station. At this screen, oversize zinc dust is separated which is recycled to the induction furnace. The clean air passes through bag filter before it leaves into the atmosphere through stack.

By-product Production

- **Sulphuric Acid**

99.7 % of the sulphur di-oxide gases generated in the roaster is converted to sulphuric acid by DCDA acid plant. Acid strength is +98% and is used largely by fertilizer industry.

- **Calomel**

Most of the mercury in the concentrate is volatilized in the Roaster and is recovered from the gas stream in the Gas Cleaning Plant, before the Acid Plant. The mercury tower reduces the mercury in the gas to the acid plant to below 0.05 mg / Nm^3 thus achieving a sulphuric acid purity of <1 ppm Hg. Mercury is recovered by the tower as mercurous chloride (calomel). Maximum 22 TPA of calomel is produced in each zinc smelter, depending upon the mercury content in the concentrate. This tonnage is insufficient to justify the electrolysis plant to convert the calomel to mercury. The calomel is sold for downstream processing within India/ stock piled.

- **Copper Sulphate**

A relatively pure residue is produced by zinc powder addition to neutral leach overflow. A projected annual arising of 500 tonnes in each zinc smelter as Cu as Copper metal / sulphate / cement is obtained and is stored in bulk bags for sale / to be used at existing facilities in Chanderia Smelter / HZL mines.

- **Cobalt Cake**

A purification cake containing approximately 2% Co is also produced which shall be processed either on-site or off sites for metal recovery. Annual arising is estimated as 700 tonnes.

- **Cadmium Metal/Sponge**

Some 800 TPA of cadmium as sponge/metal will be produced. The cadmium is precipitated from a purified solution. It will be sold.

- **Lead – Silver Compound**:

A 40,000 TPA lead silver compound shall be recovered and shall be fed to the Lead plant for recovery of the same. Excess lead silver compound will be sold. The intermediate storage bay shall also be arranged.

Zinc balance for the proposed zinc smelter is shown in **Figure-.2.6.6.**

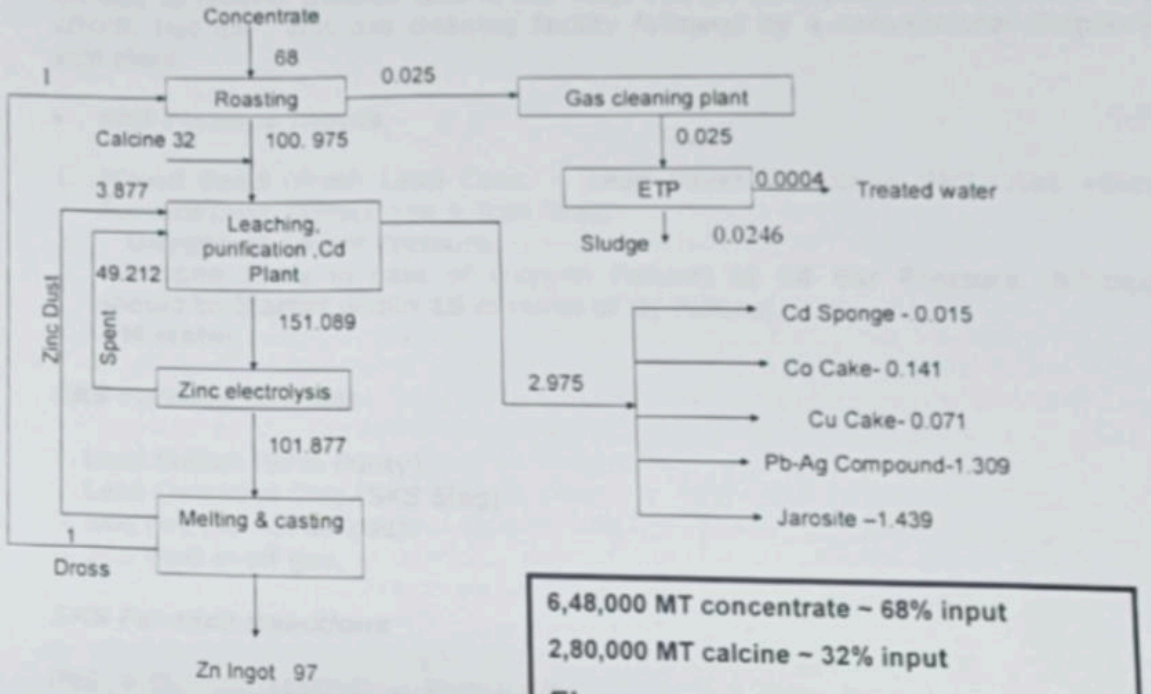
2.6.2 Lead Smelter (0.125 MTPA Capacity)

In line with HZL's long term strategy of meeting India's Lead demand, it has been decided to up our Lead production capacity by 0.125 MTPA by adopting the proven pyro metallurgical processing route. With the installation of this new lead capacity HZL's overall primary lead production capacity shall reach 0.22 MTPA.

- **Details of Selected Process Technology**

The SKS process uses the following process flow,

Zinc Balance



6,48,000 MT concentrate ~ 68% input

2,80,000 MT calcine ~ 32% input

Figures are based on 100 units of Zinc in concentrate

FIGURE-2.6.6
ZINC BALANCE

- **Raw Material Storage**

As like any other pyro smelting technology, a robust feed storage facility is considered for the storage of Concentrate, Coal fluxes, intermediates and secondaries. This will primarily consist of storage bunkers, conveyors and storage bins for plant consumption with necessary weigh feeding arrangement. This system will also include feed preparation facility like pelletising system.

- **SKS Smelting Furnace**

The SKS smelting furnace is a horizontal cylindrical vessel with bottom blowing capability. The furnace will be fed with feed materials from the top through feed port and oxygen shall be blown from the bottom of the furnace. The furnace is operated on a continuous smelting philosophy. Bullion from the furnace is tapped at regular intervals and cast into ingots. The bullion ingots are then transported to the refinery for further purifications. The slag with approximately 45% lead content will be cast on a cooled chain conveyor which will then be fed to the blast furnace to recover balance lead in the slag. The off gas system shall consist of a WHRB, Hot ESP, Wet gas cleaning facility followed by a conventional Sulphuric acid plant.

- ***SKS Furnace Inputs***

1. **Mixed Feed** (Fresh Lead Conc. + Lead Silver Complex+ SKS Dust +Blast Furnace Dust +Limestone + Iron Ore).
2. **Oxygen** at **16** bar Pressure.
3. **Nitrogen** (Only in case of Oxygen Failure) at **16** Bar Pressure (Nitrogen should be Started within **15** minutes of O_2 Failure).
4. **DM water**.

SKS Furnace Outputs

1. Lead Bullion (97% Purity).
2. Lead Oxidation Slag (SKS Slag)
3. **SO_2** (~13% rich off gas).
4. SKS dust in off gas.

SKS Furnace Reactions

$$PbS + O_2 \xrightarrow{1150^\circ C} PbO + SO_2$$

$$PbO + PbS \xrightarrow{1150^\circ C} Pb + SO_2$$

At 1150°C, Lead Sulphide reacts with Oxygen to form Lead Oxide and Sulphur-di-oxide. The Lead Oxide in turn reacts with Lead Sulphide to form pure lead metal and Sulphur-di-Oxide is liberated. The Heavier Lead bullion collects at the bottom of the furnace and the Slag floats at the top. The Furnace has an inbuilt Siphon to tap out the lead bullion. Lead Oxidation Slag is tapped out through a slag tap-

hole at the opposite side of the siphon. Sulphur forms Sulphur-di-oxide and escapes through Off Gas.

Off-Gas Collection

The SO_2 rich Off gas with lead dust generated in the smelting process is continuously removed under the negative pressure created by an Induced Draft Fan in the Off-Gas System. Along, with the Smelting Off Gas, air sucked from throat and feed inlets also enters the Off gas stream. Around 15 % PbS to PbO Conversion takes place in the off gas. The off gas stream passes through the Waste Heat Recovery Boiler (WHRB) and Electro-Static Precipitator (ESP) before entering the Acid Plant Battery Limit(Gas Cleaning Plant).

Almost 97.67% of sulphur fed into the furnace enters the off gas and rest being carried in the SKS Slag.

Waste Heat Recovery Boiler

The excess heat in the Off-Gas (which is at ~1150°C) is recovered as steam in the Waste Heat Recovery Boiler System along with collection of off-gas dust. Some of the Dust in the stream gets collected at the bottom of the Boiler which is conveyed by a chain conveyor to the common dust chain conveyor of Dust Collection System. This dust which is rich in lead (~60% Pb) in the form of PbO is then sent to the SKS feed Pelletiser through a weigh feeder and a Bucket Elevator.

Electrostatic Precipitator

The Off-gas leaving the WHRB enters the Hot ESP, which is having 60 m^2 collection area in five fields. The discharge electrodes in the fields are charged with high voltage and the collecting plates are neutral which collects the statically charged dust. The dust from the collecting plates is discharged by rapping system during each cycle of operation. Dust gets collected at the bottom of the ESP, which is conveyed by a chain conveyor to the intermediate chain conveyor. The Off-Gas with a dust load of ~400 mg/Nm^3 and at temperature ~350°C then enters the Gas cleaning section for recovery of SO_2.

- **Blast Furnace**

The slag from SKS furnace shall be fed to a conventional blast furnace along with coke for recovering the lead. Bullion produced from the blast furnace is cast into ingots and transported to the refinery for further treatment. The slag from blast furnace containing approximately 3% lead and 15% Zn is fed to the electric arc holding furnace. Off-gas from the blast furnace is treated through a Cooling Fin Bag filter to recover dust in the off-gas. The dust collected from the Cooling Fin and Bag Filter is re-cycled as they have high lead content.

Blast Furnace Inputs

1. Lead Oxidation Slag (40% lead content).
2. Limestone.
3. Coke
4. Air Blast from Blower House.
5. Lean Slag from Noble Lead Furnace.

Blast Furnace Outputs

1. Lead Bullion (97 % purity).
2. Blast Furnace Slag.
3. Blast Furnace Dust.

Blast Furnace Reactions

$$PbO + C \xrightarrow[\text{Reduction}]{} Pb + CO + CO_2$$

Off-Gas Dust Collection Section

The off-gas from blast furnace passes through the cooling flue (Surface Cooler) and bag filter and then will be sent to the Tail-gas Scrubbing section. The Induced Draft Fan located at the Outlet of the Bag filter keeps the negative pressure in operation for off gas flow from Blast furnace through Cooling flue and Bag Filter. The Dust load of the off gas is ~10.69g/m3.

There are 3 sets of 900m^2 cooling flues for the Dust Collection. A cold air valve is installed on the inlet of cooling flue. When Off-gas temperature is above 170°C, this valve will automatically open for diluting the off gas with cold air. When temperature becomes less than 100°C, it will automatically close. The Duct between blast furnace and cooling flue is designed as up-side-down 'V' shaped to avoid dust accumulation.

A cooling water jacket is equipped on the outlet pipe of the Blast furnace. When the off-gas temperature is higher than the design value, the water feed system will turn on automatically for cold water charging.

After the cooling Flue, the gas enters a Bag filter of collection area 2400m^2. The bag filter is waterproof and covered with temperature resistant materials. The bag filter is designed to meet the gas emission requirements. Explosion valves are equipped on the bag filter for safe operation as the off gas from blast furnace contains good amount of CO (refer equation).

The Dust collected in the cooling flue and Bag Filter are conveyed to the lead Dust receiving bin located at SKS furnace workshop through a Pneumatic Conveying System. This Pneumatic conveying system uses compressed nitrogen from the oxygen plant for SKS furnace.

- **Slag Fuming Furnace**

The blast furnace slag is first taken to the electric arc furnace to maintain the temperature of the slag and also to buffer a stock of slag for one batch of slag fuming furnace operation. The slag fuming is done on batch processing philosophy by using pulverized coal along with high pressure air. The final slag produced after fuming is discardable quality with huge potential for downstream applications. The off-gas system is designed to recover Waste heat through WHRB. Zinc Oxide compound (with ~10 to 20% Lead and ~55% Zinc) in the off gas shall be recovered from WHRB and Bag Filter system. The Zinc Oxide shall be utilized in the Leaching section of Zinc smelter or in the Pyro smelter at CLZS.

Fuming Furnace Inputs

1. Blast Furnace Slag.
2. Pulverized Coal (fed to furnace by Air Blast Stream).
3. Blast Air (from Blower House).

Fuming Furnace Outputs

1. ZnO Fume.
2. Fuming Furnace Slag.

Discard Slag

The slag tapped from the fuming furnace will have ~0.5% of Pb and ~2.5% of Zn. This slag is not viable for further recovery of metals and hence shall be discarded. The slag is tapped and granulated by a jet of water in slag launder. After water Granulation and Settlement, the Slag will be grabbed by bridge crane and is stored in Slag Bin. From Slag bin, the slag is transported to Slag yard by trucks.

Off-Gas Collection System

The Off-Gas generated is sucked by an Induced Draft Fan located at the Outlet of the Bag filter and the fan keeps the negative pressure in operation. The off-gas passes through the WHRB and the temperature of off-gas drops to 360°C.Then it enters the cooling flue (Surface Cooler) and bag filter where the zinc rich dust is collected. The off gas leaving the bag filter will be sent to Tail gas Scrubbing unit. The Dust load of the Off gas is ~79g/m3.

The dust collection in fuming furnace is similar to the dust collection system of Blast furnace section. The Zinc oxide compound (~55% Zn, 10~20% Pb) collected in the cooling flue and Bag Filter are conveyed to the Intermediate storage bin by chain conveyors. From the bin, the dust is collected and bagged in nylon bags by bagging machine of capacity 10-40 bags/hour. The Bags are then stored in Zinc Oxide Storage building and before being sent for recovery of zinc & lead.

Coal Pulverization Plant

The Off-gas from pulverized Coal Combustion in the firebox is sent to the coal mill through the spark catcher and after feeding with Cold Air. The Output of Coal mill is classified by the separator to separate the large-size granules (which are sent back to coal mill) and fine granules enter the cyclone separator and Blowback Bag filter which collect fine dust(sent to Intermediate Silo). The process block diagram of Lead smelter is shown in **Figure 2.6.7**. The lead balance is shown in **Figure-2.6.8.**

- **Lead Refinery**

The lead refining section consists of the following three main sub-section

1. *Copper De-drossing and Anode Fabrication.*
2. *Cell House*
3. *Cathode Preparation / Melting & Ingot Casting Section*

The cast bullion produced from SKS & Blast furnace is transported to the electrolytic refinery for melting and drossing to remove copper from the bullion. After copper drossing, the lead bullion is cast into anode forms suitable for electro refining. The initial thin cathode sheets are produced from refined lead and the final thick cathodes produced from the electro-refining process are removed on periodical basis for melting and casting into saleable ingots. The slime from the electro-refining operation is further treated for recovery of valuable metals like silver, antimony, Bismuth etc.

- **Silver Refinery**

The proposed plant shall have Rotary furnaces like Noble Lead furnace & Cupel furnace to produce silver bullion. The antimony and bismuth concentrate shall be recovered from the off-gas handling system of the furnaces which has Cooling Fins and Bag Filter. The bismuth concentrate is skimmed from the Cupel furnace. Lead rich slag (recyclable) and copper matte (saleable) is also recovered from the Cupel furnace. The silver bullion is further refined by electrolysis. The pure silver powder from the electrolytic process is melted and casted into silver ingot of 99.99% purity.

- **Copper Recovery Plant**

The proposed plant will take the copper dross from the electro-refinery plant and will produce copper matte of around 40% purity. This plant uses the ball mill and reverberatory furnaces to produce the copper matte. Copper matte shall be sold.

Off-Gas Collection

The Off-Gas having little content of sulphur as SO_2 passes through a flue gas chamber and bag filter system under negative pressure created by induced draft fan and finally sent to Tail gas treatment plant. The hot off-gas is cooled in the flue chamber and in turn, the inlet air for the burner of Reverberatory furnace is preheated. The dust is collected in the bag filter and is sent back to SKS Furnace.

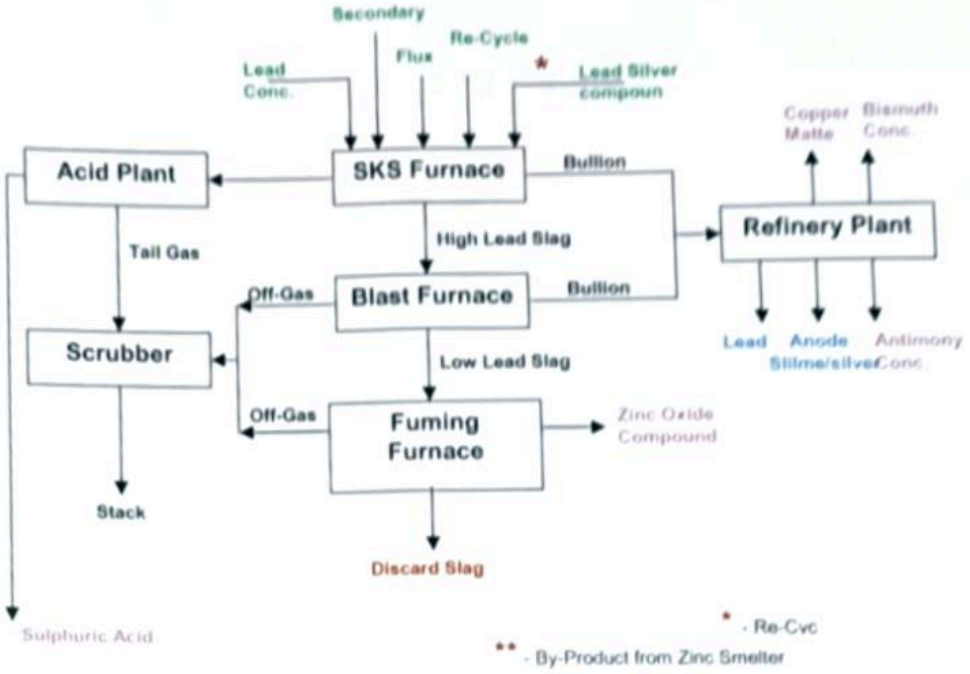


FIGURE-2.6.7
PROCESS BLOCK DIAGRAM OF LEAD SMELTER

Lead Balance

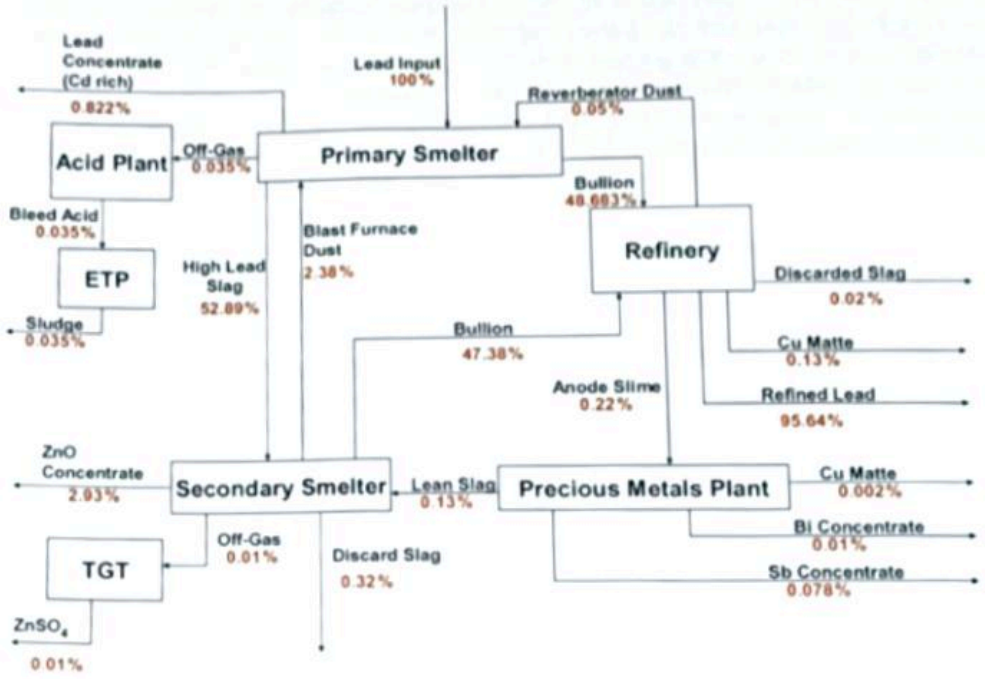


FIGURE-2.6.8
LEAD BALANCE

- **Tail Gas Treatment Plant**

The off gas from the Sulphuric acid plant, Blast and Fuming Furnace plant, Copper Recovery Plant are all treated in the Calcine Based Scrubbing plant where the SO_2 is removed before letting out to the atmosphere, to meet the statutory norms. The Zinc Sulphate solution which is obtained form the scrubbing process shall be treated in the leaching section of the Zinc Smelter.

Tail Gas Treatment

The Off-gases received from various plants are passed in counter current through a Scrubber unit (Dynaware Technology from USA, supplied by MECS to ENFI). This scrubber is Calcine based scrubber, where calcine (ZnO) solution is sprayed into the vessel to absorb sulphur from the off gas. The SO_2 and gaseous compounds of sulphur enter the scrubber vessel at the top and reacts with ZnO solution to form weak acid ($ZnSO_3$). The intermediate weak acid collected at the bottom of the vessel is enriched by oxygen by a roots air blower to convert $ZnSO_3$ to Zinc Sulphate Solution ($ZnSO_4$). This Zinc sulphate solution is then pumped to Leaching section of Dariba Zinc Smelter. The scrubbed off-gas is vented to the atmospheres through the 106 metre tall stack.

2.6.3 Captive Power Plant

- ***Raw Material***

Coal will be the only raw material required for the project apart from LDO which will be required during start up of the plant. The requirement of coal will be around 3320 TPD depending on the quality of coal used.

- **Process Description**

Each process is dealt with detail in the following chapters. The stepwise process proceeds in the order as given below:

- Fuel system
- Boiler and its auxiliaries
- Steam turbine& auxiliaries
- Generator and electrical system
- Water treatment plant
- Environment aspects, pollution control and safety measures

The flow diagram of the proposed power plant is given in **Figure-2.6.9.**

- **Fuel System**

As coal is the prime fuel for a thermal power plant, adequate emphasis needs to be given for its proper handling and storage. It is also important to have a

sustained flow of the fuel to maintain uninterrupted power generation. The capacity of the coal storage for proposed CPP is 45, 000 ton. The conveyor belts will be of capacity about 220 TPH for each unit. However, the conveying rate depends on the gross calorific value of the fuel used.

- **Coal Bunkers**

These are in-process storage silos used for storing crushed coal conveyed from the coal handling system. These will be made up of welded steel plates with vibrating arrangement at the outlet to avoid choking of coal. For each mill there will be a bunker and all together there will be four bunkers for two crushing units, which will be fed through gravimetric feeders. These bunkers present on top of the mill to aid in gravity feeding of coal to the mills.

- **Coal Conveying System**

This section deals with two primary aspects of preparation and firing of coal in detail. The coal preparation equipment viz. feeders and mills, firing systems and the firing equipment viz. the burners and their arrangement are described here under.

- ***Feeders***

In most of the power stations, the types of feeders used for transportation of coal from bunker to the mills are

- Drag chain feeders
- Belt feeders
- Table type rotary feeders
- Gravimetric type of feeders

- ***Mills***

Pulverized fuel firing is a method whereby the crushed coal, generally reduced to fineness such that 70-80% passes through a 200 mesh sieve, is carried forward pneumatically directly to burners or storage bins from where it is passed into burners. When discharged into combustion chamber, the mixture of air and coal ignites and burns in fluidized state.

The economic motives for the introduction and development of pulverized fuel firing are:

- Efficient utilization of low grade coals
- Flexibility in firing with ability to meet fluctuating loads
- Elimination of banking losses

- Better reaction to automatic control
- Ability to use high combustion air temperature increasing the overall efficiency of boiler
- Better availability

Even though the high capital cost is involved, the pulverized system is proposed due to the above mentioned advantages.

- ***Pulverizers***

Milling plant is divided into three main types- low, medium and high speed; each having its own advantages and drawbacks. In proposed CPP the mills will be of bowl mill type and will be operated at medium speed.

- ***Pulverized Coal Conveying System***

The system for direct firing of pulverized coal utilizes bowl mills to pulverize the coal and to admit the pulverized coal together with the air required for combustion (secondary air) to the furnace. As crushed coal is fed to each mill by its feeder, primary air is supplied from the primary air fans, which dries the coal as it is being pulverized and transports the pulverized coal through the coal piping system to the coal nozzles in the wind box assemblies. The pulverized coal and air discharged from the coal nozzles is directed towards the center of the furnace to form a fire ball. Fully preheated secondary air for combustion enters the furnace around the pulverized coal nozzles and through the auxiliary air compartments directly adjacent to the coal nozzle compartments. The pulverized coal and air streams entering the furnace are initially ignited by a suitable ignition source at nozzle exit. Above a predictable minimum loading condition the ignition becomes self sustaining. Combustion is completed as the gases spiral up in the furnace.

Air and Draft System

The air we need for combustion in the furnace and the flue gas that we must evacuate would not be possible without using fans. A fan is capable of imparting energy to the air/gas in the form of a boost in pressure. The losses through the system are overcome by means of this pressure boost. The boost is dependent on density for a given fan at a given speed. The higher the temperature, the lower is the boost. Fan performance (maximum capability) is represented as volume Vs pressure boost. The basic information needed to select a fan is:

1) Air or gas flow
2) Density (as a function of temperature and pressure)
3) System resistance (losses)

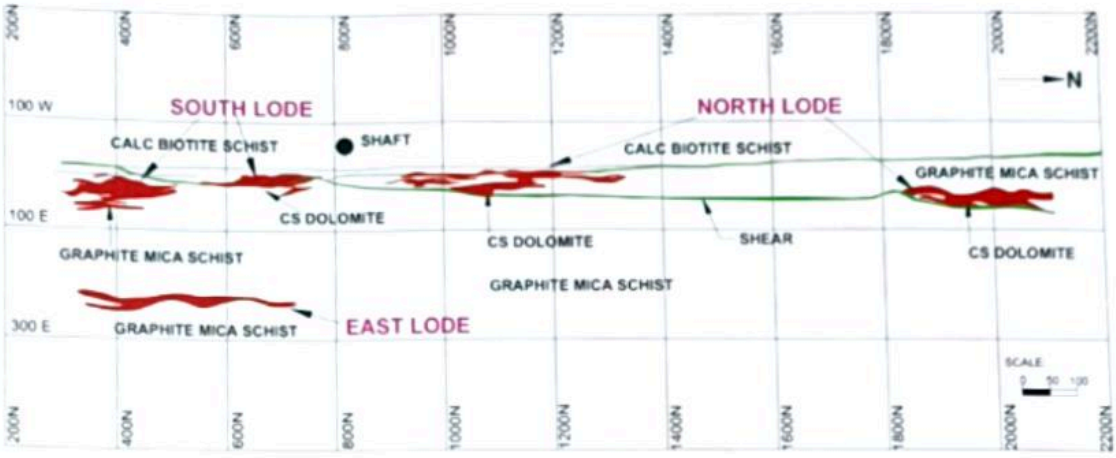


FIGURE 2.6.10
TYPICAL OREBODY LEVEL PLAN

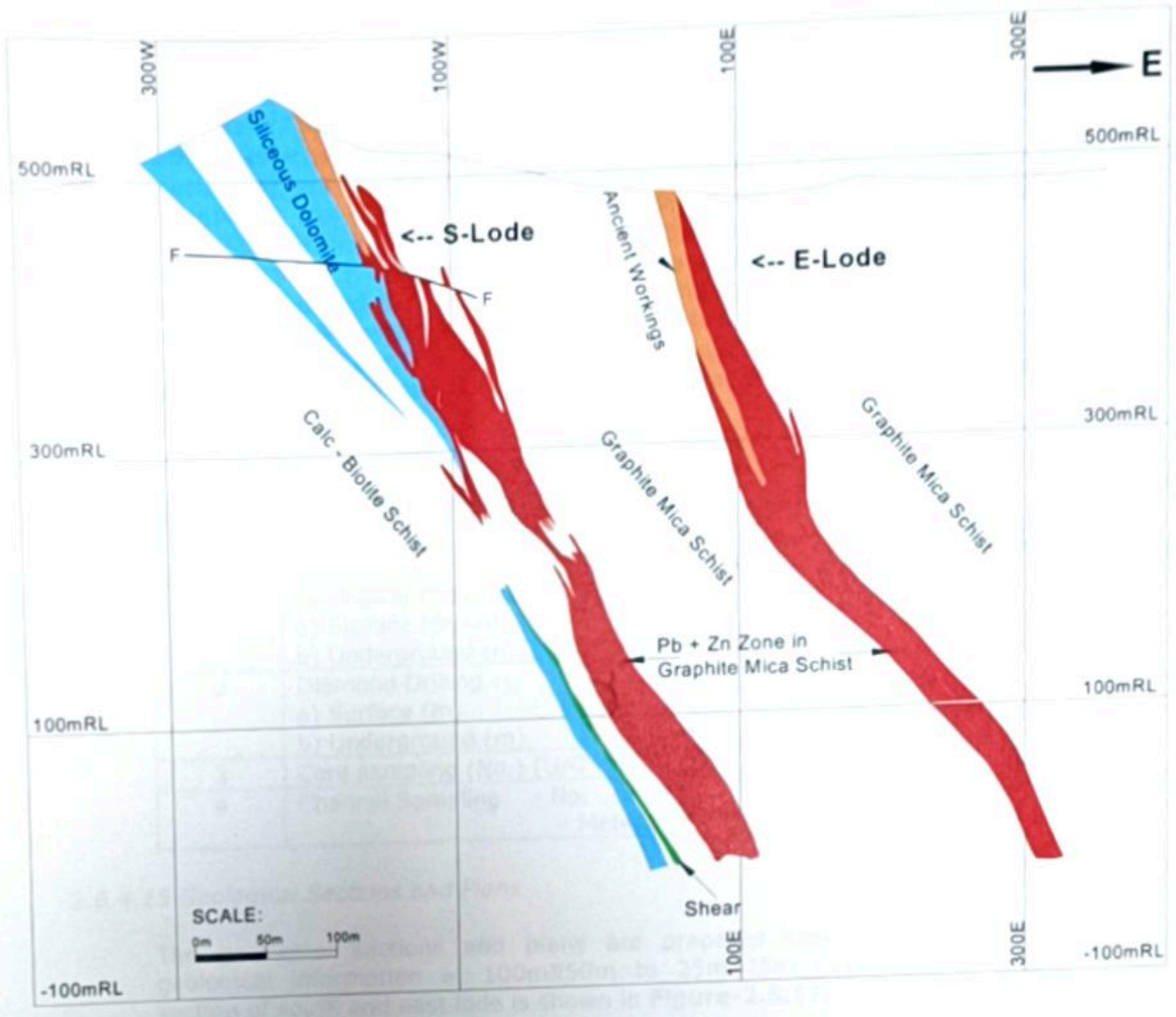


FIGURE 2.6.11
TYPICAL GEOLOGICAL TRANSVERSE SECTION-403N

The mineralization in graphite mica schist is in the form of lamiae parallel to schistosity, stringers, blebs and recrystallised massive patches. However, rich concentration of lead and zinc in the form of localized occurrences are found. Massive and coarsely crystalline bands are also found in this rock.

2.6.4.14 Exploration

The preliminary surface exploration of deposit was carried out by GSI followed by Hindustan Zinc Limited. With sequential development of underground levels, subsurface exploration commenced by diamond drilling carried out on 25/30m spacing for precise delineation of orebody, reserves/ resource estimation and purpose of stope planning and extraction of ore. Geological information of mineralisation, lithology and structure is also being collected from underground excavations. The future detailed exploration for precise delineation of mineralisation and defining the stoping boundary will commensurate with mine development. Average 2500-3000m/ anum sub-surface exploratory drilling will be required for the purpose. The quantum of exploration carried out till February 2009 is shown in **Table-2.6.2**. The contours and existing layout are shown in **Figure-2.6.12.**

TABLE-2.6.2
QUANTUM OF EXPLORATION (CARRIED OUT TILL FEBRUARY 2009)

Sr. No.	Particulars	Quantum
1	Geological Mapping a) Surface (sq.km) b) Underground (m)	 2.25 41481
2	Diamond Drilling :- a) Surface (m) b) Underground (m)	 56621 67275
3	Core sampling (No.) (U/G BH)	50579
4	Channel Sampling - No. - Meters	10678 9487

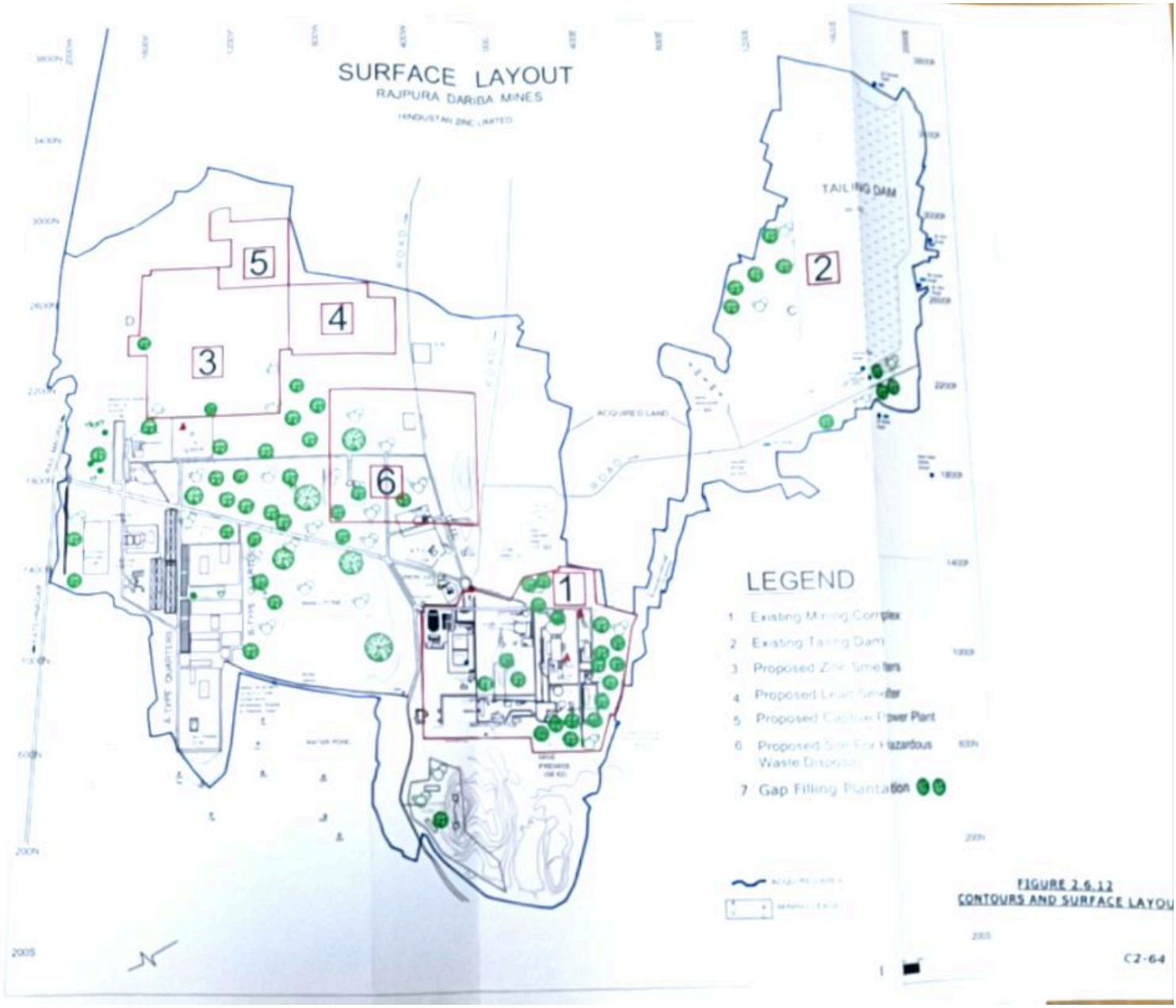
2.6.4.15 Geological Sections and Plans

The geological sections and plans are prepared based on exploration and geological information at 100mX50m to 25mX25m interval. The transverse section of south and east lode is shown in **Figure-2.6.13.**

2.6.4.16 Year Wise Future Exploration Program for Next Five Years

- **Surface Exploration**

Surface exploration is in progress and planned for the year 2009-10 to establish the depth and strike continuity of mineralization in the leasehold area particularly NL-1 below 0mRL and NL 2- L 4 in strike extension up to 2500N & below 0mRL up to the depth of (-) 400mRL. It is envisaged the resource enhancement in these blocks to about 6 t0 8 million tons for future detailed exploration and exploitation.



Notes Scanner

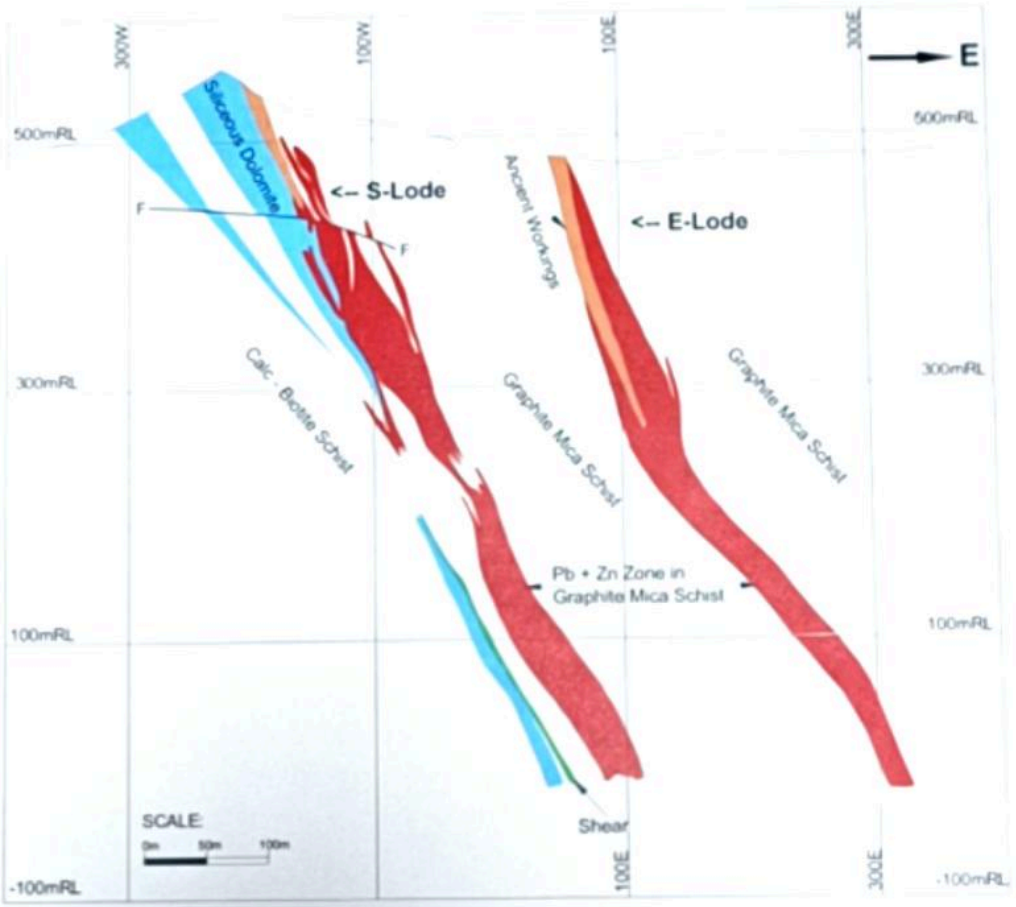


FIGURE 2.6.13
TRANSVERSE SECTION-SOUTH LODE & EAST LODE

There is no plan at present for further surface exploration drilling in the first five years of Mine Plan.

- **Underground Exploration**

Underground exploration drilling is being carried out at 25X25m interval for precise delineation of ore boundaries and estimation of tonnage grades for mining block. The exploratory drilling planned for next five years is shown in **Table-2.6.3** and shown in **Figure-2.6.14 , Figure-2.6.15 & Figure-2.6.16.**

TABLE-2.6.3
PROPOSED UNDERGROUND EXPLORATORY DRILLING FOR NEXT FIVE YEARS

Area	Level (mRL)	Between	2010-11	2011-12	2012-13	2013-14	2014-15
NL 2- NL 4	200	1900N-2100N	1000	1200			
		2100-2400N			500	1000	2500
	150	1700N-2100N					500
	100	1800N-2100N		1000	500	500	
NL-1	(-)55	1250N-1400N	500	1000			
	(-)95	800-1400N		500	500	800	
	(-)135	800-1400N	500	500	1500		
EAST-LODE	50	300N-700N					
	100	300N-700N		500	1000		
	150/200	300N-700N			500	500	1000
Total			**2000**	**4700**	**4500**	**2800**	**4000**

The underground exploration drilling will commensurate with mine development.

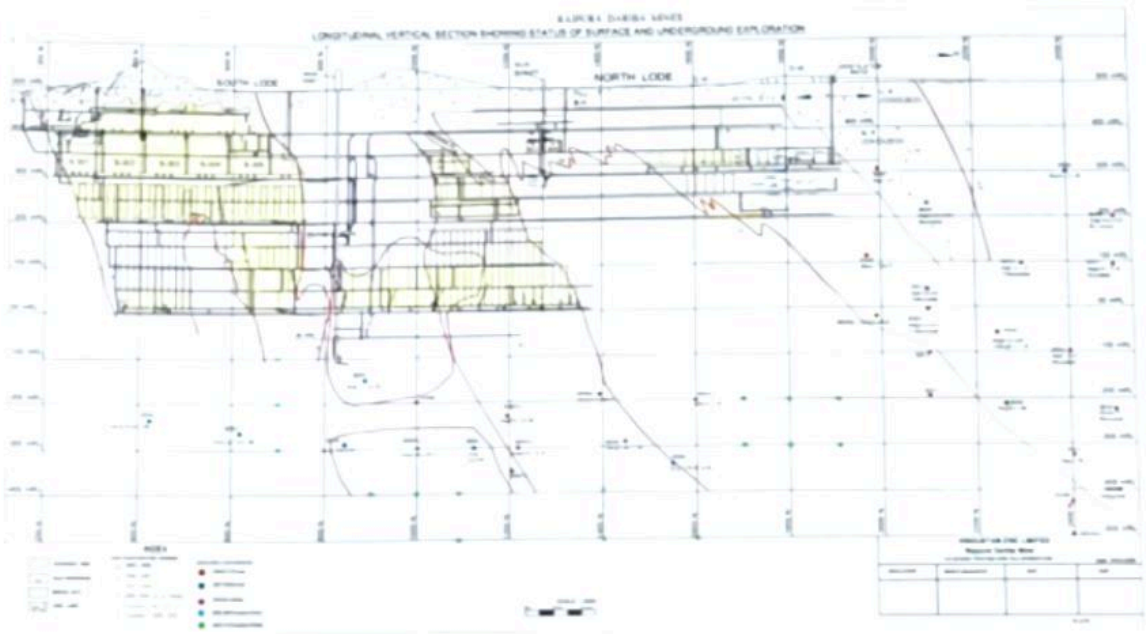


FIGURE-2.6.14
LVS SHOWING STATUS OF SURFACE AND UNDERGROUND EXPLORATION

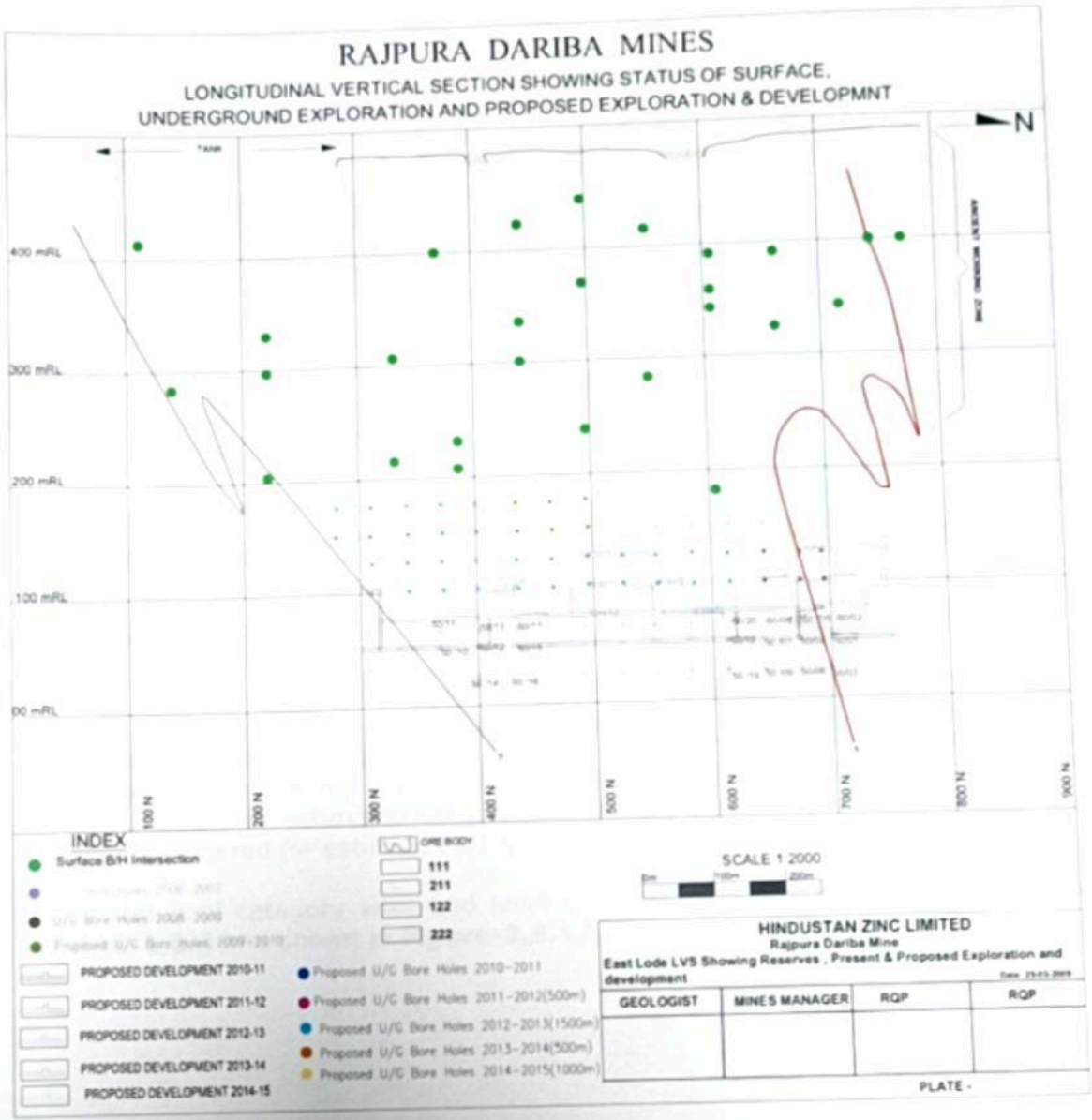


FIGURE-2.6.15
LVS SHOWING STATUS OF SURFACE, UNDERGROUND EXPLORATION AND PROPOSED EXPLORATION AND DEVELOPMENT

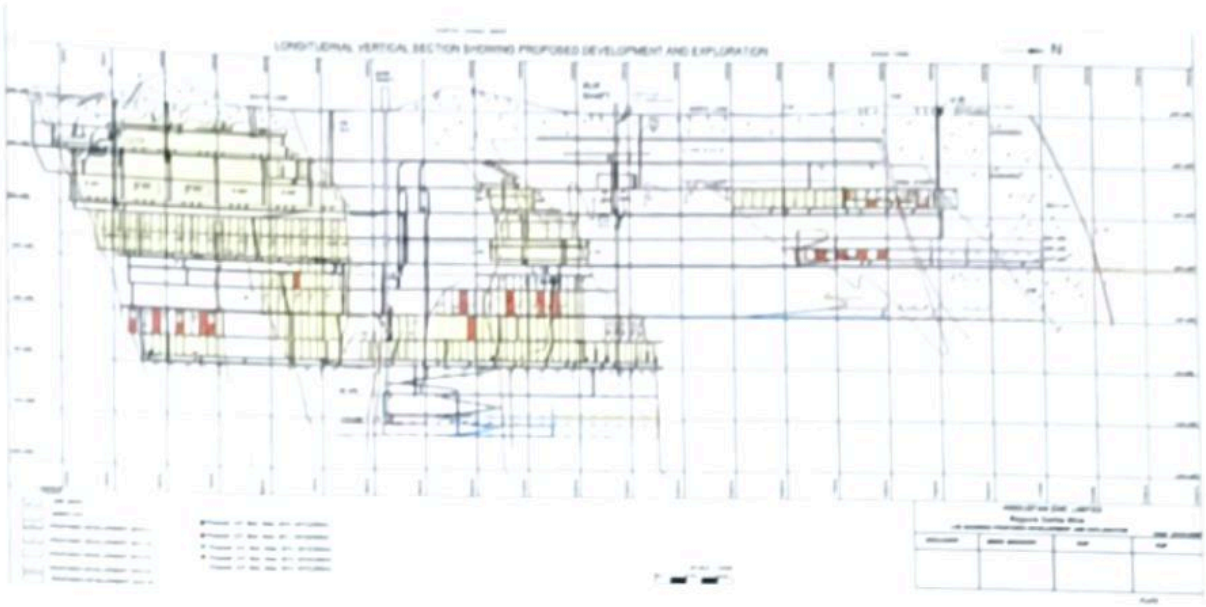


FIGURE-2.6.16
LVS SHOWING PROPOSED DEVELOPMENT AND EXPLORATION

2.6.4.17 Geological and Recoverable Reserves

- **Ore Reserves**

The ore body shapes are interpreted based on correlation of geological structures and ore intersections on transverse section at 25/30m interval and level plans. The reserves/ resource are being computed using IDS (inverse distance square) software. Depth of mineralisation is 500m and ore bodies are open in depth. Reserve/Resource estimated upto 0mRL. (Up to (-) 100mRL in part strike). Strike length considered for estimates is1.6km.

The status of category wise and level wise ore reserves and resource is given **Table–2.6.4** and shown in **Figure-2.6.17.**

TABLE-2.6.4
STATUS OF RESERVES & RESOURCE AS ON 01-02-2009

000' t, %Pb, %Zn, Ag g/t

Lode	Developed Ore Reserves			Other Ore Reserves	Demon. Ore Reserves			Possible	Total
	Fully	Partly	Total	Proved	Proved	Probable	Total		
UNFC	111	111		211	111	122		222	
I-South (480-0mRL)	354 1.44 5.88 121	361 1.27 4.94 132	715 1.35 5.41 127	1972 2.81 7.77 -	1822 1.84 7.14 -	-	1822 1.84 7.14 -	200 1.57 5.71	4709 2.14 7.08
II-North (450- (-)75 mRL)	284 1.77 7.54 67	808 1.8 7.91 68	1092 1.79 7.81 68	1295 2.09 8.22 -	4383 2.32 8.24 -	1888 2.67 8.76 -	6271 2.42 8.43 -	2829 1.55 6.58 -	11487 2.11 7.89
Sub Total (I+II)	638 1.61 6.72 93	1169 1.64 6.99 87	1807 1.63 6.89 89	3267 2.53 7.95 -	6205 2.18 7.95 -	1888 2.67 8.76 -	8093 2.29 8.14 -	3029 1.55 6.53 -	16196 2.13 7.66
IV-East Lode (400-100mRL)	-	-	-	-	-	2178 0.96 5.56	2178 0.96 5.56	5828 1.34 5.55	8006 1.24 5.55
Grand Total	638 1.61 6.72 93	1169 1.64 6.99 87	1807 1.63 6.89 89	3267 2.53 7.95 -	6205 2.18 7.95 -	4066 1.75 7.05 -	10271 2.01 7.59 -	8857 1.41 5.88 -	24202 1.83 6.96

At 70% recovery, total mineable reserves available for mining will be about 16.8 million tons sufficient for +18 years mine with progressive ramping up of production from @ 0.6 mtpa to 0.9mtpa.

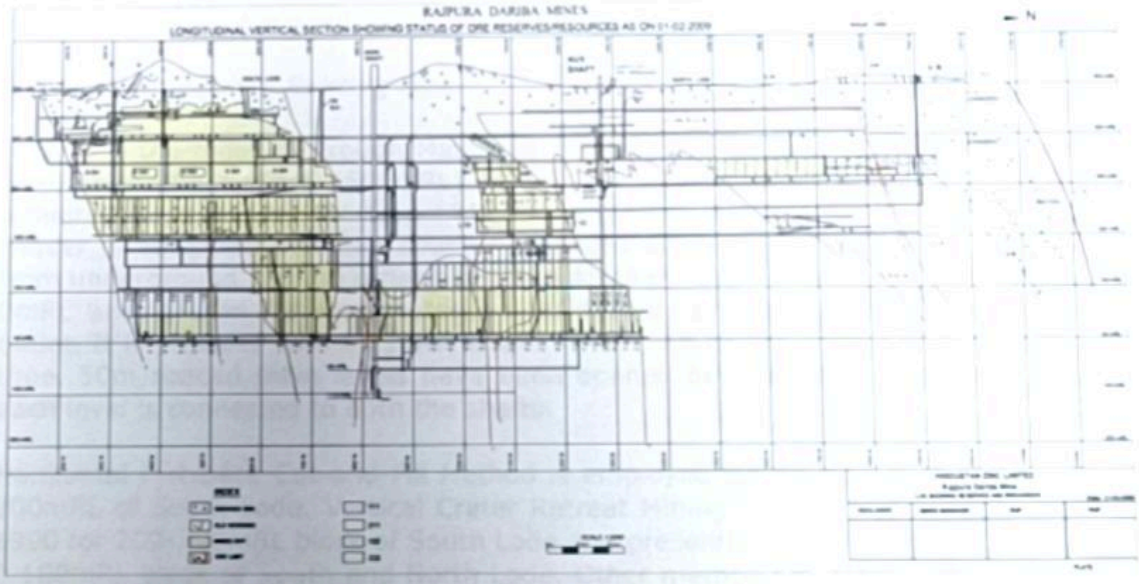


FIGURE-2.6.17
LVS SHOWING STATUS OF RESERVES/RESOURCES AS ON 01-02-2009

- **Basis of Ore Reserves Estimation**

Parameters:
Cut-off for geological correlation - 3% total metal (Pb+Zn) content
Bulk Density - 3.2 gm/cc
Depth and Strike length:
Depth: Upper limit varies between 450mRL to 00mRL & open in depth in some lenses.
Strike Length: 1600m
Minimum width - 3m (minimum horizontal width)

- **Method of Estimation of Ore Reserves**

The ore body shapes are interpreted based on correlation of geological structures and ore intersections on transverse sections and level plans. The reserves/ resource are being computed using IDS (inverse distance square) and DATAMINE software as well.

2.6.4.18 Mining

Underground exploratory mine development was started by GSI in July 1967 through two incline shafts, located 100m apart on the western side of the Dariba Hill to open levels at 436 and 400 mRL respectively.

Subsequently, HZL acquired mining lease of 11.42 Sq. km covering Dariba and parts of Rajpura blocks in April 1970. Mine was reopened by HZL on December 28, 1971 and deepening of one of the inclines upto 300mRL was taken up for underground exploration and mine/stope developmental works. M/s RTZ, UK were appointed as consultant in 1972 for the techno engineering studies of the mine project, and upon their recommendations the mine was formally commissioned in April 1983 with a designed capacity of 3000 tpd.

2.6.4.19 Brief Description of Existing Mine

Access to the mine is through Main and Auxiliary shaft. The Main shaft is 612m deep from the surface (500mRL) to (-) 112mRL. It is equipped with Tower mounted Kope Winder for Skip (740KW) and Cage Winding (236KW). The skip winder is equipped with two counter balanced 6t capacity skips and hoists ore from underground. On the other hand, the Auxiliary shaft extends from surface to 0mRL and is used for men/material winding only besides serving as a second outlet. It is provided with a 225KW Drum winder, which can hoist 3.5t of load at a time. 50m spaced main levels have been opened between 400 and 0mRL, and each level is connected to both the shafts.

Horizontal Flat-back Cut-and-Fill Method is employed for extraction of ore above 300mRL of South Lode. Vertical Crater Retreat Mining Method was introduced in 1990 for 200-300mRL block of South Lode and presently is being applied between 0-180mRL block of South and North Lode. Other method i.e. blast-hole is also in practice for extraction of ore in North Lode. The voids created by stoping are back

filled by cemented fill to provide support to the walls. In addition, adequate reinforcement of the crown pillars, weak hangingwall and other geologically weak ground through cable bolting and systematic rock bolting is also done.

In Vertical Crater Retreat and Blast-Hole mining methods large diameter holes are drilled by the ITH and DTH drill machines. Main compressor is installed at Surface.

Booster compressor of make GARDNER DENVER is used to enhance air pressure for ITH dill machine at working level for efficient drilling. 3.5 m3 electric LHDs are used to load and haul the broken ore up to the nearest ore-pass which opens at a track facilitated haulage-drive. Electric and diesel locomotives pull a train of 5t Granby Car carrying the ore up to the main ore-pass.

Ore from various stopes is fed through main ore-passes to a Double Toggle Jaw crusher located at (-) 35mRL. The crushed ore of (-)150mm is hoisted to surface by counter balanced 6 ton capacity skips and conveyed to coarse ore stockpile of 3000tpd beneficiation plant.

The main shaft serves as the primary intake airway. Two main mechanical exhaust ventilators have been installed on the surface, one at southern extremity of the mine and one at the auxiliary shaft serving the south and north lode areas respectively. These ventilators together circulate 10,000 m^3 per minute fresh air through the mine. The fresh air is regulated in underground work places by providing ventilation doors as per requirement.

Mine water is constituted by the small quantity of seepage of percolating ground water into the mine and water added due to mining activities, viz. drilling, filling etc. This water is collected in underground sumps from where it is pumped to surface storage tanks and re-circulated for industrial purposes to minimize the fresh water addition (excluding drinking).

The waste generated by mine development is partially used for filling of mine voids created by extraction of ore and rest is hoisted to surface and used for construction activities in the lease area or stacked at designated waste dump.

The lay out of mine is shown on LVS of mine in **Figure-2.6.18.**

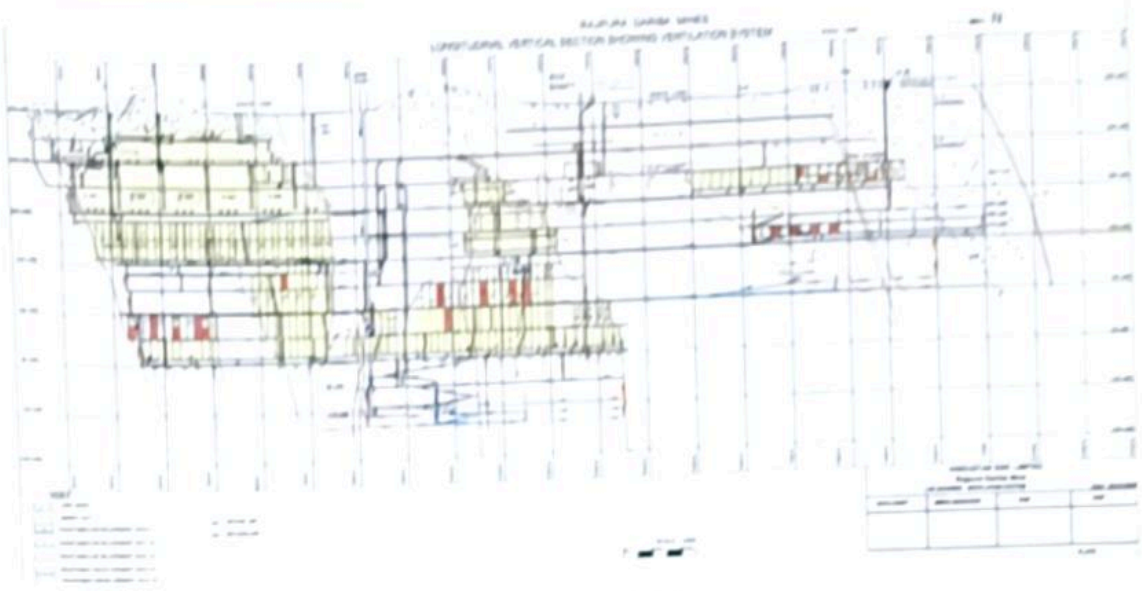


FIGURE-2.6.18
LONGITUDINAL VERTICAL SECTION SHOWING VENTILATION SYSTEM

2.6.4.20 Proposed Development for next Five Years

Besides development required for developing the stope panels in current mining block, developments for making new mining blocks additional ventilation raises and other associated mine developments will be carried out progressively. The year wise proposed development is given in following Table-2.6.5 and shown in **Figure-2.6.19.**

TABLE-2.6.5
YEAR WISE PROPOSED DEVELOPMENT (M)

Year	2010-11		2011-12		2012-13		2013-14		2014-15	
Area	Ore	Waste	Ore	Waste	Ore	Waste	Ore	Waste	Ore	Waste
South Lode South Block 100-180mRL & NL-1 Block 100 to 180mRL										
Ore (3X3)	815		540		400		400		400	
Waste(3X3)		270		180		135		135		135
Raise 2x2		55		55		55		55		55
Ramp 1in8 3x3, 4.3x3.5		0		0		0		80		160
NL2-L4 200 to 400mRL										
Ore (3X3)	870		540		540		670		670	
Waste(3X3)		1090		740		740		810		640
Raise 2x2		55		55		100		0		0
Raise 3x3		55		0		0		55		0
Ramp 1in8 3x3, 4.3x3.5		150		150		210		150		0
Lower Level -35 to -135mRL										

Year	2010-11		2011-12		2012-13		2013-14		2014-15	
Ore 4x3.5	0		290		480		480		480	
Waste 3.5x3.0		580		605		800		640		640
Raise 3x3		40		80		0		80		80
Ramp 1in8 4.3x3.5		380		0		0		0		0
East Lode 50 to 150mRL										
Ore 4x3.5	220		380		220		220		220	
Waste 3.5x3.0		410		560		760		960		260
Raise 2x2		0		150		150		90		60
Raise 3x3		35		0		60		0		0
Ramp 1in8 4.3x3.5		200		100		100		100		100
NL2-L4 100 to 200mRL										
Ore 4x3.5	0		0		165		250		410	
Waste 3.5x3.0		450		460		480		550		480
Raise 3x3		25		130		25		25		25
Ramp 1in8 4.3x3.5		160		80		80		80		80
Total Development (m)	**1905**	**3955**	**1750**	**3345**	**1805**	**3695**	**2020**	**3810**	**2180**	**2715**
Total Development (m)	**5860**		**5095**		**5500**		**5810**		**4895**	

The quantities are indicative & may vary depending upon delineation of ore body by exploratory drilling, as the development is progressively done.

2.6.4.21 Year Wise Proposed Ore Production

In the first two years production will be mainly obtained from current mining blocks only and shall be progressively enhanced with development of new stoping blocks in north lode L-1 below '0' mRL, NL 2- L 4 below 200mRL and east lode between 50 -150 mRL. The year wise and block wise production with estimated grades for first five year is given in **Table–2.6.6.**

TABLE-2.6.6
YEAR WISE PROPOSED PRODUCTION

(Tons)

AREA / BLOCKS	LEVEL	2010-11	2011-12	2012-13	2013-14	2014-15
South Lode	50-180	200000	200000	200000	150000	150000
North Lode L1	100-180	200000	105000			
North Lode L2-L4	200-350	190000	200000	200000	200000	175000
North Lode L2-L4	350-400		95000	100000	100000	100000
North Lode L2-L4	100 -180				50000	75000
North Lode L1 Lens	(-135 to -35)		150000	250000	250000	250000
East Lode	50-150	60000	100000	100000	100000	100000
Development		50000	50000	50000	50000	50000
	Total	**700000**	**900000**	**900000**	**900000**	**900000**
	%Pb	1.12	1.33	1.41	1.45	1.47
	%Zn	5.20	5.61	5.70	5.66	5.61
	Ag g/t	70	72	73	68	68

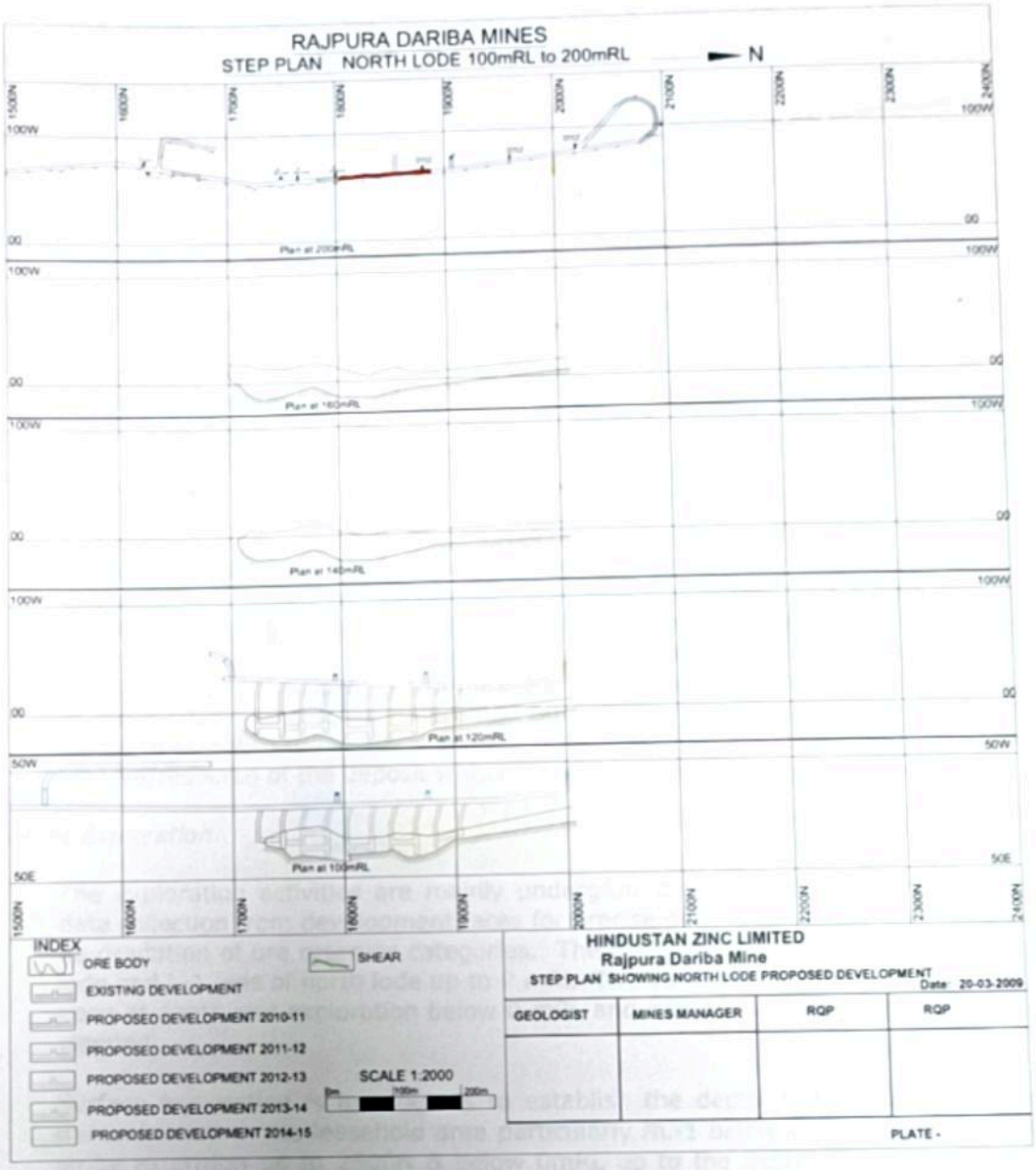


FIGURE-2.6.19
STEP PLAN-NORTH LODE 100MRL O 200MRL

The waste muck generated from mine development of ramp, footwall drives and cross cuts etc in barren is brought to surface and stacked at designated waste dump. The location of active waste dump is shown on the surface layout plan.

The mineralisation is strata bound and confined within well defined limits. As the total mineralized zone shall be stoped out as ore, hence there is no chance of generation of sub-grade minerals.

2.6.4.22 Proposed Rate of Production and Life of Mine

The mine is under production since 1983. The proposed rate of production will be 0.9mtpa, when the new stope blocks will be developed, from 2012-13. The anticipated life of mine will be about 18 years from the present year.

2.6.4.23 Conceptual Mining Plan

Rajpura Dariba Mine is under production since 1983. The winning of ore has been done by horizontal cut & fill mining leaving in between post and rib pillars in the south lode above 300 mRL. Subsequently Vertical Retreat Mining (VRM) and Blast Hole (BH) methods were adopted for higher ore recovery, safety and enhanced productivity.

The current mining block is under production are south lode & north lode L1 lens between 0 - 200 mRL by way of VRM & BH stoping method and north lode L2-4 lens above 200mRL. The total ore reserves and resources in the main & east lode stand at 24.20 million tons as on 01.02.2009. The mine life is anticipated as 18 years assuming 70% ore recovery at annual production rate at 0.9 million tons. However, the north lode L-1 below (-) 135 mRL and north lode L2-L4 below 100 mRL is open in dip direction and strike extension. Surface exploration is in progress in these blocks to establish the depth and strike continuity of mineralization and will enhance reserve/resource of the deposit which will increase the ultimate mine life.

2.6.4.24 Exploration

The exploration activities are mainly underground diamond drilling and geological data collection from development faces for precise delineation of ore boundaries and up-gradation of ore reserves categories. The diamond drilling is complete for south lode and L-1 lens of north lode up to 0 mRL. The north lode L-1 below (-) 110mRL is open at depth and exploration below 0 mRL and east lode between 0 to 100 mRL is planned.

Surface exploration is in progress to establish the depth and strike continuity of mineralization in the leasehold area particularly NL-1 below 0mRL and NL 2- L 4 in strike extension up to 2500N & below 0mRL up to the depth of (-) 400mRL. It is envisaged the resource enhancement in these blocks to about 6 t0 8 million tons for future detailed exploration and exploitation.

The underground exploration will be commensurate with the mine development/ production.

2.6.4.25 Exploitation

The ore production activities in south lode are complete between 450 mRL to 200 mRL & in north lode L-1 lens between 350mRL to 200mRL.

The ore body in south lode below 200 mRL is getting bifurcated and the mining block below 200 mRL in south lode is termed as North and South blocks respectively. In the North block the mining is nearly completed between 11 mRL & 180mRL.The production is in progress in S-lode S-block between 11-100 mRL.

In North Lode in L1 and L1 main lens the production between 100-180 mRL is in progress. The stope preparatory work will commensurate with the ore production in this block.

It is proposed to enhance the mine production progressively from current 0.6 million tons to 0.9 million tons per annum. Presently the mining activity is confined to main lode (South Lode & North Lode L1 lens above "0"mRL and in North Lode L2- L4 lens above 200 mRL).

The proposed enhancement in mine production will be met by development of new mining blocks in North Lode L1 lens between 0 – (-) 135mRL and North Lode L2-L4 lens between 100-200 mRL in the main Lode. Besides this the East Lode parallel to Main Lode between 0-200 mRL will be developed as a new mining block.

A ramp(decline) from surface may also be planned in future, which will ultimately connected to underground ramp system to facilitate the enhanced ore production, easy movement of mining machineries, materials and transportation of ore & waste from mine to surface.

2.6.4.26 North Lode L1 lens between 0 – (-) 135 mRL

The block contains about 1.9 million tons mineable reserves. The block will be approached by a ramp (1 in 8) from 11 mRL to (-) 100 mRL and approach/ service drive in the footwall of mineralisation will be developed. Development for Vertical Retreat Mining (VRM) / Blast hole stoping (BHS) stopes will be carried out through footwall drive. The ore will be transported by 20t diesel LPDT's through ramp to 11 mRL and dumped into the existing main ore pass for crushing to (-) 150 mm size and taken to surface through existing hoisting system.

2.6.4.27 North Lode L2-L4 lens between 100-200 mRL

In this area mining activity is confined up to 200 mRL. The new mining block between 100-200 mRL block will be developed through ramp. The existing haulage drive at 0 mRL will be extended up to this block. The haulage will be connected to 200 mRL level by long raises which will be used as ore passes. The ore will be transported to existing crushing and hoisting facility by Granby cars hauled by electric locomotive.

This block contains about one million ton mineable reserves. The mining will be carried out by post filled VRM/BHS method as is being practiced presently.

2.6.4.28 East Lode between 0 - 200 mRL

The East Lode mineralisation exists parallel to main lode at a distance of about 150m in the east in the leasehold area of Rajpura Dariba mine. This lens was explored by Geological Survey of India (GSI) and Hindustan Zinc Limited by surface exploratory drilling. Recently exploration drilling has been carried out from 100 mRL drive. Based on the subsurface exploration data, it is planned to develop new mining block between 0 – 200 mRL to enhance the mine production. This block contains about 1.6 million tons mineable reserves. The block will be approached at 50 and 100 mRL levels from the existing main lode developments. The mining method adopted will be post filled VRM/BHS. The ore will be transported to existing hoisting system by diesel operated LPDT's.

2.6.4.29 Waste & Sub-grade Mineral Management

The mineralisation is strata bound and confined within well-defined limits in the host rock. The immediate hanging wall & footwall of mineralized zone are totally devoid of mineralisation. As the total mineralised zone is stoped out as ore hence there is no chance of generation of sub grade minerals.

Waste rock, generated by mine development, will be partially used for filling the available mine voids, land reclamation and road construction within the acquired area and rest will be stacked at designated waste dumps in the industrial premises. Due care will be taken for stabilizing the waste dump by plantation in future.

Classified mill tailing, generated at beneficiation plant will continue to be used for filling the underground voids created by ore extraction. Slimes will continue to be stacked at existing tailing dam.

2.6.4.30 Open Cast Mines

No open cast operation / mining is being done as the ore body is deep seated about 100 m below the surface cover.

2.6.4.31 Underground Mining Operation

- **Mode of Entry**

Access to the mine is through Main and Auxiliary shaft. The Main shaft is 612m deep from the surface (500mRL) to (-) 112mRL. It is equipped with Tower mounted Kope Winder for Skip (740KW) and Cage Winding (236KW). The skip winder is equipped with two counter balanced 6t capacity skips and hoists ore from underground. On the other hand, the Auxiliary shaft extends from surface to 0mRL and is used for men/material winding only besides serving as a second outlet. It is provided with a 225KW Drum winder, which can hoist 3.5t of load at a time. 50m spaced main levels have been opened between 400 and 0mRL, and

each level is connected to both the shafts. Besides this out of two old inclines in the south from foot wall side of the deposit, one can be used up to 300mRL at the time of emergency as exit and which is closed at present by providing gate & kept locked.

The present two primary entries to the deposit cater the following services / requirements:

- Hoisting of mined out ore/waste from underground to surface.
- Provides access for men & material to mine
- Provide intake & exhaust for ventilating air
- Supply of mine services like power, compressed air, drilling water and drinking water supply line etc.

- **Present Ventilation System**

The main shaft serves as the primary intake airway. Two main mechanical exhaust ventilators have been installed on the surface, one at southern extremity of the mine and one at the auxiliary shaft serving the south and north lode areas respectively. These ventilators together circulate 10,000 m^3 per minute fresh air through the mine. The fresh air is regulated in underground work places by providing ventilation doors as per requirement.

2.6.4.32 Mining Method

- **Blast Hole Stoping Method (BHS)**

This mining method is being applied in the mining blocks where the ore body width is narrow and varying from 8 to 15m. The entire strike length is divided into 20m long panels, designated as primary and pillar stopes. The stopes are mined using Simba (57mm) for trough and DTH (115mm) holes for down drilling from the upper drill level. Blasting is done against a slot raise. The stopes are back filled with cement fill after removal of ore.

- **Development**

Entry to stoping area is through main level connected to main shaft & auxiliary shaft. The sill level is developed through a set of man passes and ore passes taken from the main haulage level. Extraction drive, ore drive and extraction x-cuts at sill level are of 3.0 x 3.0m size. The development of ore drive/ x-cuts of drill level are carried out from the footwall drive at that level. The drill drive and slot x-cut at this level are of 3.6m (height) x 4.2m (wide) size to accommodate DTH drill equipment.

- **Drilling & Blasting**

Trough drilling is carried out from trough drive at sill level using 57mm dia up-holes by Simba. Both spacing & burden in trough are kept 1.5 m. From upper drill level blast hole drilling is done by using 115m dia DTH machine. Spacing &

burden of blast holes is kept 3m & 3.5m respectively. Over-lapping of 1.0m is kept between Simba & DTH holes to avoid wedge formation. A slot raise of 2.0m x 2.0m size is developed by conventional raising from sill level at least 15m upwards. Similarly, another slot raise is excavated from drill level to connect the above-mentioned slot by drop-raising technique. After connection, the slot is widened to full width of the stope. Subsequent to this, blasting of trough holes commence and is followed by blasting of blast holes against the slot as shown in **Figure-2.6.20**.

- **Mucking & Haulage**

Electric LHD is used at sill level for extraction of ore through x-cut & dumped into the ore passes. The ore is then filled in Granby cars at the haulage level for dumping in main ore passes for subsequent underground crushing & hoisting to surface.

- **Filling**

Stopes are hydraulically filled with cement fill material after barricading of respective stope at the sill level. Perforated pipes of 4" dia are hung from upper to lower level for draining of water. Composition of fill is maintained at 1:10 of cement & classified mill tailing up to height of 7m from floor of sill level. This serves as a fill plug. After proper curing of the plug, the remaining void of the stope is filled with 1:20 of cement & classified mill tailing.

- **Vertical Retreat Mining (VRM)**

Vertical Retreat Mining (VRM) was adopted at Rajpura Dariba Mine in consultation with M/s INCO TECH of Canada to increase the safety of man & machineries, high productivity & higher ore recovery compared to Cut & Fill stoping method. This method was first adopted for the stoping of mining block of S-Lode between 212 mRL to 285 mRL. After successful implementation and results this method is being adopted in the current production block of South and North lodes between 11mRL to 180 mRL.

In the VRM block of 212 to 285 mRL total ore recovery was 84.95% in comparison to 69% ore recovery of 310-395 mRL cut and fill stopes. The less ore recovery in cut and fill stopes accounted to designed rib pillars, (5m wide) at the distance of 30m apart in strike and post pillars of (5m X 5m) at the distance of 15 m center to center in strike direction and 12 m center to center in dip direction. These pillars after stoping and back filling got embedded and are non-recoverable. In case of VRM the skin-to-skin stope blocks are mined without leaving rib and post pillar unlike cut and fill method.

The VRM method is being adopted in the ore blocks where the ore body width is more than 10m.

VRM stopes are mined using downward large dia hole (165mm) by ITH drills from upper levels. These holes are charged & blasted using spherical charge

technology. A slice of 2.5 to 3.0m blasted at a time, thus retreating in upward direction and mucking is done by electric LHD at sill level. The empty stopes are filled by classified mill tailing with cement. There is no change in blasting practices with respect to the approved scheme.

- **Development**

Entry to the stoping area is through main levels connected to main shaft & auxiliary shaft. The entire ore block has been divided into 15m wide block along the strike. Each stope is developed at 3 levels viz Sill (extraction) level, and two drill levels. The sill level 12 m above the main haulage level is developed through a ramp & set of man pass and ore passes, connecting the haulage & sill level. Sill level has x-cuts of size 8.0m (w) x 3.5m (h), 15 m apart centre to centre. Drill x-cut of the same size developed for each stope in the same fashion, at two drill levels for each stope block.

- **Drilling & Blasting**

Large dia blasting holes (165mm) are drilled by ITH drill machine as per pre-defined pattern, from the two drill levels. Spacing and burden of drill holes kept at 3.0m. All the holes are drilled along the dip of ore body. These holes are charged & blasted using spherical charge technology. 2.5 - 3.0m slice is blasted at a time, retreating in upward direction. After each blast, sufficient ore is removed to provide expansion room for the next blast (**Figure-2.6.21**).

- **Mucking & Haulage**

Large capacity 3.5 cu.yd Radio-remote controlled LHD's are being used for ore mucking at extraction level. Balance ore remains in the stope to provide support to the surrounding walls till the blasting is completed. The ore is hauled and dumped in to ore passes located in the footwall side. At haulage levels, diesel/ electric locomotives tram the train of Granby cars up to the main ore pass near the main shaft for crushing and hoisting of ore to surface.

- **Filling**

The voids thus created in the stope, is back filled to provide support to the surroundings wall. For this, barricades are constructed at the entrance of the x-cuts at sill level and intermediate drill level. A decant drainage system is established behind the barricade within the empty block by hanging flexible, perforated PVC pipes from upper levels. To prevent collapse of the filled stope walls, cement is added to increase the cohesion of the back fill. An initial pour of 1:10 cement to fill (by weight), stabilizes the barricade & act as a fill plug. Subsequent pours of back fill are made with a cement ratio of 1:20 till the empty void is completely filled. Later, mining of stope adjacent to these back- filled blocks is done (**Figure-2.6.22**).

- ***Tailing Disposal***

There will be a tailing disposal system along with fill plant. Tailings from floatation stream will be fed to hydro cyclones. The underflow (+37 micron) of cyclones at 65% solids will be collected in Fill Storage Tank (FST) to be used for mine back-fill (Figure-2.6.23). The overflow (-37 micron) of cyclones will be fed to high rate tailing thickener. From thickener the thickened slurry will be pumped to tailing dam via tailing disposal pumps.

The tailing is the only waste generated from the mine due to beneficiation of the lead-zinc ore. The tailing is stored in existing tailing dam located at a distance of 3.0 km from having an area of 82 ha within the acquired land and have sufficient storage capacity for next twenty years. The material for construction of the tailing dam consists of mine waste and sand and tailing.

Tailing from beneficiation plant after recovery of Lead and Zinc concentrates will be sent to tailing thickener for dewatering. Water recovered from tailing thickener will be recycled to beneficiation plant for use in the process. Tailing thickener underflow will be partly used as backfill for mines and remaining part will be disposed to tailing dam located 3 K.M away from the plant. Water from tailing dam will colleted through filter bed on the downstream side of the tailing dam and it will be pumped to plant for reuse in the process. The tailing line length will be approx. 5-km and the dia of the pipe will be 8/10" consisting of three lines.

The height of the existing tailing dam will be raised progressively for storage of tailing generated from beneficiation plant. Water in the tailing dam is allowed to settle out, is reclaimed on continuous basis and pumped to the water reservoir for re-use for the process. No water is allowed to discharge outside the dam to maintain zero discharge. The quality of the water is regularly monitored through piezometers installed around the tailing dam.

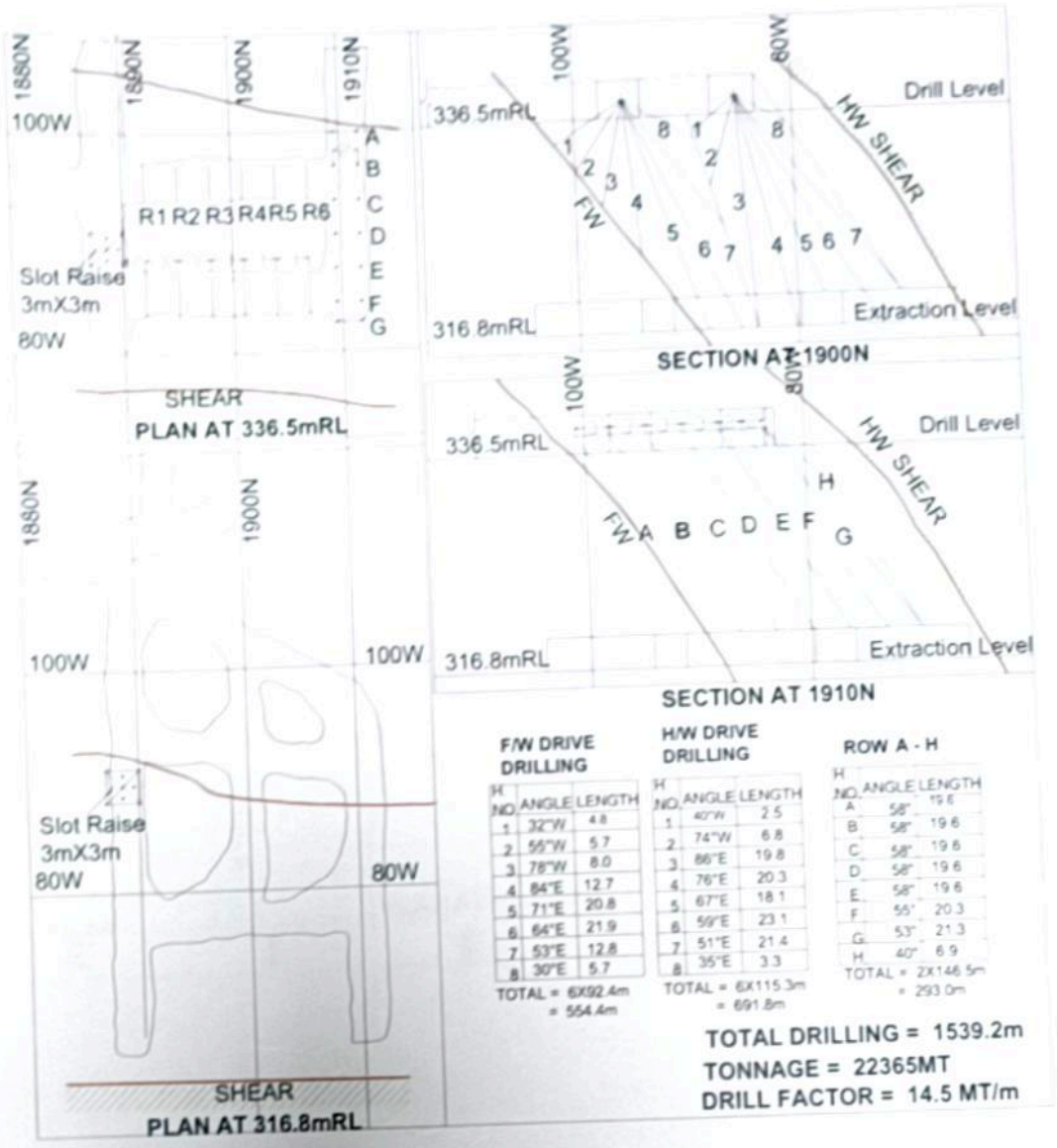


FIGURE 2.6.20
BLAST HOLE STOPING METHOD

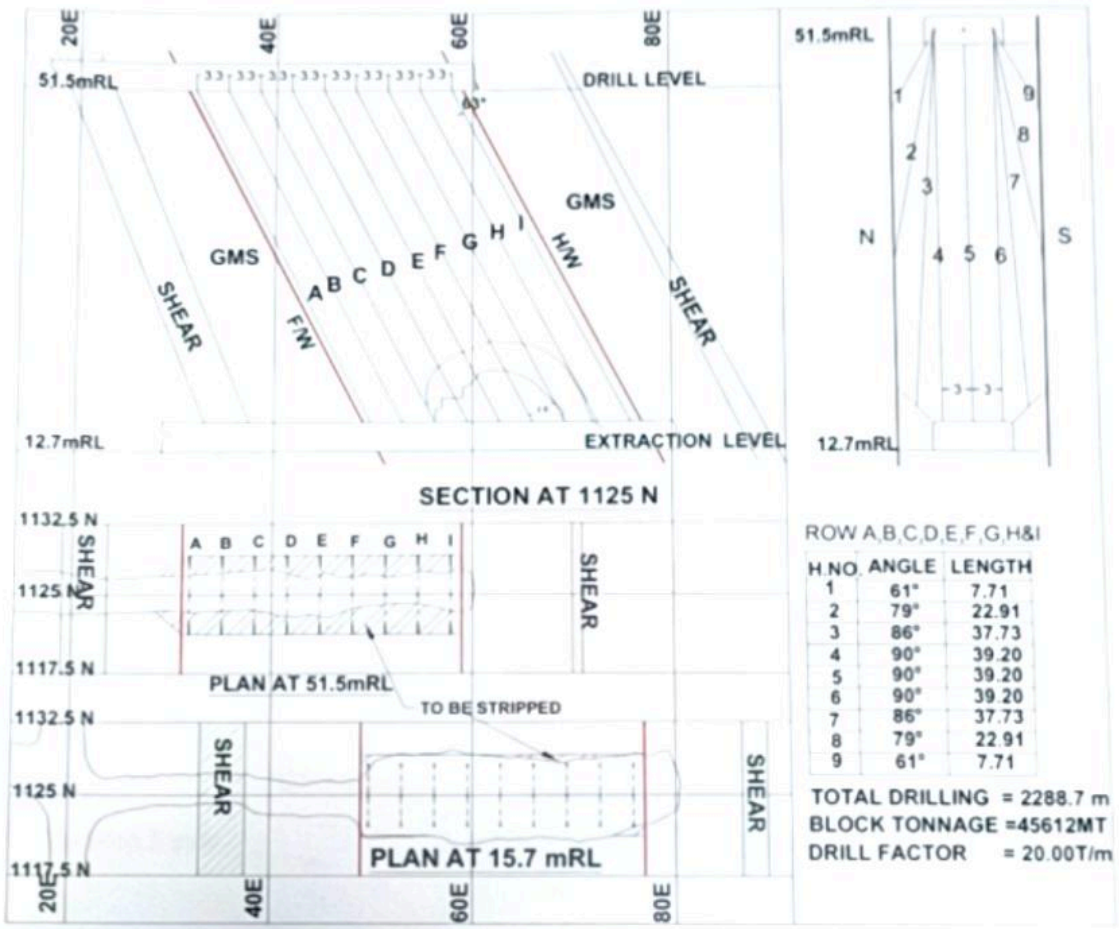


FIGURE 2.6.21
VERTICAL CRATER RETREAT MINING METHOD

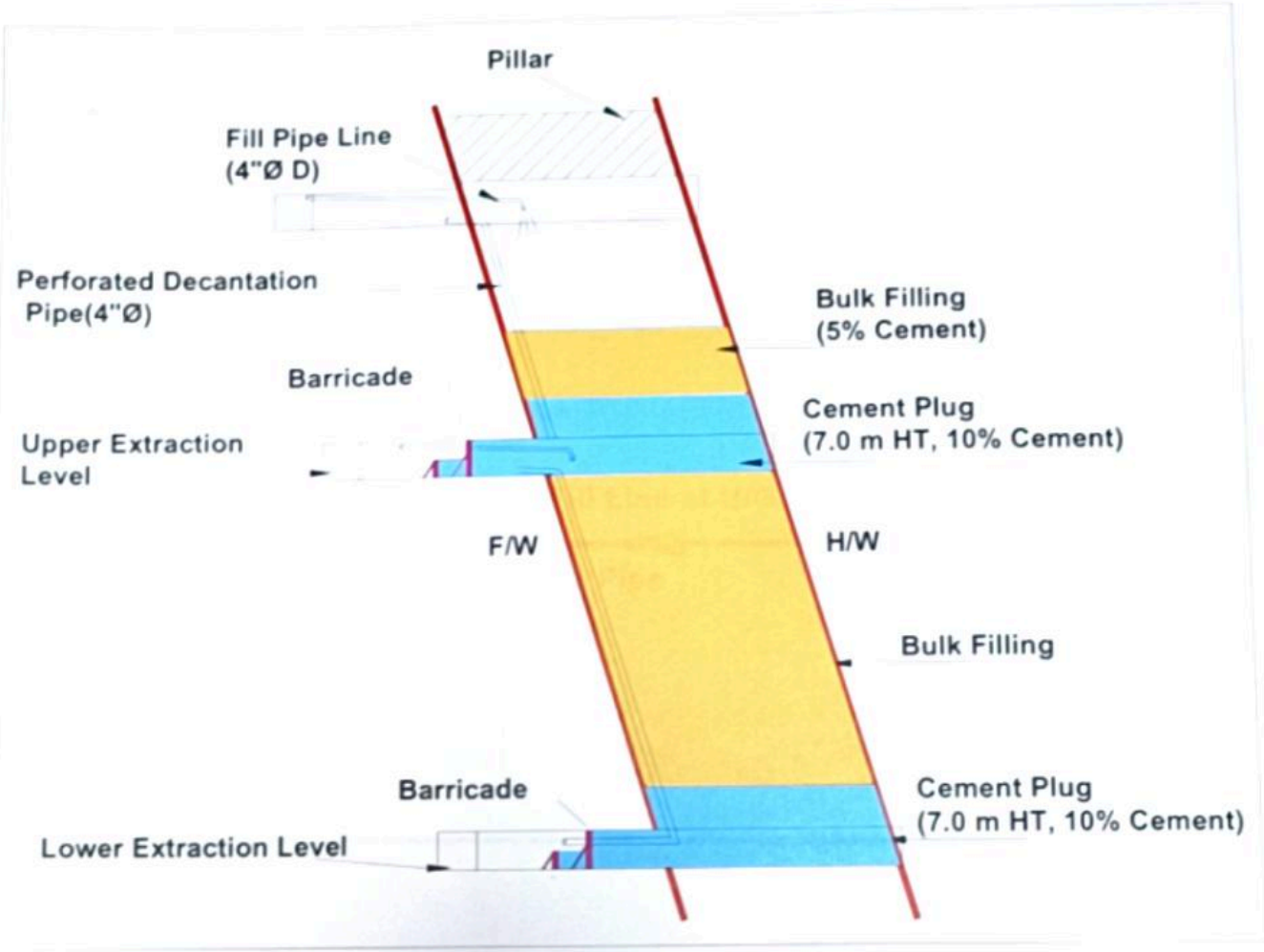


FIGURE-2.6.22
STOPE FILLING SYSTEM

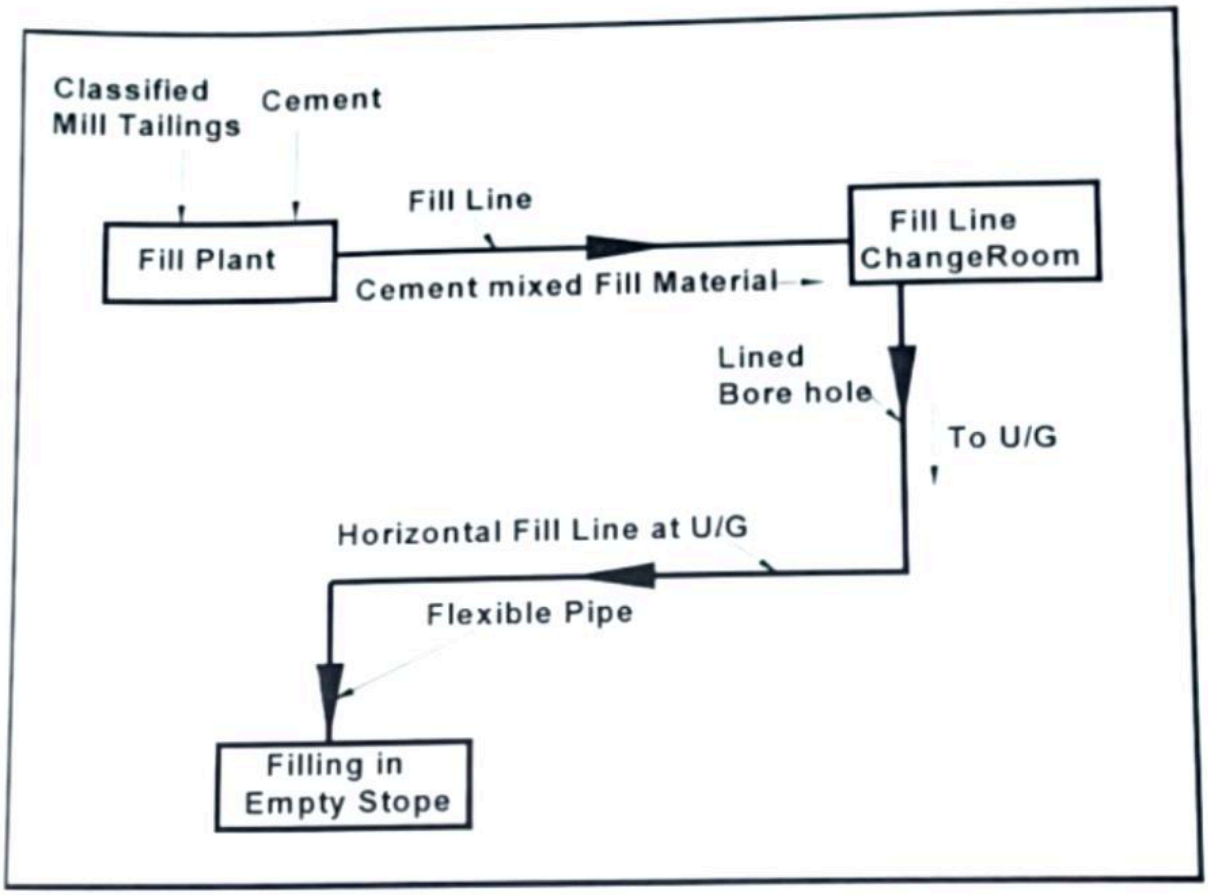


FIGURE-2.6.23
FILL RETICULATION

- **Strata Control Monitoring**

To monitor the stability of strata surrounding the VRM stopes, instrumentation is done in hanging wall & the crown pillar. Multipoint borehole extensometers are installed from the hanging wall drive along the ore body in order to measure any movement in the immediate hanging wall. The crown pillar of the stoping block is being monitored with vibration wire stress-meters to determine the gradual build-up of stresses across the ore body due to stoping.

A full-fledged Rock Mechanics Cell (RMC) provides support system analyses, excavation design analysis and recommendations for mine modelling. Multi-point Borehole Extensometers (MPBES) and Vibrating Wire Stress meters (strain gauge type) and support testing equipments are installed to monitor back of cut & fill stopes, hanging wall and crown pillar of VRM stopes. Ground vibration analyses, blast charge designing, fill quality testing and rock strength determination is regularly carried out. Mine modelling is done with the help of FLAC, UDEC, PHASES and EXAMINE software.

2.6.4.33Future Mine Expansion Scheme

It is proposed to enhance the mine production progressively from current 0.6 million tons to 0.9 million tons per annum. Presently the mining activity is confined to main lode (South Lode & North Lode L1 lens above "0"mRL and in North Lode L2- L4 lens above 200 mRL).

The proposed enhancement in mine production will be met by development of new mining blocks in North Lode L1 lens between 0 – (-) 100mRL and North Lode L2-L4 lens between 100-200 mRL in the main Lode. Besides this the East Lode parallel to Main Lode between 0-200 mRL will be developed as a new mining block.

- ***North Lode L1 lens between 0 – (-) 100 mRL***

The block contains about 1.9 million tons mineable reserves. The block will be approached by a ramp (1 in 8) from 11 mRL to (-) 100 mRL and approach/ service drive in the footwall of mineralisation will be developed. Development for Vertical Retreat Mining (VRM) / Blast hole stoping (BHS) stopes will be carried out through footwall drive. The ore will be transported by 20t diesel LPDT's through ramp to 11 mRL and dumped into the existing main ore pass for crushing to (-) 150 mm size and taken to surface through existing hoisting system.

- ***North Lode L2-L4 lens between 100-200 mRL***

In this area mining activity is confined upto 200 mRL. The new mining block between 100-200 mRL block will be developed through ramp. The existing haulage drive at 0 mRL will be extended upto this block. The haulage will be connected to 200 mRL level by long raises which will be used as ore pass. The ore will be transported to existing crushing and hoisting by Granby cars hauled by electric locomotive. This block contains about one million ton mineable reserves.

The mining will be carried out by post filled VRM/BHS method as is being practiced presently.

- ***East Lode between 0 - 200 mRL***

The East Lode mineralisation exists parallel to main lode at a distance of about 150m in the east in the leasehold area of Rajpura Dariba mine (Fig.-2.19). This lens was explored by Geological Survey of India (GSI) and Hindustan Zinc Limited by surface exploratory drilling. Recently exploration drilling has been carried out from 100 mRL drive. Based on the subsurface exploration data, it is planned to develop new mining block between 0 – 200 mRL to enhance the mine production. This block contains about 1.6 million tons mineable reserves. The block will be approached at 50 and 100 mRL levels from the existing main lode developments. The mining method adopted will be post filled VRM. The ore will be transported to existing hoisting system by diesel operated LPDT's.

2.6.4.34 Mine Ventilation

The main shaft serves as the primary intake airway. Two main mechanical exhaust ventilators have been installed on the surface, one at southern extremity of the mine and one at the auxiliary shaft serving the south and north lode areas respectively. These ventilators together circulate 10,000 m^3 per minute fresh air through the mine. The fresh air is regulated in underground work places by providing ventilation doors as per requirement.

A detailed study of ventilation requirement of future expanded mine to determine fan and airways sizes have been carried out with the following assumptions:

- Population of major mining equipments;
- Air requirement for diesel emission dilution ;
- 20t truck used for development waste – used in level and sublevel; and
- Use of Diesel LHD.

During mine development auxiliary ventilation system will be used. Additional auxiliary ventilators will be provided at the working faces for adequate supply of air in all parts of the mine and prevention of noxious gases produced and excessive rise of temperature or humidity to ensure required ventilation of the mine.

2.6.4.35 Extent of Mechanisation

The mine development is being carried out using combination of Jack hammer machine, Drill jumbo and LHD. In stopes, for production drilling Simba, DTH and ITH machines are being used. For mucking electric LHD and diesel LHD's are being deployed. The ore is hauled at haulage level by electric/ diesel locomotive and 5t Granby cars and dumped in to the main ore pass. The ore is crushed to (-) 150mm by primary double toggle jaw crusher and hoisted to surface through main shaft by two counter balanced 6t skips. For mine expansion and development of new mining blocks few diesel operated LHD, LPDTS will be added.

The list of major mining machineries & equipment is given in **Table-2.6.7.**

TABLE -2.6.7
LIST OF MINING MACHINERIES IN USE

Sr. No	Type of Machinery & Name	HP	Qty.	Total HP	Place of Installation
1	Main Cage Winder	315	1	315	Main Shaft Winding Engine Room
2	Skip Winder	992	1	992	Main Shaft Winding Engine Room
3	Auxiliary Shaft Winder	300	1	300	Aux.Shaft Winding Engine Room
4	Compressor	550	5	2750	Compressor House
5	Ventilation Fan	350	1	350	South Ventilation Fan House
		215	1	215	North Ventilation Fan House
6	Dewatering Pumps	150	7	1050	300 mRL Pumping Station (One for South Lode & 1 for North Lode)
		240	3	720	0' mRL South, One for 300 mRL
7	Diesel Locomotives	96	2	576	300 / 200 mRL
8	Jaw Crusher	200	1	200	-35 mRL
9	Belt Conveyors	40	1	40	-55 mRL
10	Surface Conveyors	80	2	160	Surface
11	ITH Drills	30	3	90	100/150mRL
12	Booster Compressor	80	3	240	100/150 mRL
13	Wagner Remote Control LHDs - Model EST 3½ each	100	4	400	50mRL- 1 Nos, 100 mRL - 2 No. each
14	Wagner LHDS- Model EST - 2D	75	1	75	200 mRL North
15	Trolley Wire Locomotive	170	2	340	0' mRL

2.6.4.36 Transportation of Ore to Destination

The mined out ore is brought out side the mine by 6t skips through main shaft and transported by conveyor system to RD Mine beneficiation plant. The different oprations in the mine are shown in flowsheet as **Figure-2.6.24.**

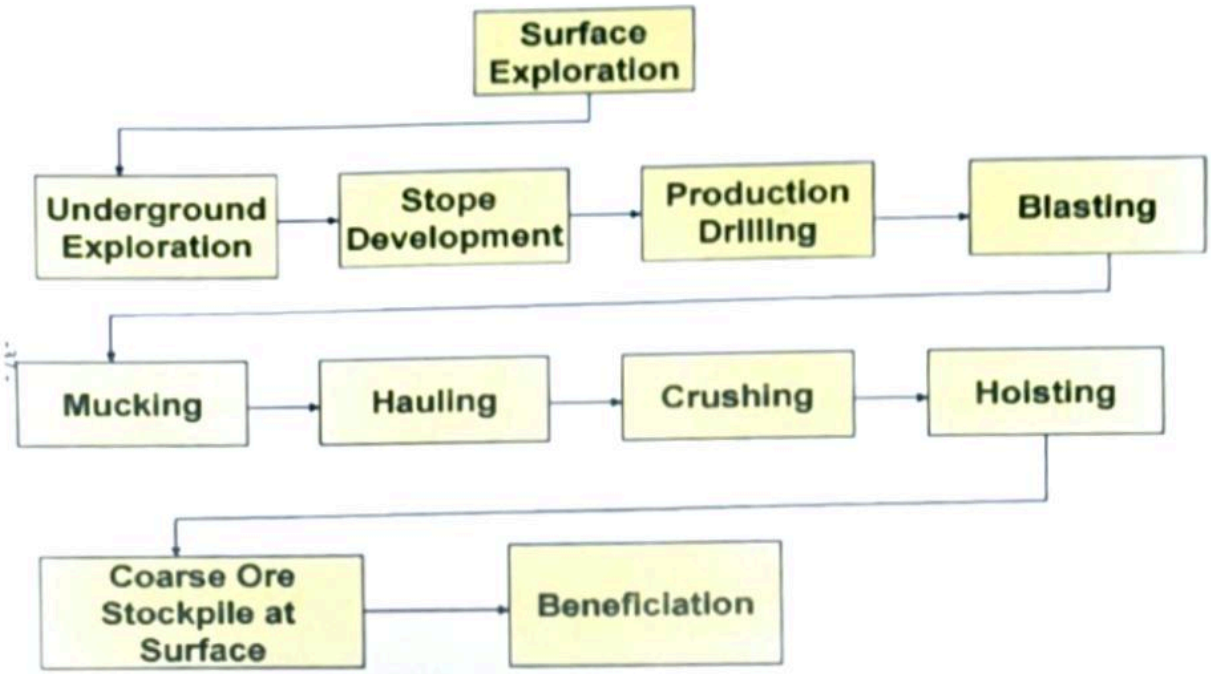


FIGURE-2.6.24
PROCESS OF MINING ACTIVITIES

2.6.4.37 Blasting

In the development faces, dimensions will vary from 3mX3m to 4.5mX3.5m, and will be blasted by drilling 36/45 mm dia holes in burn cut fashion. Parameters of drilling and blasting are as follows:

Face Dimensions:	3.0m X3.0m to 4.5mX3.5m
Nos. of holes / face	45 to 56
Diameter of the hole:	36/45mm
Explosive used	Cartridge Emulsion explosive of 25/40mm dia
Length of the hole	1.5 to 3.0 m
Explosive consumption	3-4 kg/m^3
Face advance	1.0 -2.5m
Total tonnage	27-47.25 t/m of pull
Powder factor	1.0-1.4

Stope Blasting:

BHS

Dia of the hole:	115 mm
Explosive used	Emulsion Explosive (83mm dia)
Max. Length of the hole	27m
Drill factor	10 t/m
Max. Charge per delay	for 115mm dia hole: 600kg
Face advance	2.5m
Total tonnage	Approx. 3000 t/ring for 20m average width of ore body
Powder factor	0.40-0.50 kg/t

VRM

Dia of the hole:	165 mm
Explosive used	Emulsion Explosive (125mm dia)
Max. Length of the hole	55m
Drill factor	15 t/m
Max. Charge per delay	600kg
Face advance	3.0m
Total tonnage	Approx. 2700 t/blast for 20m average width of ore body
Powder factor	0.40-0.50 kg/t

2.6.4.38 *Type of explosive to be used*

- **Face Blasting**

25/40mm Cartridge Emulsion Explosive with half second electric delay detonators

- **Stope Blasting**

83/125 mm Cartridge Emulsion Explosive with 200-400g booster charge. Initiation by non-electric detonators.

- **Powder factor in ore and barren (O/B)**

In development 1.07-1.40 kg/t
In stope blasting 0.40-0.50 kg/t

2.6.4.39 *Secondary Blasting*

The large sized boulders are required to be fragmented before loading dumping in to ore passes. Secondary blasting will be done in underground only in safe manner.

2.6.4.40 *Storage of Explosives*

Explosive shall be stored in an appropriate magazine approved from respective authority and the explosive is carried to mine by approved licensed vehicle.

2.6.4.41 *Blast Vibration Monitoring*

To control blast vibrations within permissible limits each ring in the stope is being blasted in multiple stages, so that the blast vibrations are kept within safe limits. Care shall be taken to maintain through proper hole measurement, charge length, stemming and adequate delay in holes. Adequate numbers of detonators are used to keep the charge per delay in permissible limit. The blast vibrations are monitored by geophones and microprocessor, which gives both amplitude and frequency distribution.

2.6.4.42 *Mine Drainage*

Mine water is constituted by the small quantity of seepage of percolating ground water into the mine and water added due to mining activities, viz. drilling, filling etc. This water is collected in underground sumps at '0' and 300mRL, from where it is pumped to surface storage tanks and re-circulated for industrial purposes to minimize the fresh water addition (excluding drinking).

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.

2.6.4.43 Stacking of Mineral Rejects and Disposal of Waste

The mineralisation is strata bound and confined within well-defined limits in the host rock. The immediate hanging wall & footwall of mineralized zone are totally devoid of mineralisation. As the total mineralised zone is stoped out as ore hence there is no chance of generation of sub grade minerals.

Waste rock, generated by mine development, will be partially used for filling the available mine voids, land reclamation and road construction within the acquired area and rest will be stacked at designated waste dumps in the industrial premises. Due care will be taken for stabilizing the waste dump by plantation in future.

Classified mill tailing, generated at beneficiation plant will continue to be used for filling the underground voids created by ore extraction. Slimes will continue to be stacked at existing tailing dam.

- **Nature of Waste**

The muck generated from the development heading would be dolomite calc biotite schist and graphite mica schist.

- **Stacking of Sub Grade Minerals**

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

- **Selection of Site for Stacking**

Following factors have been considered while selecting the site for stacking of waste:

- It will develop plain area near mining activity.
- The waste dump shall not have any visual impact

2.6.4.44 Use of Minerals

The combined lead-zinc ore is separated and enriched into respective concentrates by physical processes of grinding and froth floatation. The respective concentrates are dispatched to company's smelters viz. Debari Zinc Smelter, Vishakhapatnam Zinc Smelter or to Chanderia Lead-Zinc Smelter for recovery and refining of metals.

- **Mining Closure Plan**

The land put in use for mining and allied activities in mining lease area is 109.27 ha. The present land use pattern is as given in **Table-2.6.8**.

- **Disposal of Mining Machinery**

Mining machineries after their useful life are being disposed off by use at company's other units/sites by inter unit transfer or auction etc. the same procedure will continue in future also.

TABLE-2.6.8
MINE CLOSURE PLAN

Particulars	Within Lease Area(ha)	In Acquired Land outside Lease Area(ha)	Total Area (ha)
A) OPERATIONAL USE			
MINE			
a) Mine/Industrial Area (Mine Infrastructure, beneficiation plant, workshops and other office buildings.)	58.62	0.00	58.62
b) Old Mine Premise (Sala Mill, incline, vent. Fan etc.)	7.32	0.00	7.32
c) Main Explosive Magazine	1.56	0.00	1.56
a) Old Tailing Dam	3.02	0.00	3.02
b) Core shed	0.06	0.00	0.06
c) Tailing pipeline	1.78	0.05	1.83
d) Tailing Dam (Main)	0.00	82.00	82.00
SUB TOTAL	**72.36**	**82.05**	**154.41**
SMELTER COMPLEX			
a) Zinc Plant	22.64	11.36	34.00
b) Lead Plant	20.15	8.43	28.58
c) Captive Power Plant	0.00	18.86	18.86
d) Utilities (ETP, RO etc)	0.42	6.04	6.46
e) Hazardous Waste Disposal Site	53.00	0.00	53.00
f) Others(Open space & internal roads)	3.10	18.00	21.10
SUB TOTAL	**99.31**	**62.69**	**162.00**
TOTAL (A)	**171.67**	**144.74**	**316.41**
B) OTHER USE Residential Colony, welfare buildings and internal roads	41.41	2.86	44.27
TOTAL (A+B) Considered for financial assurance	**213.08**	**147.60**	**360.68**
(C) Public roads and open spaces	15.58	3.98	19.56
(D) Green Belt (Plantation in residential, tailing dam and mine/industrial premise areas.)	134.00	16.00	150.00

2.6.5 Ore Beneficiation

The mineral beneficiation process remains the same as present process of crushing, grinding and selective froth floatation of lead & zinc concentrates.

The coarse ore stockpile is of 2500t live capacity. This ore is crushed to (-) 16mm size in two stages by one secondary and two tertiary cone crushers in close circuit with a double deck vibrating screen which is then conveyed to a 10,000t live capacity fine ore stockpile. Fine ore is wet ground to 60-65% (-) 74mm size by three 900tpd (3.3m dia by 4.5m long) and one 400tpd (2.7m by 3.6m) ball mills in close circuit with 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 vacuum disc filters for dewatering and then conveyed to separate stockpiles for onward despatch.

Typical assays of Lead and Zinc concentrates are around 51% and 51.5% with a recovery of 65% and 82% respectively.

A computerised Process Control System along with an automated Grinding Circuit Control, In-stream analysis (ISA) and instrumentation for other parameters is in use for improving metallurgical efficiency.

2.6.5.1 Change Made In Beneficiation Plant

During the scheme period (2005-06 to 2008-09) two RV drum filters having capacity of 10t/hr have been installed one each for zinc and Lead concentrate to reduce the moisture content for better handling and storage. Multi Stream Analyser (MSA) has been installed for monitoring and control the quality of the product. The In stream Analyser (ISA) probes were also changed for feed and tailing circuits for continuous monitoring of the process. Renovation of the floatation cells and modification in lay out of floatation circuit carried out for better process control.

2.6.5.2 Capacity Enhancement of Beneficiation Plant

For the proposed expansion of beneficiation plant from 0.9 MTPA to 1.2 MTPA (3000 TPD to 4000 TPD) same process technology and methodology will be used. The best in class equipments and technologies would also be adopted for achieving the optimum metallurgical performance and the lowest operating cost. The layout of proposed expansion of beneficiation plant for enhancement of milling capacity and Flow sheet after expansion is given in **Figure-2.6.25 & 2.6.26.**

2.6.5.3 Secondary and Tertiary Crushing

Run of Mine Ore of 150 mm size crushed at R.D.Mine and S K Mine in jaw crusher will be taken to coarse ore stockpile which has live capacity of 2500 MT and five nos. of reciprocating feeders is provided for withdrawal of ore from stockpile. Existing secondary crusher will be replaced with higher capacity standard head cone crusher along with scalping screen, and one additional tertiary short head cone crusher with vibrating screen will be installed to meet the additional crushing requirement i.e. from 3000 to 4000 TPD. New Venturi type dust collector

system will be installed to suppress the dust effectively and to keep clean environment. The flow diagram of the crushing plant is shown in **Figure 2.6.27.**

2.6.5.4 Wet Grinding and Classification

A new grinding circuit of existing type 900 TPD Ball Mill (4.4X3.3 m) will be installed to produce total output of 4000 TPD. The list of proposed equipments at beneficiation plant are given in **Table 2.6.9.**

TABLE-2.6.9
LIST OF MAJOR EQUIPMENTS AT BENEFICIATION PLANT

Particulars	Present	Proposed for Expansion	Total after Expansion
Secondary standard head cone crusher	1	0	1
Tertiary short head cone crusher	2	1	3
Vibrating Screens	2	0	2
Dust Collection system	1	1	2
Ball Mill 3.3 x 4.5 meter of 900 TPD	3	1	4
Flotation Stream of 900 TPD	4	1	5
Rotary Vacuum Drum Filter	2	2	4
Air Blower	3	1	4
Tailing Batteries	3	1	4
Tailing Lines	3	1	4

2.6.5.5 Froth Flotation

Additional stream of 900 TPD flotation cells will be added to treat the product from new 900 TPD ball mill. The total flotation capacity will be enhanced to 4000TPD. The flotation circuit will be automated using state-of-art instrumentation and process control technology in order to optimize concentrate grades and recoveries.

Thickening and Filtration

Existing thickeners will be retrofitted with HRT (High Rate Thickeners) mechanism to handle lead & zinc concentrates and tailings generated from expanded plant.

Two additional drum filters will be installed out of which one will handle additional Zinc concentrate and one will handle additional lead concentrates produced.

Process Instrumentation and Automation

A highly automated/instrumented process control has been envisaged in the beneficiation plant design. Salient features of the process instrumentation are as below:

- In Stream Analysis System for online measurement of elements concentration in feed, concentrates and tailing streams.
- Suitable operating system is designed to optimize, stabilize and control individual unit operations as well as the entire plant.

LAYOUT FOR 6000 TPD LEAD ZINC BENEFICIATION PLANT

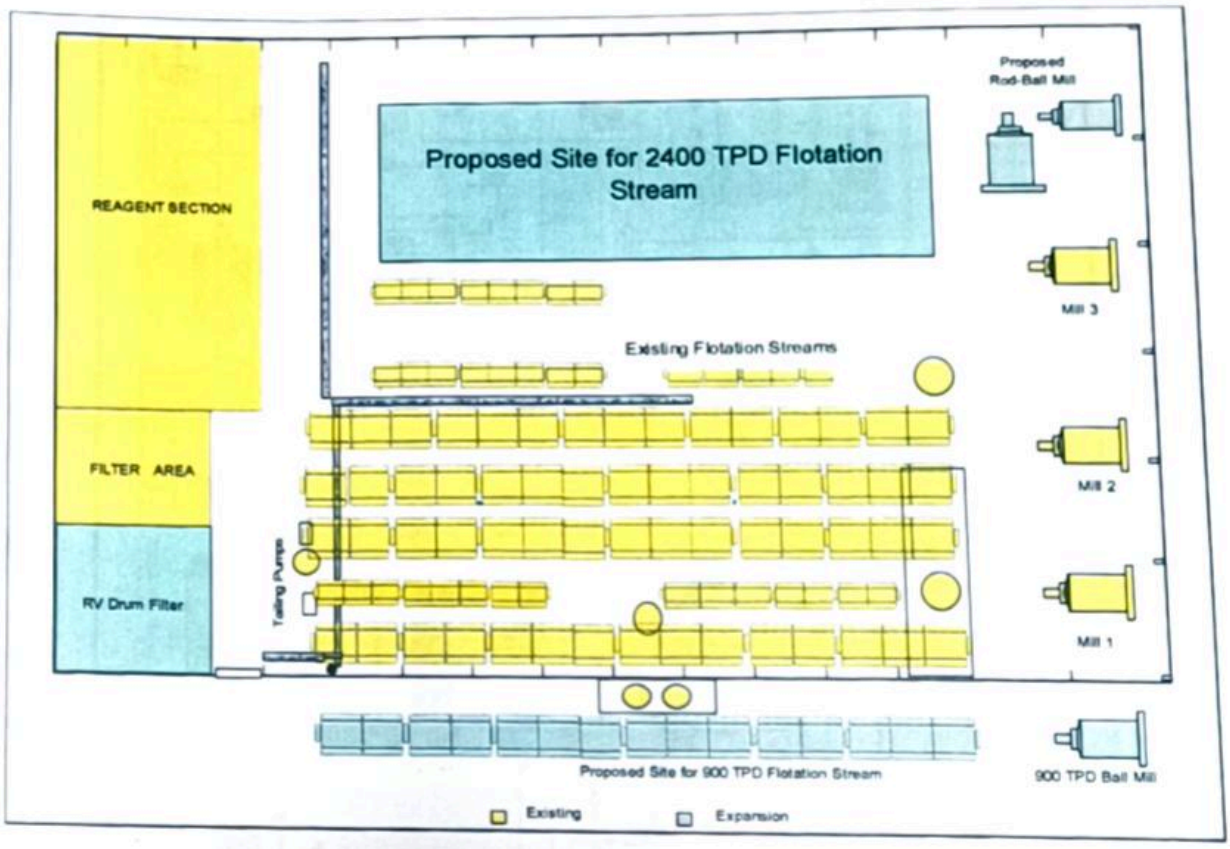


FIGURE-2.6.25
LAYOUT FOR 6000 TPD LEAD ZINC BENEFICIATION PLANT

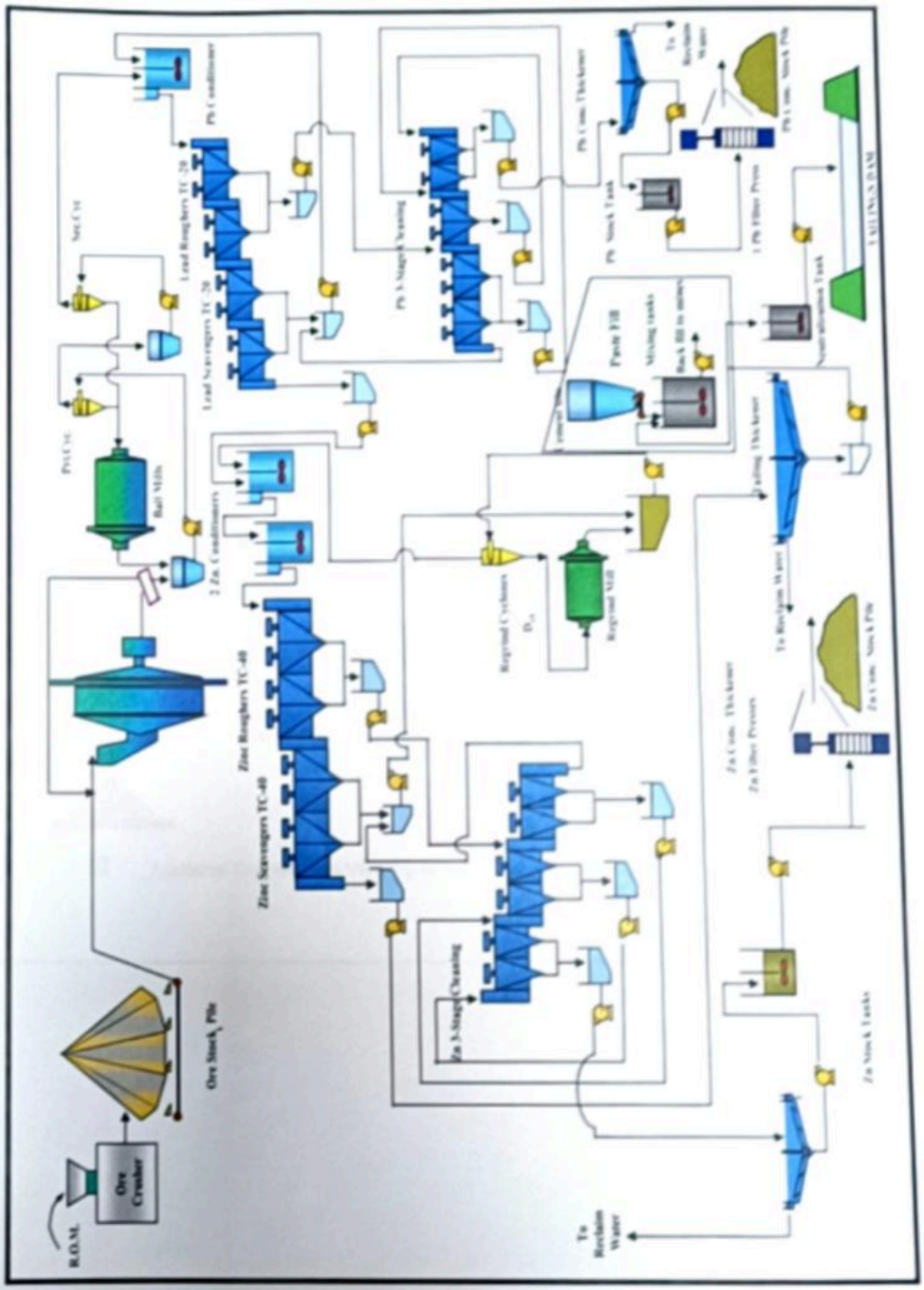


FIGURE-2.6.26
PROPOSED BENEFICIATION FLOW SHEET

Flow Diagram of 6000 TPD Crushing Plant

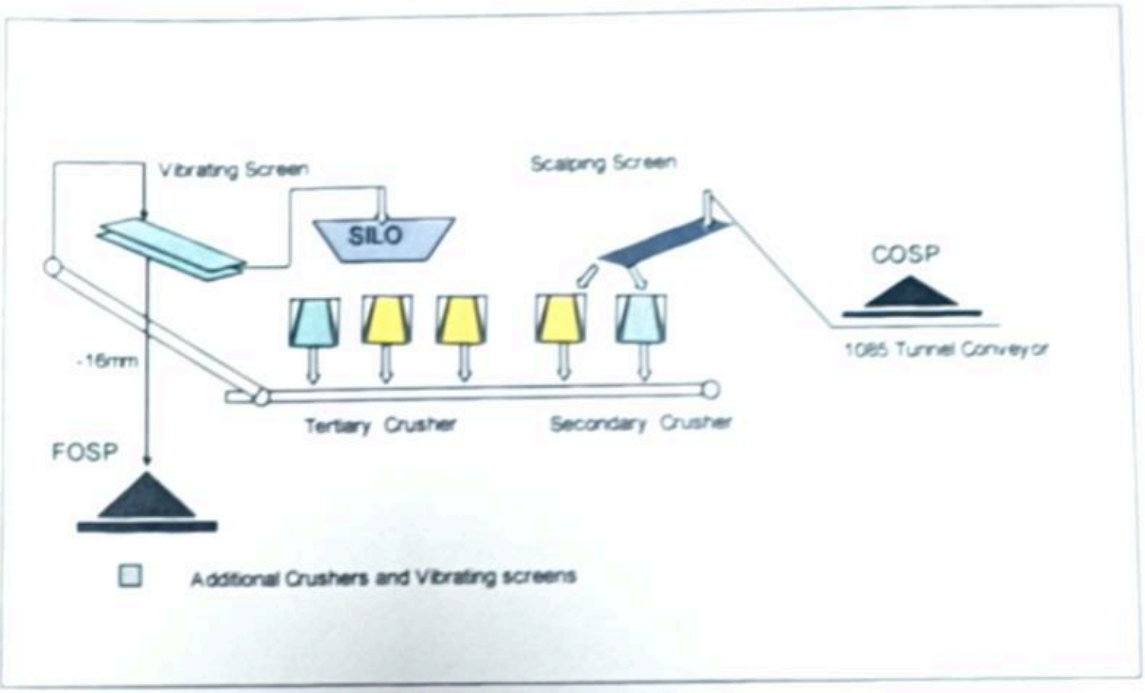


FIGURE-2.6.27
FLOW DIAGRAM CRUSHING PLANT

Chapter-3

Baseline Environmental Status

3.0 BASELINE ENVIRONMENTAL STATUS

This chapter illustrates the description of the existing environmental status of the study area with reference to the prominent environmental attributes. The study area covers the area falling within 10-km radius around the existing and proposed complex.

The existing environmental setting is considered to adjudge the baseline environmental conditions, which are described with respect to climate, hydro-geological aspects, atmospheric conditions, water quality, soil quality, vegetation pattern, ecology, socio-economic profiles of people, land use. The objective of this section is to define the present environmental status. This would help in assessing the environmental impacts due to the proposed Integrated complex.

This report incorporates the baseline data monitored from 1st December 2007 to 31st May 2008 and 1st October to 31st November 2008 covering Winter season 2007-2008, Pre-Monsoon and Post-Monsoon seasons 2008. Secondary data was collected from various Government and Semi-Government organizations.

Environmental attributes are given in **Table-3.0.1.**

3.1 Meteorology

The meteorological data recorded during the monitoring period is very useful for proper interpretation of the baseline information as well as for input prediction models for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region.'

The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-monsoon season : March to May
- Monsoon season : June to September
- Post-monsoon season : October to November

On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected at site every hour continuously from 1st December 2007 to 31st May 2008 and 1st October 2008 to 31st November 2008 covering Winter season 2007-2008, Pre-Monsoon and Post-Monsoon seasons 2008. The generated data is then compared with the meteorological data generated by nearest India Meteorological Department (IMD) station located at Udaipur located at a distance of approximately 65 -km.

3.1.1 Methodology

The meteorological parameters were recorded on hourly basis during the study period and include 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-3.1.1.**

TABLE-3.0.1
ENVIRONMENTAL ATTRIBUTES AND FREQUENCY OF MONITORING

Sr. No	Environmental Component	Sampling Locations	Sampling Parameters	Total Sampling Period	Sampling Frequency	Methodology
1	Meteorology	One central location	Temperature Wind Speed, Wind Direction	3 seasons	Hourly	The meteorology Parameters were recorded using automatic micro-meteorological equipment consisting of Anemometer, Wind wane and thermometer. Review of secondary data collected from IMD station at Udaipur.
			Rainfall	3 seasons	Daily	Rainfall was recorded every morning at 0830 hours
			Relative Humidity, Cloud Cover	3 seasons	Hourly	Humidity recorded using wet and dry thermometer and psychometric charts on hourly basis.
2	Ambient Air Quality	16 locations	SO_2, NOx, CO, SPM, RPM, Lead, Zn,Cd	Two days per week for 8 months	24 H	Gravimetric method for SPM and RPM. Modified West & Gaeke method for SO_2 (IS-5182 part-II 1969) using Tetrachloro mercurate 0.01 N absorbing solution. Jacob-Hochheiser method (IS-5182 part-IV 1975) for NOx using Sodium Arsenate absorbing solution of 0.01 N absorbing solution. CO was measured by GC method. Trace metals were analysed by using ICP.
2a	Dust fall	10 locations	Dust	One month in each season	-	-

Sr. No	Environmental Component	Sampling Locations	Sampling Parameters	Total Sampling Period	Sampling Frequency	Methodology
3	Water Quality	18 locations	As per IS:10500-1991	Grab sampling	Thrice during study period	As per APHA methods. The conductivity, temperature were analyzed at site laboratory and rest of the Parameters were analyzed at VIMTA's Central Laboratory at Hyderabad.
			Heavy metals (As, Hg, Pb, Cd, Cr^{+6}, Total Cr, Cu, Zn, Se, Fe)	Grab sampling	Thrice during study period	
4	Noise	10 locations	Leq	24 h composite	Once during study period	Integrated on hourly basis
5	Soil	8 locations	Soil profile, Chemical constituents, Suitability for agricultural growth	Composite sample	Once during study period	Analysis was carried out as per Soil Chemical analysis by ML Jackson
6	Terrestrial Ecology	Total study area	Flora and fauna	Field observations	Once during study period	Through field visits and collected secondary data. List count and quadrate method
7	Demography and Socio-economic aspects	Total study area	Demographic profile	-	-	Through field visits and secondary information sources like National Informatics Centre, Delhi and Census operation division
8	Land Use	Total study area	Trend of land use change for different categories	-	-	Through field visits and secondary information sources like National Informatics Centre, Delhi and from satellite imagery.
9	Geology	Total study area	Geological history	-	-	Secondary sources
10	Hydrogeology (Surface and ground)	Total study area	Drainage pattern, nature of streams, aquifer characteristics, recharge and discharge areas	-	-	Secondary sources

TABLE-3.1.1
SUMMARY OF METEOROLOGICAL DATA GENERATED AT SITE

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Cloud Cover (Oktas)		Atmospheric Pressure (hPa)	
	Max	Min	Max	Min		Min	Max	0830	1730
December 2007	32.2	7.5	94	41	4.4	2/8	5/8	945.7	943.5
January 2008	29.2	6.6	93	39	4.5	2/8	4/8	939.5	935.2
February 2008	31.8	11.4	84	35	3.6	1/8	4/8	936.2	932.8
March 2008	33.4	14.9	82	32	4.6	3/2	4/8	946.5	943.1
April 2008	35.7	19.3	76	33	3.2	0/8	3/8	943.8	939.7
May 2008	36.8	23.4	97	48	7.2	0/8	2/8	941.5	935.2
October 2008	31.2	18.9	84	35	21.4	3/8	5/8	945.8	944.3
November 2008	26.1	12.2	94	34	6.9	2/8	4/8	950.9	946.1

- **Wind Speed/ Wind Directions**

The wind rose for the study period representing Winter 2007-2008, Pre – monsoon season 2008 and Post-Monsoon season 2008 are shown in **Figure-3.1.1(A), Figure-3.1.1(B) and Figure-3.1.1(C)** respectively and the data is presented in **Table 3.1.2.**

TABLE-3.1.2
SUMMARY OF WIND PATTERN AT THE STUDY AREA

Parameters	Winter Season 2007-2008	Pre-Monsoon Season 2008	Post-Monsoon Season
First Predominant Wind Direction	WSW (12.9%)	SW (18.7%)	W (24.1%)
Second Predominant Wind Direction	W (11.7%)	NW (14.7 %)	NNE (10.2 %)
Predominant Wind Speeds (kmph)	1.0 to 5.0 5.0 to 11.0	1.0 To 5.0 5.0 to 11.0	1.0 To 5.0 5.0 to 11.0
Calm conditions (%)	32.5%	18.5 %	28.0 %

Note: Figures in parenthesis indicates percentage of time wind blows

➢ ***Winter Season 2007-2008***

Predominant winds from West South West direction were observed for 12.9 % of the total time, with wind speeds and frequencies in the range of 1.01-5 kmph (11.7%) and 5.01-11 kmph (1.2%). In West direction the winds were observed for 11.7% of the total time with wind speeds and frequencies in the range of 1.01-5 kmph (10.9%) and 5.01-11 kmph (0.8%) respectively. In South direction, the winds was observed for 6.5% of the total time with wind speeds and frequencies in the range of 1.01-5 kmph (6.2%) and 5.01-11 kmph (0.3%) respectively. In other directions, the percentage frequencies observed were WNW (6.3%), SSW (4.5%), NW (4.4%), N (4.1%), SW (3.8%), NNE (3.5.1%), NNW (2.2%), NE (1.8%), E (1.7%), ESE (1.5%), ESE (1.4%), SE(0.7%), SSE(0.5%) and Calm conditions prevailed for 32.5% of the time.

➢ ***Pre-Monsoon Season 2008***

Predominant winds from South West direction were observed for 18.7 % of the total time, with wind speeds and frequencies in the range of 1.01-5 kmph (11.3%) and 5.01-11 kmph (6.5%). In North West direction the winds were observed for 14.7% of the total time with wind speeds and frequencies in the range of 1.01-5 kmph (8.7%) and 5.01-11 kmph (5.5%) respectively. In West South West direction, the winds were observed for 13.6% of the total time with wind speeds and frequencies in the range of 1.01-5 kmph (7.0%) and 5.01-11 kmph (5.7%) respectively. In other directions, the percentage frequencies observed were W (11.3%), NNE (9.6%), N (3.2%), NE (2.0%), NNW (1.7%), ESE (1.5%), E (1.5%), ENE (1.3%), WNW (0.8%), SSW (0.8%), SE (0.6%), SSE (0.2%), S (0.0%) and Calm conditions prevailed for 18.5% of the time.

➢ ***Post-Monsoon Season 2008***

Predominant winds from West direction were observed for 24.1 % of the total time, with wind speeds and frequencies in the range of 1.01-5 kmph (12.9%) and 5.01-11 kmph (7.2%). In North North East direction, the winds were observed for 10.2% of the total time with wind speeds and frequencies in the range of 1.01-5 kmph (3.9%) and 5.01-11 kmph (4.9%) respectively. In North direction the winds were observed for 10.1% of the total time with wind speeds and frequencies in the range of 1.01-5 kmph (3.2%) and 5.01-11 kmph (4.9%). respectively. In other directions, the percentage frequencies observed were WSW (8.2%), NNW (5.2%), WNW (4.9%), NW (3.3%), NE (3.0%), SW (1.0%), ENE (0.9%), E (0.8%), ESE (0.4%), and SE (0.1%). Calm conditions prevailed for 28.0% of the time.

3.1.2 Secondary Data Collected from IMD- Udaipur

Secondary data from IMD-Udaipur has been collected for atmospheric pressure, temperature, relative humidity, rainfall, evaporation, wind speed and direction and is presented in **Table-3.1.3**. The data at IMD is usually measured twice a day viz., at 0830 and 1730 hr.

TABLE-3.1.3
CLIMATOLOGICAL DATA-STATION: IMD, UDAIPUR (1997-2007)

Month	Atmospheric Pressure (mb)		Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	0830	1730	Max	Min	0830	1730	Monthly Total
January	950.7	947.9	24.2	7.2	65	38	7.0
February	949.3	946.3	27.4	9.8	57	31	2.6
March	947.5	944.6	32.2	15.1	45	27	9.6
April	945.1	942.0	36.4	20.4	37	25	3.0
May	942.0	938.6	38.5	24.3	42	28	8.6
June	938.2	935.4	36.0	24.9	65	50	85.2
July	936.7	934.7	31.0	23.5	79	70	195.4
August	938.3	936.4	29.5	22.6	82	75	177.3
September	942.3	939.8	31.1	21.2	76	65	117.0
October	947.3	944.7	32.7	16.6	62	42	18.5
November	950.6	947.7	29.5	11.6	60	43	9.7
December	951.4	948.6	26.0	8.2	66	43	2.3

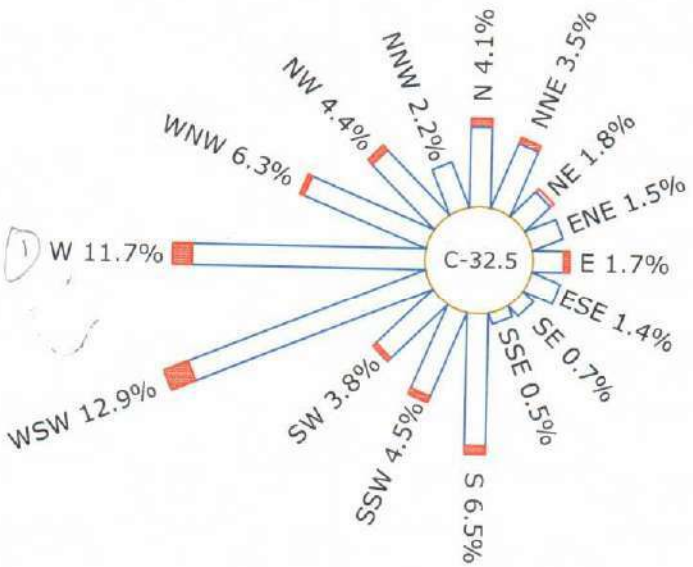
Wind Speed/Direction

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours. While during the afternoon hours the winds were stronger. The seasonal and annual wind roses of IMD, Udaipur are shown in **Figure-3.1.2 (A), Figure-3.1.2 (B), & Figure-3.1.2 (C)** respectively and the data is presented in **Table-3.1.4**.

TABLE-3.1.4
SUMMARY OF WIND PATTERN-IMD UDAIPUR

Season	First Predominant Winds		Second Predominant Winds		Calm Condition		Predominant Wind Speed (kmph)
	0830	1730	0830	1730	0830	1730	
Winter	NW (13.6)	NE (14.0)	NNW (8.6)	E (11.3)	37.5	17.4	1 to 5 5 to 11
Pre-Monsoon	NW (14.3)	SW (16.6)	W (11.6)	W(12.5)	30.2	7.8	1 to 5 5 to 11
Monsoon	SW (19.2)	SW (21.2)	W (11)	W (13)	21.6	13	1 to 5 5 to 11
Post Monsoon	NW (10.7)	NE (9.7)	NNW (8.2)	NNW (7.1)	37.6	30.1	1 to 5 5 to 11
Annual	NW (14.2)	SW (11.8)	W (7.8)	W (9.5)	28.3	17.9	1 to 5 5 to 11

Note: Figures in parenthesis indicates % of time wind blows



SITE WINDROSE-WINTER SEASON

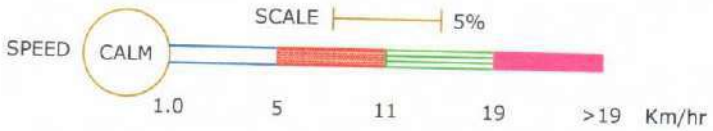
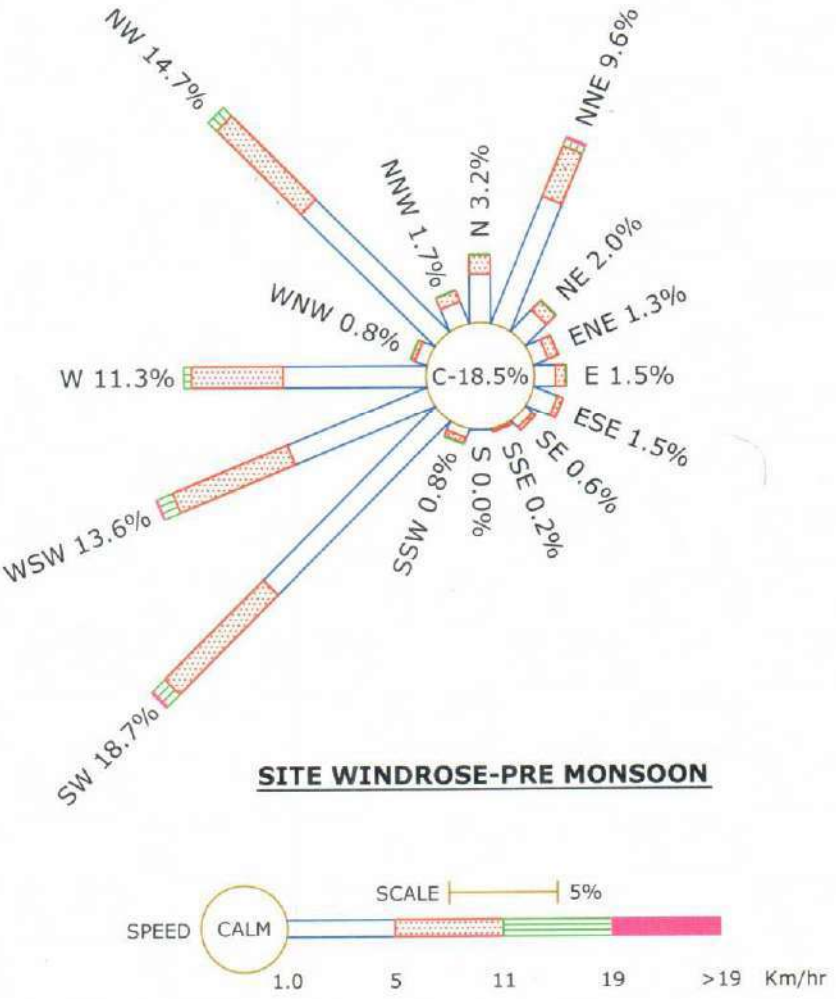


FIGURE-3.1.1(A)
SITE SPECIFIC WINTER SEASON WINDROSE



SITE WINDROSE-PRE MONSOON

FIGURE-3.1.1(B)
SITE SPECIFIC PRE MONSOON SEASON WINDROSE

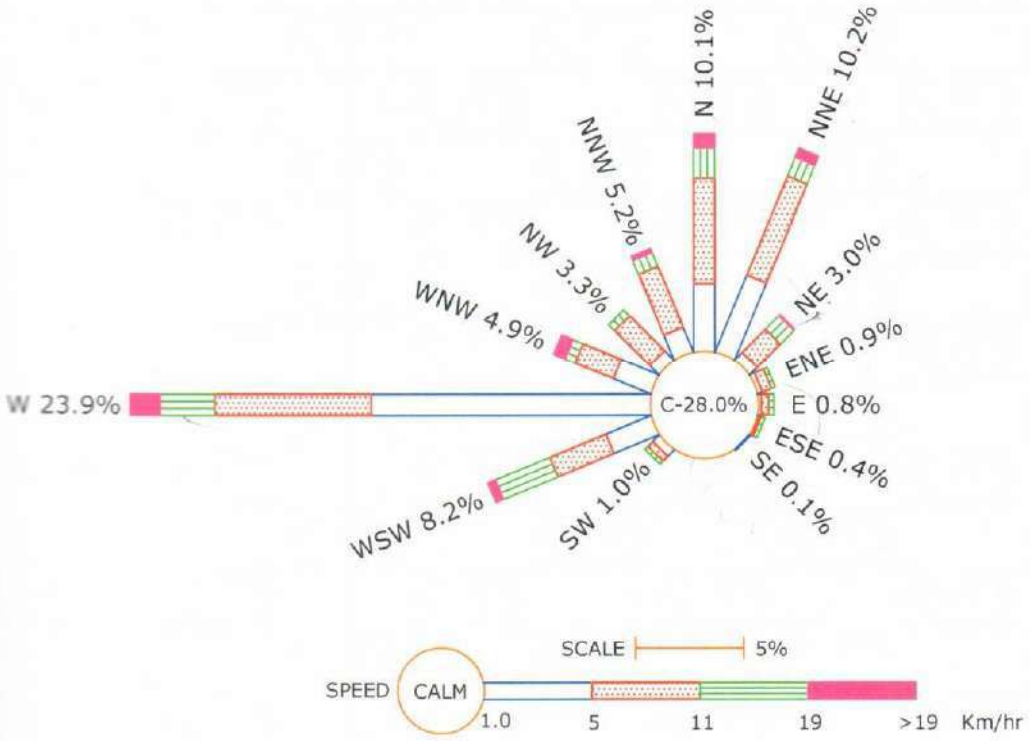
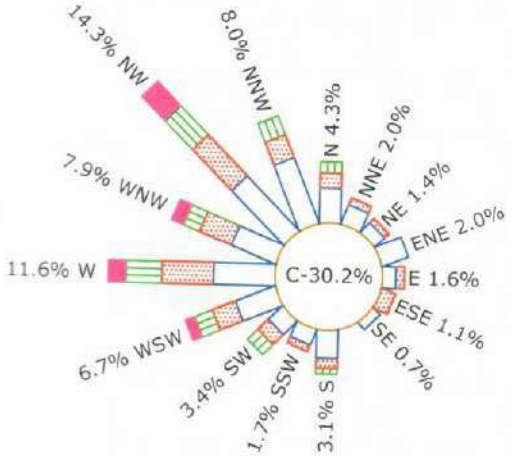
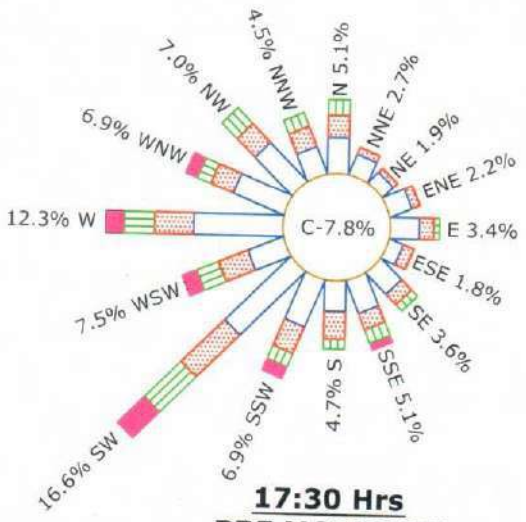


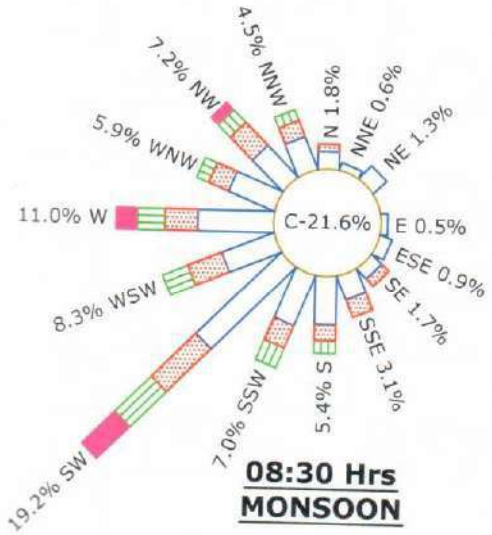
FIGURE-3.1.1(C)
SITE SPECIFIC POST MONSOON SEASON WINDROSE



08:30 Hrs
PRE MONSOON



17:30 Hrs
PRE MONSOON



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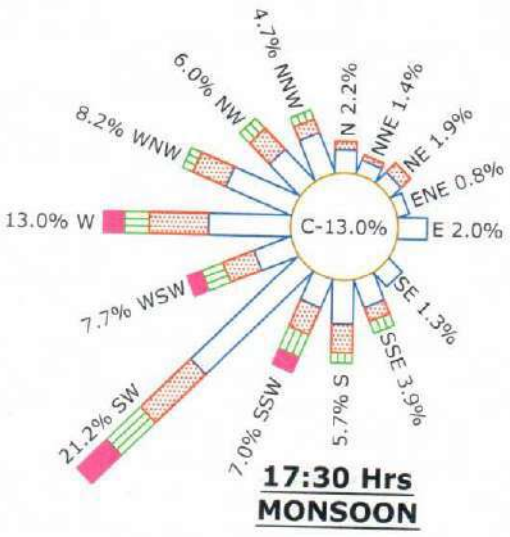
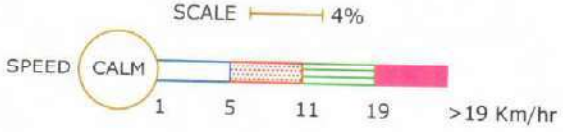
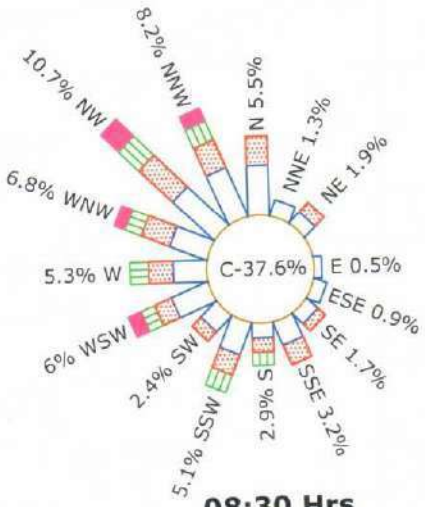
MONSOON

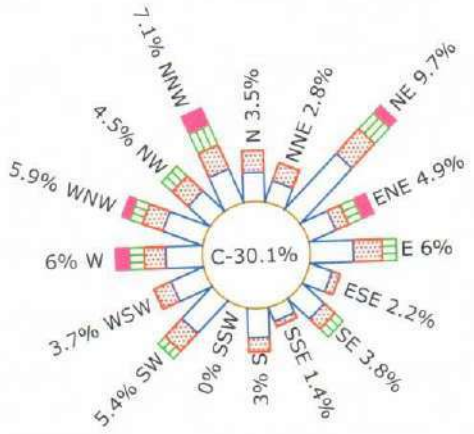


17:30 Hrs
MONSOON

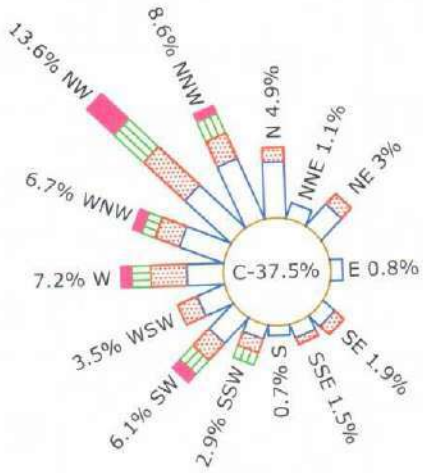




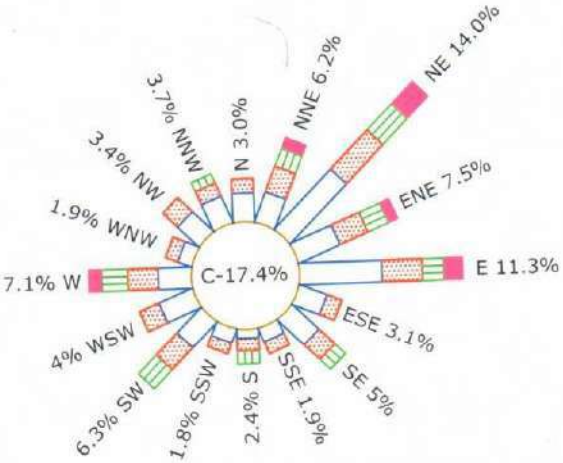
08:30 Hrs
POST MONSOON



17:30 Hrs
POST MONSOON



08:30 Hrs
WINTER



17:30 Hrs
WINTER

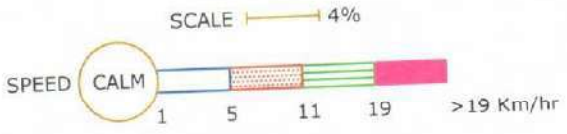
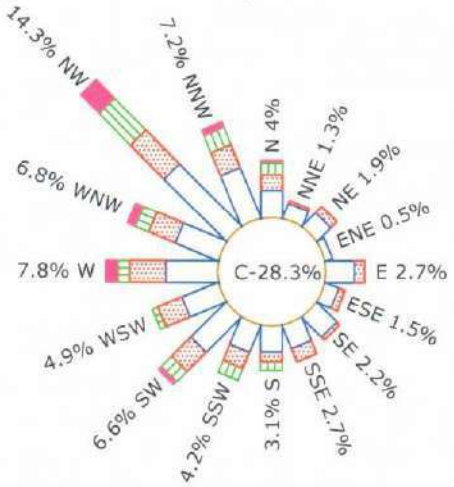
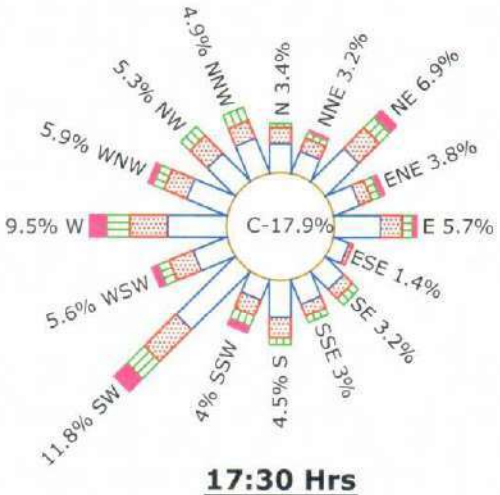


FIGURE-3.1.2 (B)
SEASONAL WINDROSES IMD, UDAIPUR



08:30 Hrs
ANNUAL



17:30 Hrs
ANNUAL

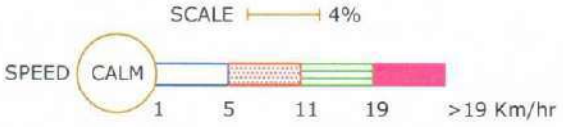


FIGURE-3.1.2 (C)
ANNUAL WINDROSE IMD, UDAIPUR

3.1.3 Comparison of Primary and Secondary Data

The India Meteorological Department (IMD) records the meteorological data twice a day viz. 0830 hr and 1730 hr while the site specific data has been recorded continuously at hourly intervals. On comparison of site specific data generated for study period vis-à-vis the IMD data, slight variations were observed. The following observations are brought out:

- The temperature recorded onsite when compared vis-à-vis the IMD data, slight variations were found. The maximum and minimum temperatures recorded at site during study period were 36.8 °C and 6.6 °C whereas the maximum and minimum temperature recorded at IMD, Udaipur for the same period are 38.5 °C and 7.2°C respectively during the same period;

- The relative humidity was observed to range between 32% to 97% during the study period whereas according to IMD, Udaipur data the relative humidity was observed to range between 66% to 25%. The variation could be because of the fact that RH values considered for the site are actual values recorded continuously; while the IMD, Udaipur data represents data collected only twice a day, and averaged for 10 years; and

- The data generated at continuous monitoring station at project site when compared with the data recorded at IMD, it can be observed that the data generated at the site is broadly compatible with regional meteorology, except minor variations as described above. However, the data cannot be compared on one to one basis as the stations (IMD and Site) are 60-km away and there is site elevation difference of 100-m between the two sites.

Based on the above analysis, one can conclude that the data generated on the site is broadly compatible with the regional meteorology.

3.2 Air Quality

The ambient air quality with respect to the study zone of 10-km radius around the proposed complex area forms the baseline information. The prime objective of the baseline air quality study was to assess the existing air quality of the area. The study area represents mostly rural environment.

3.2.1 Methodology adopted for Air Quality Survey

3.2.1.1 Selection of Sampling Locations

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality-monitoring network. The design of monitoring network in the air quality surveillance program 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 ***ten*** permanent locations and ***six*** mobile locations with due consideration to the above mentioned points. **Table-3.2.1** gives the details of environmental setting around each monitoring station. The location of the selected stations with reference to the project site is given in the same table and shown in **Figure-3.2.1**.

3.2.1.2 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two days per week at all permanent locations and once a month at mobile locations during study period. The baseline data of air environment is generated for the following parameters:

- Total Suspended Particulate Matter (TSPM);
- Respirable Particulate Matter (RPM);
- Sulphur dioxide (SO_2);
- Oxides of Nitrogen (NOx);
- Carbon Monoxide (CO);
- Lead;
- Zinc;
- Cadmium; and
- Dust fall rate.

TABLE-3.2.1
DETAILS OF AMBIENT AIR QUALITY MONITORING

Station Code	Location	Distance w.r.t. Mine Lease Boundary (km)	Direction w.r.t Mine Centre	Environmental Setting
Ambient Air Quality Locations (Permanent)				
AAQ1	Mine Lease Area	--	--	Industrial area
AAQ 2	Rajpura	1.2	N	Rural/ Residential Area
AAQ 3	Makhanpuriya	2.2	NNE	Rural/ Residential Area
AAQ 4	Sunariya Khera	1.5	NE	Rural/ Residential Area
AAQ 5	Chothpura	3.1	ENE	Rural/ Residential Area
AAQ 6	E of ML area	0.5	E	Rural/ Residential Area
AAQ 7	Lunera	4.2	SE	Rural/ Residential Area
AAQ 8	Chawandiya	4.1	S	Rural/ Residential Area
AAQ 9	Chhapari	2.7	SSW	Rural/ Residential Area
AAQ 10	Gawardi	1.2	SW	Rural/ Residential Area
Mobile Locations				
MA1	Larapacha	3.8	WSW	Rural/ Residential Area
MA2	Anjana	0.4	W	Rural/ Residential Area
MA3	Mahenduriya	0.8	NW	Rural/ Residential Area
MA4	Bera ka khera	1.9	NNW	Rural/ Residential Area
MA5	Kotari	1.4	ESE	Rural/ Residential Area
MA6	Pipawas	1.9	SSE	Rural/ Residential Area

➢ ***Duration of Sampling***

The sampling duration for Total Suspended Particulate Matter (TSPM), RPM, SO_2 and NOx is twenty four hourly continuous samples per day and CO is sampled for 8 hours continuously thrice a day. This is to allow a comparison with the present revised standards mentioned in the latest Gazette Notification of the Central Pollution Control Board (CPCB) (May 20, 1994). Lead, Zinc, and Cadmium have been analyzed in the RPM samples.

Dustfall was measured using dustfall jars. The dustfall jar was installed at ten AAQ locations for one month during AAQ monitoring. The jar was filled with 2.5 litre of water. The water in the jar was mixed with copper sulphate solution (0.02 N solution) to prevent any growth of algae. A funnel was attached to the top of the jar on which dust falls and slides into the jar. The water level in the jar is constantly maintained in such way that the 2.5-liter of water is retained. After one month the water was analyzed for total un-dissolved matter, ash, total dissolved matter and total solids to arrive at dust fall concentration. Dustfall in 1 m^2 area was calculated by using following formula:

$$Factor = \frac{127.3 \times 10^4}{d^2}$$

where d = top diameter of funnel in m.

The factor is multiplied to the mg of dust collected to get the dust deposition in $mg/m^2/day$.

3.2.2 Presentation of Primary Data

Various statistical parameters like, average, maximum and minimum values have been computed from the observed raw data for all the AAQ monitoring stations. The results of monitoring carried out are presented in **Annexure-IV**. The summary of the results representing Winter season 2007-2008, Pre-Monsoon and Post-Monsoon seasons 2008 at the monitored locations are presented in **Table-3.2.2.** These are compared with the standards prescribed by Central Pollution Control Board (CPCB) for rural and residential zone and Industrial zone. Dust fall rate are presented in **Table-3.2.2.**

MA4(M)
AAQ3
Makhanpuriya
Laxmipura
Bera ka Khera
Rajpura
AAQ2
AAQ4
Chothipura
AAQ5
Dhani
Bharai Dam
Mahenduriya
MA3(M)
PLANT
Sansera ki Khera
Sansera
Kabara
AAQ6
Dariba
AAQ1
MA2(M)
Anjana
Kotari
MA5(M)
MA1(M)
Larapacha
Mataji ka Khera
Gadariya
Udaipura
Gawardi
AAQ10
Kantiyakhera
Devaran ka Kh
MA6(M)
Pipawas
Charana
Lunera
Chhapari
AAQ9
AAQ7
AAQ8
Chawandiya
Gadariyawa
Bari
Charangakhera
Dhaneriya
Jajaron ka Khera
Jagatsingh ka Khera
Morath
Phalasiya
Bhumalawas
Sanawar
Sadri
Meniya
Amarpura
Ganeshpura
Khar Bamaniya
Soniyana
Champakheri
Raghunathpura
74° 5'
74° 10'
Topo Sheet No.
Ambient Air Quality Locations
Ambient Air Quality Locations (Mobile)
2 KM

TABLE 3.2.2 (A)
SUMMARY OF AMBIENT AIR QUALITY RESULTS (WINTER SEASON 2007-2008)

Location	TSPM (µg/m³)				RPM (µg/m³)				SO_2 (µg/m³)				NO_x (µg/m³)				CO (µg/m³)		
	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg
ML Area	215.2	128.4	161.5	206.8	74.3	47.5	59.9	72.4	16.6	10.5	13.3	16.3	17.8	12.5	14.8	17.7	442	176	275
Rajpura	192.2	103.9	162.4	189.9	66.5	35.8	56.9	66.3	11.7	7.4	9.7	11.7	13.2	9.5	11.4	13.2	396	192	263
Makhanpuriya	151.3	91.1	118.3	148.9	52.4	32.7	41.6	51.9	12.4	7.8	9.9	12.4	14.6	9.1	11.6	14.4	354	142	221
Sunariya Khera	169.8	83.8	126.7	163.0	57.2	29.7	41.1	52.6	12.6	8.2	10.7	12.6	15.5	9.3	12.5	15.5	325	138	237
Chothpura	142.6	83.2	118.6	140.6	49.9	29.1	42.0	49.7	12.8	7.6	10.1	12.4	16.4	9.2	12.9	16.4	313	155	227
East of ML area	172.5	92.2	111.9	169.6	58.6	27.2	37.5	57.4	13.9	7.9	10.4	13.8	15.8	8.5	11.5	15.2	348	172	252
Lunera	165.4	81.2	120.7	161.8	57.8	25.9	41.2	54.1	13.2	7.5	10.5	13.2	15.6	7.8	11.3	15.5	329	156	250
Chawandiya	138.4	91.2	122.1	138.1	50.7	30.1	42.7	50.3	12.3	7.7	9.8	12.1	14.4	8.9	12.4	14.4	331	145	267
Chhapari	139.4	89.3	129.4	139.2	46.4	28.7	35.7	43.0	12.9	9.6	11.4	12.9	14.1	9.4	12.2	14.0	299	141	230
Gawardi	135.7	87.5	113.2	135.5	47.9	28.9	36.2	47.5	12.5	8.1	10.2	12.5	13.8	8.3	10.9	13.3	297	157	238
Range	**81.2-215.2**				**25.9-74.3**				**7.4-16.6**				**8.3-17.8**				**141-442**		

SUMMARY OF AMBIENT AIR QUALITY RESULTS (WINTER SEASON 2007-2008)

Sr. No	Location	Lead (µg/m³)		Zinc (µg/m³)		Cadmium (µg/m³)	
		Max	Min	Max	Min	Max	Min
1	ML Area	0.23	0.11	0.31	0.16	BDL	BDL
2	Rajpura	0.15	0.10	0.19	0.11	BDL	BDL
3	Makhanpuriya	BDL	BDL	BDL	BDL	BDL	BDL
4	Sunariya Khera	BDL	BDL	BDL	BDL	BDL	BDL
5	Chothpura	BDL	BDL	BDL	BDL	BDL	BDL
6	East of ML area	BDL	BDL	BDL	BDL	BDL	BDL
7	Lunera	BDL	BDL	BDL	BDL	BDL	BDL
8	Chawandiya	BDL	BDL	BDL	BDL	BDL	BDL
9	Chhapari	BDL	BDL	BDL	BDL	BDL	BDL
10	Gawardi	BDL	BDL	BDL	BDL	BDL	BDL
	Range	**BDL-0.23**		**BDL-0.31**		**BDL**	

TABLE-3.2.2 (B)
SUMMARY OF AMBIENT AIR QUALITY RESULTS (PRE-MONSOON SEASON 2008)

cation	TSPM (µg/m3)				RPM (µg/m3)				SO_2 (µg/m3)				NOX (µg/m3)				CO (µg/m3)			
	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%
ea	242.6	136.2	175.6	241.4	88.6	51.6	65.0	87.1	15.1	10.1	12.7	15.0	17.3	12.1	14.4	17.0	413	206	338	406
ra	218.4	131.6	156.5	206.3	71.8	48.1	56.8	70.8	10.5	7.1	8.7	10.5	12.2	8.3	10.3	12.1	354	212	284	346
npuriya	156.8	106.1	133.3	155.8	59.3	39.1	47.9	59.0	11.6	6.6	9.4	11.6	13.8	9.1	11.2	13.7	265	112	207	263
iya Khera	164.2	95.4	131.1	164.0	59.1	31.7	46.8	58.4	11.2	7.1	8.9	11.2	14.2	8.6	11.3	14.2	282	128	212	278
pura	148.4	91.2	120.1	147.3	63.2	31.5	46.1	62.2	10.6	7.2	8.9	10.6	13.6	8.4	10.8	13.5	284	153	232	283
f ML area	184.5	106.3	141.5	180.0	63.1	32.5	49.6	62.7	11.7	7.8	9.8	11.7	13.9	8.2	10.8	13.7	303	131	228	298
a	172.6	97.2	119.6	162.1	64.4	34.2	45.1	61.0	11.5	6.9	8.7	11.4	12.6	7.1	9.5	12.4	293	144	217	290
ndiya	155.3	91.3	108.8	143.9	59.3	36.7	42.7	54.8	12.6	6.8	9.8	12.4	14.3	8.1	11.5	14.3	310	143	230	309
ar	158.9	96.5	137.5	158.7	57.2	38.4	49.8	57.1	11.7	7.3	10.2	11.7	13.7	7.8	11.6	13.5	268	170	224	266
di	151.7	97.1	122.3	150.6	54.6	32.2	43.3	54.2	10.7	7.5	9.0	10.6	12.8	7.5	10.2	12.7	235	115	168	226
e	91.2-242.6				31.5-88.6				6.6-15.1				7.1-17.3				112-413			

SUMMARY OF AMBIENT AIR QUALITY RESULTS (PRE-MONSOON SEASON 2008)

Sr. No	Location	Lead (µg/m³)		Zinc (µg/m³)		Cadmium (µg/m³)	
		Max	Min	Max	Min	Max	Min
1	ML Area	0.28	0.18	0.36	0.24	BDL	BDL
2	Rajpura	0.23	0.1	0.29	<0.1	BDL	BDL
3	Makhanpuriya	BDL	BDL	BDL	BDL	BDL	BDL
4	Sunariya Khera	BDL	BDL	BDL	BDL	BDL	BDL
5	Chothpura	BDL	BDL	BDL	BDL	BDL	BDL
6	East of ML area	BDL	BDL	BDL	BDL	BDL	BDL
7	Lunera	BDL	BDL	BDL	BDL	BDL	BDL
8	Chawandiya	BDL	BDL	BDL	BDL	BDL	BDL
9	Chhapari	BDL	BDL	BDL	BDL	BDL	BDL
10	Gawardi	BDL	BDL	BDL	BDL	BDL	BDL
	Range	BDL-0.28		BDL-0.36		BDL	

TABLE-3.2.2 (C)
SUMMARY OF AMBIENT AIR QUALITY RESULTS (POST-MONSOON SEASON 2008)

Location	TSPM (µg/m³)				RPM (µg/m³)				SO_2 (µg/m³)				NO_x (µg/m³)				CO (µg/m³)			
	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%
IL Area	150.6	88.3	112.2	146.6	47.7	24.7	31.7	47.2	11.9	7.4	9.7	11.7	13.4	8.8	11.0	13.1	309	123	199	300
ajpura	97.6	62.5	90.8	97.5	27.7	21.6	25.1	27.7	11.4	8.6	10.1	11.3	12.5	8.6	10.9	12.4	209	98	157	205
lakhanpuriya	105.9	63.8	83.4	104.0	37.5	22.9	29.9	36.9	11.5	7.1	9.1	11.4	13.1	8.2	10.5	13.0	248	100	156	242
unariya Khera	99.8	58.2	83.0	99.1	34.9	20.4	28.9	34.8	11.6	6.8	9.1	11.3	12.8	8.3	10.9	12.8	219	109	158	206
hothpura	110.7	56.8	82.8	110.0	35.3	18.1	28.2	35.1	11.8	7.3	9.4	11.8	13.3	7.1	10.1	13.1	223	108	161	215
ast of ML area	134.5	74.1	112.5	130.1	46.6	25.1	37.8	46.1	10.7	7.6	9.2	10.7	12.2	8.9	10.7	12.1	277	120	183	276
unera	96.9	63.8	82.9	96.5	35.5	21.1	29.3	35.2	11.1	6.9	8.9	10.9	12.9	8.5	11.2	12.8	227	102	180	226
hawandiya	118.9	58.7	89.7	115.6	40.3	20.8	29.8	39.3	11.3	7.7	9.8	11.3	12.5	8.4	10.8	12.5	220	97	156	205
hhapari	120.8	64.5	78.4	119.3	41.1	19.9	26.2	40.5	11.7	7.9	10.3	11.6	12.6	7.7	10.7	12.4	244	120	175	242
awardi	95.3	68.8	83.8	95.1	33.6	22.7	26.4	33.6	10.9	7.5	9.3	10.8	12.4	7.8	10.2	12.3	208	127	169	205
ange	56.8-150.6				18.1-47.7				6.8-11.9				7.1-13.4				97-309			

SUMMARY OF AMBIENT AIR QUALITY RESULTS (POST-MONSOON SEASON 2008)

Sr. No	Location	Lead (µg/m³)		Zinc (µg/m³)		Cadmium (µg/m³)	
		Max	Min	Max	Min	Max	Min
1	ML Area	0.14	BDL	0.20	BDL	BDL	BDL
2	Rajpura	BDL	BDL	BDL	BDL	BDL	BDL
3	Makhanpuriya	BDL	BDL	BDL	BDL	BDL	BDL
4	Sunariya Khera	BDL	BDL	BDL	BDL	BDL	BDL
5	Chothpura	BDL	BDL	BDL	BDL	BDL	BDL
6	East of ML area	0.11	BDL	0.14	BDL	BDL	BDL
7	Lunera	BDL	BDL	BDL	BDL	BDL	BDL
8	Chawandiya	BDL	BDL	BDL	BDL	BDL	BDL
9	Chhapari	BDL	BDL	BDL	BDL	BDL	BDL
10	Gawardi	BDL	BDL	BDL	BDL	BDL	BDL
Range		BDL-0.14		BDL-0.20		BDL	

TABLE-3.2.2 (D)
SUMMARY OF THE AMBIENT AIR QUALITY LEVELS - MOBILE LOCATIONS (WINTER SEASON)

Sr. No	Location	TSPM (µg/m³)		RPM (µg/m³)		SO_2 (µg/m³)		NOx (µg/m³)		CO (µg/m³)		Lead(µg/m³)		Zinc(µg/m³)		Cadmium(µg/m³)	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	Larapacha	143.1	82.7	46.5	25.9	11.9	9.5	13.3	7.8	310	228	0.16	0.13	0.23	0.15	BDL	BDL
2	Anjana	161.2	118.2	49.5	27.1	12.6	10.2	14.1	11.6	293	242	0.13	0.10	0.18	0.10	BDL	BDL
3	Mahenduriya	145.3	104.1	45.6	26.3	12.2	9.2	15.5	11.9	298	236	BDL	BDL	BDL	BDL	BDL	BDL
4	Barakakhera	129.3	96.5	40.6	27.1	9.5	9.1	14.8	11.4	292	225	BDL	BDL	BDL	BDL	BDL	BDL
5	Kotari	168.4	91.2	58.9	25.2	9.4	8.9	16.3	12.2	356	232	0.22	0.13	0.32	0.14	BDL	BDL
6	Pipawas	139.8	81.2	51.6	26.7	13.6	8.6	14.2	12.5	321	222	0.18	0.12	0.22	0.13	BDL	BDL
	Range	**81.2-168.4**		**25.2-58.9**		**8.6-13.6**		**7.8-16.3**		**222-356**		**0.1-0.22**		**0.1-0.32**		**BDL**	

TABLE-3.2.2 (E)
SUMMARY OF THE AMBIENT AIR QUALITY LEVELS – MOBILE LOCATIONS (PRE-MONSOON SEASON)

Sr.No	Location	TSPM (µg/m³)		RPM (µg/m³)		SO_2(µg/m³)		NOx (µg/m³)		CO µg/m³)		Lead(µg/m³)		Zinc(µg/m³)		Cadmium(µg/m³)	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	Larapacha	166.2	96.3	56.3	28.4	10.7	8.5	12.2	6.6	293	212	0.22	0.16	0.31	0.15	BDL	BDL
2	Anjana	169.2	122.3	58.2	35.3	11.2	9.6	12.8	10.3	281	235	0.19	0.12	0.22	0.13	BDL	BDL
3	Mahenduriya	157.2	113.5	58.3	34.8	11.6	7.8	13.7	10.5	295	224	BDL	BDL	BDL	BDL	BDL	BDL
4	Barakakhera	152.1	118.4	59.6	36.2	9.3	7.4	12.6	10.2	289	215	BDL	BDL	BDL	BDL	BDL	BDL
5	Kotari	172.3	109.6	73.6	33.8	12.1	8.2	14.1	11.4	315	223	0.26	0.16	0.36	0.18	BDL	BDL
6	Pipawas	142.6	113.2	63.5	37.6	9.5	7.9	13.5	10.8	308	217	0.23	0.13	0.31	0.14	BDL	BDL
	Range	**96.3-172.3**		**28.4-73.6**		**7.4-12.1**		**6.6-14.1**		**212 - 308**		**0.12-0.26**		**0.13-0.36**		**BDL**	

TABLE-3.2.2 (F)
SUMMARY OF THE AMBIENT AIR QUALITY LEVELS - MOBILE LOCATIONS (POST-MONSOON SEASON)

Sr. No	Location	TSPM (µg/m³)		RPM µg/m³)		SO_2 (µg/m³)		NOx (µg/m³)		CO (µg/m³)		Lead(µg/m³)		Zinc(µg/m³)		Cadmium(µg/m³)	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	Larapacha	100.2	83.7	32.6	18.1	10.7	9.6	12.3	7.7	197	160	0.10	BDL	0.13	0.10	BDL	BDL
2	Anjana	97.9	56.8	36.1	33.8	12.2	7.8	12.8	10.8	208	123	BDL	BDL	0.13	BDL	BDL	BDL
3	Mahenduriya	101.7	94.4	31.9	18.4	11.7	8.3	14.3	10.7	207	161	BDL	BDL	BDL	BDL	BDL	BDL
4	Bera ka khera	90.5	67.6	28.4	19.9	8.6	8.2	10.6	9.9	201	168	BDL	BDL	BDL	BDL	BDL	BDL
5	Kotari	117.9	63.8	41.2	17.6	13.5	9.8	14.7	11.3	249	165	0.12	BDL	0.13	BDL	BDL	BDL
6	Pipawas	112.8	111.2	34.7	32.6	11.3	9.5	12.7	11.8	199	161	0.12	BDL	0.14	BDL	BDL	BDL
	Range	**56.8-117.9**		**17.6-41.2**		**7.8-13.5**		**7.7-14.7**		**160-249**		**BDL-0.12**		**BDL-0.14**		**BDL**	

TABLE-3.2.2(G)
SUMMARY OF DUSTFALL CONCENTRATION (WINTER SEASON)

Sr. No.	Location	Dust fall Concentration ($mg/m^2/day$)
1	ML Area	329
2	Rajpura	279
3	Makhanpuriya	312
4	Sunariya Khera	308
5	Chothpura	257
6	East of ML area	292
7	Lunera	273
8	Chawandiya	251
9	Chhapari	262
10	Gawardi	273
	Range	**251-329**

TABLE-3.2.2(H)
SUMMARY OF DUSTFALL CONCENTRATION (PRE-MONSOON SEASON)

Sr. No.	Location	Dustfall Concentration ($mg/m^2/day$)
1	ML Area	360
2	Rajpura	275
3	Makhanpuriya	296
4	Sunariya Khera	315
5	Chothpura	278
6	East of ML area	305
7	Lunera	289
8	Chawandiya	265
9	Chhapari	285
10	Gawardi	283
	Range	**265-360**

TABLE-3.2.2(I)
SUMMARY OF DUSTFALL CONCENTRATION (POST-MONSOON SEASON)

Sr. No.	Location	Dust fall Concentration ($mg/m^2/day$)
1	ML Area	237
2	Rajpura	186
3	Makhanpuriya	208
4	Sunariya Khera	196
5	Chothpura	164
6	East of ML area	184
7	Lunera	171
8	Chawandiya	166
9	Chhapari	191
10	Gawardi	186
	Range	**171-237**

➢ ***Summary of Observations***

- ***Winter Season, 2007-2008***

TSPM

Out of the ten locations the maximum concentration for Total Suspended Particulate Matter (TSPM) was observed as 215.2 $\mu g/m^3$ recorded at Mine Lease Area (AAQ 1) with the minimum concentration observed as 81.2 $\mu g/m^3$ recorded Lunera (AAQ 7) during the study period. At all ambient air quality locations the TSPM levels recorded are within the prescribed standards for Residential and Industrial areas of 200 and 500 $\mu g/m^3$ respectively.

RPM

Out of the ten locations the maximum concentration for Respirable Particulate Matter (RPM) was observed as 74.3 $\mu g/m^3$ recorded at Mine Lease Area (AAQ 1) the minimum concentration observed as 25.9 $\mu g/m^3$ recorded near Lunera (AAQ 7). At all ambient air quality locations the RSPM levels recorded are within the prescribed standards for Residential and Industrial areas of 100 and 150 $\mu g/m^3$ respectively.

SO_2

Out of the ten locations the maximum concentration for Sulphur dioxide (SO_2) was observed as 16.6 $\mu g/m^3$ recorded at Mine lease area (AAQ 1) and the minimum concentration observed as 7.4 $\mu g/m^3$ recorded at Rajpura (AAQ 2) during the study period. At all ambient air quality locations the SO_2 levels recorded are within the prescribed standards for Residential and Industrial areas of 80 and 120 $\mu g/m^3$ respectively.

NOx

Out of the ten locations the maximum concentration for Oxides of Nitrogen (NOx) was observed as 17.8 $\mu g/m^3$ recorded at Mine lease area (AAQ1) and the minimum concentration observed as 8.3 $\mu g/m^3$ recorded near Gawardi (AAQ 10) during the study period. At all ambient air quality locations the NOx levels recorded are within the prescribed standards for Residential and Industrial areas of 80 and 120 $\mu g/m^3$ respectively.

CO

Out of the ten residential and rural locations the maximum concentration for Carbon Monoxide (CO) was observed as 442 $\mu g/m^3$ recorded at Mine Lease area (AAQ1) and the minimum concentration observed as 141 $\mu g/m^3$ recorded near Chhapari (AAQ 9) villages during the study period. At all ambient air quality locations the CO levels recorded are within the prescribed standards for Residential and Industrial areas of 5.0 and 2.0 mg/m^3 respectively.

Heavy Metals

Heavy metals measured in ambient air are absent in all locations except in mine lease area and Rajpura Dariba village. At all ambient air quality locations the lead levels recorded are within the prescribed standards for Residential and Industrial areas of 1.0 and 1.5 $\mu g/m^3$ respectively.

Dust Fall

The maximum rate of dust fall concentration at the monitored locations was recorded as 329.0 mg/m^2/day at Mine lease area(AAQ 1) and the minimum was recorded as 251.0 mg/m^2/day at Chawandiya (AAQ 8).

- ***Pre-Monsoon Season, 2008***

TSPM

Out of the ten locations the maximum concentration for Total Suspended Particulate Matter (TSPM) was observed as 242.6 $\mu g/m^3$ recorded at Mine Lease Area (AAQ 1) with the minimum concentration observed as 91.2 $\mu g/m^3$ recorded at Chothpura (AAQ 5) during the study period. At all ambient air quality locations the TSPM levels recorded are within the prescribed standards for Residential and Industrial areas of 200 and 500 $\mu g/m^3$ respectively.

RPM

Out of the ten locations the maximum concentration for Respirable Particulate Matter (RPM) was observed 88.6 $\mu g/m^3$ recorded at Mine Lease Area (AAQ 1) the minimum concentration observed as 31.5 $\mu g/m^3$ recorded at Chothpura (AAQ 5). At all ambient air quality locations the RSPM levels recorded are within the prescribed standards for Residential and Industrial areas of 100 and 150 $\mu g/m^3$ respectively.

SO_2

Out of the ten locations the maximum concentration for Sulphur dioxide (SO_2) was observed as 15.1 $\mu g/m^3$ recorded at Mine lease area (A1) and the minimum concentration observed as 6.6 $\mu g/m^3$ recorded at Makhanpuriya (AAQ 3) during the study period. At all ambient air quality locations the SO_2 levels recorded are within the prescribed standards for Residential and Industrial areas of 80 and 120 $\mu g/m^3$ respectively.

NOx

Out of the ten locations the maximum concentration for Oxides of Nitrogen (NOx) was observed as 17.3 $\mu g/m^3$ recorded at Mine lease area (AAQ 1) and the minimum concentration observed as 7.1 $\mu g/m^3$ recorded at Lunera (AAQ 7) during the study period. At all ambient air quality locations the NOx levels recorded are within the prescribed standards for Residential and Industrial areas of 80 and 120 $\mu g/m^3$ respectively.

CO

Out of the ten locations the maximum concentration for Carbon Monoxide (CO) was observed as 413 $\mu g/m^3$ recorded at Mine Lease area (AAQ 1) and the minimum concentration observed as 112 $\mu g/m^3$ recorded at Makhanpuriya (AAQ 3) villages during the study period. At all ambient air quality locations the CO levels recorded are within the prescribed standards for Residential and Industrial areas of 5.0 and 2.0 mg/m^3 respectively.

Heavy Metals

Heavy metals measured in ambient air are absent in all locations except in mine lease area and Rajpura Dariba village. At all ambient air quality locations the lead levels recorded are within the prescribed standards for Residential and Industrial areas of 1.0 and 1.5 $\mu g/m^3$ respectively.

Dust Fall

The maximum rate of dust fall concentration at the monitored locations was recorded as 360.0 mg/m^2/day at Mine lease area(AAQ 1) and the minimum was recorded as 265.0 mg/m^2/day at Chawandiya (AAQ 8).

- ***Post- Monsoon Season, 2008***

TSPM

Out of the ten locations, the maximum concentration for Total Suspended Particulate Matter (TSPM) was observed as 150.6 $\mu g/m^3$ recorded at Mine Lease Area (AAQ1) with the minimum concentration observed as 56.8 $\mu g/m^3$ recorded Chothpura (AAQ5) during the study period. At all ambient air quality locations the TSPM levels recorded are within the prescribed standards for Residential and Industrial areas of 200 and 500 $\mu g/m^3$ respectively.

RPM

Out of the ten locations, the maximum concentration for Respirable Particulate Matter (RPM) was observed as 47.7 $\mu g/m^3$ recorded at Mine Lease Area (AAQ1) the minimum concentration observed as 18.1 $\mu g/m^3$ recorded near Chothpura (AAQ5). At all ambient air quality locations the RSPM levels recorded are within the prescribed standards for Residential and Industrial areas of 100 and 150 $\mu g/m^3$ respectively.

SO_2

Out of the ten locations, the maximum concentration for Sulphur dioxide (SO_2) was observed as 11.9 $\mu g/m^3$ recorded at Mine lease area (AAQ1) and the minimum concentration observed as 6.8 $\mu g/m^3$ recorded at Sunariya Khera (AAQ4) during the study period. At all ambient air quality locations the SO_2 levels recorded are

within the prescribed standards for Residential and Industrial areas of 80 and 120 $\mu g/m^3$ respectively.

NOx

Out of the ten locations, the maximum concentration for Oxides of Nitrogen (NOx) was observed as 13.4 $\mu g/m^3$ recorded at Mine lease area (AAQ1) and the minimum concentration observed as 7.1 $\mu g/m^3$ recorded at Chothpura (AAQ5) during the study period. At all ambient air quality locations the NOx levels recorded are within the prescribed standards for Residential and Industrial areas of 80 and 120 $\mu g/m^3$ respectively.

CO

Out of the ten locations, the maximum concentration for Carbon Monoxide (CO) was observed as 309 $\mu g/m^3$ recorded at Mine Lease area (AAQ1) and the minimum concentration observed as 97 $\mu g/m^3$ recorded near Chawandiya (AAQ8) village during the study period. At all ambient air quality locations the CO levels recorded are within the prescribed standards for Residential and Industrial areas of 5.0 and 2.0 mg/m^3 respectively.

Heavy Metals

Heavy metals measured in ambient air are absent in all locations except in mine lease area and East of ML area. At all ambient air quality locations the lead levels recorded are within the prescribed standards for Residential and Industrial areas of 1.0 and 1.5 $\mu g/m^3$ respectively.

Dust Fall

The maximum rate of dust fall concentration at the monitored locations was recorded as 237.0 mg/m^2/day at Mine lease area (AAQ 1) and the minimum was recorded as 171.0 mg/m^2/day at Lunera (AAQ7).

The ambient air quality standards specified by Central Pollution Control Board are as given in **Table-3.2.3**.

TABLE-3.2.3
NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutants	Time-weighted average	Concentration in ambient air		
		Industrial Areas	Residential, Rural & other Areas	Sensitive Areas
Sulphur Dioxide (SO2)	Annual Average*	80 $\mu g/m^3$	60 $\mu g/m^3$	15 $\mu g/m^3$
	24 hours**	120 $\mu g/m^3$	80 $\mu g/m^3$	30 $\mu g/m^3$
Oxides of Nitrogen as (NO2)	Annual Average*	80 $\mu g/m^3$	60 $\mu g/m^3$	15 $\mu g/m^3$
	24 hours**	120 $\mu g/m^3$	80 $\mu g/m^3$	30 $\mu g/m^3$
Suspended Particulate	Annual Average*	360 $\mu g/m^3$	140 $\mu g/m^3$	70 $\mu g/m^3$

Pollutants	Time-weighted average	Concentration in ambient air		
		Industrial Areas	Residential, Rural & other Areas	Sensitive Areas
Matter (SPM)	24 hours**	500 µg/m³	200 µg/m³	100 µg/m³
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m³	60 µg/m³	50 µg/m³
	24 hours**	150 µg/m³	100 µg/m³	75 µg/m³
Lead (Pb)	Annual Average*	1.0 µg/m³	0.75 µg/m³	0.50 µg/m³
	24 hours**	1.5 µg/m³	1.00 µg/m³	0.75 µg/m³
Ammonia	Annual Average*	0.1 mg/ m³	0.1 mg/ m³	0.1 mg/m³
	24 hours**	0.4 mg/ m³	0.4 mg/m³	0.4 mg/m³
CarbonMonoxide (CO)	8 hours**	5.0 mg/m³	2.0 mg/m³	1.0 mg/ m³
	1 hour	10.0 mg/m³	4.0 mg/m³	2.0 mg/m³
*	Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.			
**	24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.			

3.3 Noise Environment

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 loudness distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. 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 a human ear.

The impact of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent, or continuous in nature). It can be observed that steady noise is not as annoying as one which is continuously varying in loudness;
- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance; and
- The location of the noise source, with respect to noise sensitive landuse, which determines the loudness and period of exposure.

The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise. The environmental impact assessment of noise from the mine and smelter operations, vehicular traffic can be undertaken by taking into consideration various factors like potential damage to hearing, physiological responses, annoyance and general community responses.

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise expected to be generated after the proposed mining and industrial activities.

3.3.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noises at different noise generating sources have been identified based on the activities in the village area and ambient noise due to traffic.

The noise monitoring has been conducted for determination of noise levels at **ten** locations during winter, pre-monsoon and post-monsoon seasons. The noise levels at each of the locations were recorded for 24 hours. The environmental setting of noise monitoring locations are given in **Table-3.3.1** and shown in **Figure-3.3.1**.

TABLE-3.3.1
DETAILS OF NOISE MONITORING LOCATIONS

Code	Location	Distance w.r.t. Mine Lease Boundary (km)	Direction w.r.t Mine centre	Details of the Surroundings
N1	RD Mine	-	-	Industrial Area
N2	RD Mine Hospital	-	-	Sensitive Area
N3	RD Mine Colony	-	--	Rural /Residential Area
N4	Sunariya Khera	1.5	NE	Rural /Residential Area
N5	Rajpura	1.2	N	Rural/Residential Area
N6	Mahenduriya	0.8	NW	Rural /Residential Area
N7	Anjana	0.4	W	Rural /Residential Area
N8	Gawardi	1.2	SW	Rural /Residential Area
N9	Kotari	1.4	ESE	Rural /Residential Area
N10	Pipawas	1.9	SSE	Rural /Residential Area

3.3.2 Method of Monitoring

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. 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 10-km radius of the study area.

3.3.3 Parameters Measured During Monitoring

The statistical analysis is done for measured noise levels at ***ten*** locations during the study period. The parameters are analyzed for L_{day}, L_{night}, and L_{dn}. These results for the monitored period during December 2007, April 2008 and November 2008 are tabulated in **Table-3.3.2 (A), Table-3.3.2 (B) and Table-3.3. (C).**

TABLE-3.3.2 (A)
AMBIENT NOISE LEVELS (WINTER 2007-08)

Sr. No.	Location	L10	L50	L90	Leq	Lday	Lnight	Ldn
1	RD Mine	61.2	58.4	49.4	60.7	59.4	50.1	59.7
2	RD Mine Hospital	48.2	45.9	38.1	47.6	47.1	39.6	48.2
3	RD Mine Colony	49.6	47.5	40.3	48.9	48.9	41.7	50.2
4	Sunariya Khera	55.1	49.5	40.1	53.3	50.1	42.2	51.0
5	Rajpura	58.2	53.8	43.3	57.5	54.2	43.7	54.7
6	Mehanduriya	56.5	52.1	39.1	57.1	54.1	40.5	53.1
7	Anjana	51.7	47.2	38.7	50.0	48.2	39.1	48.6
8	Gawardi	47.7	46.0	39.5	47.1	46.2	43.3	50.3
9	Kotari	50.7	47.6	37.8	50.4	48.5	42.9	50.7
10	Pipawas	50.0	46.5	39.1	48.5	47.3	40.7	48.9

TABLE-3.3.2 (B)
AMBIENT NOISE LEVELS (PREMONSOON 2008)

Sr. No.	Location	L10	L50	L90	Leq	Lday	Lnight	Ldn
1	RD Mine	59.6	57.7	48.8	59.6	59.6	49.2	59.5
2	RD Mine Hospital	47.6	44.8	37.7	46.4	46.4	38.2	47.2
3	RD Mine Colony	48.5	46.2	39.7	47.5	47.3	41.1	49.1
4	Sunariya Khera	53.5	48.5	39.2	51.9	49.6	41.3	50.3
5	Rajpura	57.1	52.2	42.2	55.9	54.6	43.8	54.3
6	Mehanduriya	55.8	51.1	38.5	56.1	53.5	39.6	52.4
7	Anjana	50.2	46.6	37.4	49.3	47.6	38.5	48.0
8	Gawardi	46.1	45.4	38.8	46.3	45.8	42.3	49.4
9	Kotari	49.4	46.1	37.6	48.4	47.3	42.2	49.8
10	Pipawas	49.1	45.9	38.5	47.8	46.8	39.8	48.2

TABLE-3.3.2 (C)
AMBIENT NOISE LEVELS (POST MONSOON 2008)

Sr. No.	Location	L10	L50	L90	Leq	Lday	Lnight	Ldn
1	RD Mine	58.8	56.1	47.4	58.3	58.2	48.1	58.2
2	RD Mine Hospital	46.3	44.1	36.6	45.7	45.2	38.1	46.5
3	RD Mine Colony	47.6	45.6	38.7	46.9	46.9	40.7	48.7
4	Sunariya Khera	52.9	47.5	38.5	51.0	48.1	40.5	49.2
5	Rajpura	55.9	51.6	41.6	55.1	53.0	42.4	52.8
6	Mehanduriya	54.2	50.0	37.5	54.6	52.8	38.9	51.7
7	Anjana	49.6	45.3	37.2	47.9	46.3	37.5	46.8
8	Gawardi	45.8	44.2	37.9	45.2	44.4	41.6	48.5
9	Kotari	48.7	45.7	36.3	48.3	46.6	41.2	48.9
10	Pipawas	48.2	44.6	37.5	46.5	45.4	39.1	47.2.

- ***Winter Season, 2007-08***

a) Day time Noise Levels (L_{day})

Residential zone: The daytime noise levels at the residential locations ranged between 46.2 – 54.2 dB (A). The maximum value of 54.2 dB (A) was recorded at Rajpura (N5) and the minimum value of 46.2 dB (A) was recorded at Gawardi (N8). It is observed that the day time noise levels at residential locations are within the prescribed limit of 55 dB(A).

Industrial zone: The daytime noise levels at the industrial location is 59.4 dB(A) was recorded at RD Mine (N1). It is observed that the day time noise level at Industrial Zone location is within the prescribed limit of 75 dB (A).

Sensitive zone: The daytime noise levels at the sensitive location is 47.1 dB (A) was recorded near RD Mine Hospital (N2). It is observed that the day time noise levels at Sensitive Zone location is not exceeding the prescribed limit of 50 dB (A).

b) Night time Noise Levels (L_{night})

Residential zone: The night time noise levels ranged between 39.1 to 43.7 dB(A). The maximum value of 43.7 dB (A) was recorded at Rajpura (N5) and the minimum value of 39.1 dB (A) was recorded at Anjana (N7). It is observed that the night time noise levels at the residential locations are within the prescribed limit of 45 dB (A).

Industrial zone: The night time noise levels at the industrial location is 50.1 dB (A) recorded at RD Mine(N1). It is observed that the night time noise levels at Industrial Zone location is within the prescribed limit of 70 dB (A)

Sensitive zone: The night time noise levels at the sensitive location is 39.6 dB (A) recorded near RD Mine Hospital (N2). It is observed that the night time noise levels at Sensitive Zone location is within the prescribed limit of 40 dB (A).

- ***Pre-Monsson Season, 2008***

a) Day time Noise Levels (L_{day})

Residential zone: The daytime noise levels at the residential locations ranged between 45.8 – 54.6 dB (A). The maximum value of 54.6 dB (A) was recorded at Rajpura (N5) and the minimum value of 45.8 dB (A) was recorded at Gawardi (N8). It is observed that the day time noise levels at residential locations are within the prescribed limit of 55 dB(A).

Industrial zone: The daytime noise levels at the industrial location is 59.6 dB(A) was recorded at RD Mine (N1). It is observed that the day time noise level at Industrial Zone location is within the prescribed limit of 75 dB (A).

Sensitive zone: The daytime noise levels at the sensitive location is 46.4 dB (A) was recorded near RD Mine Hospital (N2). It is observed that the day time noise levels at Sensitive Zone location is not exceeding the prescribed limit of 50 dB (A).

b) Night time Noise Levels (L_{night})

Residential zone: The night time noise levels ranged between 41.1 to 43.8 dB(A). The maximum value of 43.8 dB (A) was recorded at Rajpura (N5) and the minimum value of 41.1 dB (A) was recorded at RD Mine colony (N3). It is observed that the night time noise levels at the residential locations are within the prescribed limit of 45 dB (A).

Industrial zone: The night time noise levels at the industrial location is 49.2 dB (A) recorded at RD Mine(N1). It is observed that the night time noise levels at Industrial Zone location is within the prescribed limit of 70 dB (A)

Sensitive zone: The night time noise levels at the sensitive location is 38.2 dB (A) recorded near RD Mine Hospital (N2). It is observed that the night time noise levels at Sensitive Zone location is within the prescribed limit of 40 dB (A).

- ***Post-Monsoon Season, 2008***

a) Day time Noise Levels (L_{day})

Residential zone: The daytime noise levels at the residential locations ranged between 44.4 – 53 dB (A). The maximum value of 53 dB (A) was recorded at Rajpura (N5) and the minimum value of 44.4 dB (A) was recorded at Gawardi (N8). It is observed that the day time noise levels at residential locations are within the prescribed limit of 55 dB(A).

Industrial zone: The daytime noise levels at the industrial location is 58.2 dB(A) was recorded at RD Mine (N1). It is observed that the day time noise level at Industrial Zone location is within the prescribed limit of 75 dB (A).

Sensitive zone: The daytime noise levels at the sensitive location is 45.2 dB (A) was recorded near RD Mine Hospital (N2). It is observed that the day time noise levels at Sensitive Zone location is not exceeding the prescribed limit of 50 dB (A).

Bamaniya Kalan
Mandara
Jiwakhera
Champakheri
Relmagra
Sindesar Kalan
Soniyana
Sadri
Khar Bamaniya
Sindesar Khurd
Raghunathpura
Amarpura
Malikhera
Ganeshpura
Laxmipura
Makhanpuriya
Bera ka Khera
Bharai Dam
Rajpura
N5
N4
Chothpura
Dhani
Sunariyakhera
Mahenduriya
N6
PLANT
Sansera ki Khera
N2
N1
Kabara
Dariba
N7
N3
Anjana
N9
Kotari
Larapacha
Mataji ka Khera
Gadariyawas
N8
Gawardi
Udaipura
Kantiyakhera
Devarah ka Khera
N10
Charana
Pipawas
Chhapari
Lunera
Chawandiya
Gadariyawas
Charangakhera
Dhaneriya
Bari
Jajaron ka Khera
Jagatsingh ka Khera
Morath
Phalasiya
Bhupalsagar
Bhumalawas
Sanawar
74° 5'
74° 10'
Topo Sheet No. 45 K/4,
KM
Noise Monitoring Locations

b) Night time Noise Levels (L_{night})

Residential zone: The night time noise levels ranged between 37.5 to 42.4 dB(A). The maximum value of 42.4 dB (A) was recorded at Rajpura (N5) and the minimum value of 37.5 dB (A) was recorded at Anjana (N7). It is observed that the nighttime noise levels at the residential locations are within the prescribed limit of 45 dB (A).

Industrial zone: The night time noise levels at the industrial location is 48.1 dB (A) recorded at RD Mine (N1). It is observed that the night time noise levels at Industrial Zone location is within the prescribed limit of 70 dB (A)

Sensitive zone: The nighttime noise levels at the sensitive location is 38.1 dB (A) recorded near RD Mine Hospital (N2). It is observed that the night time noise levels at Sensitive Zone location is within the prescribed limit of 40 dB (A).

The ambient air quality standards in respect of noise as recommended by CPCB are as given in **Table-3.3.3.**

TABLE-3.3.3
AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE

Area Code	Category of Area / Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

3.4 Water Environment

Selected water quality parameters of ground and surface water resources within 10-km radius of the study area has been studied for assessing the water environment and evaluate anticipated impact of the proposed integrated complex. Understanding the water quality is essential in preparation of Environmental Impact Assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities.

The information required has been collected through primary surveys and secondary sources.

3.4.1 Methodology

Reconnaissance survey was undertaken and monitoring locations were finalised based on:

- Drainage pattern;
- Location of residential areas representing different activities/likely impact areas; and
- Likely areas, which can represent baseline conditions.

Water sources covering 10-km radial distance from project complex were examined for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and other activities on water. The samples were collected and analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA), 21st Edition.

3.4.2 Water Sampling Locations

Ten groundwater sources and ***eight*** surface water sources covering 10-km radial distance were examined for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of proposed mining and other smelter activities on water.

The samples were collected and analysed once during the study period. The water sampling locations are listed below in **Table-3.4.1** and are depicted in **Figure-3.4.1**.

TABLE-3.4.1
DETAILS OF WATER SAMPLING LOCATIONS

Code	Location	Distance w.r.t. Mine Lease Boundary (km)	Direction w.r.t Mine Centre	Environmental Setting
Ground Water				
GW-1	Sunariya Khera village	1.5	NE	Hand pump, used for drinking and domestic purposes
GW-2	Rajpura village	1.2	N	Hand pump, used for drinking and domestic purposes
GW-3	Mahenduriya village	0.8	NW	Hand pump, used for drinking and domestic purposes
GW-4	Gawardi	1.2	SW	Hand pump, used for drinking and domestic purposes
GW-5	Kotari village	1.4	ESE	Hand pump, used for drinking and domestic purposes
GW-6	Relmagra	6.8	NNW	Hand pump, used for drinking and domestic purposes
GW-7	Lunera	4.2	SE	Hand pump, used for drinking and domestic purposes
GW-8	Sansera	6.3	WNW	Hand pump, used for drinking and domestic purposes
GW-9	RD Smelter Project Site	--	--	--

Code	Location	Distance w.r.t. Mine Lease Boundary (km)	Direction w.r.t Mine Centre	Environmental Setting
GW-10	RD Mine	--	--	--
Surface Water				
SW-1	Mataji Ka Khera Tank	--	--	Village supply water
SW-2	Kotari Tank	1.4	ESE	Village supply water
SW-3	Bharai Dam	3.9	NW	Village supply water
SW-4	Bari Tank	6.4	SE	Village supply water
SW-5	Tailing Dam	0.2	NE	Village supply water
SW-6	Banas River	9.0	NNE	Village supply water
SW-7	Raghunathpura Tank	4.0	NE	Village supply water
SW-8	Jagatsingh Ka Khera	7.5	SW	Village supply water

3.4.3 Presentation of Results

The results of the ground water quality and surface water quality monitored during study period are given in **Table-3.4.2** and **Table-3.4.3** respectively. The results were compared with standards for drinking water as per IS:10500-1983 "Specifications for Drinking Water" for ground water and with Class 'C' water quality (fit for drinking after conventional treatment) as per IS:2296-1982 "Tolerance Limits for Inland Surface Waters subject to Pollution" for surface water. The wells around secured landfill have been monitored for water quality and results are given in **Table-3.4.4**. The sampling location of wells are given in **Figure-3.4.2.**

3.4.3.1 Ground Water Quality

- ***Winter Season, 2007-2008***

Most of the villages in the project area have bore well and tube well facilities, as most of the residents of these villages make use of this water for drinking, agricultural, and other domestic uses. Therefore, bore well samples have been considered for sampling.

The analysis results indicate a pH range of 7.4 to 8.1, which is well within the desirable limit of 6.5 to 8.5. The TDS was observed to range between 580 to 1830. Total hardness was observed to range between 212 to 665 mg/l.

Chlorides are found to range between 104.9 to 516.3 mg/l. The chloride concentrations were observed to be within the permissible limit of 1000 mg/l. Fluorides are found to range between 0.1 to 0.7 mg/l and within the permissible limit of 1.5 mg/l at all locations. Nitrates are found to range between 6.6 to 64.5 mg/l, few samples were found to be exceeding the prescribed limit of 45.0 mg/l. Presence of heavy metals is observed but the concentrations are within the permissible limits.

- ***Pre-Monsoon Season, 2008***

Most of the villages in the project area have bore well and tube well facilities, as most of the residents of these villages make use of this water for drinking, agricultural, and other domestic uses. Therefore, bore well samples have been considered for sampling.

The analysis results indicate a pH range of 7.4 to 7.8, which is well within the desirable limit of 6.5 to 8.5. The TDS was observed to range between 810 to 3720. Total hardness was observed to range between 259.9 to 1256.5 mg/l.

Chlorides are found to range between 106.4 to 815.4 mg/l. The chloride concentrations were observed to be within the permissible limit of 1000 mg/l. Fluorides are found to range between 0.8 to 1.3 mg/l and within the permissible limit of 1.5 mg/l at all locations. Nitrates are found to range between 1.0 to 61.2 mg/l and are exceeding the prescribed limit of 45.0 mg/l for samples collected at few locations. Presence of heavy metals is observed but the concentrations are within the permissible limits.

- ***Post-Monsoon Season, 2008***

The analysis results indicate a pH range of 7.4 to 8.2, which is well within the desirable limit of 6.5 to 8.5. The TDS was observed to range between 486 to 1653. Total hardness was observed to range between 179 to 604 mg/l.

Chlorides are found to range between 86.6 to 486.6 mg/l. The chloride concentrations were observed to be within the permissible limit of 1000 mg/l. Fluorides are found to range between 0.1 to 0.7 mg/l and within the permissible limit of 1.5 mg/l at all locations. Nitrates are found to range between 8.7 to 52.6 mg/l, few samples were found to be exceeding the prescribed limit of 45.0 mg/l. Presence of heavy metals is observed but the concentrations are within the permissible limits.

3.4.3.2 Surface Water Quality

- ***Winter Season, 2007-2008***

The analysis results indicate a pH range of 7.1 to 7.8, which are within the specified desirable limit of 6.5 to 8.5. The TDS was observed to range between 196 to 348 mg/l. Dissolved oxygen was observed to range between 5.6 to 6.3 mg/l, which is more than the requisite minimum concentration of 4.0 mg/l.

The Chlorides were found to range between 35.5 to 64.0 mg/l and Sulphates were found to range between 13.6 to 33.1 mg/l. It can be observed that the concentrations of all the Parameters, in comparison with IS: 2296, come under Class 'C', category of drinking water source without conventional treatment but with disinfection. The Heavy metal content is either very low or below detectable limits.

- ***Pre-Monsoon Season, 2008***

The analysis results indicate a pH range of 7.3 to 7.8, which are within the specified desirable limit of 6.5 to 8.5. The TDS was observed to range between 212 to 386 mg/l. Dissolved oxygen was observed to range between 4.1 to 4.8 mg/l, which is more than the requisite minimum concentration of 4.0 mg/l.

The Chlorides were found to range between 28.4 to 78.0 mg/l and Sulphates were found to range between 16.3 to 39.9 mg/l. It can be observed that the concentrations of all the Parameters, in comparison with IS: 2296, come under Class 'C', category of drinking water source without conventional treatment but with disinfection. The Heavy metal content is either very low or below detectable limits.

- ***Post-Monsoon Season 2008***

The analysis results indicate a pH range of 7.4 to 7.8, which are within the specified desirable limit of 6.5 to 8.5. The TDS was observed to range between 139 to 206 mg/l. Dissolved oxygen was observed to range between 7.0 to 7.4 mg/l, which is more than the requisite minimum concentration of 4.0 mg/l.

The Chlorides were found to range between 24.3 to 67.6 mg/l and Sulphates were found to range between 14.6 to 24.6 mg/l. It can be observed that the concentrations of all the Parameters, in comparison with IS: 2296, come under Class 'C', category of drinking water source without conventional treatment but with disinfection. The Heavy metal content is either very low or below detectable limits.

10 KM
PLANT
GW1
GW2
GW3
GW4
GW5
GW6
GW7
GW8
GW9
GW10
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
Jitawas
Mandara
Jiwakhera
Relmagra
Sindesar Kalan
Sadri
Sindesar Khurd
Amarpura
Meniya
Malikhera
Laxmipura
Bharai Dam
Bera ka Khera
Rajpura
Makhanpuriya
Chothpura
Mahenduriya
Sunariyakhera
Sansera
Sansera ki Khera
Dariba
Anjana
Kotari
Mataji ka Khera
Larapacha
Gawardi
Kantiyakhera
Udaipura
Charana
Pipawas
Chhapari
Lunera
Chawandiya
Charangakhera
Dhaneriya
Bari
Jagatsingh ka Khera
Jajaron ka Khera
Morath
Phalasiya
Bhumalawas
Sanawar
Bhupalsa
BANAS RIVER

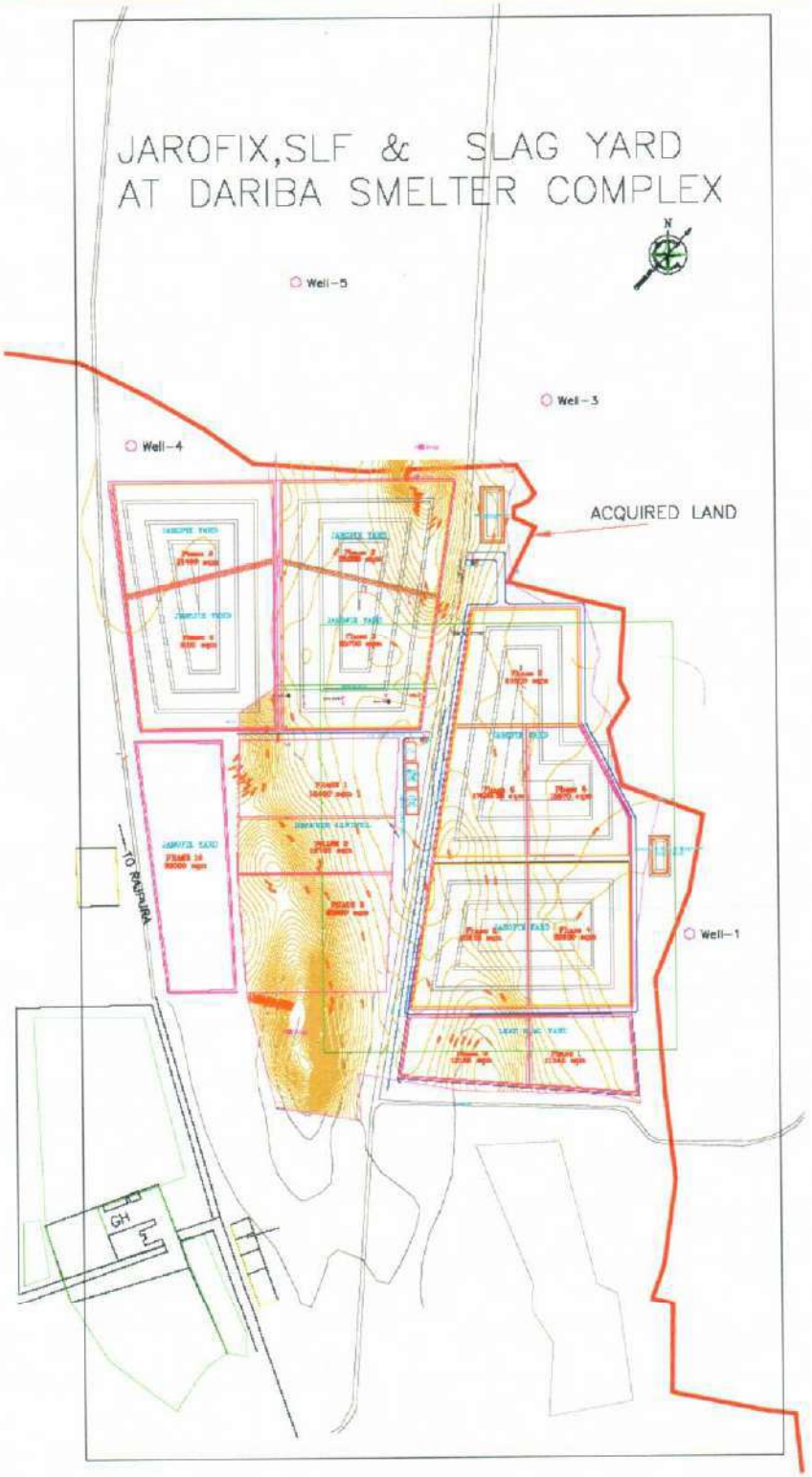


FIGURE-3.4.2
WELL WATER SAMPLING LOCATIONS AROUND SLF

TABLE-3.4.2(A)
GROUND WATER QUALITY- WINTER SEASON

Parameters	Units	IS:10500 Limits	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
pH	-	6.5 -8.5	7.4	7.5	7.6	7.8	7.7	8.1	7.9	7.7	7.8	7.9
Colour	Hazen	5 (25)	2	1	3	2	1	1	2	2	3	1
Taste	-	Agreeable	A	A	A	A	A	A	A	A	A	A
Odor	-	U.O	UO	UO	UO	UO	UO	UO	UO	U.O	U.O	U.O
Conductivity	µ S/cm	$	780	2460	719	1270	1560	2480	1296	1682	1428	1286
Turbidity	NTU	5(10)	3	4	3	3	4	3	4	3	2	1
TDS	Mg/l	500 (2000)	580	1568	620	958	1024	1830	1064	1152	957	1520
Total Hardness as $CaCO_3$	Mg/l	300 (600)	354	640	212	410	490	665	350	328	312	522
Total Alkalinity	Mg/l	200 (600)	210	616	126	444	276	328	324	354	328	386
Calcium as Ca	Mg/l	75 (200)	61.3	108	37.6	84	108	120	48	42.3	52.4	94
Magnesium as Mg	Mg/l	30 (100)	48.9	89.9	28.6	48.6	53.5	88.6	55.9	56.8	38.4	52.6
Residual Chlorine	Mg/l	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	Mg/l	1 (5)	0.59	0.53	0.12	0.06	0.05	0.98	0.03	0.56	0.32	0.44
Chlorides as Cl	Mg/l	250 (1000)	125.6	322.6	116.6	104.9	237.5	516.3	170.2	174.2	125.9	212.6
Sulphates as SO_4	Mg/l	200 (400)	48.1	8.4	56.9	31.0	104.9	186.7	31.4	56.2	73.2	182.7
Fluorides as F	Mg/l	1.0 (1.5)	0.6	0.4	0.4	0.6	0.7	0.1	0.4	0.3	0.5	0.4
Nitrates as NO_3	Mg/l	45 (NR)	36.0	60.0	10.3	24.2	6.6	48.6	28.4	64.5	8.7	5.3
Sodium as Na	Mg/l	$	41.3	238	63.6	95.5	125.5	259.6	111	132.3	136.6	198.7
Potassium as K	Mg/l	$	8.4	12.6	4.8	3.6	3.0	10.2	3.5	7.6	6.8	6.3
Phenolic Compounds	Mg/l	0.001 (0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanides as CN	Mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anionic Detergents	Mg/l	0.2 (1.0)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium as Cd	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper as Cu	Mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead as Pb	Mg/l	0.05 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese as Mn	Mg/l	0.1 (0.3)	<0.01	<0.02	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron as Fe	Mg/l	0.3 (1)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium as Cr^{+6}	Mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium as Se	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05
Zinc as Zn	Mg/l	5(15)	0.01	0.29	0.01	0.05	0.05	0.31	0.34	0.14	0.45	0.8

Parameters	Units	IS:10500 Limits	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
Aluminium as Al	Mg/l	0.03(0.2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury as Hg	Mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01
Mineral oil	Mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pesticides	Mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	<0.001	<0.001	<0.001
E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Total Coliforms	MPN/100 ml	10	<2	<2	<2	<2	<2	<2	<2	Absent	Absent	Absent

TABLE-3.4.2 (B)
GROUND WATER QUALITY- PRE-MONSOON SEASON

Parameters	Units	IS:10500 Limits	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
pH	-	6.5 -8.5	7.6	7.6	7.8	7.6	7.7	7.4	7.4	7.5	7.7	7.5
Colour	Hazen	5 (25)	1	2	1	2	3	2	1	3	1	2
Taste	-	Agreeable	A	A	A	A	A	A	A	A	A	A
Odor	-	U.O	UO	UO	UO	UO	UO	U.O	U.O	U.O	U.O	U.O
Conductivity	μ S/cm	$	1260	1930	994	1860	1520	3130	3810	1355	1009	1670
Turbidity	NTU	5(10)	2	1	1	2	1	1	2	1	2	1
TDS	Mg/l	500 (2000)	1120	1820	810	1346	1410	3030	3720	1260	985	1520
Total Hardness as $CaCO_3$	Mg/l	300 (600)	399	566.6	325	640	266	939.9	1256.5	331.4	259.9	430
Total Alkalinity	Mg/l	200 (600)	225	240	195	580	385	385	375	335	300	375
Calcium as Ca	Mg/l	75 (200)	63.7	91	67.6	160.0	55.8	205	280	37.6	44.5	88
Magnesium as Mg	Mg/l	30 (100)	55.2	78	36.1	58.3	29.1	98.3	128	54.6	34.2	48.3
Residual Chlorine	Mg/l	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	Mg/l	1 (5)	0.26	0.56	0.12	0.82	0.35	0.55	0.03	0.41	0.21	0.36
Chlorides as Cl	Mg/l	250 (1000)	212.7	531.8	170.2	182.6	205.6	744.5	815.4	163.1	106.4	191.4
Sulphates as SO_4	Mg/l	200 (400)	54.6	121.4	120.9	31.0	67.4	216.1	323.2	53.2	69.2	176.5
Fluorides as F	Mg/l	1.0 (1.5)	1.1	0.9	0.8	1.0	1.2	0.8	1.3	1.3	1.1	0.9
Nitrates as NO_3	Mg/l	45 (NR)	60.6	57.8	9.2	31.0	17	60.4	61.2	60.2	8.3	1.0
Sodium as Na	Mg/l	$	98	165	75.6	118.3	225.1	287.5	6.0	127.5	128.7	185.5
Potassium as K	Mg/l	$	24.5	35	11.9	22.8	8.9	22.9	2.1	56.5	6.7	12
Phenolic Compounds	Mg/l	0.001 (0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanides as CN	Mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Parameters	Units	IS:10500 Limits	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
Anionic Detergents	Mg/l	0.2 (1.0)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium as Cd	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper as Cu	Mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	<0.02	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
Lead as Pb	Mg/l	0.05 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese as Mn	Mg/l	0.1 (0.3)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron as Fe	Mg/l	0.3 (1)	0.21	0.17	0.14	0.40	0.22	0.24	0.10	0.09	0.20	0.21
Chromium as Cr^{+6}	Mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium as Se	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc as Zn	Mg/l	5(15)	0.23	0.19	0.27	0.81	0.40	0.58	0.16	0.13	0.41	0.76
Aluminium as Al	Mg/l	0.03(0.2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury as Hg	Mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mineral oil	Mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pesticides	Mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Total Coliforms	MPN/100 ml	10	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

TABLE-3.4.2 (C)
GROUND WATER QUALITY - POST MONSOON SEASON

Parameters	Units	IS:10500 Limits	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
pH	-	6.5 -8.5	7.6	7.5	7.4	7.9	7.5	8.2	8.0	8.0	7.9	8.0
Colour	Hazen	5 (25)	3	2	2	2	3	2	2	3	2	2
Taste	-	Agreeable	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag
Odor	-	U.O	U.O	U.O	U.O	U.O	U.O	U.O	U.O	U.O	U.O	U.O
Conductivity	μ S/cm	$	780	2460	670	1186	1420	2376	1123	1433	1130	1190
Turbidity	NTU	5(10)	4	6	4	4	5	6	4	3	4	4
TDS	Mg/l	500 (2000)	486	1240	430	729	827	1653	891	906	898	904
Total Hardness as $CaCO_3$	Mg/l	300 (600)	333	576	179	377	440	604	294	326	266	427
Total Alkalinity	Mg/l	200 (600)	196	587	110	420	260	295	296	316	286	340
Calcium as Ca	Mg/l	75 (200)	56.6	96	34.2	80	96	106	46	43.9	49.6	88
Magnesium as Mg	Mg/l	30 (100)	46.6	81.6	22.6	42.9	48.6	82.4	43.6	52.6	34.6	50.2

Parameters	Units	IS:10500 Limits	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
Residual Chlorine	Mg/l	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	Mg/l	1 (5)	0.7	0.4	0.5	0.8	0.5	0.2	0.4	0.3	0.2	0.1
Chlorides as Cl	Mg/l	250 (1000)	118.6	278.6	104.6	92.6	210	486.6	146.3	164.6	104.6	86.6
Sulphates as SO_4	Mg/l	200 (400)	42.9	7.4	48.6	27.4	96.4	169.6	24.9	42.6	64.6	165.6
Fluorides as F	Mg/l	1.0 (1.5)	0.5	0.6	0.4	0.5	0.7	0.1	0.4	0.6	0.5	0.4
Nitrates as NO_3	Mg/l	45 (NR)	29.6	52.6	8.7	19.6	5.9	42.4	22.4	62.3	7.1	5
Sodium as Na	Mg/l	$	34.9	186	54.2	87.4	108.6	248.6	106	124.6	124.6	75.6
Potassium as K	Mg/l	$	7.8	10.3	4.0	3.2	2.4	9.4	3.4	6.4	6.8	6.0
Phenolic Compounds	Mg/l	0.001 (0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanides as CN	Mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anionic Detergents	Mg/l	0.2 (1.0)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium as Cd	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper as Cu	Mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead as Pb	Mg/l	0.05 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese as Mn	Mg/l	0.1 (0.3)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron as Fe	Mg/l	0.3 (1)	0.01	0.03	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01
Chromium as Cr^{+6}	Mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium as Se	Mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc as Zn	Mg/l	5(15)	<0.01	0.12	<0.01	0.01	0.02	0.13	0.14	<0.01	0.21	0.24
Aluminium as Al	Mg/l	0.03(0.2)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury as Hg	Mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mineral oil	Mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pesticides	Mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
E.Coli	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Total Coliforms	MPN/ 100 ml	10	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

TABLE-3.4.3 (A)
SURFACE WATER QUALITY - WINTER SEASON

Parameter	Unit	IS:2296 Class 'C' Limits	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
pH	-	6.5 to 8.5	7.7	7.6	7.8	7.1	7.3	7.3	7.8	7.7
Colour	Hazen	300	9	11	10	12	14	26	6	5
Conductivity	µS/cm	$	420	324	306	251	289	358	318	347
TDS	mg/l	1500	348	252	224	196	212	322	284	324
DO, Minimum	mg/l	4	6.2	5.8	5.9	5.8	5.7	5.8	5.6	6.3
BOD	mg/l	3	<3	<3	<3	<3	<3	<3	<3	<3
COD	mg/l	$	5.2	9.8	5.7	10	6.3	10.0	9.8	9.9
Total Hardness as $CaCO_3$	mg/l	$	105	99	89	64	82	125	109	126
Total Alkalinity as $CaCO_3$	mg/l	$	65	63	20	64	60	61	70	66
Calcium as Ca	mg/l	$	23.4	21.9	19.2	18.9	21.5	27.4	22.6	26.2
Magnesium as Mg	mg/l	$	10.8	10.1	9.6	3.8	6.5	13.1	12.1	13.8
Chlorides as Cl	mg/l	600	63.8	56.7	62.4	35.5	42.5	64.0	42.2	58.2
Residual Free Chlorine	mg/l	$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	< 0.2
Phosphates as PO_4	mg/l	$	0.01	0.35	0.05	0.04	0.18	46.0	0.61	0.67
Sulphates as SO_4	mg/l	400	33.1	22.1	19.9	13.8	19.4	16.4	13.6	18.8
Fluorides as F	mg/l	1.5	0.3	0.3	0.4	0.5	0.4	0.2	0.2	0.4
Nitrates as NO_3	mg/l	$	3.1	2.6	7.1	4.9	1.5	6.0	7.1	3.9
Sodium as Na	mg/l	$	31	26.2	28.4	24.9	22.7	24.3	21.2	20.8
Potassium as K	mg/l	$	6.2	8.3	6.5	6.6	6.1	5.2	4.2	6.2
Total Boron as B	mg/l	$	0.02	0.12	0.16	0.29	0.05	1.27	0.13	0.1
Cyanides	mg/l	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenolic Compounds	mg/l	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Oil and Grease	mg/l	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Cadmium as Cd	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper as Cu	mg/l	1.5	<0.01	0.02	0.02	0.02	0.02	<0.01	<0.01	<0.01
Lead as Pb	mg/l	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron as Fe	mg/l	50	0.03	0.05	0.04	0.08	0.03	0.03	0.02	0.03
Chromium as Cr^{+6}	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Parameter	Unit	IS:2296 Class 'C' Limits	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Selenium as Se	mg/l	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05
Zinc as Zn	mg/l	15	<0.01	0.15	0.58	7.78	1.22	0.02	<0.01	0.49
Aluminium as Al	mg/l	$	<0.01	<0.01	<0.01	<0.01	<0.01	0.09	0.07	0.06
Mercury as Hg	mg/l	$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SAR	-	$	1.07	4.56	5.44	4.72	1.23	1.27	0.56	1.61
Insecticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Anionic detergents as MBAS	mg/l	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0. 2	<0. 2	<0. 2

$: Limits not specified, UO: Un-Objectionable

TABLE-3.4.3 (B)
SURFACE WATER QUALITY - PRE-MONSOON SEASON

Parameter	Unit	IS:2296 Class 'C' Limits	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
pH	-	6.5 to 8.5	7.6	7.7	7.8	7.3	7.3	7.4	7.3	7.5
Colour	Hazen	300	11	09	13	06	15	4.2	3.3	4.1
Conductivity	µS/cm	$	455	362	346	281	334	424	398	446
TDS	mg/l	1500	386	288	264	212	236	364	312	348
DO, Minimum	mg/l	4	4.8	4.6	4.2	4.2	4.8	4.6	4.9	4.1
BOD	mg/l	3	<3	<3	<3	<3	<3	<3	<3	<3
COD	mg/l	$	10	10	5	5	10	9.8	8.2	9.8
Total Hardness as $CaCO_3$	mg/l	$	130	115	100	63	97	150	132	132
Total Alkalinity as $CaCO_3$	mg/l	$	71	74	58	77	76	70	80	90
Calcium as Ca	mg/l	$	28.5	24.8	20.6	20.3	25.6	32.8	26.9	30.2
Magnesium as Mg	mg/l	$	13.6	12.2	11.1	2.8	7.6	15.6	14.8	12.9
Chlorides as Cl	mg/l	600	78.0	56.7	62.4	28.4	49.6	72.0	56.7	70.9
Residual Free Chlorine	mg/l	$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0. 2
Phosphates as PO_4	mg/l	$	0.12	0.31	0.02	0.13	0.12	0.54	0.67	0.61
Sulphates as SO_4	mg/l	400	39.9	25.2	22.1	16.3	21.9	25.3	24.4	23.4
Fluorides as F	mg/l	1.5	0.3	0.5	0.4	0.4	0.3	0.2	0.3	0.2
Nitrates as NO_3	mg/l	$	3.9	10.5	7.9	0.6	0.8	11.1	6.2	1.3
Sodium as Na	mg/l	$	36	28.4	26.2	28.2	26.3	29.8	24.9	34.5

Parameter	Unit	IS:2296 Class 'C' Limits	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Potassium as K	mg/l	$	6.2	8.3	6.5	6.6	6.1	5.9	5.6	6.9
Total Boron as B	mg/l	$	0.15	0.24	0.31	0.08	0.06	0.19	0.14	0.122
Cyanides	mg/l	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenolic Compounds	mg/l	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Oil and Grease	mg/l	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1
Cadmium as Cd	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper as Cu	mg/l	1.5	0.02	0.02	0.02	0.02	0.02	<0.01	<0.01	<0.01
Lead as Pb	mg/l	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron as Fe	mg/l	50	0.20	0.02	0.02	0.02	0.05	0.02	0.03	0.03
Chromium as Cr^{+6}	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium as Se	mg/l	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05
Zinc as Zn	mg/l	15	0.36	0.12	0.32	0.53	1.12	0.22	<0.31	0.44
Aluminium as Al	mg/l	$	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	0.06	0.04
Mercury as Hg	mg/l	$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SAR	-	$	1.39	5.39	5.35	1.56	1.17	2.23	0.51	1.57
Insecticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Anionic detergents as MBAS	mg/l	1	1	1	1	1	1	<0. 2	<0. 2	<0. 2

$: Limits not specified, UO: Un-Objectionable

TABLE-3.4.3 (C)
SURFACE WATER QUALITY- POST MONSOON SEASON

Parameter	Unit	IS:2296 Class 'C' Limits	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
pH	-	6.5 to 8.5	7.6	7.4	7.7	7.4	7.5	7.7	7.6	7.8
Colour	Hazen	300	3	2	4	2	3	5	2	4
Conductivity	µS/cm	$	396	347	346	246	334	424	364	446
TDS	mg/l	1500	206	186	167	139	157	205	183	194
DO, Minimum	mg/l	4	7.1	7.3	7.4	7.2	7.0	7.5	7.1	7.3

Parameter	Unit	IS:2296 Class 'C' Limits	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
BOD	mg/l	3	<3	<3	<3	<3	<3	<3	<3	<3
COD	mg/l	$	10	10	5	<5	5	5	5	10
Total Hardness as $CaCO_3$	mg/l	$	93	90	83	58	76	108	100	108
Total Alkalinity as $CaCO_3$	mg/l	$	58	62	22	62	54	55	63	64
Calcium as Ca	mg/l	$	21.3	20.7	19.4	17.6	20.6	22.6	21.4	22.4
Magnesium as Mg	mg/l	$	9.6	9.4	8.4	3.4	6	12.4	11.4	12.7
Chlorides as Cl	mg/l	600	67.6	49.4	59.9	24.3	42.6	64.1	50.4	57.9
Residual Free Chlorine	mg/l	$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phosphates as PO_4	mg/l	$	0.06	0.14	0.01	0.06	0.07	0.12	0.14	0.21
Sulphates as SO_4	mg/l	400	24.6	21.3	16.9	14.6	18.9	21.3	19.6	21.6
Fluorides as F	mg/l	1.5	0.2	0.5	0.4	0.3	0.3	0.2	0.3	0.2
Nitrates as NO_3	mg/l	$	2.4	9.4	7.1	0.5	0.8	9.8	5.4	1.2
Sodium as Na	mg/l	$	32.9	24.6	24.6	22.9	21.6	22.9	19.4	19.6
Potassium as K	mg/l	$	6	6.9	6.1	6	5.4	4.9	4	5.8
Total Boron as B	mg/l	$	0.04	0.05	0.03	0.02	0.01	0.01	0.02	0.03
Cyanides	mg/l	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenolic Compounds	mg/l	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Oil and Grease	mg/l	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium as Cd	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper as Cu	mg/l	1.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead as Pb	mg/l	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron as Fe	mg/l	50	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Chromium as Cr^{+6}	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium as Se	mg/l	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc as Zn	mg/l	15	20.01	0.12	<0.01	<0.01	0.01	0.08	0.07	0.09
Aluminium as Al	mg/l	$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury as Hg	mg/l	$	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SAR	-	$	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Insecticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Anionic detergents as MBAS	mg/l	1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

$: Limits not specified, UO: Un-Objectionable

TABLE-3.4.4
WATER QUALITY- AROUND THE SECURE LAND FILL AREA

Parameter	Unit	IS:2296 Class 'C' Limits	Well 1	Well 2	Well 3	Well 4	Well 5
pH	-	6.8 to 8.5	7.5	7.6	7.7	7.4	7.6
Colour	Hazen	5 [25]	1	2	1	2	1
Odour	-	UO	UO	UO	UO	UO	UO
Conductivity	µS/cm	$	1640	1570	956	1740	1556
Taste	-	Ag	A	A	A	A	A
Turbidity	NTU	5 [10]	1	2	1	1	2
Total Hardness as $CaCO_3$	mg/l	300 [600]	396	560	435	650	390
Total Dissolved solids	mg/l	500 [2000]	1432	1270	840	1790	1616
Chlorides as Cl	mg/l	250 [1000]	186	178	205	170.4	219
Residual Free Chlorine	mg/l	0.2 min	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorides as F	mg/l	1.0 [1.5]	0.9	1.1	1.2	1.0	0.8
Calcium as Ca	mg/l	75 [200]	72	90	105	141	97.5
Magnesium as Mg	mg/l	30 [100]	56.2	79	58	44	69
Sulphates as SO_4	mg/l	200 [400]	141	157	109	172	149
Nitrates as NO_3	mg/l	45	50	40	56	60.5	49.7
Cyanides as CN	mg/l	0.05	<0.02	<0.02	<0.02	<0.02	<0.02
Alkalinity as $CaCO_3$	mg/l	200 [600]	250	300	270	281	240
Boron	mg/l	1 [5]	<0.1	<0.1	<0.1	<0.1	<0.1
Sodium as Na	mg/l	$	160	90.6	120	200	150
Potassium as K	mg/l	$	25.6	50.1	35.6	30.2	25.5
Iron as Fe	mg/l	0.3 [1.0]	0.21	0.4	0.23	0.3	0.29
Copper as Cu	mg/l	0.05 [1.5]	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese as Mn	mg/l	0.1 [0.3]	0.21	0.18	0.24	0.22	0.24
Aluminium as Al	mg/l	0.03 [0.2]	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium as Cr^{+6}	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium as Cd	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic as As	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead as Pb	mg/l	0.05	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc as Zn	mg/l	5 [15]	0.81	0.42	0.59	0.72	0.85
Mercury as Hg	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Coliform	MPN/100 ml	10	<2	<2	<2	<2	<2

$: Limits not specified, UO: Un-Objectionable

Note : Well No.1 & 2 : Downstream of the proposed SLF Site
Well No.3,4, & 5 : Upstream of the proposed SLF Site

3.5 Hydrology and Hydrogeology

3.5.1 Hydrology

3.5.1.1 Physiography of Banas River Basin

The buffer zone of Rajpura- Dariba mine falls in the catchment area of Banas river, which flows 10-km north of the northern boundary of the lease area. Banas river originates in the eastern slopes of the Aravali ranges near Kumbhalgarh and after flowing eastwards for about 512-km through districts of Rajsamand, Chittorgarh, Bhilwara, Tonk, and Sawai Madhopur meets Chambal river near Rameshar village in Sawai Madhopur district. The Banas river basin covers an area of 47,052 sq.km. The Banas river after originating in the eastern slopes of Aravali ranges, and traveling through Rajsamand district enters Chittorgarh district near Rashmi. Banas river, within Rajsamand district is joined from left by Chandrabhaga river near village Gangas. Banas river is an ephemeral river and flows in direct response to rainfall and goes dry during summer months. It is an influent river, recharging ground water all along its course before it meets Chambal river. Banas river has limited flow till mid - December and afterwards dry till monsoon.

Physiography of the lease area is characterized by almost flat country with isolated few low ridges. The mineralized zone from Dariba to Rajpura is marked by yellowish brown gossan, which forms a conspicuous physiographic feature of the terrain. Similarly, the NNE-SSW quartzite ridge, south of Sindesar Kalan is a prominent feature of the area achieving the elevation of 579-m above msl. There are few tanks near Chokri, Mandara, Relmagra, Jitwas and Armi which get filled up during rainy season and dry up by the summer. There is big size tank west of mine known as Mataji Ka Khera and another near village Pipawas in the south.

3.5.1.2 Major Surface Water Reservoirs of Banas River Upstream of Relmagra

The surface water resources of Banas river and its tributaries have been harnessed at many locations by constructing major and medium irrigation projects. The major irrigation projects (having CCA more than 10,000 ha and medium irrigation projects (having CCA from 2,000 to 10,000 ha) upstream of Relmagra are shown in **Table-3.5.1**.

TABLE-3.5.1
MAJOR IRRIGATION PROJECTS

Sr. No.	Project Name	River	Catchment Area (km^2)			Live Storage Mm^3	CCA Ha
			Total	Intercepted	Free		
1	Rajsamand	Banas	523	93	432	98.7	10441
2	Matrikundia	Banas	3415	2472	943	50	9500
3	Badgaon	Banas	1699	1300	398.9	30.2	9400
4	Bhopalsagar	Banas	215	38.6	176.4	18.4	3870
5	Nandsamand	Banas	839.2	217	622	19.5	7881

CCA- Culturable Command Area
Source – Irrigation Department, 1996

There are few minor irrigation tanks constructed on tributaries of Banas river basin. These tanks when completely filled provide irrigation to command area developed in nearby villages. However, this year due to exceptionally high rainfall, the tanks were full providing irrigation to the area of buffer zone.

3.5.1.3 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 576 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.

3.5.1.4 Run -off

Average annual rainfall in the buffer zone of Rajpura-Dariba mine is 576-mm out of which 90% happens to be during monsoon period from June to October. Winter monsoon is low, hardly contributing any surface runoff. The rainfall during the year 2006 was recorded as 1025 mm at the mine area which is much more than the average annual rainfall of 576-mm. (79.5 % above the average annual rainfall). The surface run-off in Banas river basin has been computed as 15 to 18% based on the storage of minor irrigation dams.

3.5.1.5 Rainfall

Average annual rainfall based on rainfall data recorded at Rajpura- Dariba mine for last 12 years has been observed as 576-mm. The rainfall recorded from January 2006 to October, 2006 at Rajpura- Dariba was 1025-mm, much above the average annual rainfall of 576-mm. Of the annual rainfall, about 90 % fall during four monsoon months (June to September) with July and August getting the maximum rains.

The following **Table-3.5.2** gives the annual rainfall recorded at Rajpura-Dariba, since 1995.

TABLE-3.5.2
RAINFALL RECODED AT RAJPURA- DARIBA MINES

Sr. No	Year	Rainfall in mm
1	1995	479
2	1996	690
3	1997	609
4	1998	590
5	1999	440
6	2000	324
7	2001	593
8	2002	254
9	2003	450
10	2004	624
11	2005	780
12	2006	1025
13	2007	587
14	2008	615
Average	**Annual**	**Rainfall = 576 mm**

3.5.2 Hydrogeology

Of all the rocks exposed in the area, only mica schists form poor aquifers while alluvium generally thin, remains above water table shown in **Figure-3.5.1.**

Mica schists are the main rocks exposed in the buffer zones. Mica schist are intruded by pegmatite and quartz veins. The general strike of the rocks is NNE-SSW to NE-SW with steep dips towards east.

- ***Nature of Occurrence of Ground Water***

Ground water occurs under water table conditions and is transmitted through fractures, joints and foliations. Mica schists are impervious in nature and have developed secondary porosity only due to tight joints and fractures. There is very limited thickness of weathered zone and generally it lies above the zone of saturation.

The depth to water in crystalline metamorphics in , during post monsoon period ranges within very wide limit from 1-m to 15-m below the land surface. It is shallow near the river courses, surface water reservoirs and ponds while it is deeper in the area away from these sources. The depth to water ranges from 10-m to 25-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.

- ***Movement of Ground Water***

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 foliations of the crystallines.

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 east and southeast and is 0.6 m/km. The ground water flow in this part of the buffer zone is also towards southeast with hydraulic gradient as 2.5 to 3.5 m/km as calculated from the monitoring of wells of the area.

- ***Nature of Hydraulic Conductivity***

As the principal aquifer of the area is mica schists in Rajpura-Dariba area, the hydraulic conductivity is mainly developed due to fractures and foliations. The hydraulic conductivity is very low the depth of productive hydraulic conductivity has been observed up to maximum depth of 90-m in the metamorphics, beyond which there are hardly any secondary openings, making the metamorphics completely barren.

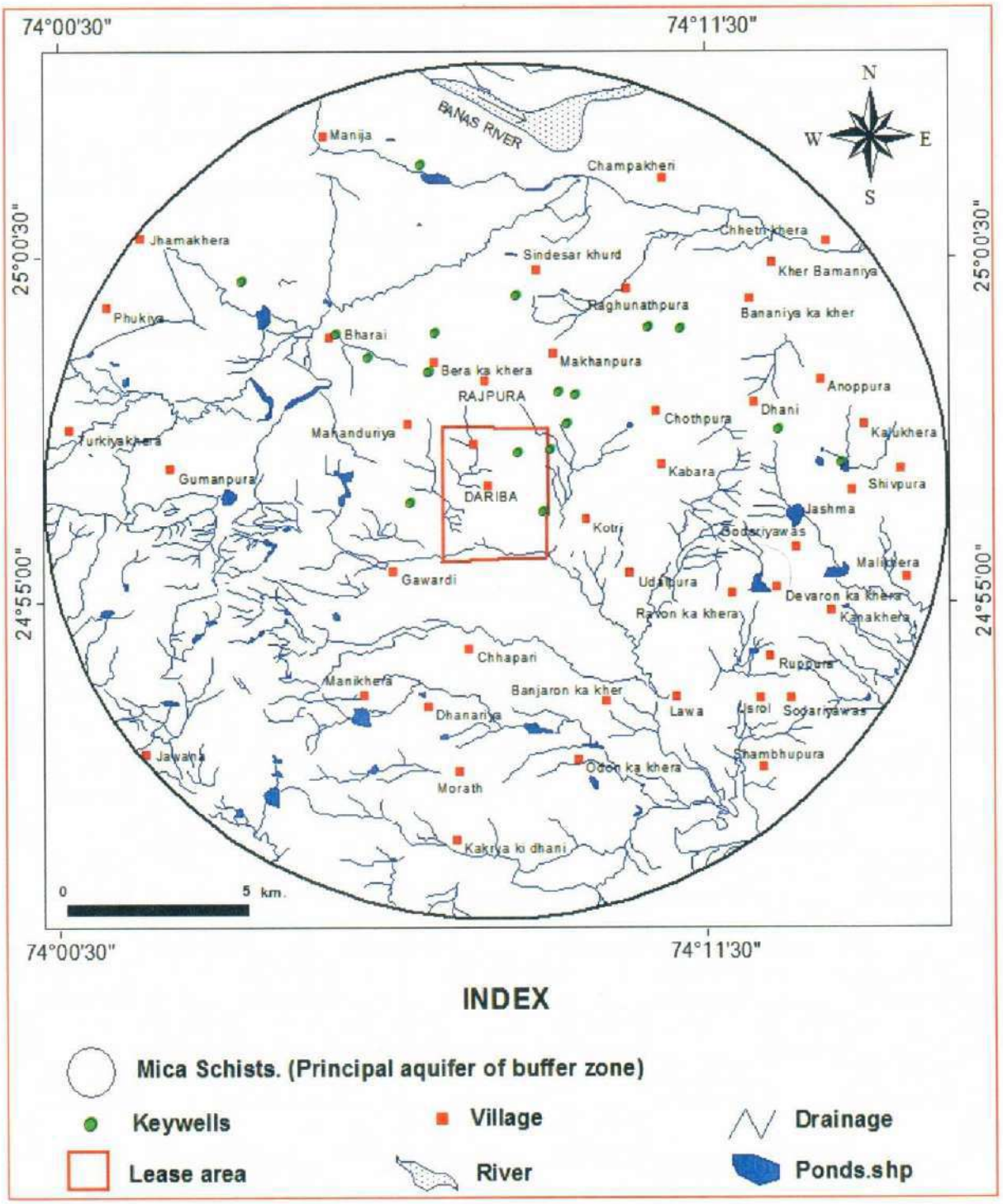


FIGURE-3.5.1
HYDROGEOLOGICAL MAP

Field permeability tests conducted in mica schists at depths from 25-m to 30-m indicate the hydraulic conductivity in the range of 0.86 to 3.36 x 10^{-2} m/day. Such a low hydraulic conductivity of country rock indicates that percolation of water in the mine will be mainly from the upper zone up to depth of 90-m only and there will be hardly any percolation from deeper depth where the rocks will not have any fracture porosity. However, water from upper zone can get accumulated at the mine sumps located at depths around 200-m or more.

- ***Yield of Wells***

There are 10 open wells in the mining lease area but there are large numbers of open dug wells in the buffer zone. Majority of these wells yield meager discharge ranging from 30 to 80-m^3/day of potable quality of water. These wells do not sustain pumping more than few hours and go dry and recoup after 12 to 16 hours further confirming very low hydraulic conductivity. Wells are mostly operated by centrifugal pumps either by electrical motors of 5 H.P or diesel engines of 8 H.P.

- ***Ground Water Recharge***

The main source of ground water recharge is by the rainfall by direct percolation to the zone of saturation. As already indicated, there is well developed drainage in the area due to loamy soils. A significant part of the rainfall is lost as runoff from the area due to thin loamy soils. A limited percentage of rainfall therefore reaches zone of saturation and becomes the part of ground water storage after meeting the evaporation and evapotranspiration losses. There is also ground water recharge from the return flow of irrigation water pumped from dug wells operated by the cultivators. As there are small tanks and irrigation projects in the buffer zone, an area of 1520-ha is commanded. The ground water recharge from return flow of irrigation is normally taken as 20 % of the total water applied for irrigation. This percentage has been suggested by the Ground Water Estimation Committee for ground water assessment for this part of the state.

Ground water recharge from rainfall for the year 2006, which was almost double than the average rain fall year (1025-mm against average annual rainfall of 576-mm, has been calculated by measuring the rise of water levels in the key wells of the buffer zone. The water levels in the month of first week June 2006 were recorded and were again measured in the first week of October, 2006. The rise of water levels indicate the quantity of water percolated to zone of saturation due to recharge from rainfall. Areal average rise of water table has been noted as 2.55-m in mica schists and 2.35-m in quartzites. Taking specific yield of 1.75% for mica schists and 2% for quartzites, (the values adopted by GWD& CGWB in assessment report for this area) the ground water recharge has been calculated for core and buffer zones.

- ***Ground Water Recharge of Lease Area (Core zone)***

Increment in Ground Water Storage

The mining lease covers an area of 1142.20-ha. There are four open wells in operation the lease area owned by private cultivators operated for irrigation. The

rise of water table due to rainfall for the year 2006 has been determined from these existing open wells by recording water table during pre and post monsoon periods, which was observed as 5.55-m for the mica schists. The ground water recharge is calculated for core zone as under.

11.42 * 1000 * 1000 * 5.55 * 0.0175 = 1.109 mcm.
Area of core zone * Rise of water level * Specific Yield = Recharge

The ground water recharge for the core zone therefore amounts to 1.109 mcm which when adjusted to normalized rainfall year, amounts to 0.618 mcm.

Rainfall Infiltration

The Ground Water Resource Estimate Committee, formed by Govt. of India has proposed rainfall infiltration factor to be used for estimation of ground water recharge for the areas where monitoring of wells has not been done.

The committee has suggested 10% to 15% as the rainfall infiltration factor for metamorphics area having loamy soils with moderate rainfall and well developed drainage. An infiltration factor of 10% is adopted for this area which appears to be reasonable looking to the hydrogeological and geomorphological settings. Although, there is no need to use this theoretical approach in this case which has been monitored on a comprehensive scale, an attempt can be made to find out if it matches with the ground water recharge as calculated by increment in the ground water storage and it is found that it matches very well.

11.42 * 1000 * 1000 * 0.576 * 0.1 = 0.61 mcm
Area of core zone * rainfall * infiltration = Recharge

- ***Ground Water Recharge of 10 km Area (Buffer Zone)***

Buffer zone has mainly mica schists as principal aquifer occupying an area of 302.58 km^2 (314 – 11.42 km^2 of core zone) in the tehsil of Relmagra, district Rajsamand.
The ground water fluctuation of water table during pre and post monsoon periods were recorded for the year 2006 from the 30 key wells as per the guidelines of the Ministry of Environment & Forests and taking specific yield values of 1.75% for mica schists, the ground water recharge by rain fall has been calculated as under.

- ***Increment in Ground Water Storage***

The rise of water table in key wells tapping gneisses was recorded for year 2006 when the area received rainfall of 1025-mm (long term average being 576-mm). The rise of water level was found 5.85-m in the mica schist's after aerial averaging for buffer zone. The ground water recharge can be calculated as under.

302.58 * 1000 * 1000 * 5.85 * 0.0175 = 30.97 mcm

Area of mica schists * Rise of water level * Specific Yield = Recharge

The ground water recharge for the year 2006 by rainfall of 1025-mm when measured as increment in ground water storage amounts to 30.97-mcm which when adjusted for a normalized rainfall year (576-mm) amounts to 17.25-mcm.

- ***Rainfall Infiltration***

The Ground Water Resource Estimate Committee, formed by Govt. of India has proposed rainfall infiltration factor to be used for estimation of ground water recharge for the areas where monitoring of wells has not been done.

The committee has suggested 10% to 15% as the rainfall infiltration factor for metamorphics area having loamy soils with moderate rainfall and well developed drainage. An infiltration factor of 10% is adopted for this area which appears to be reasonable looking to the hydrogeological and geomorphological settings. Although, there is no need to use this theoretical approach in this case which has been monitored on a comprehensive scale, an attempt can be made to find out if it matches with the ground water recharge as calculated by increment in the ground water storage and it is found that it matches very well.

302.58 * 1000 * 1000 * 0.576 * 0.1 = 17.27 mcm

Area of buffer zone * rainfall * infiltration = Recharge

- ***Return Flow of Irrigation***

The norms prescribed by the Estimate Committee for return seepage from the irrigation fields having loamy soils has been suggested as 20% of the total water applied for the irrigation. The total water applied for irrigation from open wells in the buffer zone is 15.58-mcm and from surface reservoirs is 3.04-mcm (1520 ha). The total water applied for irrigation amounts to 18.62-mcm, of which 20 % joins ground water storage as return flow of irrigation, amounting to 3.72-mcm.

18.62 * 0.20 = 3.72 mcm

Water applied for irrigation * Return seepage = Recharge

The total ground water recharge of buffer zone from all the sources therefore amounts to 20.97-mcm.

- ***Ground Water Discharge***

Ground Water Discharge of Core Zone

The ground water abstraction in the core zone comprising lease area of 11.42 km^2 is by 10 open wells owned by private cultivators. The average yield of these open wells tapping mica schists is 70 m^3/ day (go dry after few hours of pumping by electrical pump of 5 hours or diesel engine of 8 H.P.) and are operated for 120 days in a year.

10 * 70 * 120 = 0.084 mcm
No. of wells * average yield * No. of days of irrigation = Withdrawal

In addition, the daily dewatering of mines during the average normal rainfall has been observed as 900 m^3 or 0.328-mcm. The total discharge from private wells and from mine amounts to 0.412-mcm.

- ***Ground Water Discharge of Buffer Zone***

Ground water discharge in the buffer zone takes place mainly by dugwells operated for irrigation by cultivators. There are 1855 dugwells with pumps tapping mica schists with average yield of 70 cu.m/day. The annual ground water withdrawal from these wells is calculated as under.

1855 * 70 * 120 = 15.58 mcm (wells with pumps tapping mica schists)

No. of wells * yield/day * No. of days of operation = Annual withdrawal

In addition, the drinking and livestock water requirement of all the villages located in the buffer zone is met by open dugwells and hand pumps and is around 1.15-mcm. The total ground water discharge therefore amounts to 16.73-mcm. It is observed that against the total ground water recharge of buffer zone of 20.48-mcm, the ground water discharge is 20.97-mcm, indicating the status of ground water development as 80%. The area however shows regular depleting trend of water table during pre-monsoon and post monsoon period indicating the present status of ground water development as critically exploited.

- ***Present Status of Ground Water Development of the Area***

The state Ground Water Department in consultation with Central Ground Water Board also works out the status of ground water development for each development block and publishes the findings once in two years after monitoring the key wells. The findings of the Ground Water Department have been released for the year 2004 which indicate that ground water potential zone comprising mica schists of Relmagra block of Rajsamand district as critically exploited zone. Against the long term recharge of 10.62-mcm of mica schist zone measuring 542.12 km^2 and the ground water withdrawal has been calculated as 8.955-mcm indicating the status of ground water development is 91%. The findings of the present study also match with the assessment done by the Ground Water Department & Central Ground Water Board in the report released in September, 2005. Hydrological data of key wells in the buffer zone of Rajpura Dariba mines monitored during 2006 are presented in **Table-3.5.3**.

TABLE-3.5.3
HYDROLOGICAL DATA OF KEY WELLS IN THE BUFFER ZONE

Sr. No.	Village	Latitude	Longitude	Depth Of Well (m)	Pre Monsoon Water Level(m)	Post Monsoon Water Level (m)	Aquifer	Yield (m^3/day)	Pump Capacity (Hp)	Purpose
1	Bamnia Kalan	25°03'07.6"	74°09'23.3"	28.00	22.80	21.54	Quartzite	136	5HP/EM	Irrigation
2	HZL Well	25°02'29.3"	74°08'43.4"	20.00	17.05	15.57	Alluvium/Mica Schists	36	10HP/EM	Drinking
3	Relmagra	25°02'07.8"	74°05'47.0"	30.00	15.35	11.84	Granite/Gneisses	136	5HP/EM	Drinking
4	Sakhrawas	25°02'12.6"	74°04'21.7"	20.00	14.40	12.90	Mica Schists	205	5HP/EM	Irrigation
5	Mohra	25°03'00.3"	74°06'06.4"	22.05	21.15	16.64	Gneisses	227	5HP/EM	Irrigation
6	Makanpuria	24°59'22.2"	74°08'39.8"	25.80	22.56	20.14	Schists	182	5HP/EM	Irrigation
7	Basanta	25°01'19.8"	74°11'38.3"	24.80	23.05	22.84	Schists	160	5HP/EM	Irrigation
8	Suniyana	25°01'16.9"	74°12'45.1"	23.90	21.10	16.14	Mica Schists	90	5HP/EM	Irrigation
9	Chajri Khera	25°01'46.0"	74°13'37.1"	22.80	21.45	14.14	Quartzite/Mica Schists	135	5HP/EM	Irrigation
10	Jagpura	25°02'40.5"	74°13'37.8"	15.80	14.95	10.40	Schists	23	5HP/EM	Irrigation
11	Punotia	25°03'00.0"	74°11'58.9"	18.20	17.77	13.64	Calc.Schist/Marble	160	5HP/EM	Irrigation
12	Ganeshpura	25°04'56.4"	74°10'12.5"	10.20	8.90	6.54	Quartzite/Mica Schists	68	5HP/EM	Irrigation
13	Joonda	25°05'35.8"	74°09'13.4"	25.70	20.40	18.49	Gneisses/Quartzite	90	5HP/EM	Irrigation
14	Bamnia Kalan	25°03'14.5"	74°08'55.2"	23.50	21.22	19.44	Schists	68	5HP/EM	Irrigation
15	Jeetwas	25°03'54.0"	74°07'07.2"	24.00	21.95	15.05	Mica Schists	9	Manual	Drinking
16	Dariba	24°57'26.8"	74°08'51.1"	27.40	14.80	5.45	Mica Schists	-	Manual	Drinking
17	Sunariya Kheda	24°58'18.9"	74°09'15.7"	24.38	9.20	6.92	Mica Schists	-	5HP/EM	Irrigation
18	Sunariya Kheda	24°58'21.8"	74°08'59.4"	22.18	7.40	5.57	Mica Schists	-	Manual	Irrigation
19	Dariba	24°57'52.1"	74°09'07.4"	20.15	9.55	5.92	Mica Schists	-	Manual	Irrigation
20	Dariba	24°57'24.5"	74°08'19.6"	26.10	8.45	7.02	Mica Schists	-	Manual	Irrigation
21	Dariba	24°56'28.0"	74°08'44.2"	24.50	13.24	8.49	Mica Schists	-	Manual	Domestic
22	Anjana	24°56'36.6"	74°06'33.5"	24.40	10.23	8.09	Mica Schists	40	5HP/EM	Irrigation
23	Jashma	24°57'14.0"	74°13'37.7"	14.12	12.05	9.14	Mica Schists	100	5HP/EM	Irrigation
24	Dhani	24°57'46.8"	74°12'35.6"	16.05	14.28	11.84	Mica Schists	40	5HP/EM	Irrigation
25	Ganeshpura	24°59'23.3"	74°10'58.3"	14.68	12.90	8.84	Mica Schists	-	Manual	Irrigation
26	Amarpura	24°59'24.1"	74°10'26.6"	17.80	13.34	10.14	Mica Schists	-	Manual	Drinking
27	Sindesar Khurd	24°59'54.8"	74°08'18.0"	20.40	19.10	15.77	Mica Schists	80	5HP/EM	Irrigation
28	Malikhera	24°59'19.0"	74°06'57.6"	17.30	16.34	14.94	Mica Schists	-	Manual	Drinking
29	Laxmipura	24°58'55.0"	74°05'52.1"	22.20	11.12	9.74	Mica Schists	16	2HP/EM	Drinking
30	Bharai	24°59'17.7"	74°05'20.4'	13.25	11.45	8.94	Mica Schists	-	Manual	Drinking
31	Sadri	25°00'07.9"	74°03'47.3"	15.26	14.55	11.84	Mica Schists	80	5HP/EM	Irrigation
32	Malikhera	24°58'41.0"	74°06'51.6"	24.40	16.80	8.39	Mica Schists	80	5HP/EM	Irrigation
33	Malikhera	24°58'41.5"	74°06'50.8"	25.05	19.55	18.70	Mica Schists	-	Manual	Drinking
34	Relmagra	25°02'00.3"	74°06'43.4"	22.82	14.80	11.44	Mica Schists	120	5HP/EM	Irrigation

Source: Hydro-Geosurvey Consultants Private Limited, Jodhpur

➢ ***Conclusions***

The hydrological and hydrogeological studies carried out in the mining lease area (core zone) and 10 km radius (buffer zone) have revealed that there are adequate surface and ground water resources which are being utilized for irrigation from irrigation dams and open dugwells. There is ground water development in the buffer zone for irrigation by 1855 open dugwells. The ground water development is within safe limits in core zone and will remain within safe limits even at the conceptual stage. The ground water inflow in the mines and its withdrawal will not influence any nearby private or public wells.

The quality of surface water is relatively better than the ground water but both are suitable for drinking and irrigation purposes as all the constituents are within prescribed limits. Nature of aquifer being crystalline, hard and chemically resistant to weathering with thin alluvial cover, does not contribute any pollutants to surface and ground water.

3.6 Land Environment

The baseline information on soils in the area is essential to determine the impact of mining along with their associated activities for assessing the current impacts of mining on the soil quality and the anticipated impacts in future. Accordingly, the assessment of the soil quality has been carried out.

3.6.1 Data Generation

For studying soil quality in the region, sampling locations were selected to assess the existing soil conditions in and around the project 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 90-cm depth.

Eight locations within 10-km radius of the proposed mine lease boundary were selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and homogenized. The homogenized samples were analyzed for physical and chemical characteristics. Sampling was done thrice during the study period.

The details of the sampling locations are given in **Table-3.6.1** and are shown in **Figure-3.6.1**. The soil quality for all the locations is shown in **Table-3.6.2.** The results are compared with standard soil classification as given in **Table-3.6.3.**

TABLE-3.6.1
DETAILS OF SOIL SAMPLING LOCATIONS

Location Code	Location	Distance w.r.t. Mine Lease Boundary (km)	Direction w.r.t Mine Centre	Present Land Use
S1	Mine lease area	--	--	Agricultural land
S2	Sunariya Khera	1.5	NE	Agricultural land
S3	Kotari	1.4	ESE	Agricultural land
S4	Rajpura	1.2	N	Agricultural land
S5	Anjana	0.4	SW	Agricultural land
S6	Mahenduriya	0.8	NW	Agricultural land
S7	Shivpura	3.2	NNE	Agricultural land
S8	Pipawas village	1.9	SSE	Agricultural land

3.6.2 Baseline Soil Status

- ***Winter Season, 2007-08***

It has been observed that the texture of soil is mostly sandy clay in the study area. The common color of the soil ranged from brown to brownish black.

It has been observed that the pH of the soil ranged from 6.9 to 7.7 indicating that the soils are usually neutral to slightly alkaline in nature.

The Electrical Conductivity was observed to be in the range of 161 to 771 µmho/cm, with the maximum (771 µmho/cm) observed in Rajpura (S4) and with the minimum (161 µmho/cm) observed in Kotari (S3).

The Nitrogen values ranged between 34.3 to 153 Kg/ha. The maximum value (153 Kg/ha) was observed in village Anjana (S5), the minimum value (34.3 Kg/ha) was observed in Pipawas village (S8) indicating that the soils have very less to good quantity of Nitrogen.

The Phosphorus values ranged between 63.8 to 104.2 Kg/ha. The maximum value (104.2 Kg/ha) was observed in Anjana village (S5), the minimum value (63.8 Kg/ha) was observed in Kotari village (S3) indicating that the soils have sufficient to more than sufficient quantity of Phosphorus.

The Potassium values range between 223.3 to 434.7 Kg/ha. The maximum value (434.7 Kg/ha) was observed in Shivpura (S7) indicating that the soil has more than sufficient quantity of Potassium. The minimum value (223.3 Kg/ha) was observed in the village Pipawas village (S8) indicating that the soils have average to more than sufficient quantity of Potassium.

NPK values are very less to more than sufficient.

- ***Pre-Monsoon Season, 2008***

It has been observed that the texture of soil is mostly sandy clay in the study area. The common color of the soil ranged from brown to brownish black.

It has been observed that the pH of the soil ranged from 7.6 to 8.1 indicating that the soils are usually slightly alkaline to moderately alkaline in nature.

The Electrical Conductivity was observed to be in the range of 182 to 384 µmho/cm, with the maximum (384 µmho/cm) observed in Kotari (S3) and with the minimum (182 µmho/cm) observed in Anjana (S5).

The Nitrogen values ranged between 34.3 to 136.6 Kg/ha. The maximum value (136.6 Kg/ha) was observed in village Maheanduriya (S6), the minimum value (34.3 Kg/ha) was observed in Anjana village (S5) indicating that the soils have very less to good quantity of Nitrogen.

The Phosphorus values ranged between 66.1 to 103.7 Kg/ha. The maximum value (103.7 Kg/ha) was observed in Anjana village (S5), the minimum value (66.1 Kg/ha) was observed in Kotari village (S3) indicating that the soils have sufficient to more than sufficient quantity of Phosphorus.

The Potassium values range between 196.9 to 521.3 Kg/ha. The maximum value (521.3 Kg/ha) was observed in Shivpura (S7) indicating that the soil has more than sufficient quantity of Potassium. The minimum value (196.9 Kg/ha) was observed in the village Mahenduriya village (S6) indicating that the soils have medium to more than sufficient quantity of Potassium.

NPK values are very less to more than sufficient.

- ***Post-Monsoon Season, 2008***

It has been observed that the texture of soil is mostly sandy clay in the study area. The common color of the soil ranged from brown to brownish black.

It has been observed that the pH of the soil ranged from 7.1 to 7.9 indicating that the soils are usually neutral to moderately alkaline in nature.

The Electrical Conductivity was observed to be in the range of 94 to 464 µmho/cm, with the maximum (464 µmho/cm) observed in Rajpura (S4) and with the minimum (94 µmho/cm) observed in Kotari (S3).

The Nitrogen values ranged between 18.0 to 80.1 Kg/ha. The maximum value (80.1 Kg/ha) was observed in village Anjana (S5), the minimum value (18.0 Kg/ha) was observed in Pipawas village (S8) indicating that the soils have very less to less quantity of Nitrogen.

The Phosphorus values ranged between 33.4 to 54.5 Kg/ha. The maximum value (54.5 Kg/ha) was observed in Anjana village (S5), the minimum value (33.4 Kg/ha) was observed in Kotari village (S3) indicating that the soils have medium to on an average sufficient quantity of Phosphorus.

The Potassium values range between 117 to 298 Kg/ha. The maximum value (298 Kg/ha) was observed in Shivpura (S7) and the minimum value (117 Kg/ha)

was observed in the village Pipawas village (S8) indicating that the soils have very less to average quantity of Potassium.

NPK values are less to average.

TABLE-3.6.2 (A)
SOIL ANALYSIS RESULTS (WINTER SEASON 2007-08)

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
pH (1:5 extract)	7.0	7.0	6.9	7.5	6.9	7.1	7.7	7.7
Electrical Conductivity, µS/cm (1:5 extract)	228	379	161	771	326	338	223	182
Texture*	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay
Sand (%)	51	49	56	46	45	46	50	50
Silt (%)	14	09	09	06	05	04	10	08
Clay (%)	35	42	35	48	50	50	40	42
Bulk Density, gm/cc	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.1
Exchangeable Calcium as Ca	3913	3190	2675	4025	1913	3078	4024	2080
Exchangeable Magnesium as Mg	194	121	243	678	218	218	359	115
Exchangeable Sodium as Na	67.4	83.7	134.3	142.5	73.7	122.9	49.8	160.7
Av. Potassium as K (kg/ha)	314	288	236.6	363.2	259.9	291.4	434.7	223.3
Av. Phosphorus as P (kg/ha)	80.3	89.6	63.8	94.4	104.2	80.2	76.3	103.7
Available Nitrogen as N (kg/ha)	119	128.9	107.2	148.9	153	147	49.3	34.3
Organic Matter (%)	1.12	1.21	1.01	1.28	1.44	1.38	0.46	0.32
Organic Carbon (%)	0.65	0.70	0.58	0.74	0.83	0.80	0.27	0.19
Water Soluble Chloride as Cl	113.3	255.2	70.8	580.4	354.1	254.7	88.1	70.4
Water Soluble Sulphates as So_4	82.3	87.7	15.1	98.0	31.9	29.0	26.6	57.4
SAR- Sodium Abs. Ratio	0.13	0.18	0.30	0.25	0.19	0.25	0.10	0.43
Aluminum	1.84	1.69	1.93	1.88	1.49	1.83	1.98	1.98
Total Iron	0.98	1.06	0.89	1.18	0.93	0.92	0.75	0.68
Manganese	206.4	218.3	149.9	146.2	228.3	218.6	362	137.9
Boron	68.3	49.8	56.1	66.2	39.9	68.3	11.8	10.5
Zinc	148.6	186.4	272.4	254.4	188.7	214.1	61.2	62.8

TABLE-3.6.2 (B)
SOIL ANALYSIS RESULTS (PRE-MONSOON SEASON 2008)

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
pH (1:5 extract)	7.8	7.7	7.7	7.6	7.7	7.7	7.9	8.1
Electrical Conductivity, µS/cm (1:5 extract)	255	223	384	202	182	250	226	209
Texture*	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay
Sand (%)	57	50	59	42	50	55	45	57
Silt (%)	16	10	13	23	08	15	20	9
Clay (%)	27	40	28	35	42	30	35	34
Bulk Density, gm/cc	1.2	1.1	1.2	1.1	1.1	1.1	1.1	1.3
Exchangeable Calcium as Ca	4383	4024	4203	2834	2080	2624	4004	2392
Exchangeable Magnesium as Mg	217	359	644	267	115	462	241	132
Exchangeable Sodium as Na	75.5	49.8	336.3	26.9	160.7	19	77.3	184.8
Av. Potassium as K (kg/ha)	352	434.7	817.0	247.8	223.3	196.9	521.3	256.8
Av. Phosphorus as P (kg/ha)	89.9	76.3	66.1	102.4	103.7	77.9	86.1	119.3
Available Nitrogen as N (kg/ha)	133	49.3	124.9	59.3	34.3	136.6	122.8	39.4
Organic Matter (%)	1.3	0.46	1.17	0.51	0.32	1.28	1.15	0.41
Organic Carbon (%)	0.73	0.27	0.68	0.30	0.19	0.74	0.67	0.22
Water Soluble Chloride as Cl	126.9	88.1	301.0	70.2	70.4	124	70.9	81.0
Water Soluble Sulphates as So_4	92.2	26.6	40	117.6	57.4	49	53.2	66.0
SAR- Sodium Abs. Ratio	0.15	0.1	0.58	0.06	0.43	0.04	0.14	0.5
Aluminum	2.06	1.98	2.01	2.79	1.98	1.02	2.12	2.32
Total Iron	1.10	0.75	1.43	1.38	0.68	0.79	1.76	0.82
Manganese	231.2	362	294.1	102.3	137.9	380.4	442.1	157.6
Boron	76.5	11.8	16.2	13.2	10.5	14.2	14.9	10.4
Zinc	166.4	61.2	44.1	46.5	62.8	37.3	52.3	12.1

TABLE-3.6.2 (C)
SOIL ANALYSIS RESULTS (POST MONSOON SEASON 2008)

Parameters	S1	S2	S3	S4	S5	S6	S7	S8
pH (1:5 extract)	7.3	7.3	7.6	7.9	7.6	7.7	7.1	7.1
Electrical Conductivity, µS/cm (1:5 extract)	129	208	94	464	171	177	117	95
Texture*	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay	Sandy Clay
Sand (%)	46	44	51	41	40	42	45	45
Silt (%)	15	10	10	7	6	4	11	9
Clay (%)	39	46	40	52	54	54	44	46
Bulk Density, gm/cc	1.0	1.0	1.1	1.1	1.1	1.1	1.0	1.1
Exchangeable Calcium as Ca	2088	1697	1477	2173	1169	1681	2162	1894
Exchangeable Magnesium as Mg	122	68	178	553	144	187	197	94
Exchangeable Sodium as Na	53.3	83.8	90.3	84.6	99.5	74.3	62.1	84.9
Av. Potassium as K (kg/ha)	195	155	142	199	163	183	298	117
Av. Phosphorus as P (kg/ha)	32.5	46.9	33.4	49.4	54.5	42.0	39.9	54.3
Available Nitrogen as N (kg/ha)	62.3	67.5	56.1	77.9	80.1	76.9	25.8	18.0
Organic Matter (%)	0.59	0.63	0.53	0.67	0.75	0.72	0.24	0.17
Organic Carbon (%)	0.34	0.37	0.3	0.39	0.43	0.42	0.14	0.1
Water Soluble Chloride as Cl	59.3	133.6	37.1	303.8	185.4	133.3	46.1	36.9
Water Soluble Sulphates as So_4	43.1	45.9	7.9	51.3	16.7	15.2	13.9	30.0
SAR- Sodium Abs. Ratio	0.07	0.09	0.16	0.13	0.10	0.13	0.05	0.23
Aluminum	0.96	0.88	1.01	0.98	0.78	0.96	1.04	1.04
Total Iron	0.51	0.55	0.47	0.62	0.49	0.48	0.39	0.36
Manganese	108.0	114.3	78.5	76.5	119.5	114.4	189.5	71.7
Boron	35.8	26.1	29.4	34.7	20.9	35.8	6.2	5.5
Zinc	77.8	97.6	142.6	133.2	98.8	112.1	32.0	32.9

Bagmaniya Kalan
Mandara
Jiwakhera
10 KM
Champakheri
Relmagra
Sindesar Kalan
Soniyana
Sadri
Khar Bamaniya
Sindesar Khurd
Raghunathpura
Amarpura
Malikhera
Shivpura
S7
Ganeshpura
Laxmipura
Makhanpuriya
Bera ka Khera
Bharai Dam
Rajpura
S4
S2
Chothpura
Sunariyakhera
Dhani
Mahenduriya
S6
PLANT
Sansera ki Khera
S1
Dariba
Kabara
S5
Anjana
S3
Kotari
Larapacha
Mataji ka Khera
Gadariyawas
Gawardi
Udaipura
Kantiyakhera
Devarah ka Khera
S8
Pipawas
Chhapari
Lunera
Chawandiya
Gadariyawas
Dharangakhera
Dhaneriya
Bari
Jajaron ka Khera
Morath
Phalasiya
Bhupalsagar
Bhumalawas
Sanawar
74° 5'
74° 10'
Topo Sheet No. 45 K/4, L/
Soil Sampling Locations

TABLE-3.6.3
STANDARD SOIL CLASSIFICATION

Sr. No.	Soil Test	Classification
1	pH	<4.5 Extremely acidic 4.51- 5.00 Very strongly acidic 5.51-6.0 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (ppm) (1 ppm = 640 µmho/cm)	Up to 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon	Up to 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (Kg/ha)	Up to 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (Kg/ha)	Up to 15 very less 16-30 less 31-50 medium 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (Kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Handbook of Agriculture, Indian Council of Agriculture Research, New Delhi

3.7 Flora and Fauna Studies

3.7.1 Introduction

A detailed flora and faunal studies have been conducted, particularly with reference to listing of species and assessment of the existing baseline ecological (Terrestrial) conditions in the study area.

3.7.2 Objectives of Ecological Studies

The present study was undertaken with the following objectives:

- To assess the nature and distribution of vegetation in proposed mine lease area and smelter plant area;

- To assess the nature and distribution of vegetation in and around existing mine lease area - Buffer zone (in 10-km radius from mine lease boundary;
- To assess the distribution of animal life spectra in core zone of mine lease;
- To assess the distribution of animal life spectra in and around existing mine lease- Buffer zone(in 10-km radius from mine lease boundary;
- To ascertain migratory routes of fauna if any;
- Possibility of presence of breeding grounds, if any; and
- Development of green belt plant in and around mine lease area and also in smelter plant

3.7.3 Methodology Adopted for the Survey

To achieve the above objectives a detailed study of the area was undertaken with the mine lease area as its centre. The different methods adopted were as follows:

- Generation of primary data by undertaking systematic ecological studies in the area;
- Discussion with local people so as to elicit information about local plants, animals and their uses; and
- Gathering data for ethnobiology.

The present report gives the review of published secondary data and the results of field sampling conducted during winter season .

3.7.4 Terrestrial Ecological Status: Primary Survey

Eight locations were selected to conduct a detailed study within the study area. The selected locations are given in **Table-3.7.1** and **Figure-3.7.1.**

TABLE-3.7.1
DETAILS OF TERRESTRIAL ECOLOGICAL SAMPLING LOCATIONS

Code	Name of the location	Distance w.r.t. Mine Lease Boundary (km)	Direction w.r.t Mine centre
TE-1	Mine Lease Area	--	--
TE-2	Rajpura	1.2	N
TE-3	Makhanpuriya	2.2	NNE
TE-4	Sunariya Khera	1.5	NE
TE-5	Chothpura	3.1	ENE
TE-6	E of ML area	0.5	E
TE-7	Lunera	4.2	SE
TE-8	Chawandiya	4.1	S

The primary data was generated through:

1. Preparing a general checklist of all plants encountered in the study area. This would indicate the bio-diversity for wild and cultivated plants. The plants so encountered were classified into life form spectrum according to the Raunkiaer's classification of life form spectrum;
2. Determining the bird population of migratory and local birds by taking 10 random readings at every location;

3. Observing mammals, amphibians and reptiles, noting their calls, droppings, burrows, pugmarks and other signs;
4. Carrying out Physical observations from the village area and in and around mine lease areas one during day time and the other during night time for terrestrial fauna; and
5. Interviewing local inhabitants for knowing the uses of plants and animals and to get ethnobiological data.

3.7.5 Floristic Composition- Primary Survey

Floristic Richness

- ***Cryptogamic Vegetation***

The area shows many algae, fungi, bryophytes and ferns. Algae are present in aquatic bodies and in marshy places. Fungi, particularly from ascomycetes and basidiomycetes are located either on ground or epiphytically. Lichens of crustose, foliose and fruticose types are present on different substratas (Lichens, Ascomycetes and Basidiomycetes could be observed near residential houses near habitations.

During the field survey, a maximum number of 270 plant species (except algae, fungi and bryophytes) were recorded from the study area. **Table-1 of Annexure-V** lists all the species recorded in the study area.

3.7.6 Endangered Plants

A detailed enumeration of plant species from mine lease and surrounding area in 10 km radius are identified and presented in **Table-1 of Annexure-V.** As per Botanical Survey of India records and available published literature pertaining to the study area, no threatened, endangered, vulnerable and rare plant species were observed.

3.7.7 Wildlife Studies

3.7.7.1 Details of Forests and Forest land

As per records of Forest department of Rajsamand and from toposheets reveals that there are no reserve or protected or open scrubs in study area.

3.7.7.2 Details of Protected Areas as per Wildlife Protection Act, 1972

As per records from forest departments and circulars from Ministry of environment forests, New Delhi reveals that there are no protected areas as per Wildlife protection Act, 1972 in 10-km radius. The letter from the State Forest Department declaring the absence of any forest areas within 10-km radius from the project site is enclosed as **Annexure-V.**

● Terrestrial Ecological Sampling Locations

Topo Sheet No. 45 K/4, L/

3.7.7.3 Migratory Birds and Mammals

The list of animals includes avifauna (including lower and higher animals) observed during the study period are presented in **Table-3.7.2.** Among the identified birds, the local migrants were observed during study period. No migratory bird path or animal corridors were observed within 10 km radius from proposed mine site. These observations were rechecked with forest department officials and published literature.

TABLE-3.7.2
LIST OF FAUNA OBSERVED SURROUNDING THE STUDY AREA

Technical Name	English Name	Conservation status as per Wild Life protection Act (1972)
Aves		
Acridotheres tristicus	Common myna	Sch-IV
Alcedo athis	Common kingfisher	Sch-IV
Anas acuta	Common Teal	Sch-IV
Athene brama	Spotted owlet	Sch-IV
Bubo bubo	Indian Great horned Owl	Sch-IV
Bubulcus ibis	Cattle Egret	Sch-IV
Caprimulgus asiaticus	Common Indian jar	Sch-IV
Centropus sinensis	Crow Pheasant	Sch-IV
Cinnyris lotensis	Loten's sunbird	Sch-IV
Columbus livibus	Rock Pigeon	Sch-IV
Coracias benghalensis	Indian Roller	Sch-IV
Corvus corvus	Jungle Crow	Sch-IV
Corvus splendens	House Crow	Sch-IV
Dicrurus macrocerus	Black Drongo	Sch-IV
Egretta garzetta	Little Egret	Sch-IV
Haliastur Indus	Brahmny kite	Sch-IV
Hierococys varius	Common Hawk Cuckoo	Sch-IV
Lalage sykesi	Black Headed cocoo	Sch-IV
Megalaima merulinus	Indian Cuckoo	Sch-IV
Meops phillipinus phillipinus	Blue tailed bee eater	Sch-IV
Merops leschenaultia	Chestnut headed Bee Eater	Sch-IV
Merops orientalis	Common green bee eater	Sch-IV
Microfus affinis	House swift	Sch-IV
Nectarinia asiatica	Purple sunbird	Sch-IV
Oriolus oriolus	Indian Oriole	Sch-IV
Passer domisticus	House Sparrow	Sch-IV
Pavo cristatus	Pea fowl	Part-III of Sch-I
Ploceus philippines	Weaver bird	Sch-IV
Pycnonotus cafer	Red vented Bulbul	Sch- IV
Pycnonotus jokokus	White browed Bulbul	Sch- IV
Temenuchus pagodarum	Brahmny Myna	Sch- IV
Turdoides striatus	White headed Babler	Sch- IV
Nectarinia asiatica	Purple sunbird	Sch- IV
Meops phillipinus phillipinus	Blue tailed bee eater	Sch-IV
Reptiles		
Calotes versicolor	Common garden lizard	Sch-IV
Chamaleon zeylanicus (Laurenti)	Indian chamaeleon	Sch-IV
Varanus benegalensis	Monitor lizard	Sch-IV
Boiga spp.	Cat snake	Sch-III
Bangarus spp.	Krait	Sch-III

Technical Name	English Name	Conservation status as per Wild Life protection Act (1972)
Naja naja	Indian cobra	Sch-IV
Butterflies		
Triodes minos	Southern Birwing	Sch-IV
Pachliopta hector	Crimson rose	Sch-IV
Papilo demoleus	Lime butterfly	Sch-IV
Graphium agamemnos	Tailed jay	Sch-IV
Papilo polymnstor	Blue mormon	Sch-IV
Junonia atlites	Grey pansey	Sch-IV
Juninia almana	Peacock pansey	Sch-IV
Neptis hylas	Common sailor	Sch-IV
Parantica aglea	Glassy tiger	Sch-IV
Amphibians		
Rana hexadactyla	Frog	Sch-IV
Rana tigrina	Bull frog	Sch-IV
Mammals		
Lepus nigricollis	Hare	Sch-IV
Hyaena hyaena	Hyaena	Sch-III
Canis auries	Jackal	Sch-III
Presbytis entellus	Langur	Part-II of Sch-II
Funambulus palmarum	Squirrel	Sch-IV
Sus sucrofa	Wild pig	Sch-III
Rattus norvegicus	Field mouse	Sch-IV
Herpestes edwardii	Common mongoose	Part-II of SCh-II
Bandicota indica	Bandicoot	Sch-IV
Bandicota bengalensis	Bandicoot	Sch-IV
Vulpus benghalensis	Wildfox	Sch-III
Bosephalus tragocamelus	Blue bull or Nilgai	Sch-III

3.7.7.4 Endangered Animals

A Comprehensive Central Legislation namely Wild Life (Protection) Act was enforced in 1972. This law is to provide protection to wild animals and for matters related to their ancillary or incidental death. Schedule-I of this Act included the list of rare and endangered species, which are completely protected. On comparison of the checklist given in the Schedule-I of the Act and the list of the wildlife recorded in 10-km radius of the mine site and it can be concluded that there are no major endangered wild animals in the surrounding area except for peacock which is belongs to part-III of Sch-I of Wildlife Protection Act,1972.

3.7.7.5 Flora in Mine Lease Area

The list of recorded plant species in mine lease area are presented in **Table-2** of **Annexure-V.**

3.7.7.6 *Fauna in Mine Lease Area*

The list of animal species recorded in mine lease area are presented in **Table-3** of **Annexure-V**.

3.7.8 Summary

Detailed ecological studies were conducted to assess the present biological resources in and around the Dariba industrial complex. 270 plants species were

recorded during study period. *Cassia occidentalis, Datura metal, Jatropha sp, Parthenium hysterophorus, 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 and also mainly dominated by therophytes followed by phanerophytes. Primary faunal studies were conducted and presented in the report. 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. The authenticated list of flora and fauna is enclosed as **Annexure-V**.

3.8 Socio-Economics Aspects

The growth of mining and industrial sectors and infrastructure developments in and around the agriculture dominant areas, villages and towns is bound to create its impact on the socio-economic aspects of the local population of the area experiencing development. The impacts may be positive or negative depending upon the developmental activity. To assess the anticipated impacts of the mining and industrial growth on the socio-economic aspects of people, it is necessary to study the existing socio-economic status of the local population, which will be helpful for making efforts to further improve the quality of life in the area under study. For assessing the prevailing socio-economic aspects of people in the study area around the proposed mine, the required data has been collected from various secondary sources and analyzed.

3.8.1 Methodology Adopted for the Study

The methodology adopted for the study is based on the following:

- Review of secondary data, such as District Primary Census Statistical Hand Books of Rajsamand, Chittaurgarh and Udaipur districts, 2001 within the study area around the proposed mine; and
- Conducting Focus Group discussions in the villages for eliciting the general information of the study area, to support or supplement the information collected through secondary and primary surveys.

3.8.2 Review of Demographic and Socio-Economic Profile - 2001

The sociological aspects of this study include human settlements, demography, social strata such as Scheduled Castes and Scheduled Tribes and literacy levels besides infrastructure facilities available in the study area. The economic aspects include occupational structure of workers. The information on socio-economic aspects of the study area has been collected from secondary sources, which mainly include District Primary Census Handbooks 2001 of Rajsamand, Chittaurgarh and Udaipur districts, the latest census records available at the village level.

The Dariba Mine area is located in Rajsamand District. The study area within 10-km around the periphery of the mine lease area is falling in Tehsils of Railmagra, Kapasan and Mavli. About 54 villages of Rajsamand, 30 Villages of Chittaur Districts and 6 villages of Udaipur District are covered within the study area.

3.8.3 Land Use Studies

3.8.3.1 Land Use in Study Area Based on Satellite Data

The satellite IRS – P6, data LISS 4 MX was procured from National Remote Sensing Agency, Hyderabad to prepare the land use map of the mining lease covering 1142.20-ha by identifying the different land use units and the area of each land use unit of the total lease area. The satellite imagery of Rajpura Dariba Mines and buffer zone area are shown in **Figure- 3.8.1 and Figure-3.8.2.**

3.8.3.2 Thematic Mapping

By adopting the methodology as mentioned above, thematic layer on land use and drainage (water sheds) along with estimation of area of each unit and its percentage in the buffer zone and mine lease having an area of 54420-ha and 1142.20-ha was prepared. Each thematic layer is discussed as under. The base map of buffer zone and Rajpura Dariba Mines are shown in **Figure- 3.8.3** and **Figure 3.8.4.**

Villages and Rural Roads

Village Dariba is situated almost in the center of the lease, down south is Mataji ka khera and in the south east lies the village Kotri. The network of roads shows that plant and mines are well connected and roads to the three villages are also in good condition.

3.8.4 Drainage and Water Sheds of Buffer Zone

The drainage and watershed theme reveals that there are two watersheds in the lease area. Following the topography, drainage is mostly from center towards east and west and drainage density is very poor. Two watersheds have been delineated as WS-1 and WS-2 and the area of each water shed has been calculated and indicated in **Table-3.8.1** and in **Figure-3.8.5**. There is a canal entering the lease area from west then moving to the central portion and then finally going out from the southern boundary. During the field visit, there was no water in the canal and some vegetation was growing in it.

TABLE-3.8.1
AREA UNDER DIFFERENT WATER SHEDS IN RAJPURA-DARIBA BUFFER ZONE

Sr. No.	Water shed No.	Area (ha)	% of the total Area
1.	WS-1	12645	23.24
2.	WS-2	41775	76.76
	Total	**54420**	**100.00**

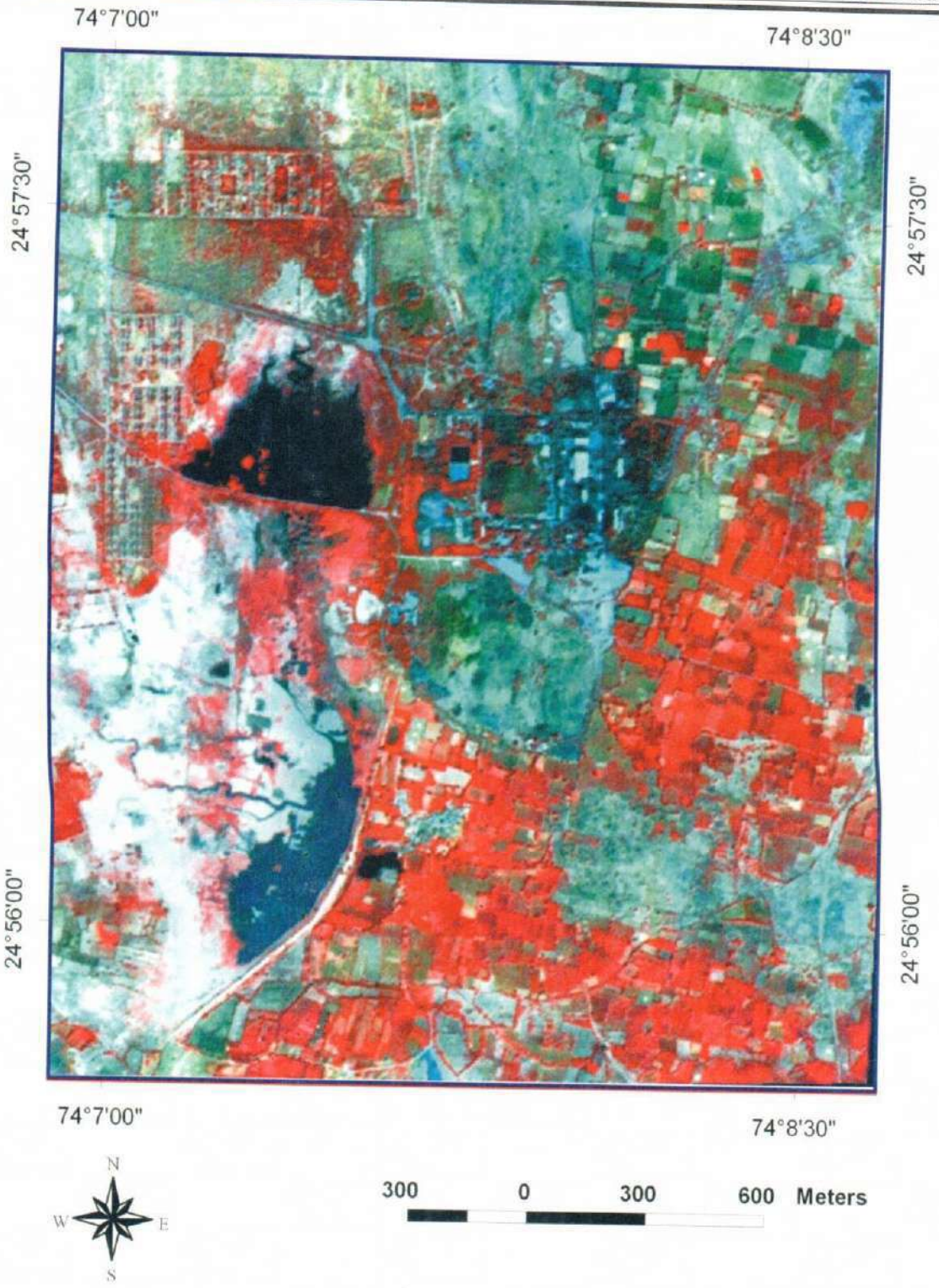


FIGURE-3.8.1
SATELLITE IMAGERY OF RAJPURA DARIBA MINES

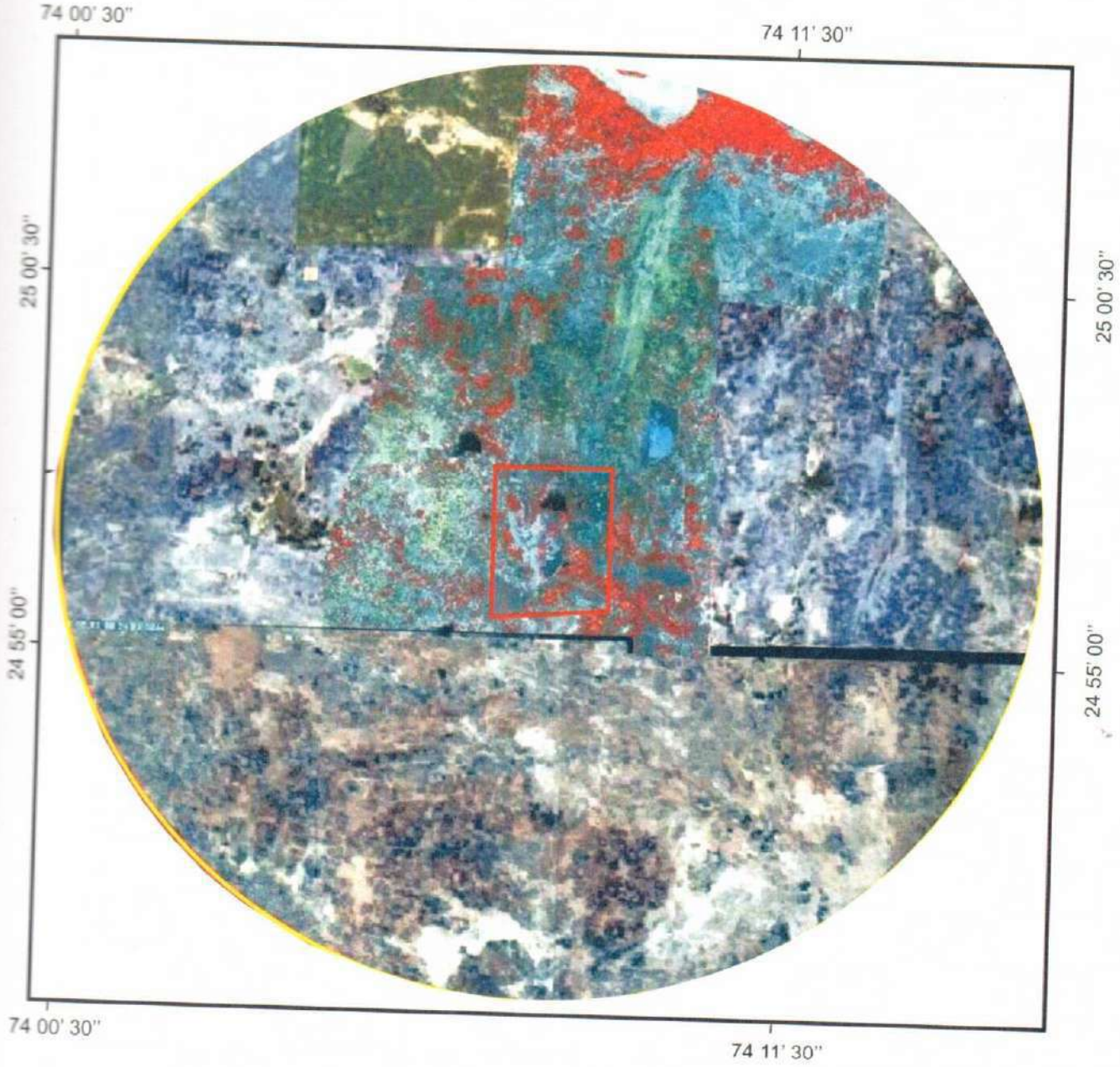


FIGURE-3.8.2
SATELLITE IMAGERY OF RAJPURA DARIBA MINES (BUFFER ZONE)

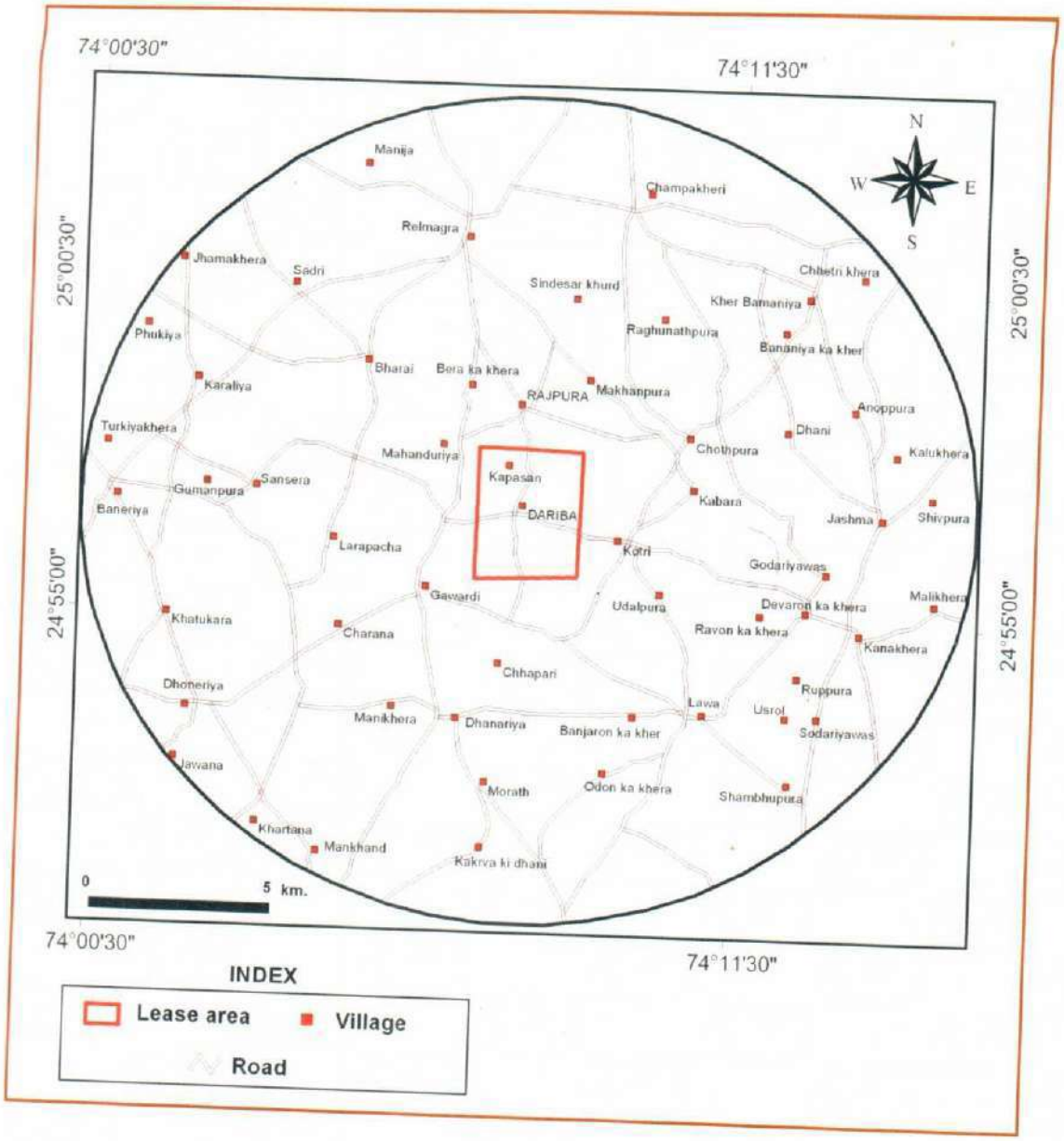


FIGURE-3.8.3
BASE MAP OF RAJPURA DARIBA ML AREA (BUFFER ZONE)

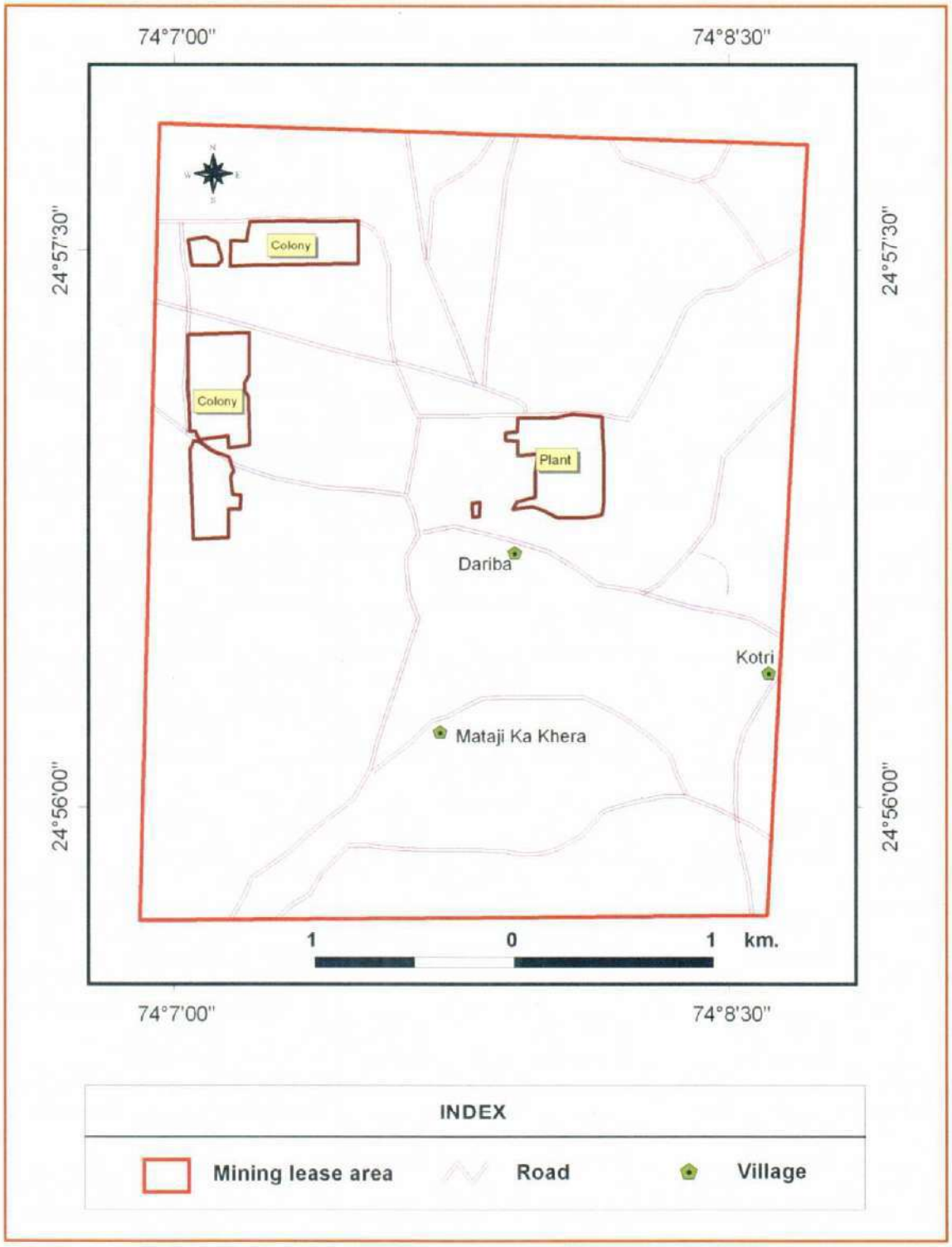


FIGURE-3.8.4
BASE MAP OF RAJPURA DARIBA ML AREA

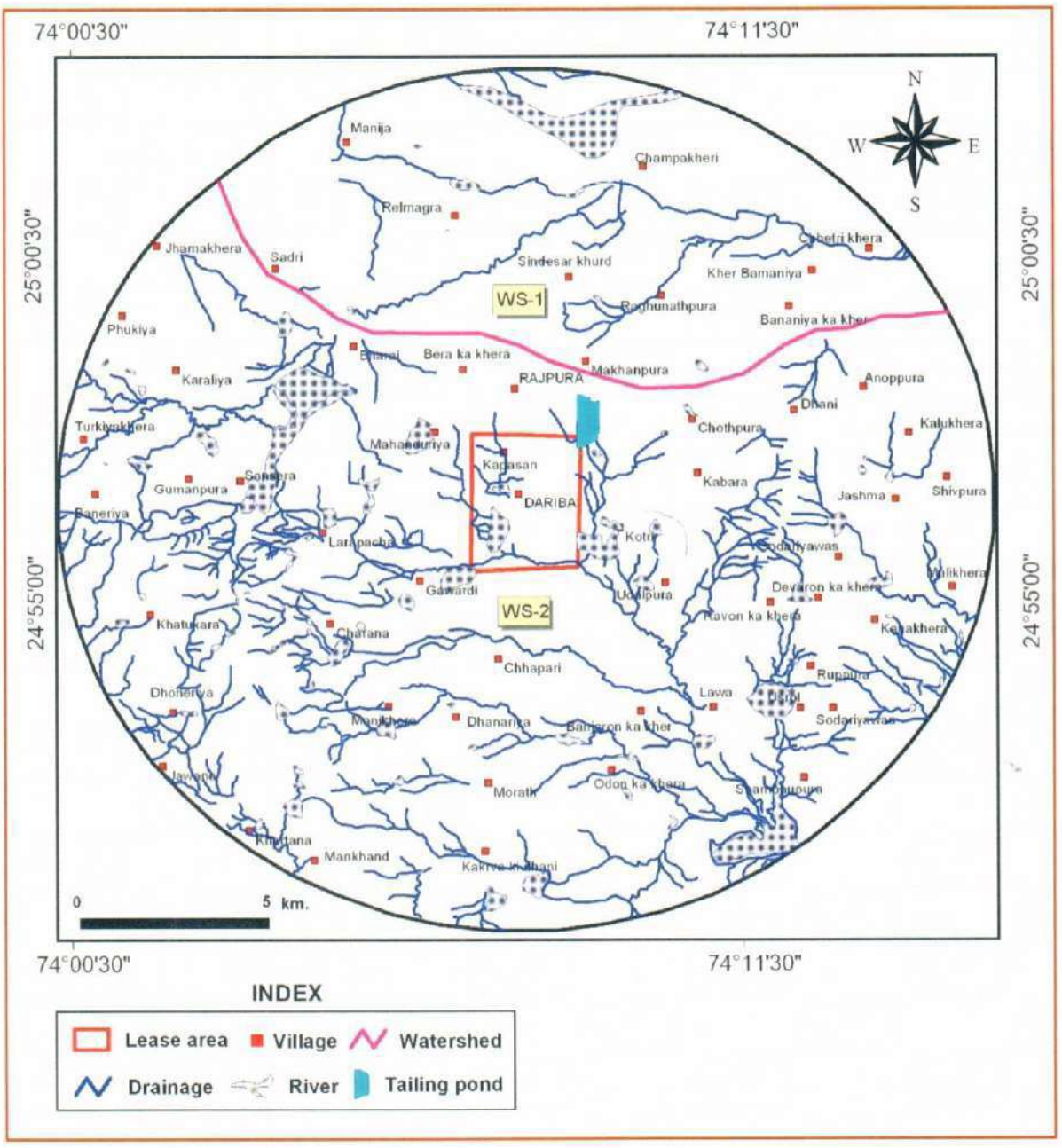


FIGURE-3.8.5
DRAINAGE AND WATER SHED MAP OF RAJPURA DARIBA ML AREA (BUFFER ZONE)

- ***Built Up Land in Buffer Zone***

There are about 25 small villages in the area and houses in these villages contribute to built up area of lease. Besides this, there are other small structures like Temple and Tower near the hill. Other built up land in the lease is of the plant and the colony. The total built up area is about 1.29 % of total buffer zone.

- ***Barren land in Buffer Zone***

A large portion of buffer zone is barren land. On account of poor soil cover and limited irrigation facilities large part in buffer zone lies as barren land. About 23045-ha of the buffer zone is barren land. During rainy season some small grass grows on these lands otherwise during summers they are dry with small bushes here and there.

- ***Structural hill in Buffer Zone***

There are two structural hills in the buffer zone. One is just above the lease area and part of it is seen in lease area also. The other is in the eastern block of the buffer zone. The elevation of these ridges is about 550 meters above msl. Besides this the buffer zone has a generally flat topography.

- ***Land use during Rabi period in Buffer Zone***

The thematic layer prepared using digitized data of Rabi period reveals that out of 54420-ha covered under agricultural land (rabi + Kharif), 274-ha is commanded during Rabi period by providing irrigation facilities from dugwells and canal. The major crop grown in this area is cotton seed, wheat and mustard.

The land depending totally on rains for cultivation is classified as fallow land in thematic layer of rabi period. However this fallow land is the kharif portion under theme of kharif period. The land use map of Rajpura Dariba MI Area buffer zone for rabi season is shown in **Figure-3.8.6**

- ***Water bodies in Buffer zone***

There are two prominent ponds in the western side of the lease area. The satellite picture clearly shows that the ponds are separated by a road. The big pond lying below the road and small pond lying above the road. Parts of these ponds get dried up during summer period. Satellite image of Rabi season shows the ponds with larger extent than that of Kharif. The other major water body in the area is canal. The area occupied by water bodies is 25.61 sq. Km.

- **Comparative analysis of land use during Kharif and Rabi periods in Buffer zone**

The comparative study of land use of Rabi and Kharif shows that out of total agricultural land the area under Kharif is slightly more than that under Rabi. The area under rabi is the double crop area., the farmers take both the Rabi and Kharif crops. The area becomes more green during Kharif due to additional vegetation on the hills. The land use map of Rajpura Dariba MI Area buffer zone for rabi season is shown in **Figure-3.8.7**

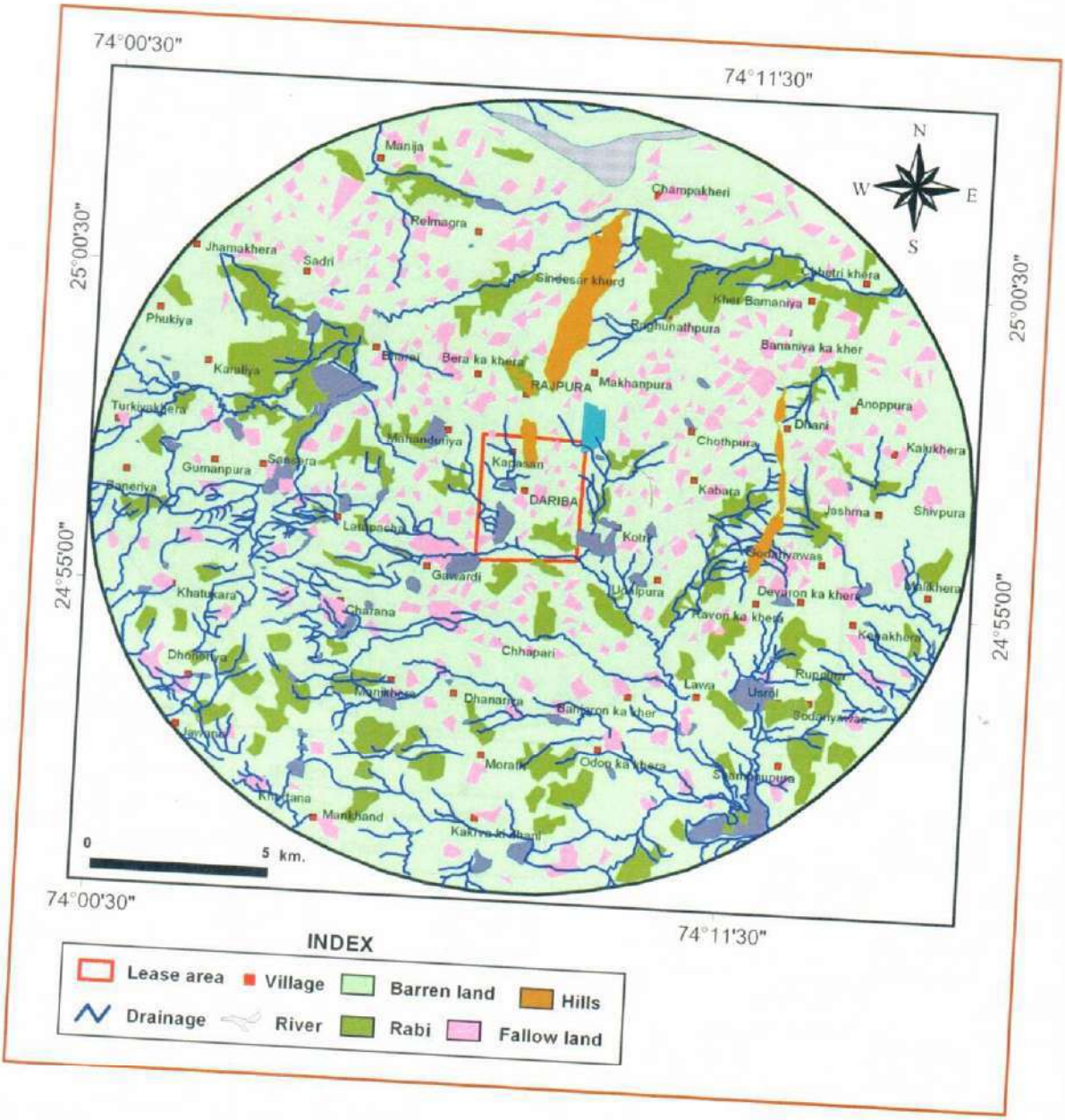


FIGURE-3.8.6
LAND USE MAP (RABI SEASON) OF RAJPURA DARIBA ML AREA (BUFFER ZONE)

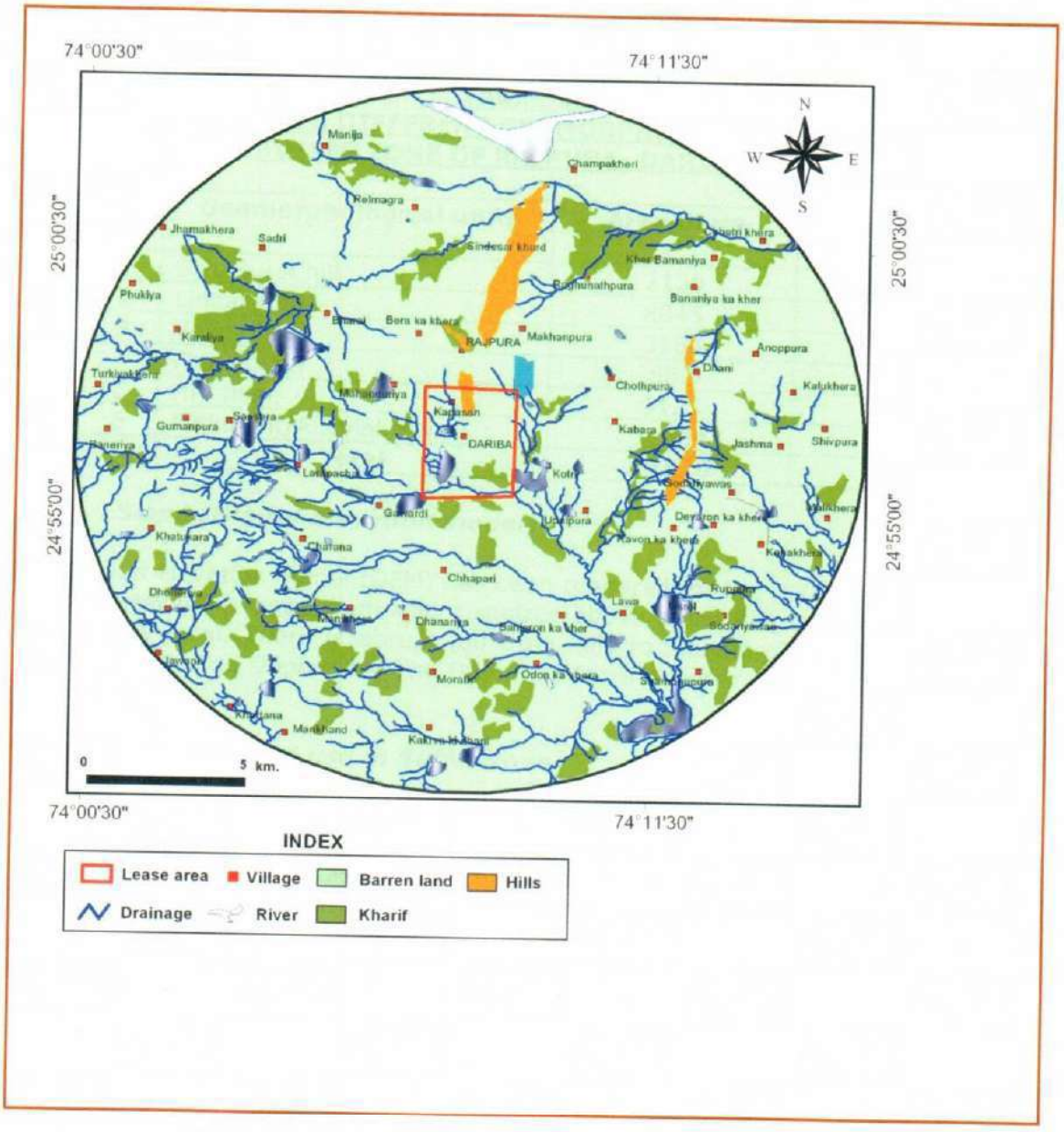


FIGURE-3.8.7
LAND USE MAP (KAHRIF SEASON) OF RAJPURA DARIBA ML AREA (BUFFER ZONE)

- **Geomorphology of the Buffer Zone**

The study of land forms an important aspect of land management and therefore it is main input for land use mapping. The different geomorphological units as observed in the imagery have been identified and delineated as shown in **Figure-3.8.8**. The area of each unit has been computed and shown in **Table–3.8.2**

TABLE-3.8.2
AREA UNDER DIFFERENT GEOMORPHOLOGICAL UNITS IN BUFFER ZONE OF RAJPURA- DARIBA MINE

Sr. No.	Geomorphological units	Area in Ha	% of the total area
1	Structural hill	2120	3.90
2	Linear ridge	8045	14.78
3	Valley fill	3184	5.85
4	Flood plain	562	1.03
5	Hill slope	9125	16.77
6	Pediment/Alluvial plain	31384	57.67
	Total	**54420**	**100%**

- ***Slope (Digital elevation model)***

Digital elevation model (DEM) has been prepared for the buffer zone which shows the elevation range from 450 metres above mean sea level (m amsl) to 540 metres amsl. There is abrupt fall from hills to alluvial plains. DEM can also be interpreted as slope map. The DEM map for the buffer zone is shown as **Figure-3.8.9.**

- ***Integrated land use in Buffer zone***

Looking at all the thematic layers separately and then integrating them together shows that most of the area is agricultural land. Entire agricultural land takes the double crop i.e. Rabi as well as Kharif seasons as shown in **Figure-3.8.10**. Most of the land is flat with three small hillocks. Drainage is poor. The irrigation is by canal and dugwells. Land other than cultivable land is barren land parts of it covered by babul and khajoor vegetation. The details of area under different land use classes in bufferzone of Rajpura Darbia mines is tabulated in **Table-3.8.3.**

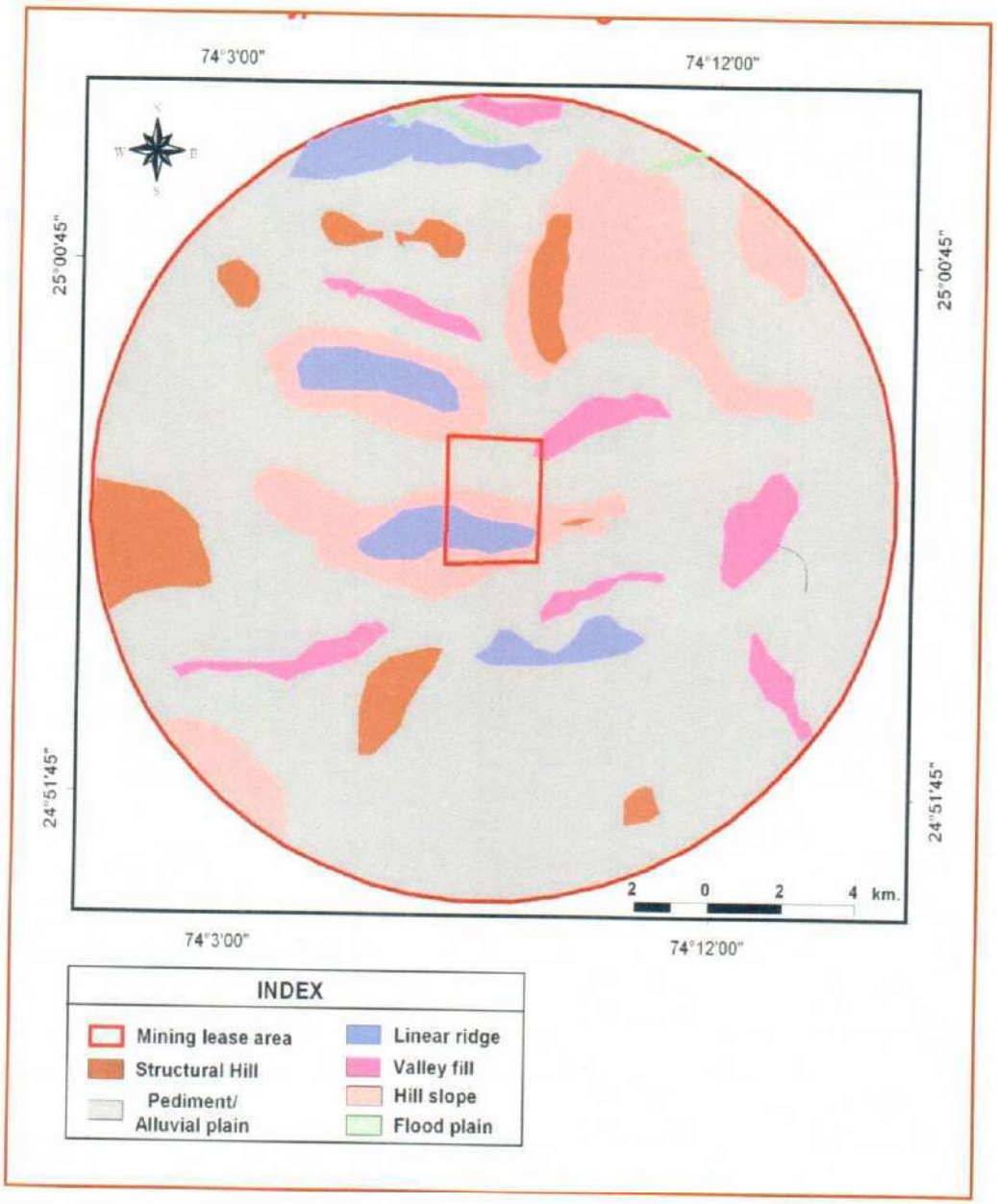


FIGURE-3.8.8
GEOMORPHOLOGICAL MAP OF
RAJPURA DARIBA ML AREA (BUFFER ZONE)

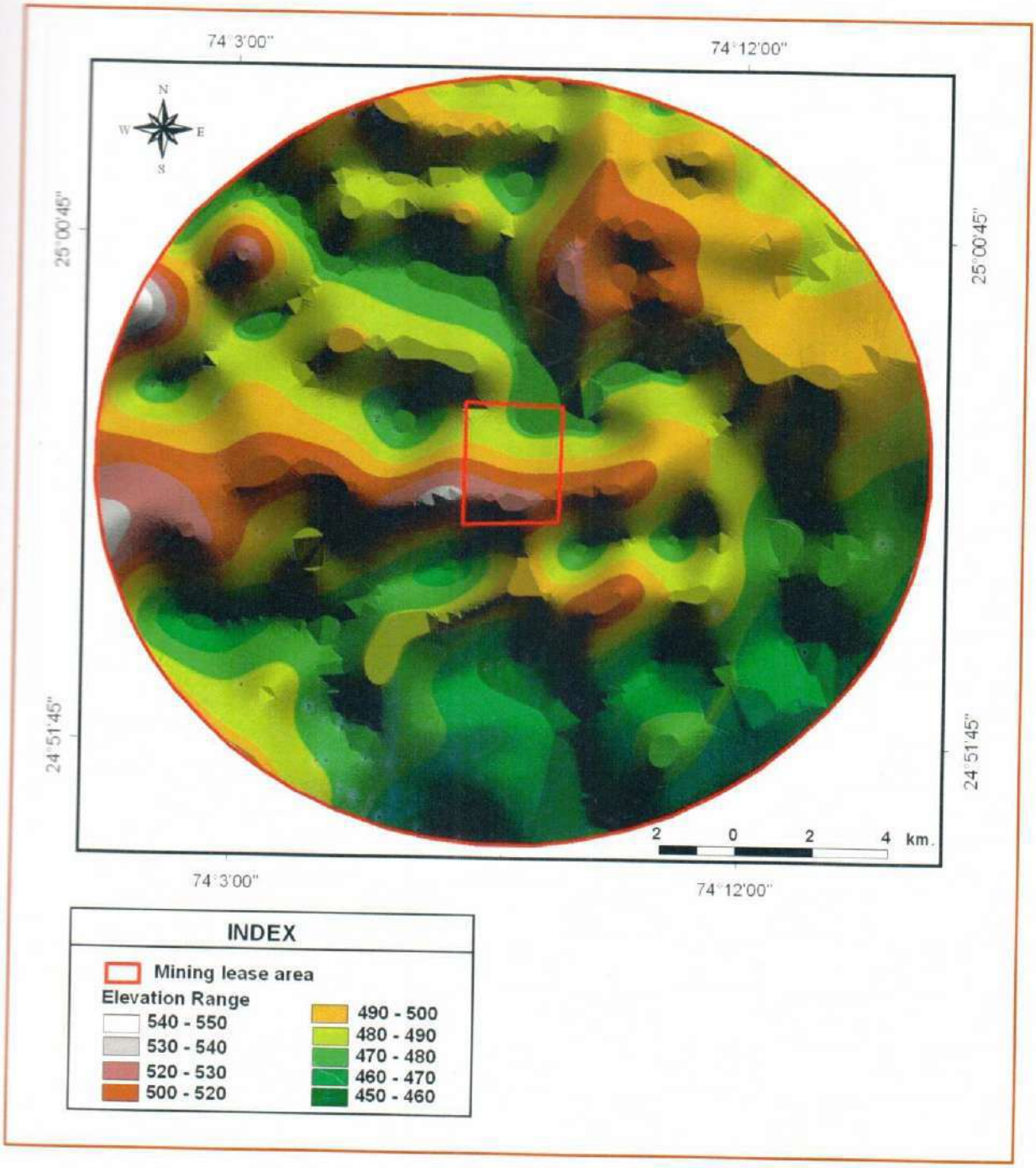


FIGURE-3.8.9
DIGITAL ELEVATION MODEL OF RAJPURA DARIBA ML AREA (BUFFER ZONE)

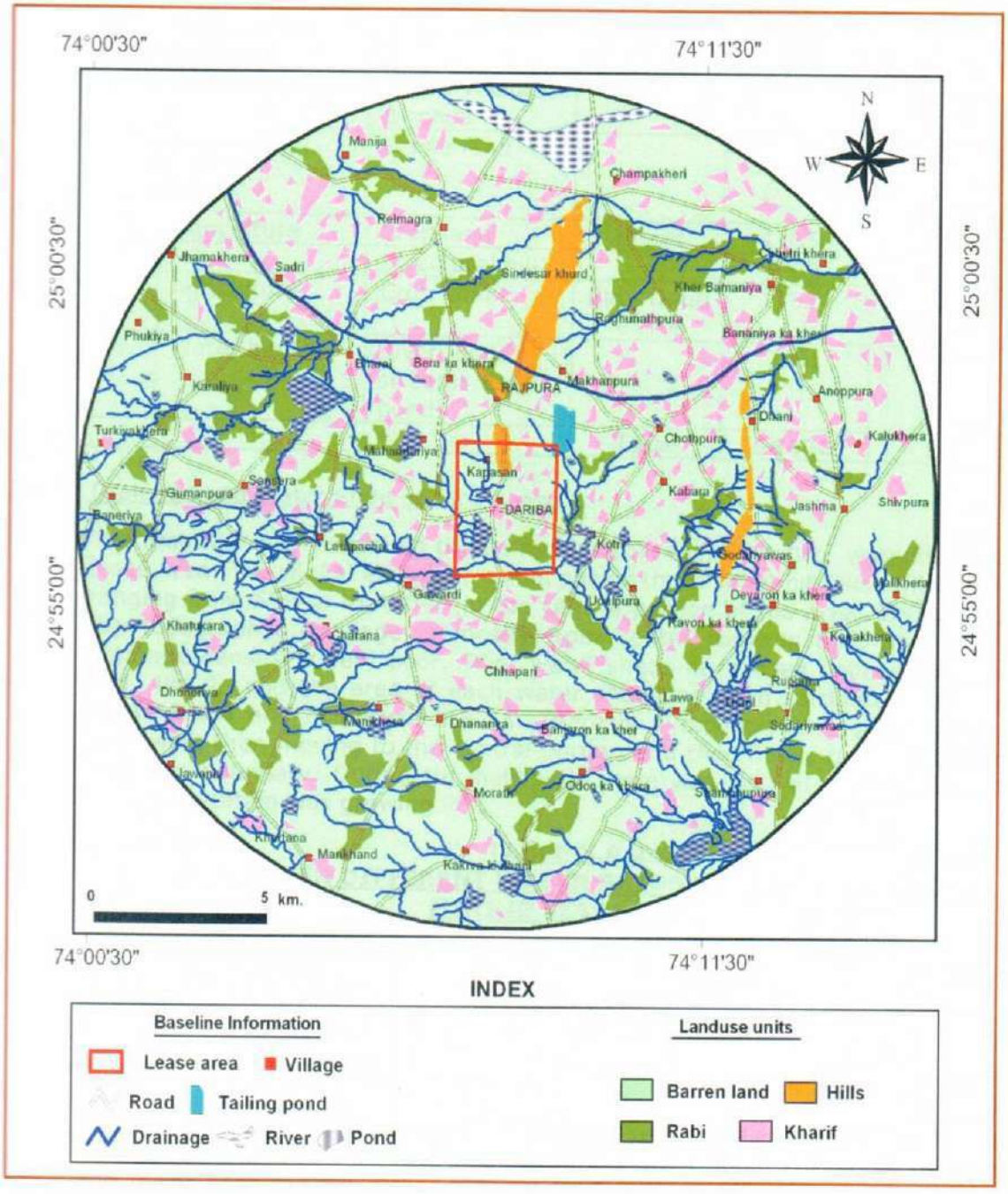


FIGURE-3.8.10
INTEGRATED LAND USE MAP OF RAJPURA DARIBA ML AREA (BUFFER ZONE)

TABLE-3.8.3.
AREA UNDER DIFFERENT LANDUSE CLASSES IN BUFFER ZONE OF RAJPURA DARIBA MINES

Sr. No.	Category Level-I	Level-II	Level-III	Area in Ha	% of the total area
1	Built up land	Town, villages & roads		705	1.29
2	Barren land	Waste land		23045	42.35
3	Agriculture	Crop land	Kharif	11850	21.78
4	Hill	Structural hill		709	1.30
5	Agriculture	Crop land	Rabi/Double crop	15550	28.57
6	Water bodies	River, pond, streams, tailing pond		2561	4.71
			Total	**54420**	**100%**

3.8.5 Drainage and Water Shed of Mine Lease

The drainage and watershed theme reveals that there are two watersheds in the lease area. The digital elevation model shows three small hillocks with elevation ranging from 559-m to 470-m in the central portion of the area. Thus, following the topography, drainage is mostly from center towards east and west and drainage density is very poor. Two water sheds have been delineated as WS-1 and WS-2 and the area of each water shed has been calculated indicated in **Table-3.8.4** and in **Figure-3.8.11**. There is a canal entering the lease area from west then moving to the central portion and then finally going out from the southern boundary. During the field visit there was no water in the canal and some vegetation was growing in it.

TABLE-3.8.4
AREA UNDER DIFFERENT WATER SHEDS IN RAJPURA-DARIBA MINING LEASE AREA

Sr. No.	Water Shed No.	Area	% of the Total Area
1	WS-1	726.34	63.59
2	WS-2	415.86	36.41
	Total	**1142.20**	**100**

- ***Built Up Land of Mine Lease***

There are three villages in the area and houses in these villages contribute to built up area of lease. Besides this, there are other small structures like temple and tower near the hill. Other built up land in the lease is of the plant and the colony. The total built up area is about 6.34% of total lease area.

- ***Land use of Mining Lease Area during Rabi Period of Mine Lease***

The thematic layer prepared using digitized data of Rabi period reveals that out of 344.85-ha covered under agricultural land (rabi + Kharif), 342.07-ha is commanded during Rabi period by providing irrigation facilities from dugwells and canal. The major crop grown in this area is cotton seed, wheat and mustard.

The land use of the Rajpura Dariba mining lease area during Rabi period is shown in **Table-3.8.5** and depicted in **Figure-3.8.12.**

TABLE-3.8.5
AREA UNDER DIFFERENT LAND USE CLASSES IN RAJPURA DARIBA MINING LEASE AREA FOR RABI PERIOD

Sr. No.	Category Level I	Level II	Area in ha	% of the total area
1	Built up land	Plant, Colony, Road and Village	72.41	6.34
2	Agriculture Land	Rabi crop	342.07	29.95
3	Waste land	Dump	0.82	0.07
		barren hill	414.59	36.30
4	Water bodies	Pond, streams and canal	65.40	5.73
		Dry pond	63.54	5.56
5	Vegetation	Babul vegetation	183.37	16.05
			1142.20 ha	**100 %**

- ***Babul vegetation of Mine Lease***

Other than cultivated land the greenery in the thematic layer for Rabi season is the signature of Babul plantation. Most of the area has babul and Khajoor vegetation. The portion of pond which gets dried in non rainy season is also covered with vegetation.

- ***Barren Hills of Mine Lease***

About 36.30% of the lease area is waste land. These are small barren hills. During rainy season these hills also gets covered by small wild grass.

- ***Dump of Mine Lease***

The area where the overburden is dumped is marked as dump in the map. It covers 0.07% of the lease area.

- ***Water bodies of Mine Lease***

There are two prominent ponds in the western side of the lease area. The satellite picture clearly shows that the ponds are separated by a road. The big pond lying below the road and small pond lying above the road. Parts of these ponds get dried up during summer period. Satellite image of Rabi season shows the ponds with larger extent than that of Kharif. The other major water body in the area is canal. The area occupied by water bodies is 65.40-ha.

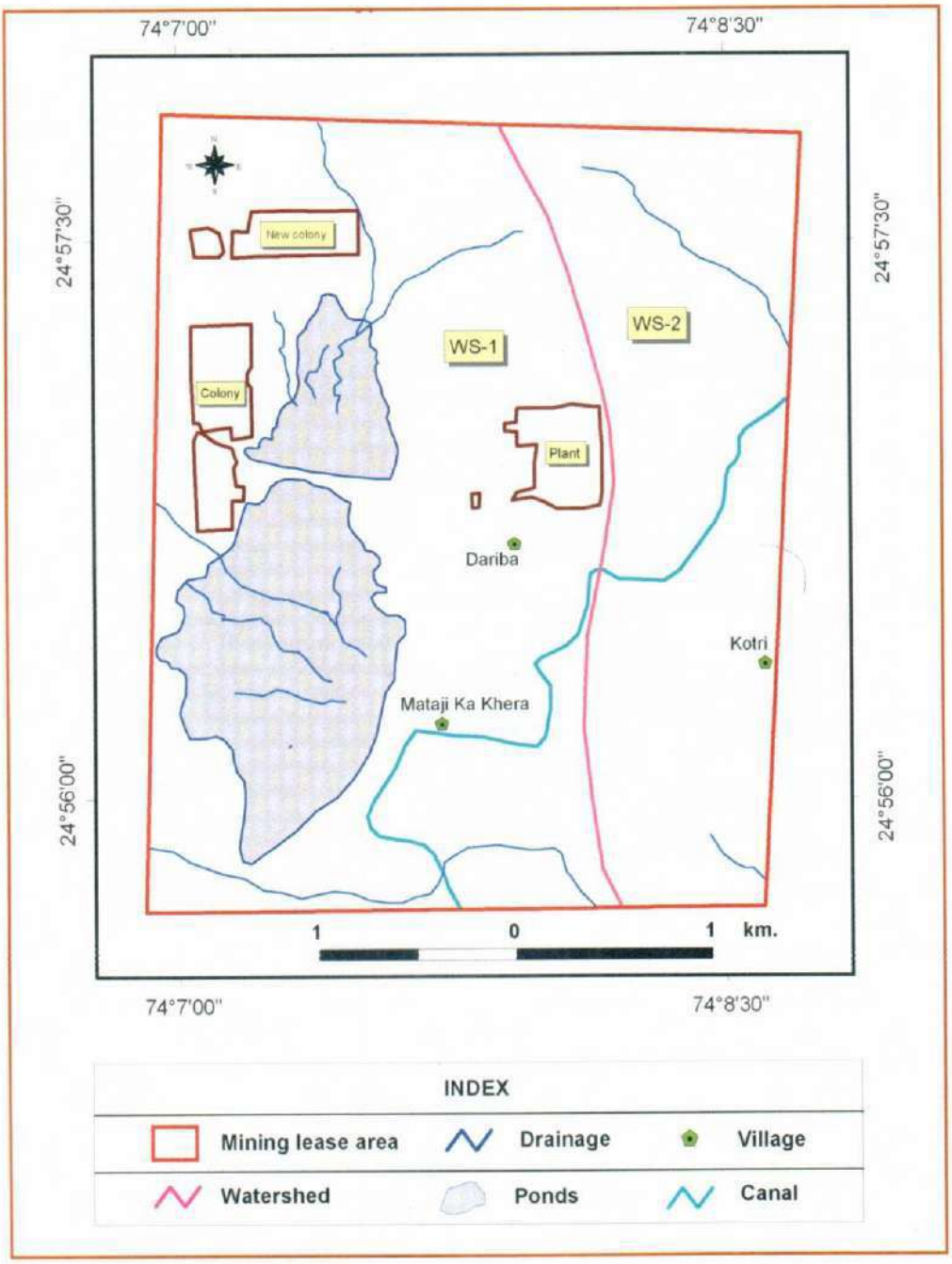


FIGURE-3.8.11
DRAINAGE AND MINING LEASE AREA OF RAJPURA DARIBA ML AREA

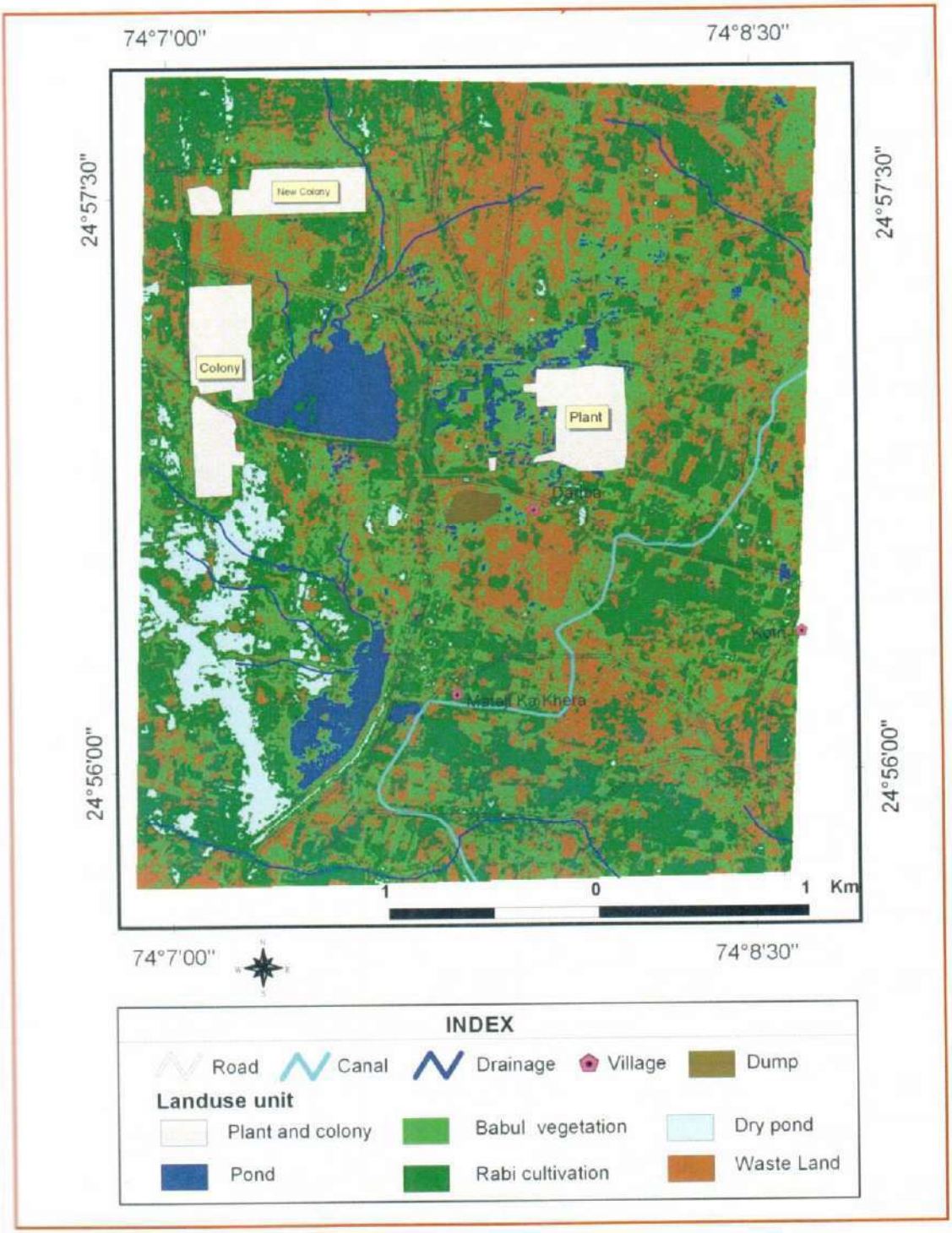


FIGURE 3.8.12
LANDUSE MAP OF RAJPURA DARIBA ML AREA (RABI PERIOD)

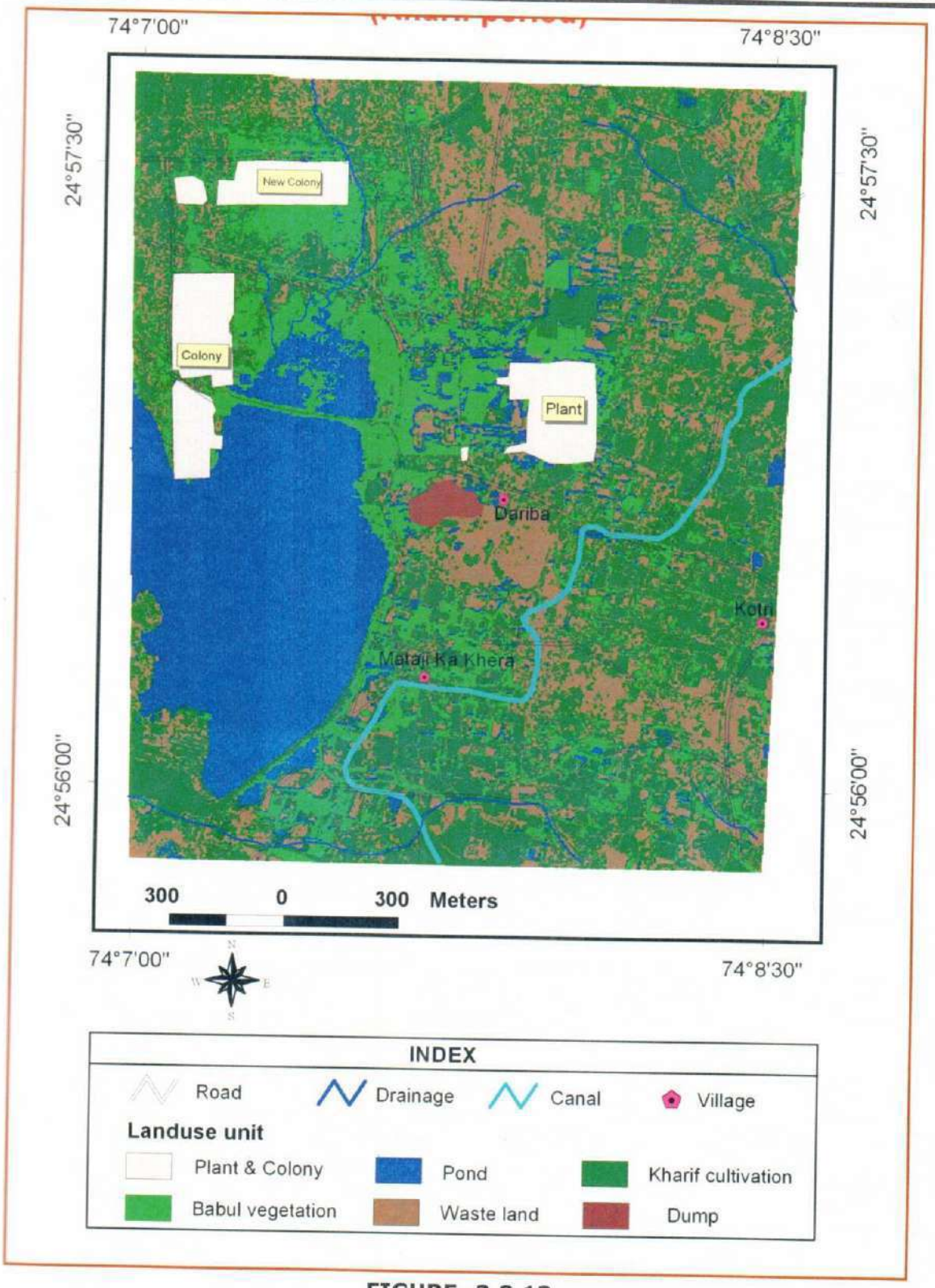


FIGURE -3.8.13
LANDUSE MAP OF RAJPURA DARIBA ML AREA(KHARIF PERIOD)

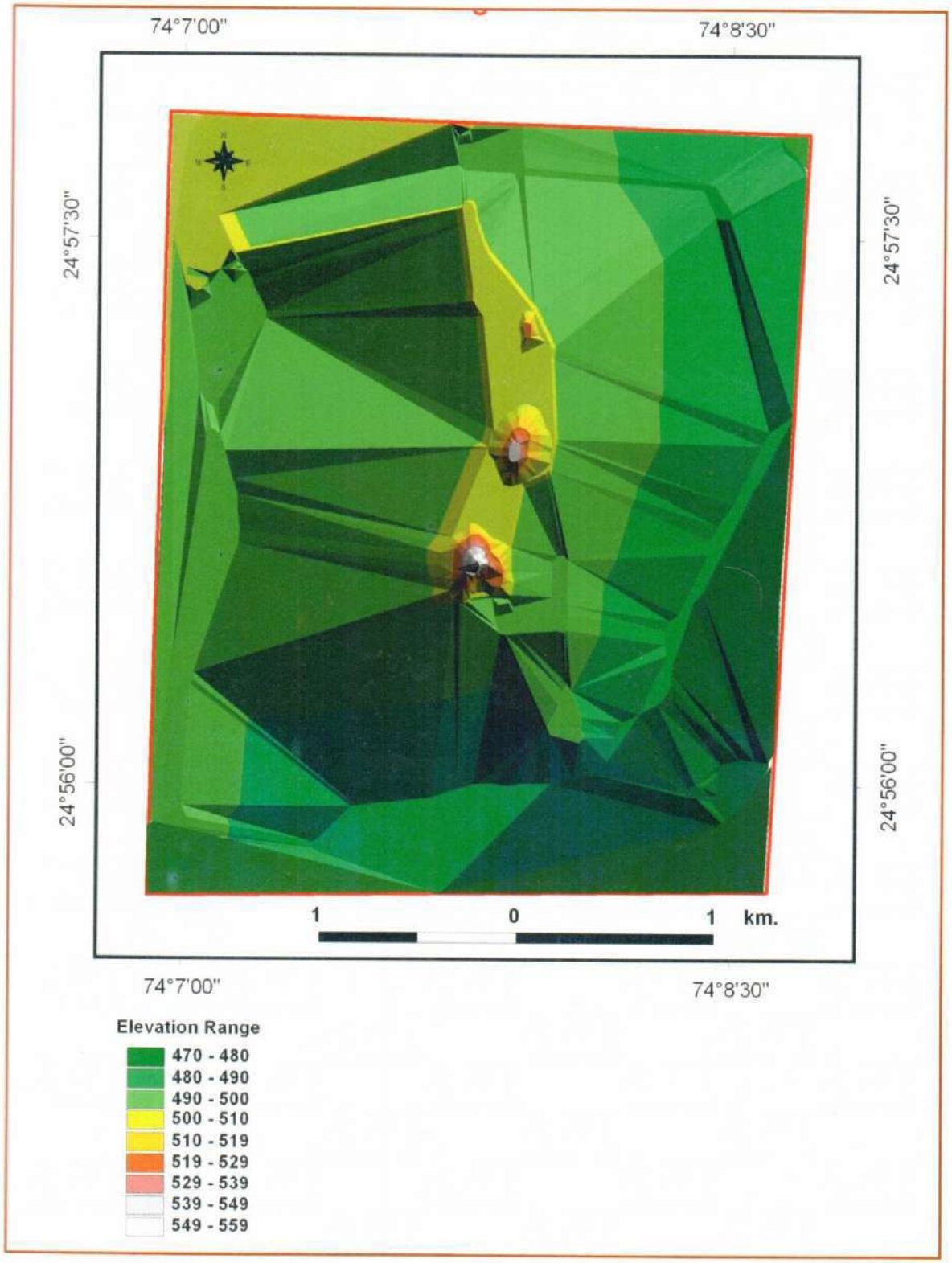


FIGURE-3.8.14
DIGITAL ELEVATION MODEL OF RAJPURA DARIBA ML AREA

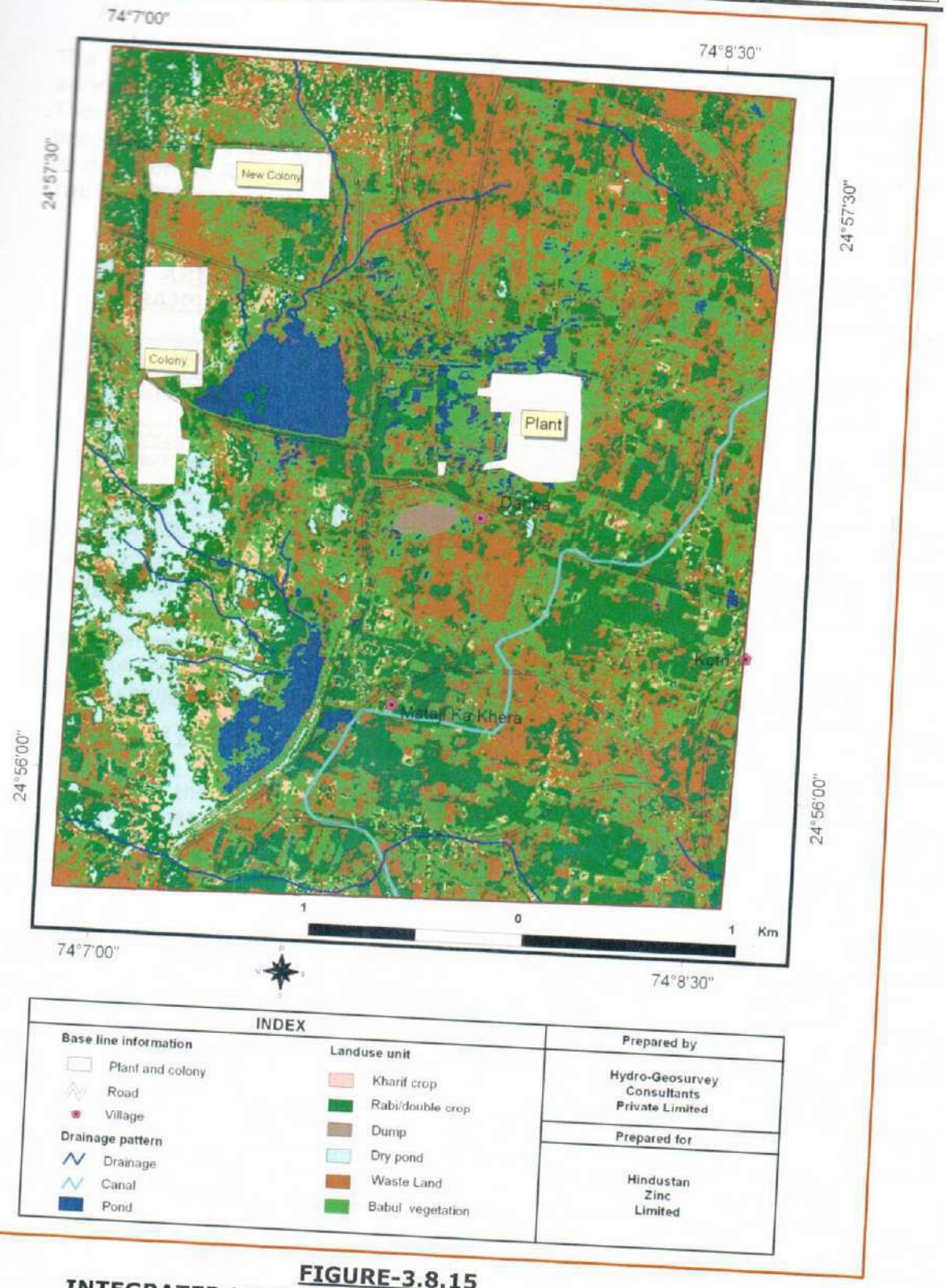


FIGURE-3.8.15
INTEGRATED LANDUSE MAP OF RAJPURA DARIBA ML

- ***Comparative Analysis of Land Use during Kharif and Rabi Periods of Mine Lease***

The comparative study of land use of Rabi and Kharif shows that out of total agricultural land the area under Kharif is slightly more than that under Rabi. There is no fallow land, the farmers take both the Rabi and Kharif crops. The area becomes more green during Kharif due to additional vegetation on the hills. The land use of the Rajpura Dariba mining lease area during Kharif period is shown in **Table-3.8.6** and depicted in **Figure-3.8.13.**

TABLE-3.8.6
AREA UNDER DIFFERENT LAND USE CLASSES IN RAJPURA-DARIBA LEASE AREA FOR KHARIF PERIOD

Sr. No.	Category Level I	Level II	Area in ha	% of the total area
1	Built up land	Plant, Colony, Road and Village	72.41	6.34
2	Agriculture Land	Kharif crop	344.85	30.19
3	Waste land	Dump	0.82	0.07
		Barren hill	414.59	36.30
4	Water bodies	Pond, Streams and canal	124.92	10.94
5	Vegetation	Babul vegetation	184.61	16.16
			1142.20 ha	**100%**

- ***Digital Elevation Model***

The digital elevation model of the area shows three small hillocks in the central portion of the lease. The highest elevation points is 559 msl. Generally, the area has undulating topography (**Figure–3.8.15**).

Integrated Land Use of Mine Lease

Looking at all the thematic layers separately and then integrating them together shows that most of the area is agricultural land. Entire agricultural land takes the double crop ie Rabi as well as Kharif. Most of the land is flat with three small hillocks. Drainage is poor. The irrigation is by canal and dugwells. Land other than cultivable land is covered by babul and khajoor vegetation.

The integrated landuse is given in **Table-3.8.7** and shown in **Figure-3.8.16**.

TABLE-3.8.7
INTEGRATED LANDUSE DETAILS

Sr. No.	Category Level I	Level II	Area in ha.	% of the total area
1	Built up land	Plant, Colony, Road and Village	72.41	6.34
2	Agriculture Land	Rabi/double crop	342.07	29.95
		Kharif crop	2.78	0.24
3	Waste land	Dump	0.82	0.07
		Barren hill	414.59	36.30
4	Water bodies	Pond, streams and canal	124.92	10.94
5	Vegetation	Babul vegetation	184.61	16.16
			1142.20 ha.	**100 %**

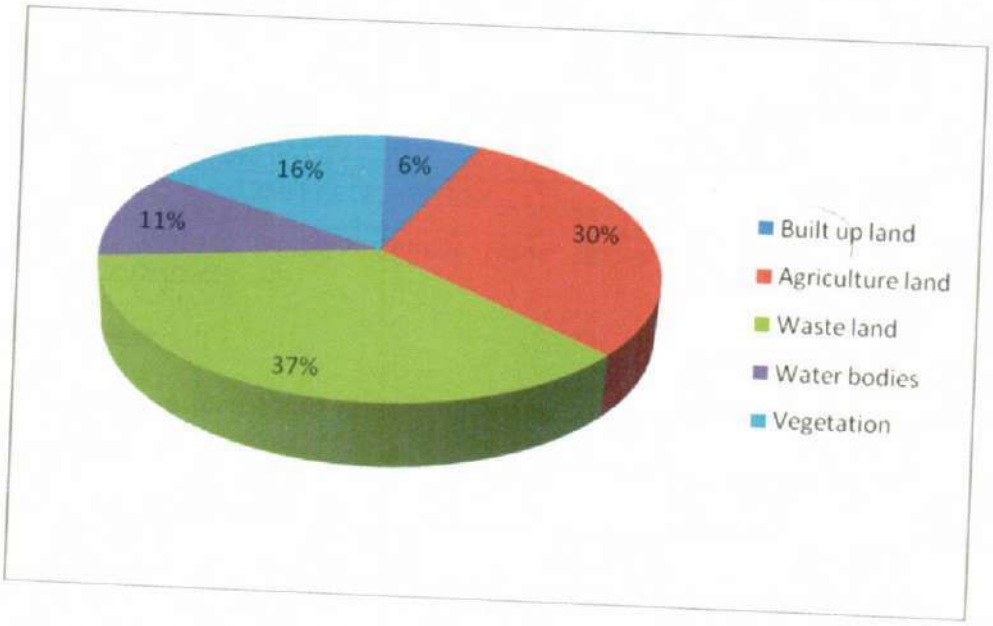


FIGURE-3.8.16
LANDUSE OF MINE LEASE AREA

3.8.6 Landuse Based on Secondary Data

The study area falls in Relmagra, Kapasan, Mavli Tehsils of Rajsamand, Chittaurgarh, and Udaipur Districts covers about 90 villages within 10-km zone around mine lease area. In order to establish the land use pattern in the study area, the total geographical area of each settlement has been considered though many villages located in the peripheries of the study block have been covered partially in the study area. These areas were studied in detail to get the idea of land use pattern in the study area. The land use pattern for the study area is given in **Table-3.8.8** and depicted in **Figure-3.8.9** and the village-wise land use pattern is presented in **Annexure-VI**.

TABLE-3.8.8
LANDUSE PATTERN IN THE STUDY AREA

Sr. No	Particulars	Study Area (ha)	Area (%)
1	Forest Land	16.39	0.03
2	Land under Cultivation		
	a) Irrigated Land	5944.36	12.09
	b) Un irrigated Land	17497.63	35.58
3	Culturable Waste Land	16808.57	34.18
4	Area not available for cultivation	8916.31	18.12
	Total Area	**49183.26**	**100.00**

Source: District Primary Census Hand Books – Rajsamand, Chittaurgarh and Udaipur Districts

- ***Forest***

The revenue forestland under the study area consists 16.39 ha (0.03 %) of the total geographic area.

- ***Land under Cultivation***

The unirrigated cultivated land is about 17497.63-ha (35.58%), the irrigated cultivated land under the study area consists of 5944.36-ha (12.09%) of the total land in the study area.

- ***Cultivable Waste Land***

This class includes that land, which was cultivated sometime back and left vacant during the past 5 years in succession. The study area comprises about 34.18% cultivable wastelands.

- ***Land not available for Cultivation***

The land not available for cultivation is 18.12% of the total study area.

3.8.7 Demographic Aspects

3.8.7.1 Distribution of Population

As per 2001 census the study area consisted of 118644 persons inhabited in 90 villages of the study area. The distribution of population in the study area is shown in **Table-3.8.9**.

TABLE-3.8.9
DISTRIBUTION OF POPULATION IN STUDY AREA

Particulars	Study Area
No. of Households	23909
Male Population	59477
Female Population	59167
Total Population	118644
Average Household Size (Persons)	4.96
Sex Ratio	994

Source: District Primary Census Hand Books – Rajsamand, Chittaurgarh and Udaipur Districts

The males and females constitute to about 50.14% and 49.86% of the study area. The details of demography are presented in **Annexure-VII.**

3.8.7.2 Average Household Size

The study area had an average family size of 4.96 persons per household in 2001. This is a normal family size in India, however less in comparison with the other areas of Rajasthan.

3.8.7.3 Sex Ratio

The configuration of male and female indicates that the males constitute to about 50.14% and females to 49.86% of the total population as per 2001 census records. The sex ratio i.e. the number of females per 1000 males indirectly reveals certain sociological aspects in relation with female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 994 females per 1000 males as per 2001 census. This ratio is considered to be lower in comparison with other states but more in comparison with the other parts of Rajasthan.

3.8.8 Social Structure

In the study area, as per 2001 census, 16.06% of the population belong to Scheduled Castes (SC) and 11.69% to the Scheduled Tribes (ST). This indicates that about one fourth of the population in the study area belong to weaker sections and works to about 27.75% of the total population in 2001. The distribution of population in the study area by social structure is shown in **Table-3.8.10.**

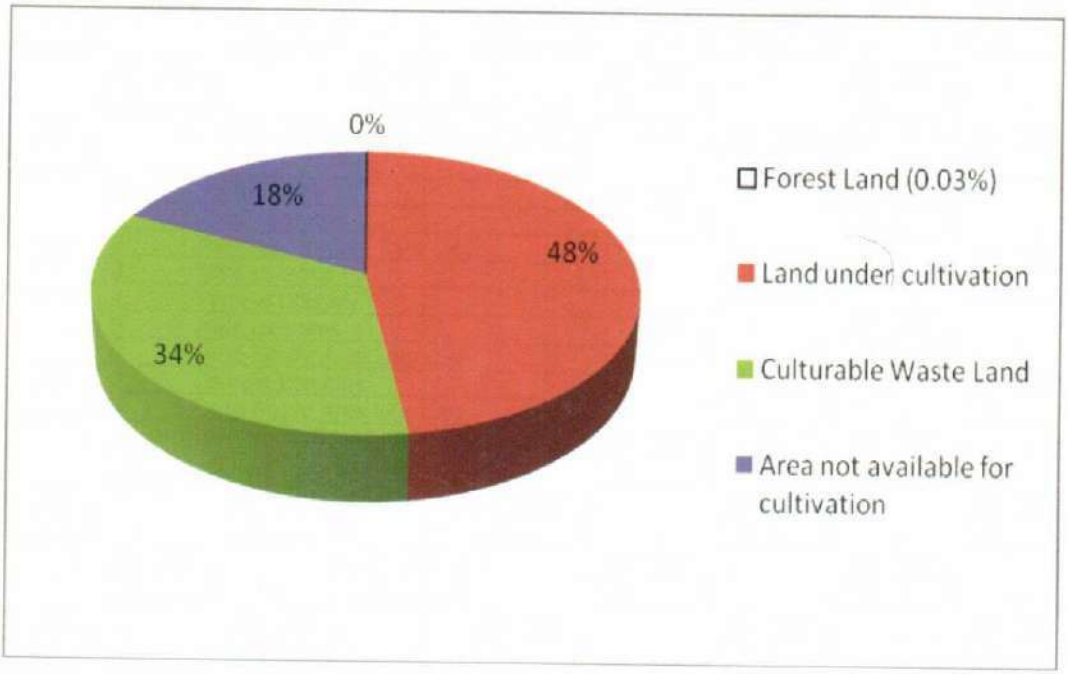


FIGURE-3.8.17
LANDUSE OF STUDY AREA

TABLE-3.8.10
DISTRIBUTION OF POPULATION BY SOCIAL STRUCTURE - 2001

Sr. No.	Particulars	Study Area
1	Scheduled Castes	19059
2	% to total population	16.06
3	Scheduled Tribes	13865
4	% to total population	11.69
5	Total SC and ST	32924
6	% to total population	27.75

Source: District Primary Census Hand Books, Rajsamand, Chittaurgarh and Udaipur Districts, 2001

3.8.9 Literacy Levels

The analysis of the literacy levels in the study area reveals a lower literacy rate in the study area. The study area experienced literacy rate of 47.34% in 2001. The distribution of literates and literacy rate in the study area is given in **Table-3.8.11.**

TABLE-3.8.11
DISTRIBUTION OF LITERATES AND LITERACY RATES

Sr. No.	Particulars	Study Area
1	Total Literates	56175
2	Average Literacy Rate (%)	47.34
3	Male Literacy (%)	61.67
4	Female Literacy (%)	32.94
5	Male Literates	36682
6	% to Study Area Literates	30.91
7	Female Literates	19493
8	% to Study Area Literates	16.43

Source: District Primary Census Hand Books, Rajsamand, Chittaurgarh and Udaipur Districts, 2001

The male literacy i.e. the percentage of literate males to the total males of the study area works out to be 61.67%. The female literacy rate, which is an important indicator for social change, is observed to be 30.91% in the study area as per 2001 census. This indicates that there is a need for major sociological development in the region with the increase in literacy levels of both males and females.

3.8.10 Occupational Structure

The occupational structure of people in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 10 categories of workers defined by the Census Department, which consists of cultivators, agricultural laborers, those engaged in live-stock, forestry, fishing, mining and quarrying; manufacturing, processing and repairs in household industry; and other than household industry, construction, trade and commerce, transport and communication and other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired

persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As per 2001 census records altogether the main workers works out to be 31.55% of the total population. The marginal workers and non-workers constitute to 13.56% and 54.88% of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The occupational structure of the study area is shown in **Table-3.8.12.**

TABLE-3.8.12
OCCUPATIONAL STRUCTURE

Sr. No	Occupation	Study Area	
		No.	% Population
1	Total main workers	37441	31.55
	Male	27598	23.26
	Female	9843	8.29
2	Marginal workers	16090	13.56
	Male	4951	4.17
	Female	11139	9.39
3	Non-workers	65113	54.88
	Male	26928	22.69
	Female	38185	32.19
Total Population		**118644**	**100.00**

Source: District Primary Census Hand Books, Rajsamand, Chittaurgarh and Udaipur Districts, 2001

3.8.10.1 Dependency Ratio

Based on the occupational structure of the study area the dependency rate of non-workers on the workers category has been estimated at 54.89, which is considered to be low or moderate while indicating that most of the people are engaged in some sort of income generating activity.

3.8.11 Infrastructure Facilities

The infrastructure and amenities available in the study area denotes the economic well being of the region. Reasonably good levels of infrastructure facilities are available in the study area, which consists of education, health care, communications, transportation, etc.

A review of infrastructure facilities available in the area has been done based on the available secondary data published in the Rajsamand, Chittaurgarh and Udaipur Districts Primary Census abstract. The infrastructure facilities available in about 54 villages of Rajsamand, 30 Villages of Chittaurgarh District and 6 villages of Udaipur District are covered within the study area. The village-wise infrastructure facilities available as per census records are presented in **Annexure–VII.**

3.8.12 Educational Facilities

The educational facilities are almost evenly distributed in the area. In all, there are 101 primary schools, 38 middle schools, 14 secondary schools and 2 other educational institutions. All the high schools are situated in larger villages. A few smaller villages are devoid of any educational institutions. The available educational facilities in the area are given in **Table-3.8.13.**

TABLE-3.8.13
EDUCATIONAL FACILITIES IN THE STUDY AREA

Sr. No.	Institution	Total
1	Educational facilities	92
2	Primary schools	101
3	Middle schools	38
4	Secondary schools	14
5	Adult Education Centers	4
6	Other Education Centers	2

Source: District Primary Census Hand Books, Rajsamand, Chittaurgarh and Udaipur Districts

3.8.13 Health Facilities

Different types of health facilities including hospitals, dispensaries and clinics are available in the study area. The health facilities include hospitals are nil, 8 primary health centers; 15 dispensaries and others as shown in **Table-3.8.14**.

3.8.14 Transport Facilities

The study area is served by rail and road transport facilities. About 49 villages have paved road connections while 41 villages are having approaches only with Mud roads.

As a whole, the study area has moderate level of communication network.

3.8.15 Post and Telegraphs

The study area has only one post and telegraphic service.

TABLE-3.8.14
HEALTH FACILITIES IN THE STUDY AREA

Sr.No.	Type of Institution	No. of Institutions in Study Area
1	Medical facilities	145
2	No. of Allopathic Hospital	0
3	No. of Ayurvedic Hospital	0
4	No. of Unani Hospital	0
5	No. of Homeopathic Hospital	0
6	Total Dispensaries	15
7	No. of Maternity and Child Welfare Center	0
8	No. of Maternity Home	0
9	No. of Child Welfare Center	0
10	No. of Health Center	2
11	No. of Primary Health Center	8
12	No. of Family Welfare Center	0
13	No. of Nursing Home	0
14	No. of Registered Private Medical Practitioners	0
15	No. of Subsided Medical Practitioners	0
16	Other Medical Facilities	0

Source: District Primary Census Hand Books, Rajsamand, Chittaurgarh and Udaipur Districts

3.8.16 Electrification

Almost all villages in the study area were electrified. Electricity was supplied for domestic, agricultural, industrial and public lighting purposes. Subsequently the electric connections have been given to many other villages.

3.8.17 Drinking Water Facility

Water supply in the study area is mainly from wells, hand pumps followed by tube wells and tanks.

3.9 Traffic Density Survey

The traffic studies were carried out at Dariba junction for 24-hours once during study period from 17th April 2009 to 29th April 2009 representing pre-monsoon season. The main objective of the survey is to characterize the type, category, and number of vehicles plying on the roads. The details of locations of traffic monitoring are given in **Table 3.9.1**.

3.9.1 Methodology

Vehicle Count

The vehicles plying in both the directions were counted continuously for 24 hours at all the ten locations. The vehicles were counted every hour and recorded under respective category. The vehicles were categorized under various heads like 2/3 wheelers, Tractors, Four Wheelers, Trucks/Tankers and Buses. The categorization of

the vehicles is necessary because the speed and the emission factors vary with type of the vehicle. The locations are presented in **Figure-3.9.1.**

TABLE-3.9.1
DETAILS OF TRAFFIC MONITORING AT VARIOUS LOCATIONS

Code	Locations
T1	Khandale chauraha -Dariba
T2	Rupaheli - Agucha
T3	Fathenagar- Dariba
T4	Dabok -Udaipur Airport
T5	Dabok-Mavli
T6	Kapasan-Chittorgarh
T7	Bhilwarr – Ajmer
T8	Relmagra road
T9	Fatehnagar road
T10	Rajpura road

3.9.2 Presentation of Results

The present level of traffic has been converted to Passenger Car Units (PCU) at all the locations as per the conversion factors stipulated by Indian Road Congress (IRC). The Passenger Car Unit (PCU) recorded at the selected traffic locations ranged between 1410-31205 The maximum PCU of 31205 was recorded on the Dabok-Udaipur (T4) and the minimum PCU of 1410 was recorded on Khandale chauraha -Dariba (T1), The details of traffic volume at each location is summarized in **Table-3.9.2.**

TABLE-3.9.2
TRAFFIC DENSITY (Vehicles/day)

Code	Location	2/3 Wheelers	Car/ Jeep	Tractor	Buses	Truck's/Multi Axels/ Trailors/Tankers	Total PCU'S
T1	Khandale chauraha - Dariba	745	258	26	68	166	1410
T2	Rupaheli - Agucha	575	298	20	32	256	1509
T3	Fathenagar- Dariba	8067	1643	337	205	691	9375
T4	Dabok -Udaipur Airport	7099	6002	346	1001	5871	31205
T5	Dabok-Mavli	3713	3535	179	583	4818	22131
T6	Kapasan-Chittorgarh	1867	1174	61	176	3205	12433
T7	Bhilwarr – Ajmer	3425	3833	233	629	5696	25219
T8	Relmagra road	2256	515	162	108	307	3374
T9	Fatehnagar road	2438	567	162	113	298	3505
T10	Rajpura road	1940	452	153	45	178	2550

With present level of traffic and the increase in existing traffic due to the project during operational phase has been estimated by comparison with the recommendations stipulated by Indian Road Congress (IRC). The IRC recommendations on traffic capacity are presented below in **Table-3.9.3**.

TABLE-3.9.3
RECOMMENDATIONS ON TRAFFIC CAPACITY - IRC

Sr. No.	Category of Road	Maximum PCU/day
1	Two lane roads (7-m) with earthen shoulders	15,000
2	4-lane highway with earthen shoulders	35,000

As per the above standards the roads are two lane roads having maximum capacity of 15000 PCU/day.

The estimated peak traffic in terms of PCUs are compared with the stipulated standards by IRC for traffic capacity of the existing road network.

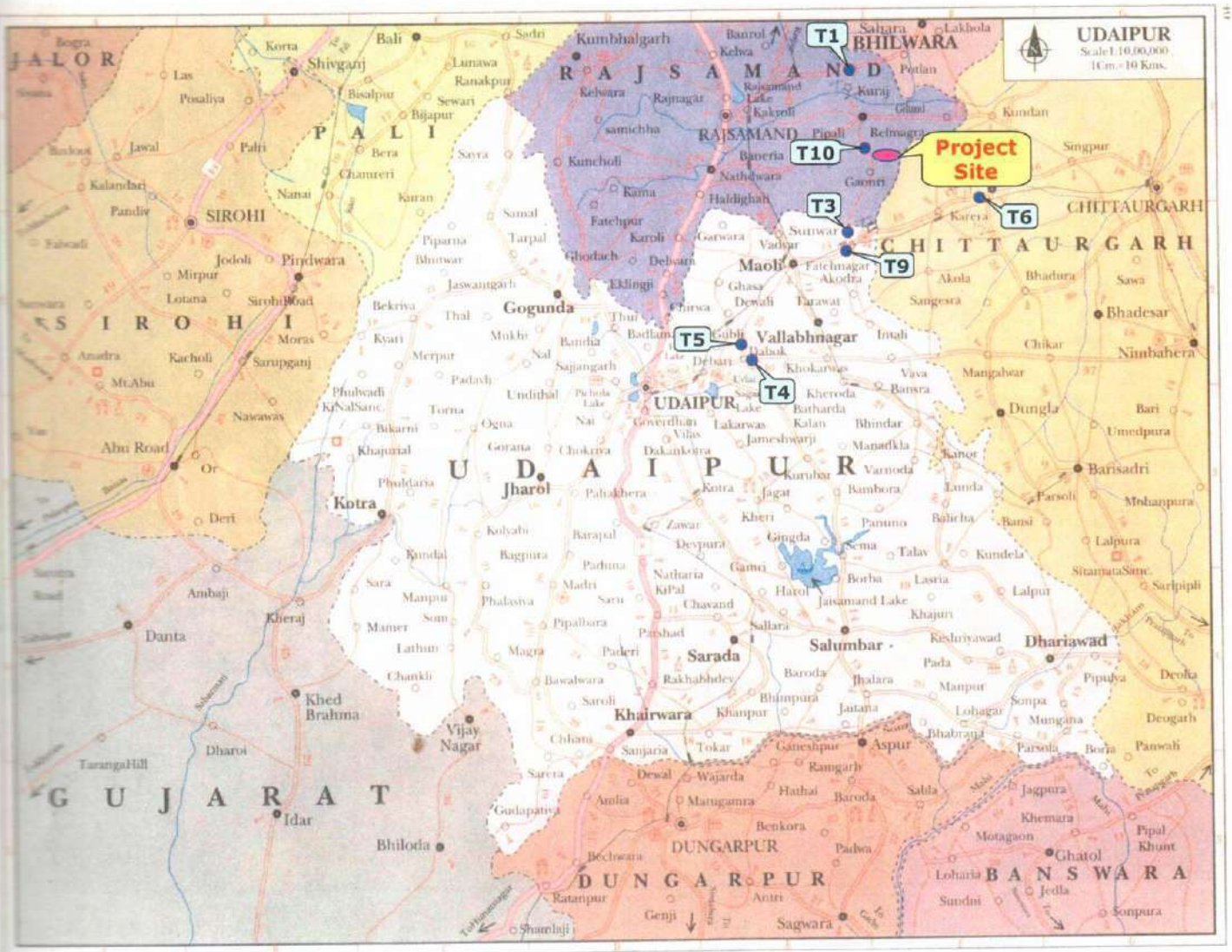
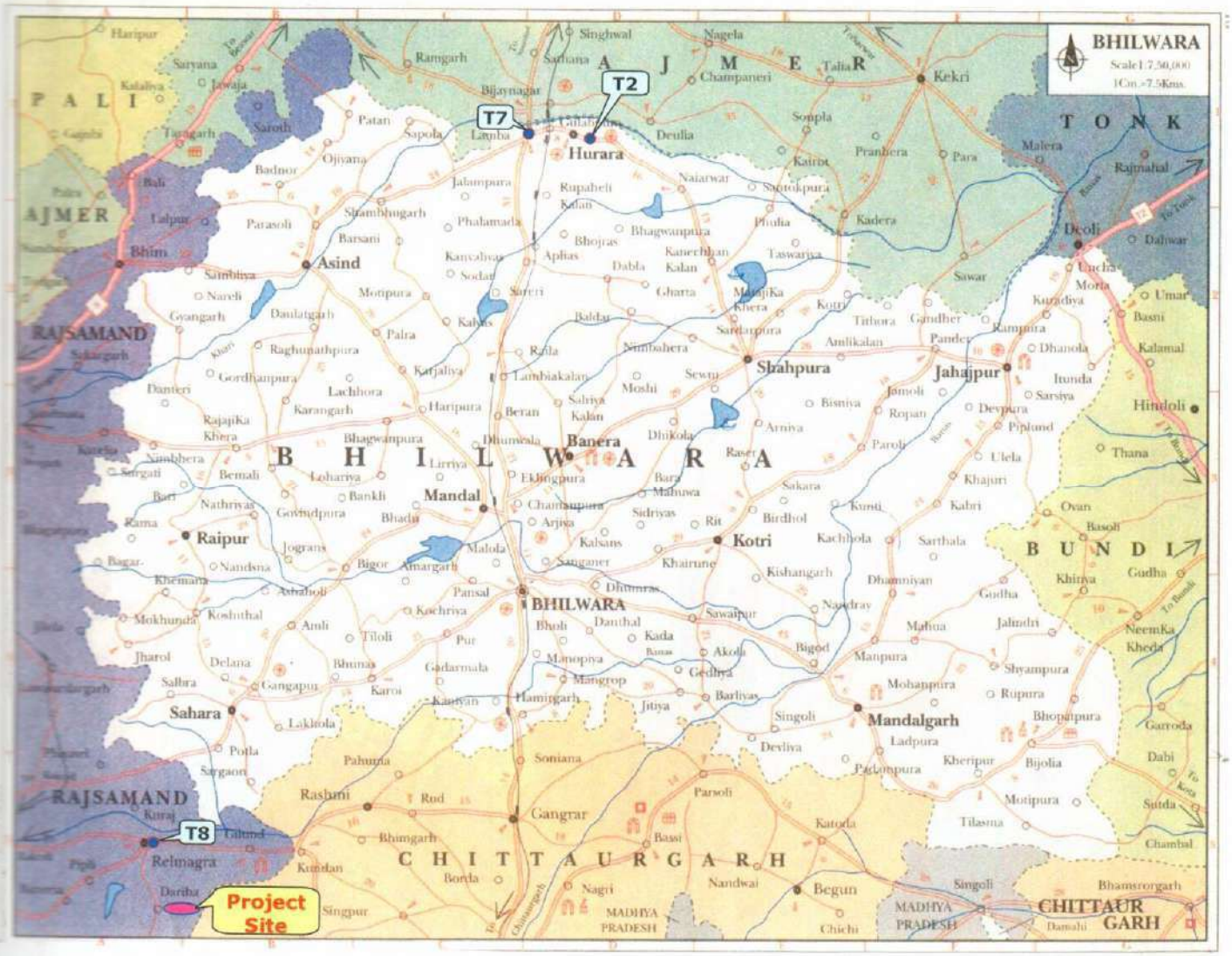


FIGURE-3.9.1
TRAFFICE LOCATION MAP


BHILWARA
Scale 1:7,50,000
1Cm.=7.5Kms.
T2
T7
T8
Hurara
Shahpura
Jahajpur
Asind
Mandal
Banera
BHILWARA
Kotri
Raipur
Sahara
Mandalgarh
Gangrar
Rashmi
Relmagra
Project Site
Begun
Kekri
Deoli
Sawar
Malpura
Kotputli
Phulia
Kadera
Pranhera
Para
Sonpla
Deulia
Singhwal
Nagela
Champaneri
Talia
Bijaynagar
Lamba
Patan
Sapola
Saroth
Badnor
Ojiyana
Jalampura
Rupaheli Kalan
Naiarwar
Santokpura
Shambhugarh
Phalamada
Bhojras
Bhagwanpura
Barsani
Aphias
Dabla
Kanerchian Kalan
Taswariya
Kanyaliya
Sodan
Sareri
Gharta
Malajika Khera
Kotri
Tithora
Gandher
Rampura
Amlikalan
Pandeo
Dhanola
Kalamal
Itunda
Sarsiya
Hindoli
Thana
Ulela
Khajuri
Kabri
Ovan
Basoli
Gudha
Khirya
Neemka Kheda
Jalmdhi
Malhua
Shyampura
Rupura
Bhopalpura
Garroda
Dabi
Sutda
Chambal
Bijolia
Motipura
Tilasma
Katoda
Nandwai
Singoli
Bhamsrorgarh
CHITTAUR GARH
Damahi
Chichi
Nagri
Bonda
Kundan
Bhimgarh
Basi
Parsoli
Soniana
Pahuna
Potla
Sargaon
Kuraj
Gamri
Pipli
Dariba
Singpur
Chhaurgarh
Ladpura
Pachampura
Kheripur
Devliya
Singoli
Mandalgarh
Manpura
Bigod
Akola
Kada
Danthal
Bhoti
Sawaipur
Nandray
Kishangarh
Dhamniyan
Khairune
Sanganer
Kalsans
Arjiya
Sidriyas
Rit
Birdhol
Kachhola
Sarthala
Kunti
Sakara
Mahuwa
Bara
Ekhingpura
Chamanpura
Dhikola
Arniya
Paroli
Bisniya
Jamoli
Ropan
Devpura
Piplond
Moshi
Sewri
Nimbahera
Amlikalan
Kotri
Sardarpura
Khera
Kotri
Tithora
Gandher
Rampura

Chapter-4

Anticipated Environmental Impacts and Mitigation Measures

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 Introduction

This chapter presents identification and appraisal of various impacts from the proposed Zinc Smelter, Lead Smelter, Captive Power Plant and expansion of mines and beneficiation capacity in the study area based on the inventory of pollution sources as well as the baseline setting described.

The impacts have been assessed for the proposed Zinc smelter, Lead Smelter, Captive Power Plant and expansion of mines and beneficiation capacity assuming that the pollution due to the existing activities with their present capacities has already been covered under baseline environmental monitoring. The proposed complex and expansion project is likely to create impact on the environment in two distinct phases:

- During the construction phase which may be regarded as temporary or short term; and
- During the operation phase which would have long term effects.

The construction and operation of the proposed project comprises various activities each of which may have an impact on some or other environmental parameters. Various impacts during the construction and operation phase on the environment parameters have been studied to estimate the impact on the environment and are discussed briefly below and elaborated in the subsequent sections.

Mitigation measures at the source level and an overall Management Plan at the study area level are elicited so as to improve the supportive capacity of the study area and also to preserve the assimilative capacity of the receiving bodies.

The environmental attributes, which are likely to be affected in the region, are air, noise, water, land, biological and socio-economic environment.

The Management Action Plan aims at controlling pollution at the source level to the extent possible, with the available and affordable technology, followed by treatment measures before they are discharged.

It is to be appreciated that mining process is to a certain extent, an inevitable destructive process, but the hazards are within measurable limits, and can be ameliorated to a significant extent.

4.2 Impacts during Construction Phase

This includes the following activities related to leveling of site, construction of plants and other related structures and other related equipment.

4.2.1 Impact on Land use

The total land required for the proposed integrated complex and expansion project is available within mine lease area. Hence, there is no additional land acquisition process and no R & R issues involved in the proposed expansion of mine and Beneficiation plant capacity, Lead Smelters, Zinc Smelters and Captive Power Plant project. Some structures and jarosite pond will be constructed under the proposed complex.

4.2.2 Impact on Soil

The proposed project involves construction of smelter complex including new housing colony. Smelter complex includes 2 streams of Zinc smelting facility, one stream of Lead smelting facility, water and waste water treatment plant, 3 units of captive power plant, raw material storage and waste disposal facilities and other infrastructural facilities, administration building, etc. Excavation quantity is around 12,00,000 m^3 which will be earth/soft rock/hard rock and excavated up to a depth of 2.5 to 3 m. The excavated material will be reutilized for refilling and leveling.

For the proposed smelter complex some of the infrastructure will be demolished which will amount to generation of 35000 m^3 of rubble which will be used for filling and leveling.

The soil in the project site predominantly consists of clayey soil. The sub-strata of this area is not rocky and as such no blasting is envisaged for either levelling or during foundation work. As the site is plain and needs no grading, filling and leveling.

The construction activities will result in loss of topsoil to some extent in the plant area and jarosite pond area. The topsoil requires proper handling like separate stacking so that it can be used for green belt development. Apart from very localized construction impacts at the plant site, no significant adverse impact on soil in the surrounding area is anticipated.

For the proposed capacity enhancement in beneficiation plant, construction of foundations for plant & machinery will be done.

4.2.3 Impact on Air Quality

During construction phase, suspended particulate matter will be the main pollutant, which would be generated from the site development activities and vehicular movement on the road. Further, concentration of NO_x and CO may also slightly increase due to increased vehicular traffic movement. However, the increase in ambient concentrations of air quality will be negligible. As most of the construction equipment will be mobile, the emissions are likely to be fugitive. The dust generated will also be fugitive in nature, which can be controlled by suitable mitigation measures like sprinkling of water.

The impacts will be localized in nature and the areas out side the project boundary are not likely to have any adverse impact with respect to ambient air quality.

4.2.4 Impact on Water Resources and Quality

The peak requirement of water during construction will be about 200 m^3/day, which will be supplied from the existing water system. No ground water will be drawn, even during construction.

Further, the wastewater generation during the construction period will be basically from the sanitary units provided for the workers. This waste will be treated in a septic tank and discharged through a soak pit. Hence, there will not be any impact on the water regime due to discharge of treated wastewater.

4.2.5 Impact on Noise Levels

The major sources of noise during the construction phase are vehicular traffic, construction equipment like dozers, scrapers, concrete mixers, cranes, pumps, compressors, pneumatic tools, saws, vibrators etc. The operation of these equipment will generate noise ranging between 85-90 dB (A) near source. These noises will be generated mostly within the existing plant boundary and will be transient in nature. Due to existing green belt around the periphery of the mine lease area, these noises will be attenuated to a large extent and are not likely to have any significant impact on the nearby villages.

4.3 Impacts During Operational Phase

The proposed project operation will involve production of 0.5 MTPA of Zinc, 0.125 MTPA Lead, 255 MW of Captive Power generation, 0.9 MTPA Lead-Zinc ore mining, and 1.2 MTPA beneficiation of lead-Zinc ore. The following activities related to the operational phase will have varying impacts on the environment and are considered for impact assessment:

- Land use;
- Soil quality;
- Topography and climate;
- Air quality;
- Water resources and quality;
- Noise levels;
- Boilogy;
- Traffic load; and
- Infrastructural facilities.

4.3.1 Impact on Topography and Drainage

The area is characterized by plain topography. The general elevation of the ground wavers between 480 and 561 mRL.

For this infrastructure, no pre-mining surface drainage is required to be modified/diverted; as such no disturbance shall be caused to the natural drainage system. Hence, the impact on the topography and drainage of the core zone will not be significant.

As underground mining is being carried out, the surface drainage is not going to be disturbed. The surface drainage is taking its natural course in the lease area.

4.3.2 Impact on Land use

Total land available at existing RD mines is 554.19-ha and has other infrastructure facilities like colony, shopping centre, schools, dispensary/hospital, club building roads, etc. Proposed mine expansion will not require any additional land. Proposed smelter and CPP will require 162 ha and will be met with the available land. The enhancement of Lead-Zinc mine and Beneficiation capacity will be in existing plant & sanctioned lease area. No additional land will be acquired for proposed capacity enhancement in Mines and Beneficiation Plant.

The proposed complex involves construction of smelter complex including housing colony. Smelter complex includes 2 streams of Zinc smelting facility, one stream of Lead smelting facility, water and waste water treatment plant, 3 units of captive power plant, raw material storage and waste disposal facilities and other infrastructural facilities, administration building, etc, the details are given in **Table-4.3.1**. Construction of additional stream for beneficiation.

TABLE-4.3.1
LAND REQUIREMENT OF SMELTER COMPLEX (IN HECTARE)

S. No.	Zinc smelter	Lead Smelter	Captive Power Plant	Hazardous Waste Disposal Facilities	Common facilities	Total
1.	34.00	28.58	18.86	53.00	27.56	162

Of the total acquired area of 554.19-ha, the acquired area within leasehold is 356.50-ha, and area acquired outside leasehold is 197.69-ha. The pre-mining landuse status of acquired area is shown in **Table-4.3.2.**

TABLE-4.3.2
PRE- MINING LAND STATUS OF ACQUIRED AREA

Land	Area (ha)
Government	301. 10
Private	253. 09
Forest	Nil
Total	**554.19 ha**

- **Progressive Mine Closure Plan**

This progressives mine closure plan will be there only due to exhaustion of mineral in future, economic viability due to change in policy and directive from

statutory organization/ court due to change in mining policy etc. Reserves and resources in the main & east lode stand at 24.20 million tons as on 01.02.2009. The mine life is anticipated as 18 years assuming 70% ore recovery at annual production rate at 0.9 million tons. The projected life of the mine may undergo change on the basis of exploration input and criteria governing economic viability hence no closure planned at this stage.

The land use in the lease area for mining activities has been given in the mining scheme 109.27 hectare. Now, with the construction of smelter complex in part of leasehold area the present land use pattern changed to 213.08 hectares. The details are given **Table-4.3.3**.

TABLE-4.3.3
PRESENT LAND USE PATTERN

Particulars	Within Lease Area(ha)	In Acquired Land outside Lease Area (ha)	Total Area (ha)
A) Operational Use			
Mine			
a) Mine/Industrial Area (Mine Infrastructure, beneficiation plant, workshops and other office buildings.)	58.62	0.00	58.62
b) Old Mine Premise (Sala Mill, incline, vent. Fan etc.)	7.32	0.00	7.32
c) Main Explosive Magazine	1.56	0.00	1.56
a) Old Tailing Dam	3.02	0.00	3.02
b) Core shed	0.06	0.00	0.06
c) Tailing pipeline	1.78	0.05	1.83
d) Tailing Dam (Main)	0.00	82.00	82.00
Sub Total	**72.36**	**82.05**	**154.41**
Smelter Complex			
a) Zinc Plant	22.64	11.36	34.00
b) Lead Plant	20.15	8.43	28.58
c) Captive Power Plant	0.00	18.86	18.86
d) Utilities (ETP, RO etc)	0.42	6.04	6.46
e) Hazardous Waste Disposal Site	53.00	0.00	53.00
f) Others(Open space & internal roads)	3.10	18.00	21.10
Sub Total	**99.31**	**62.69**	**162.00**
Total - A	**171.67**	**144.74**	**316.41**
B) Other Use Residential Colony, welfare buildings and internal roads	41.41	2.86	44.27
Total (A+B) Considered for Financial Assurance	**213.08**	**147.60**	**360.68**
C) Public roads and open spaces	15.58	19.93	35.51
D) Green Belt (Plantation in residential, tailing dam and mine/industrial premise areas.)	127.84	30.16	158

Land put in use for mining and allied activities in mining
Lease area ==========→ **213.08** hectares

Since this is an underground mine, there is no significant effect of mining activity on the environment. There is no land degradation, because the voids created due to mining of ore are back filled with classified mill tailing with cement.

The proposed smelter complex and new housing colony will occupy a part of the vacant land, abandoned buildings/sheds and scrub land.

The proposed site needs the clearing of abandoned part of the existing HZL colony. Adequate care will be taken during dismantling of these buildings to minimize the dust and noise pollution. Water sprinkling will be carried out during the transportation and demolition of the building debris. Building debris will be used for leveling the site. Reusable materials will be used in the proposed colony.

No undeveloped or agricultural land will be used for this integrated complex.

4.3.3 Impact on Soil

Predictions of the environmental impact of the mining activities on surface soil are based on the nature of activities; extent of the area covered and associated aspects of environmental concern. The lead-zinc ore is confined to the mine lease area only. The mine development and future mining activity for ore production will be solely confined to underground; hence the top soil will not be damaged in any way. Due care will be taken for minimum damage of top soil.

The proposed greenbelt plantation in the mine lease area will act as an effective barrier for control of dust.

The following management measures shall be adopted:

- As soon as construction is over, the surplus earth shall be utilized to fill up the low lying areas, the rubbish is to be cleared and all un-built surfaces be reinstated;
- The top soil from the excavated areas shall be preserved in separate stacks for re-use during the plantation;
- The proposed green belt shall be integrated with the existing plantation and locally available and sustainable species shall only be chosen for plantation;
- Green belt development shall be taken up along with the construction work so that plantation will grow to adequate height by the time of plant commissioning. Thus, green belt will be effective in containing the pollutants due to the plant operation;
- Entire plant shall be aesthetically landscaped and as much as feasible natural gradient shall be maintained;

- There shall be minimum concreting of the top surfaces such that there is a scope for maximum ground water recharge due to rainfall; and
- The contractor shall arrange for free supply of kerosene/firewood to the construction workers for their cooking needs to prevent the damage to trees.

4.3.4 Impact of Solid Waste

The solid wastes generated from the mining and industrial complex are given in **Table-4.3.4** and **Table-4.3.5**.

TABLE-4.3.4
SOLID WASTES GENERATED FROM SMELTING AND CPP COMPLEX

Sr. No.	Waste	Category	Total Qty TPA	Zinc Smelter-1 TPA	Zinc Smelter-2 TPA	Lead Smelter TPA	CPP TPA
High Volume Low Effect Wastes							
1	Fly ash	--	800 TPD	--	--	--	800TPD
2	Bottom ash	--	85 TPD	--	--	--	85 TPD
3	Lead smelter slag	--	125500	--	--	125500	--
Hazardous Wastes							
4	Spent Catalysts (KL) (V_2O_5)	17.2 Schedule 1	55	20	20	15	--
5	Jarosite (dry MT)	7.2 Schedule 1	310600	155300	155300	--	--
6	Purification cake	7.2 Schedule 1	19000	9500	9500	--	--
7	Anode mud	7.2 Schedule 1	3200	1600	1600	--	--
8	Cooler cake	7.2 Schedule 1	6000	3000	3000	--	--
9	ETP cake	7.4 Schedule 1	27500	12500	12500	2500	--
10	Cobalt cake	7.2 Schedule 1	1400	700	700	--	--
11	Waste oil	5.2 Schedule 1	75	25	25	25	--
12	Used oil (KL)	5.1 Schedule 1	100	25	25	25	25

TABLE-4.3.5
SOLID WASTES & HAZARDOUS WASTE GENERATED FROM MINING COMPLEX SOLID WASTE

Waste	Quantity
Tailings	1300 TPD

HAZARDOUS WASTE

Waste	Category	Quantity
Used oil	5.1 Schedule 1	30 KL/yr
Chemicals containing residues from decontamination & disposal	33.1	300 Kg/yr
Discarded barrels/ container used for hazardous waste/ chemicals	33.3	400 Nos/yr

The mode of disposal of the solid wastes is given in **Table-4.3.6.**

TABLE-4.3.6
SOLID WASTE DISPOSAL

Waste	Treatment/ Disposal Method
High Volume Low Effect Wastes	
Fly ash	It shall be gainfully utilized by the nearby cement manufacturer
Bottom ash	It shall be disposed off in tailing dam of Rajpura- Dariba Mine along with the tailing.
Lead smelter slag	It shall be stored in slag disposal yard. Opportunities would be explored for its gainful utilization in gainful utilization like cement manufacturing/ road construction application etc.
Hazardous Waste	
Spent Catalyst (KL) (V_2O_5)	It shall be disposed in SLF after proper neutralization
Jarosite	It shall be converted in Jarofix by treatment with lime and cement. Jarofix thus formed shall be disposed in jarofix disposal yard.
Purification cake	It shall be recycled in the process/ sold to the authorized recyclers. Balance, if any, shall be disposed in SLF after proper neutralization
Anode Mud	It shall be reused in the process to reduce the fresh MnO_2 consumption. If surplus any, shall be sold to the authorized recyclers or disposed off in SLF after neutralization
Cooler cake	It shall be disposed in SLF after neutralization
ETP cake	It shall be disposed in SLF after proper neutralization
Cobalt cake	It shall be recycled in the process/ sold to the authorized recyclers. Balance, if any, shall be disposed in SLF after proper neutralization
Waste oil	It shall be sold to authorized reusers/ recyclers registered with CPCB/ MoEF
Used oil	It shall be sold to authorized reusers/ recyclers registered with CPCB/ MoEF

- ***Zinc Smelters***

Jarosite/ Jarofix

The jarosite cake containing minor quantities of zinc, lead and other metallic impurities along with bulk of the iron, in the form of a sodium iron sulphate complex, is considered a hazardous waste on account of the metal content and their leachability in acidic pH. The internationally accepted practice for disposal of this waste is to neutralize it with lime followed by disposal in secure landfills. However, from the objective of using the state-of-the-art environment-friendly technology at this plant, it is proposed to stabilize the jarosite cake by adding lime and cement (approx 10% each by weight) which will not only improve the physical properties of the waste material (compressive strength, cohesivity, handling properties), but will also drastically reduce its leachability. The resulting stabilized product, known as Jarofix, can be used as a low-grade construction material or as a landfill material without any environmental risk. The process of solidification/stabilization of jarosite in this manner is a licensed technology developed by Canadian Electrolytic Zinc (CEZ) and is already in use at their own plant at Noranda in Canada as well as at Asturiana de Zinc, Spain – the largest zinc plant in the world apart from HZL, Chanderiya Lead Zinc Smelter (CLZS) Phase-I and Phase-II.

Hindustan Zinc is working intensively for utilization of Jarosite/ Jarofix in following gainful utilization:

- Cement manufacturing
- Concrete manufacturing
- Tiles manufacturing

For the said gainful utilization, research studies are in progress with NCCBM (National Council for Cement & Building Materials) and IIT- Roorkee. NCCBM is evaluating the technical suitability of Jarosite in cement manufacturing. IIT Roorkee is working on "Development of Sustainable construction products incorporating Jarosite and/or Jarofix". Talks are in progress with cement manufacturers, tiles manufacturers, and NHAI (National Highway Authority of India) for the said usage.

Lead Silver Complex

Lead silver complex generated from zinc smelter shall be used in lead plant for recovering lead and silver apart from other minor minerals.

Anode Mud

Anode mud generated would be recycled in the process up to maximum extent to reduce the consumption of fresh MnO_2. Surplus quantity if any would be sold or disposed in SLF.

Purification Cake

Purification cake generated will be recycled in the process to maximum extent and will be sold to the authorized recyclers registered with MoEF/ CPCB. Balance, if any, will be disposed off in TSDF/ SLF.

Cobalt Cake

Cobalt cake generated will be recycled in the process to maximum extent and will be sold to the authorized recyclers registered with MoEF/ CPCB. Balance, if any, will be disposed off in TSDF/ SLF.

Other Hazardous Wastes

ETP cake, cooler cake, part of Lead silver compound, part of anode mud, part of cobalt cake, part of purification cake and spent catalyst (V_2O_5) will be disposed in captive TSDF/SLF. Discarded containers & liners will be crushed and decontaminated before disposal in TSDF/SLF. Waste oil and used oil will be safely stored in 200 liters drums/tanks in a covered shed and sold to authorized recyclers registered with MoEF/CPCB.

Design Details of Secured Landfill and Jarofix Disposal Yard

The design details of Secured Landfill (SLF) and Jarofix Disposal Yard are as per the CPCB guidelines. The liner details are as shown in **Figure-4.3.1** and **Figure-4.3.2.** SLF and Jarofix Disposal Yard will be developed phase wise. Area has been earmarked for 20 years and is as shown in **Figure-4.3.3 and Figure-4.3.4**.

The water upstream and downstream of SLF and Jarofix Disposal Yard shall be monitored regularly.

- ***Lead Smelter***

The granulated discard slag generated from the fuming furnace of lead smelter will be inert and will be transported to slag yard through truck where slag will be properly stacked.

Hindustan Zinc is working intensively for utilization of slag in following gainful utilization:

- As a component in raw mix for manufacture of Ordinary Portland Cement (OPC);
- As a component for manufacture of Portland Slag Cement (PSC);
- As a partial substitute for sand / fine aggregates in road construction; and
- As a fine aggregate in bricks and tiles.

R&D study on ISF (Imperial Smelting Furnace) slag generated at our sister unit, Chanderiya lead zinc smelter has indicated followings:

- Physico – chemical characteristics of ISF Slag suggested that it is compatible with other raw materials used in cement manufacturing.
- Good quality clinker can be produced by using ISF slag upto 5.5% as a component of raw mix. Cement made from this clinker conformed to all the requirements of IS specifications for 33, 43 and 53 grades of OPC.
- ISF slag up to 40% can be utilized in the manufacture of PSC conforming to the requirements of the IS 455: 1989.
- There is no deterioration in compressive strength of specimens on immersion in plain water, solution of chlorides, sulphates and alkaline solutions.
- There is no leaching of metals viz., zinc & lead from the specimens in all the curing media selected, when tested as per standard procedures.
- Bureau of Indian Standard (BIS) has accorded approval for using ISF slag as performance improver in the cement manufacturing.

Based on the R&D study, Rajasthan State Pollution Control Board has granted permission to Shree cement for utilizing the ISF slag.

Similar efforts will be replicated at Rajpura- Dariba smelting complex for utilization of slag generated from lead smelters for alternative gainful utilization.

SLF- Cross-section

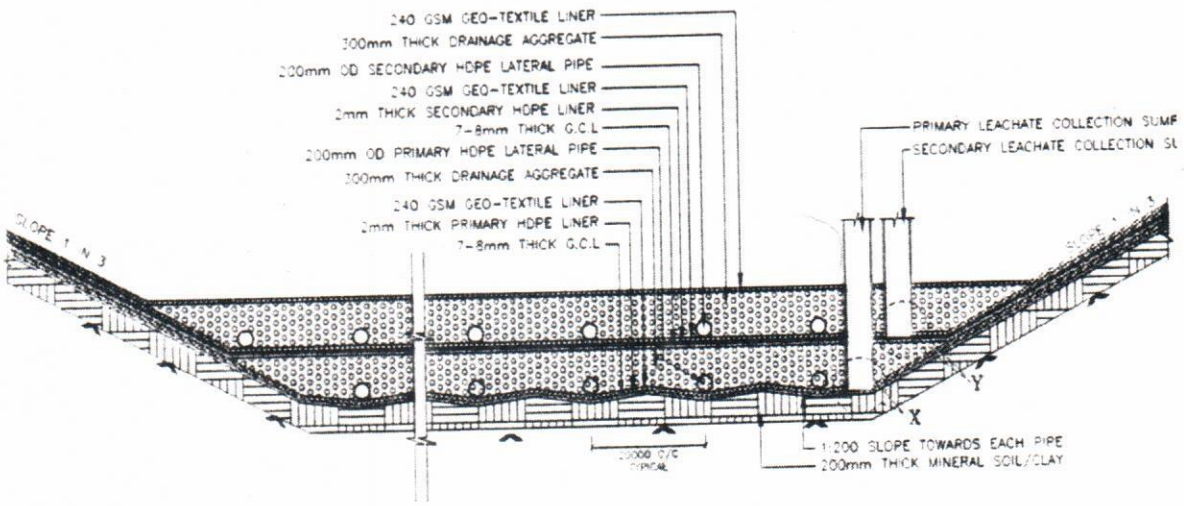
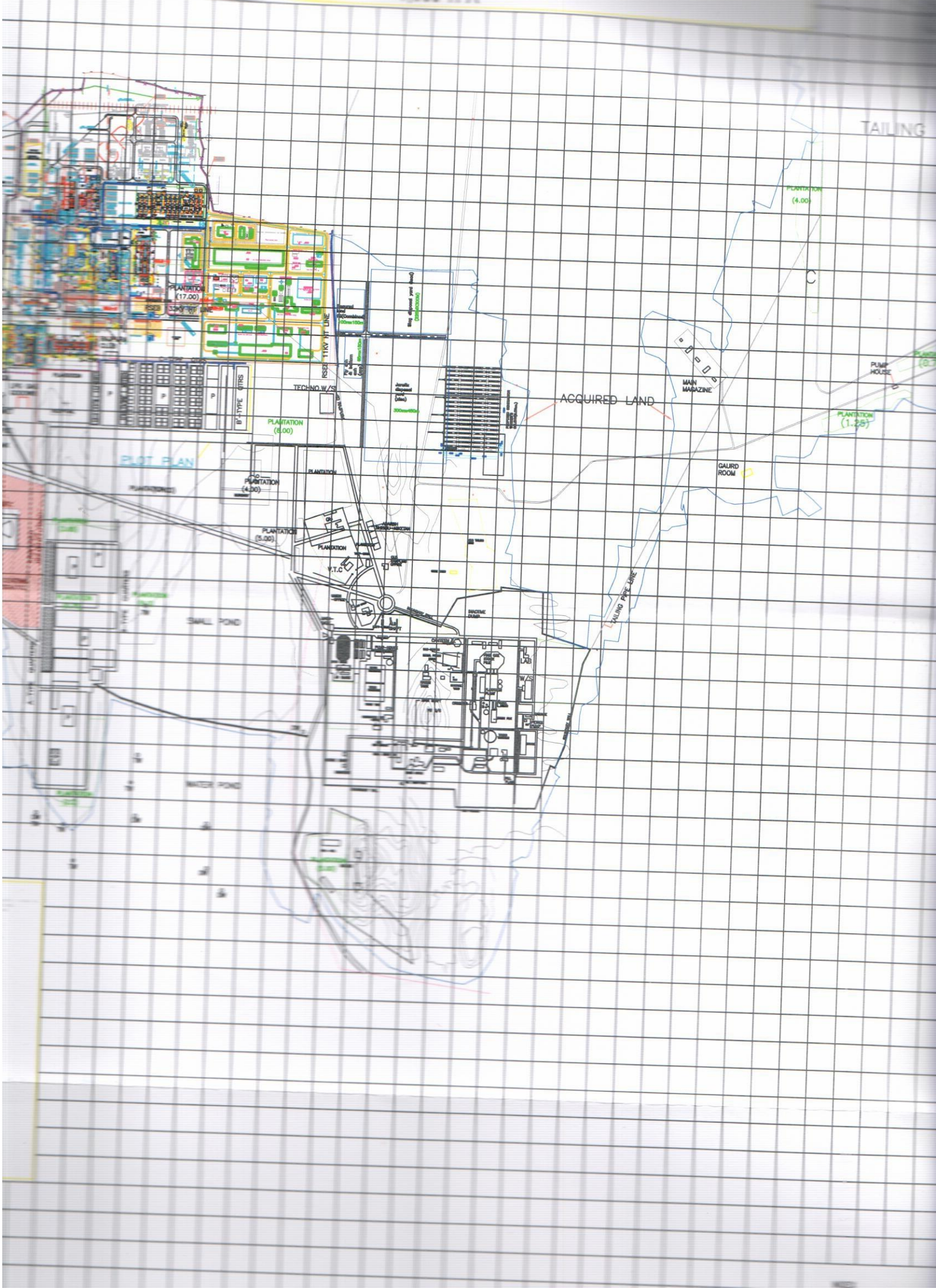


FIGURE-4.3.2
SLF- CROSS SECTION


TAILING
PLANTATION (4.00)
C
PLANTATION (17.00)
B"-TYPE QTRS
TECHNO.W/S
PLANTATION (5.00)
ACQUIRED LAND
MAIN MAGAZINE
PUMP HOUSE
PLANTATION (1.25)
GAURD ROOM
PLOT PLAN
PLANTATION (4.00)
PLANTATION (5.00)
PLANTATION
V.T.C
SMALL POND
WATER POND
TAILING PIPE LINE

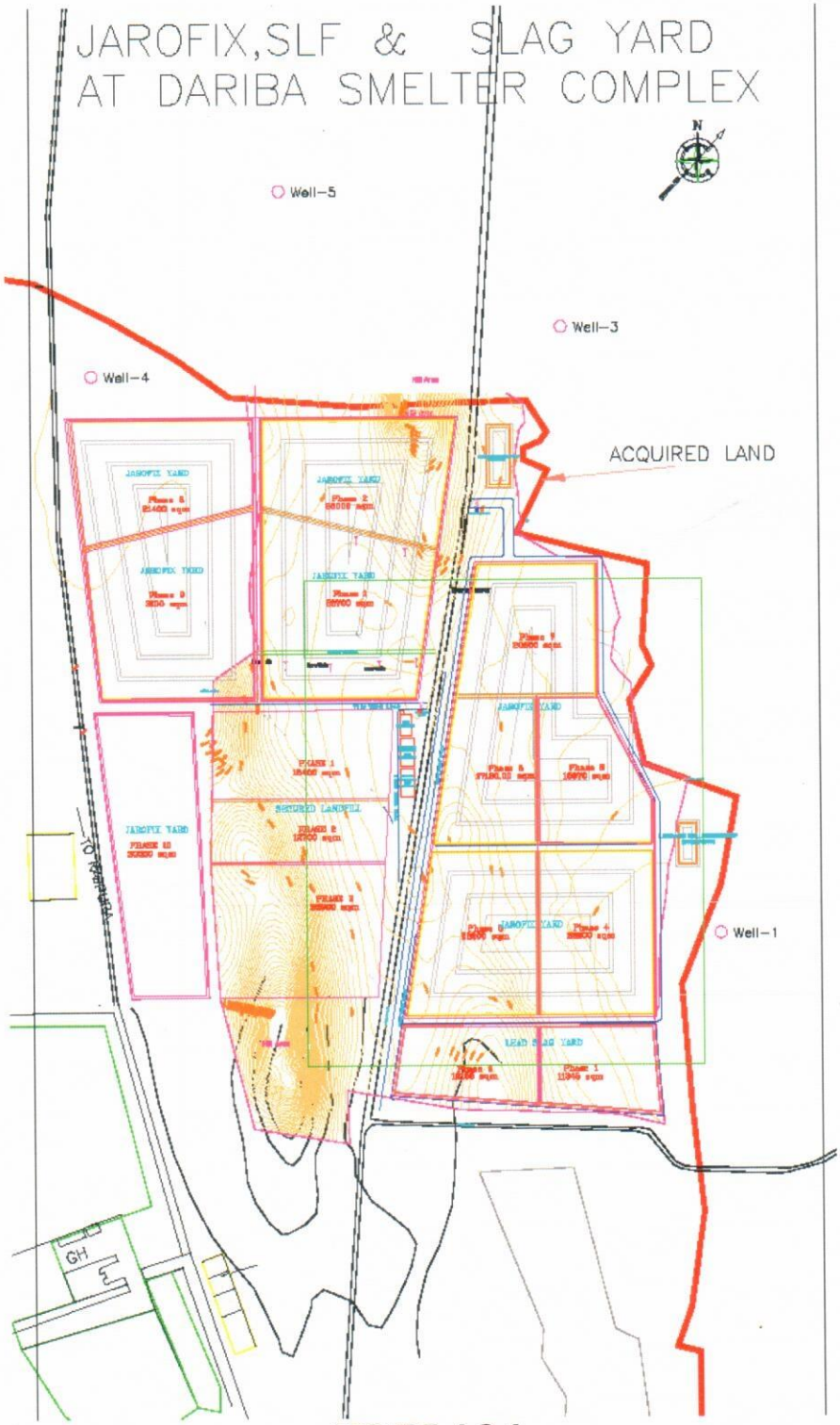


FIGURE-4.3.4
PLAN SHOWING PHASE WISE DEVELOPMENT OF JAROFIX DISPOSAL YARD, SECURED LANDFILL AND SLAG DISPOSAL YARD

It is worth mentioning that in the Hazardous Waste (Management, Handling & Trans boundary movement) Rules, 2008 the slag has been deleted from the category of hazardous waste.

Design Details of Slag Disposal Yard

Slag generated will be granulated vitreous material formed at 1100^0C - 1300^0C and will be inert in nature. It is expected that within few years all the slag generated will be utilized by the cement manufacturers. Meanwhile, it will be stored on the concrete flooring having catchment garland drains for collecting the rainwater spilled through it. Garland drains will be connected to ETP.

Captive Power Plant

Fly Ash

Coal requirement for the power generation is 3320 TPD. Ash content of the coal will be max. 35%. Fly Ash (800 TPD) will be collected at Air Preheater, Economizer, ESP and stack hoppers. The fly ash collected from the ESP hoppers will be transported to the ash silo in the dense phase form, through compressed air to avoid the dust pollution. The collected ash from the silo will be disposed to the nearby cement plant in closed containers. Total operation is automatically controlled by PLC (Programmable Logic Controllers). Even at the time of loading the containers, special arrangements will be provided at the outlet of the silo to avoid any spillage of ash. A MoU has been signed with Grasim Cement industries for supply of fly ash and is enclosed as **Annexure-VIII**.

Bottom Ash

Bottom ash (85 TPD) from the furnace will be collected through scrapper conveyor to belt conveyors to bottom ash silo. From the silo, bottom ash will be transported for disposal in the tailing dam of the existing mining operations. Opportunity will be explored for its utilization in brick manufacturing by nearby brick manufacturer.

- *Mine*

Waste Dump Management

The waste rock produced from underground mine development, required for future exploitation of ore, is brought on surface and dumped into a well earmarked place known as waste dump site. At present there are two waste dumps, one is active one and another is abandoned one. In order to stabilize the inactive dump plantation has been done on it. The nature of the waste rock is not hazardous so there is no chance of contamination of surface and ground water. It is anticipated that for the plan period approximately 15000 to 20000 m^3 per annum of waste generation from underground mine development.. This waste will be partially used for void filling in mine and rest will be hoisted separately and dumped in the specified place in the acquired area for ground leveling and other

construction work in the industrial area. The left out waste will be stacked in the specified active waste dump, west of main shaft within the industrial area. The slope of the dump is maintained by periodical leveling of the top. Some plantation has been done in last two years where the dump has attained the desired height. In future plantation will be carried out in the same manner to habilitate the waste dump.

The existing mining produces only one type of solid waste i.e. waste rock generated from the mine development. The waste rocks howsoever small in quantity will be utilized in construction and embankment of tailing dam as is in present practice. Some waste rocks will be disposed in existing dedicated dumping sites.

30000 TPA will be generated and dumped at designated place. Waste rock, generated by mine development, will be partially used for filling the mine voids, land reclamation and road construction within the acquired area and rest will be stacked at designated waste dumps in the industrial premises. Due care will be taken for stabilizing the waste dump by plantation in future. Further, the waste dump will be provided with adequate slope to prevent erosion and fugitive dust generation due to wind.

At present there are two waste dumps, one is active one and another is abandoned one. In order to stabilize the inactive dump plantation has been done on it. The nature of the waste rock is not hazardous so ther is no chance of contamination of surface and ground water. The waste dump plan is shown in **Figure-4.3.5.**

Tailings

The tailing dam of R.D. mine is spread over an area of about 82-ha. The embankment of this dam is earthen in nature. In order to allow passage of water sand -filter bed of 100m length has been laid. The ground water quality of nearby wells is being monitored regularly. At present there is no seepage from the tailing dam. In the vicinity of tailing dam a collection pond, a sump and a collection well have been provided to collect filtered water. Besides these, to trap water a few tube wells have been constructed in the vicinity of tailing dam. This water along with that collected in the well and pond is re-circulated to the plant for re-utilization.

The tailing dam is above the ground level in the acquired area outside the mining leasehold. The average height of the embankment of dam is 5.0-m. The base of the tailing dam is +20m. the dam has been constructed over hard impervious ground by laying compacted impervious soil in the inner side of the embankment covered with 1 to 2-m thick layer of mine muck. The embankment of tailing dam is strong enough to withstand and also work as fencing. Also round the clock watch and ward is deployed for security of the area.

The capacity of the tailing dam is sufficient to take care of the tailing generated in future. The tailing is pumped to the tailing dam continuously hence major area of tailing dam remains wet and there is limited generation of dust in dry months only

when the surface becomes dry and the particles get entrapped with blowing wind. For controlling the dust pollution, in the vicinity of tailing dam plantation has been carried out. Further plantation will be done in this area progressively.

This tailing dam will serve for the entire life of mine by progressive raising of the height. The rehabilitation of the dam will be done at the time of abandonment for closure by way of soil carpeting and plantation of grass and plants on the top.
Reclamation of old tailing dam

The old tailing dam area is about 3-ha. The land scaping followed by plantation of 2000 saplings.

Tailing generated from the beneficiation plant after removal of lead-zinc mineral from the ore through beneficiation process, the left out material named as tailing, will be classified in hydro cyclone classifiers at fill plant to separate coarser fraction (+32 microns) and slimes. The coarser underflow will be taken back to mine for filling the void, created during extraction of ore, to provide stability to the ground, to improve safety of the mine while the finer fraction through overflow is taken to the tailing thickener for recovery of water. Present tailing generation is 850 TPD. Additional will be 450 TPD. Total 1300 TPD tailings will be disposed in tailing dam after enhancement.

Details of Tailing Dam

The existing dam was constructed based on design studies conducted by IIT, Delhi by aligning the embankment bank along its four sides on a plain ground. The material of construction of dam consists of mine muck, local soil and tailings. The tailings are discharged in the dam through pipelines. In dam, the solid particle settle down and clean water accumulates at lower end of impoundment. The water reclaimed after sand filter bed and recycled to the plant. No water is allowed to go out of dam and zero discharge status maintain. A garland drain was made along the periphery of the dam to collect seepage, if any and discharge in reclaim water sump for recycle to beneficiation plant.

The dam section has been designed with mine overburden, local soil and tailing materials. The earth section provided a slope of 1:2 (vertical:horizontal) with compaction to maximum proctor density of 1.77 gm/cc at optimum moisture content 80%. The stability of the section has been checked by IIT, Delhi for use of soil at dam site.

The stage-wise height Raising of Tailing Dam

The initial ground level at tailing dam was 482 mRL at south side and 488 mRL at north side. In the first phase the tailing dam of 6 meter height was constructed from 482 to 488 mRL in the south side of existing dam area. In the second phase tailing dam height was raised 488 mRL to 490 mRL in the south region. In the third phase in the north region the tailing embankment was also built from 488 to 494 mRL. The fourth phase of height raising in south region was completed from 490 to 493 mRL during 2007-08. In the fifth phase of height raising in north region has been planned from 494 to 497 mRL during 2009-10.

FIGURE-4.3.5
WASTE DUMP PLAN

The existing tailing dam surface area of 82 ha and height of 11 meter in south region and 6 meter in north region from the ground level and capacity of 68 lakh cum.

The consultancy work was carried out in March 2008 for further raising scheme of existing tailing pond at R.D. Mines by Department of Civil Engineering, Indian Institute of Science, Banglore.

RocScience geotechnical analysis software "Slide" is used for the stability analysis of the proposed extension of the tailing dam. This is a 2-D program with a CAD based graphical interface with a wide range of modeling and data interpretation options. Among the various analysis methods available in SLIDE. The slope stability analysis was carried out using the Bishop simplified method.

The minimum FS values calculated for the d/s slope and u/s slope with different combinations of Ru and earthquake load (□h) are shown in **Table-4.3.7 and Table-4.3.8** show. The minimum value obtained is 1.049 for the maximum height of the embankment upto RL 499.0 (with Ru-0.5 and □h=0.1) For all these cases with the proposed method of u/s raising the slopes are stable.

TABLE-4.3.7
MINIMUM FACTORS OF SAFETY FOR DOWNSTREAM SLOPE

Crest RL	RU	αh	FS	Remarks
493	0.5	0.1	1.347	Tangent at base of tailing, after filling
493	0.4	0.1	1.477	Tangent at base of tailing, after filling
493	0.3	0.1	1.608	Tangent at base of tailing, after filling
493	0.2	0.1	1.740	Tangent at base of tailing, after filling
493	0.1	0.1	1.871	Tangent at base of tailing, after filling
493	0.5	0.1	5.035	Tangent at grid level, after filling
493	0.4	0.1	5.171	Tangent at grid level, after filling
493	0.3	0.1	5.308	Tangent at grid level, after filling
499	0.5	0.1	1.049	Tangent at base of tailing, after filling
499	0.4	0.1	1.137	Tangent at base of tailing, after filling
499	0.3	0.1	1.226	Tangent at base of tailing, after filling
499	0.2	0.1	1.315	Tangent at base of tailing, after filling
499	0.5	0.1	1.206	Tangent at grid level, after filling
499	0.4	0.1	1.290	Tangent at grid level, after filling
499	0.3	0.1	1.375	Tangent at grid level, after filling

TABLE-4.3.8
MINIMUM FACTORS OF SAFETY FOR THE UPSTREAM SLOPE

Crest RL	RU	αh	FS	Remarks
493	0.5	0.1	9.557	Tangent at base of tailing, after filling
493	0.5	0.1	6.951	Tangent at grid level after filling
493	0.4	0.1	7.365	Tangent at grid level after filling
499	0.5	0.1	5.743	Tangent at base of tailing, after filling
499	0.4	0.1	5.789	Tangent at base of tailing, after filling
499	0.3	0.1	5.836	Tangent at base of tailing, after filling
499	0.5	0.1	4.322	Tangent at grid level after filling
499	0.4	0.1	4.544	Tangent at grid level after filling
499	0.3	0.1	4.756	Tangent at grid level after filling

499	0.3	0.1	4.756	Tangent at grid level after filling

- The detailed slope stability analysis clearly indicates that the U/s method of raising on the tailing is feasible.
- The dams can be raised up to a maximum RL of 499.0m in U/S method by using the suggested approach in stages.

As per studies and recommendations of Department of Civil Engineering, Indian Institute of Science, Bangalore it is possible to go for further raising height from 493.0 to 514.0 mRL in stages of 3m each by following methods:-

For D/s method of raising: The recommended superior material of dyke constructions are solids as per IS classification 1) SC clayey sand 2) CI – clay of medium plasticity.

For U/S method of raising: ground improvement achieved either by cement grouting (for the width of the base on the settled tailing's) or geosythetic applications. Typical cross- section of u/s raising of tailing dam is shown in **Figure-4.3.6.**

By raising the height of tailing dam upto 514.0 mRL, the total volume increased will be sufficient for 20 years. Tailing dam capacity year on year after raising height in lifts is shown in **Table-4.3.9.**

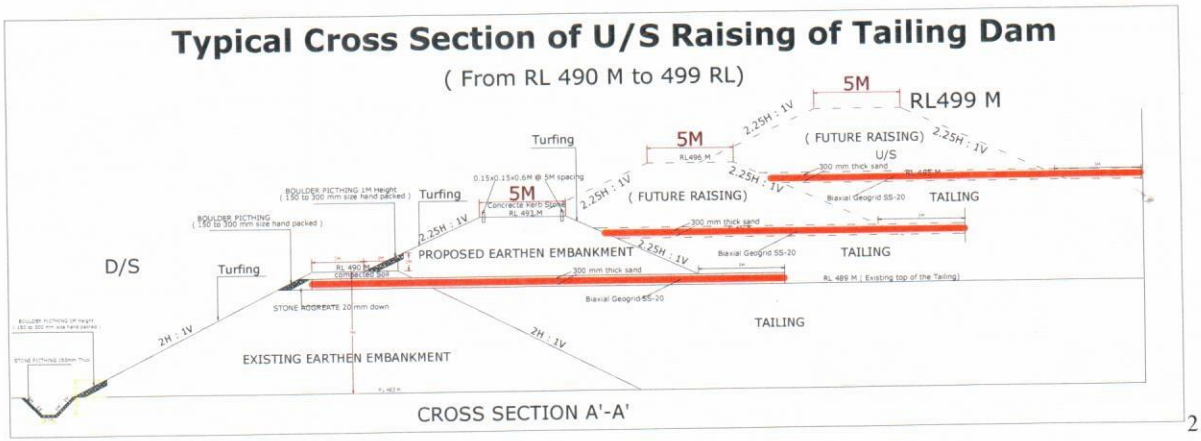


FIGURE-4.3.6
TYPICAL CROSS- SECTION OF U/S RAISING OF TAILING DAM

Table-4.3.9
TAILING DAM CAPACITY YEAR ON YEAR AFTER RAISING HEIGHT IN LIFTS OF 3 M EACH

Year	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29
SKM Production (Lakh MT)	5.00	7.50	10.00	15.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
RDM Production (Lakh MT)	6.00	7.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
BKM Production (Lakh MT)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Total Production (Lakh MT)	11.00	14.50	19.00	24.00	29.00	29.00	29.00	29.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Concentrate Production (Lakh MT)	1.65	2.18	2.85	3.60	4.35	4.35	4.35	4.35	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
Total Tails Generated (Lakh MT)	9.35	12.33	16.15	20.40	24.65	24.65	24.65	24.65	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20
Filling in mines (Lakh MT)	5.61	7.40	9.69	16.24	18.79	18.79	14.79	14.79	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32
Tails pumped to Dam (Lakh MT)	3.74	4.93	6.46	4.16	5.86	5.86	9.86	9.86	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88
Bottom ash from Power Plant (Lakh MT)	0.00	0.10	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total matarial pumped to Tailing Dam (Lakh MT)	3.74	5.03	6.76	4.46	6.16	6.16	10.16	10.16	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18
Volume occupied by tails &bottom ash (Lakh M3)	2.34	3.14	4.23	2.79	3.85	3.85	6.35	6.35	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99
Available capacity (Lakh M3)	8.80	6.46	26.72*	22.49	19.71	15.86	12.01	29.06*	22.71	15.72	8.73	25.14*	18.16	11.17	27.58*	20.59	13.61	29.66*	22.67	15.68
Balance capacity (Lakh M3)	6.46	3.32	22.49	19.71	15.86	12.01	5.66	22.71	15.72	8.73	1.74	18.16	11.17	4.18	20.59	13.61	6.62	22.67	15.68	

***Tailing dam height raising by 3 mts adds capacity of 23.04 lakh cu mts**

Table-4.3.9
TAILING DAM CAPACITY YEAR ON YEAR AFTER RAISING HEIGHT IN LIFTS OF 3 M EACH

Year	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29
SKM Production (Lakh MT)	5.00	7.50	10.00	15.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
RDM Production (Lakh MT)	6.00	7.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
BKM Production (Lakh MT)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Total Production (Lakh MT)	11.00	14.50	19.00	24.00	29.00	29.00	29.00	29.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Concentrate Production (Lakh MT)	1.65	2.18	2.85	3.60	4.35	4.35	4.35	4.35	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
Total Tails Generated (Lakh MT)	9.35	12.33	16.15	20.40	24.65	24.65	24.65	24.65	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20
Filling in mines (Lakh MT)	5.61	7.40	9.69	16.24	18.79	18.79	14.79	14.79	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32	16.32
Tails pumped to Dam (Lakh MT)	3.74	4.93	6.46	4.16	5.86	5.86	9.86	9.86	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88	10.88
Bottom ash from Power Plant (Lakh MT)	0.00	0.10	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total matarial pumped to Tailing Dam (Lakh MT)	3.74	5.03	6.76	4.46	6.16	6.16	10.16	10.16	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18
Volume occupied by tails &bottom ash (Lakh M3)	2.34	3.14	4.23	2.79	3.85	3.85	6.35	6.35	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99
Available capacity (Lakh M3)	8.80	6.46	26.72*	22.49	19.71	15.86	12.01	29.06*	22.71	15.72	8.73	25.14*	18.16	11.17	27.58*	20.59	13.61	29.66*	22.67	15.68
Balance capacity (Lakh M3)	6.46	3.32	22.49	19.71	15.86	12.01	5.66	22.71	15.72	8.73	1.74	18.16	11.17	4.18	20.59	13.61	6.62	22.67	15.68	

***Tailing dam height raising by 3 mts adds capacity of 23.04 lakh cu mts**

The assessment of ground water quality around the tailing dam area studies was conducted by NEERI in March 2008 and has been given following conclusion:

- The assessment of geological and hydro-geological information at the RDM site and its surrounding indicate that the tailing dam and the surrounding area has a flat topography with a slope of 0.6 m/km in east and southeast direction. The tailing dam is underlain by a soil cover of about 0.9 to 7.3 m thickness. The texture soil is predominantly silty clay with occurrence of gravel and sand. The permeability of the soil in and around the tailing dam is very slow to moderately slow (1.3x10-4 to 4.0x10-4 cm/sec). The groundwater occurs under water table conditions in mica schists at a depth of 1 to 15 m below ground level, and is transmitted through fractures, joints and foliations. The low values of hydraulic conductivity and specific capacity of wells in the area indicate a poor groundwater potential in the area.

- The assessment of aquifer vulnerability at RDM area using DRASTIC model indicates that the RDM area falls under moderate category of aquifer vulnerability (a score of 93 as compared to a scale of <80 (low vulnerability) to >185 (high vulnerability).

- The assessment of leaching potential of the tailings indicates a poor leachability of various heavy metals, as they exist in bound stable complexes in the tailings.

- The assessment of groundwater quality around the tailing dam indicates that high concentrations of certain parameters viz. TDS, sulphates, cadmium irrespective of their location (upstream or downstream of tailing dam) could be due to the hydrogeological setup of the area. Further, no direct correlation could be established between the tailing characteristics, seepage water from tailing dam and the groundwater quality.

- Thus, an overall conclusion could be drawn from the study that the tailing dam at RDM had been constructed at a site, which has low groundwater pollution potential. The present practice of tailing management at RDM may not pose significant danger to the existing groundwater resources in the area.

Based on the findings of hydrogeological investigations by Hydro-Geosurvey Consultants Pvt. Ltd. Jodhpur, the area surrounding the tailing dam and interpretation of geotechnical data collected from inside and outside the tailing dam and having observed the absence of heavy metals in the key wells on the downstream side of the tailing dam during the year 1997, onwards and again in the year 2006, it is conclusively stated that the ground water regime has been not been affected by the tailing dam during last 20 years and is also not likely to be affected in future. This has been mainly due to the very low permeability or hydraulic conductivity of clay loamy soil present in the tailing dam when it was constructed and also due to the very low hydraulic conductivity of underlying mica schists. The values of permeability of mica schsits is as low as that of clays and therefore mica schists are as effective as a base clay layer or synthetic liner , which is now laid in the tailing dams as per new regulations.

Hazardous Waste

Present generation of used oil is 50-60 L/day. Generation of additional used Oil will be 15-20 L/day. Total generation will be 65-80 L/day after enhancement.

Present generation of sodium cyanide container is half per day. Additional generation of sodium cyanide container will be half per day. After enhancement total generation will be one container per day. These containers will be crushed and disposed in SLF.

Sewage will be treated in septic tank and followed by soak pit. Sewage sludge 5 kg/day is composted and used as manure in plantation. Existing system is sufficient to handle the waste.

High Volume Low Effect Wastes

Vide New Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, mine tailing, slag from pyrometallurgical operations, and fly ash which are relevant to proposed project have been excluded from the category of hazardous waste and more practical approach has been taken for handling of mine tailing and classified these waste as "high volume low effect waste". Separate guidelines of management of these wastes shall be issued by Central Pollution Control Board. Proponent will ensure the compliance of those guidelines.

4.3.5 Subsidence-Prediction and Prevention

The hangwall and footwall of the ore is competent and geo-technically falls within poor to very poor category, which is being stabilized by back filling. Quality of air and water, noise level and vibrations are monitored regularly.

The mining method is one of the major component of subsidence that influences its environmental impact. The subsidence created by stope mining is usually the result of unintended cave-in's, inadequate support, pillar robbing, mining too close to the surface, and eventual collapse of the workings over time as the inevitable consolidation of the strata takes place. Most often subsidence is limited to the hanging wall side of underlying stopes. In many cases, the degree of surface subsidence that occurs from stope mining is both isolated and relatively minor.

A number of geologic and mining parameters can affect the magnitude and extent of subsidence. These include the thickness of extracted materials; overlying mining areas; depth of mining; dip of mining zone; competence and nature of mined and surrounding strata; near surface geology; geologic discontinuities; fractures and lineaments; in-situ stresses; degree of extraction; surface topography; ground water (including water elevation and fluctuation); mine area; method of mining; rate of advance; backfilling; time; and structural characteristics.

The subsidence at R.D. mines is being monitored continuously from 1992 onwards. Detailed study has been carried out on the ground stability at Rajpura Dariba, using both Empirical and Numerical modelling method.

Empirical Mathew's Stability Graph method has shown that all the stope walls are fully stable during the entire period of mining. The detailed analysis report is enclosed as **Annexure-IX.**

Numerical modelling analysis has been carried out using geomechanics software FLAC-3D ,considering yielding /plasticity failure conditions which are allowed to be transferred to surface, enabling identification of any possible surface disturbance. The modelling results have indicated that the immediate hanging wall of the stopes are stable and local ground displacements adjacent to stope wall do not exceed 7-mm up to a maximum depth 3-m.It also show that surface ground and the subsurface rocks do not experience any subsidence. However, negligible displacement of 0 to 5 mm is indicated in modelling results and is practically not measurable. Detailed analysis and relevant modelling-result drawings are annexed.

Empirical and numerical analyses show stable stope walls and marginal effect on immediate hangwall within 3 to 5-m. The surface subsidence and horizontal strain are negligible. The core area of mining will be free from subsidence and it will not have any appreciable effect on surface. No point on surface will have subsidence greater than 5-mm which is very negligible and not measurable.

- Stable stope geometry is designed based on empirical and numerical modeling
- Horizontal crown pillars are left at regular intervals
- Strengthening of crown pillars by interior reinforcement using 10m long cable bolting from drill sills
- Stope voids are post filled with cement mixed classified mill-tailings
- Subsidence measurements are regularly done at surface stations above stoping area and recorded
- Ground movement is monitored with multi point bore hole extensometers
- Stress concentrations are monitored with uniaxial bore hole stress meters specially in crown pillars
- An instrumentation plan is prepared for each stoping block as shown in **Figure-4.3.7.**

Subsidence Management Plan

The core area of mining is not likely to have appreciable subsidence and tensile strain on the surface. Therefore, no subsidence plan is being suggested. However, regular monitoring of subsidence at the surface is being carried out.

Surface subsidence is being monitored in the area at the nodes of grid formed by lines at 100-m interval. The readings are being recorded at 3 months interval. Locations having subsidence greater than 0.25-mm shall be carefully looked into and the subsidence survey shall be carried out at those locations on monthly basis.

4.3.6 Land Reclamation Measures

1. Since the mining operations would be carried out underground, minimum area on the surface would be disturbed;

2. The waste rock as such will not support growth of trees. Addition of fertile top soil and supplement of nitrogenous fertilizers will be required initially. The existing and proposed roads would be flanked by trees on either side. Only hard wood species shall be planted on waste dump; and

3. Greenbelt of trees with thick canopy shall be created to intercept dust, gaseous pollutants and noise.

Conceptual Post Mine Landuse & Reclamation and Rehabilitation of Mined out area

In case of Final Mine Closure of the mine, the following physical, chemical and biological stability criteria for Post Mining Land use, Reclamation and Rehabilitation of Mined out area have been envisaged and are addressed as under:

- All the equipments shall be removed from surface and belowground and disposed off;

- and clearance from the related authorities, all underground mine opening made at surface viz. Shaft, Ramp and Ventilation Raises shall be adequately sealed to prevent accidental / intentional entry into the underground mine openings in future;

- The exploratory drilling pads of boreholes will be reinstated and secured with cover over top of boreholes and access to this area should be retained;

- Re-use of the abandoned buildings/ infrastructure is aimed after removing their equipments. Therefore, efforts will be made to hand over all the buildings to the State Govt. for further utilization of the same;

- In case State Govt. declines to takeover the buildings/ infrastructure the same will be demolished, and the area shall be re-profiled to natural ground level and re-vegetated to ensure that they do not present any hazard to public health and safety as a result of failure or physical deterioration;

- The re-profiling of all other surface area covered by infrastructure viz. ore storage bunkers in the Mine Lease area shall be ensured to facilitate successful re-vegetation;

As the biological stability of the mine site is closely related to future rehabilitation and final land use and can consequently influence physical and chemical stability, therefore before proposing mine abandonment adequate care shall be taken to ensure prevention of erosion, wash off and leaching etc. in the disturbed area;

- After statutory inspections
- It will be ensured that no deformation or erosion of slopes created by waste rock dumps takes place, to render them physically stable;
- As far as possible original drainage system shall be restored in the area to ensure that the surface and ground water quality is made acceptable for the future re-vegetation and bio-habitat;
- To achieve important objective of the rehabilitation and long-term stability of the disturbed site, proper vegetation cover over the disturbed site shall be ensured to bring about the stable vegetation community in the area;
- Plantation done on the disturbed area will be maintained till the plants achieve self-sustenance;
- All efforts shall be made to ensure that the deterioration of ground water quality is prevented due to percolation of the pollutants from the disposal areas. The inert/soil cover spread over landfills and waste disposal facilities shall be properly secured to ensure that the vegetation grown above such surfaces is successful; and
- As part of mitigation and rehabilitation measures, for settling of suspended solids in pollutant discharge already provision of a garland drain and settling pond in waste dump area has been envisaged. Before abandonment, the said garland drain and the settling pond shall be cleaned of fines and maintained properly to improve quality and quantity of water discharged in future.

4.3.7 Impact on Air Quality

The ambient air quality with respect to the buffer zone of 10-km radius around the periphery of proposed smelter complex represents rural environment with underground mining as the major activity. The main sources of pollution in the area are industrial emissions from the existing beneficiation operation of mining activity, vehicular traffic, domestic fuel-burning etc.

The emissions from Smelters & CPP will be;

- Suspended Particulate matter from stacks;
- Sulphur dioxide in flue gases;
- Fugitive emissions;
- Dust from raw material & fume handling;
- Dust from coal & ash handling; and
- Dust from vehicle movement.

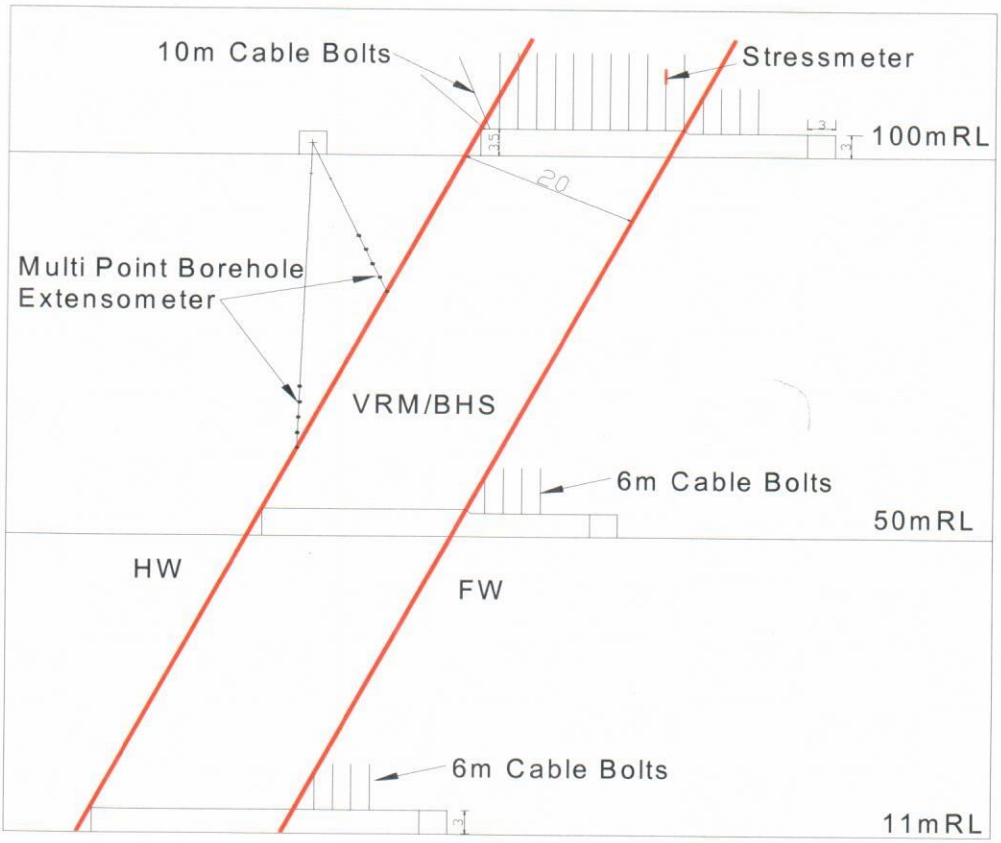


FIGURE-4.3.7
INSTRUMENTATION PLAN

The emissions from mines will be;

- Fugitive Emissions;
- Vehicular Emissions;
- Point Emission Sources; and
- Instantaneous Sources.

- **Zinc Smelter**

The mitigation measures proposed for Zinc Smelter for controlling the air pollution are as given below:

Roaster

Bag filters will be provided on the Roaster calcine handling and storage circuit. The ventilation air discharge from the bag filter stacks will contain less than 50 mg/ Nm^3 of dust. The mercury in the gas stream shall be removed in the mercury removal section.

Acid Plant

The acid plant gas will contain less than 1.5 kg SO_2 per tonne of (100%) acid produced. Acid mist and SO_3 in tail gas will not exceed 50 mg/ Nm^3.

Leaching Plant

All the leaching tanks will be operated at elevated temperature and to ensure that atmospheric pressure steam is not widely distributed in the working area; all vessels are equipped with short stacks. The stack effect will lift the water vapour above working level. The stacks will be located away from any calcine addition points to avoid entrainment of calcine in the gas stream.

Purification

Similar to the leaching sections, most vessels are operated at elevated temperatures. In this case, most of the process steps involve addition of zinc powder to mildly acidic liquors. There is a risk of hydrogen evolution exceeding the explosive mixture limits. Most of the producers rely on the stack effect to convey the produced hydrogen to atmosphere outside the building

Cooling Towers (Purification and Electro-winning)

These are fitted with drift elimination panels and emission of acid / zinc will be within the legislated limits.

Casting Areas

Fume extraction and bag filters have been provided on the melting and 'casting' operations of zinc ingots and zinc powder. Discharges to the environment will contain less than 50 mg/ Nm^3 particulates.

Waste Heat Recovery Boiler

The heat produced in the roaster because of oxidation of sulphide ores will be recovered by Waste Heat Recovery Boiler and will be used in leaching. The heat produced in the conversion of SO_2 to SO_3 will be used to preheat the gases and to reheat the gases before the second pass.

Control of SO_2 Emissions in Acid Plant

During operation of the smelter complex, the main emission sources are SO_2 from stack attached to Sulphuric Acid Plants. SO_2 emission will be restricted to 1.5 kg/tonne of acid and acid mist will be controlled below 50 mg/Nm^3 which will conform to the stipulated regulatory norms. Adequate stack height (100-m.) will be provided. DCDA process along with cesium catalyst will be used for better SO_2 conversion and absorption efficiency. Efficient candle filter system will be provided to capture acid mist. Sulphur content in the coal will be restricted to 1.5% to contain SO_2 emission.

Control of Particulate Matter Emission

The zinc concentrate, lead concentrate and calcine (raw material) for the proposed smelter complex will be transported in tarpaulin covered trucks and stored in dedicated closed shed. Water sprinkling at transfer points and storage will be employed. The concentrate has inbuilt moisture content of around 8% which will keep this powdery material in wet conditions avoiding any dust emissions. All conveyors are covered, with water sprinkling at junction points.

Apart from this, bag filters are provided in stacks of calcine handling, Zinc dust plant, melting plant and dross milling. The PM emissions will be controlled below 100 mg/Nm3.

- **Lead Smelter**

Effective measures have been considered and planned in the proposed lead smelter in regard to Hygiene ventilation, dust collection and control of dust emission at source. This has been done based on the rich experience of HZL operating team and the vast experience of the technology provider.

Primary source of lead / particulate matter emission have been clearly identified and are namely;

a. Raw material handling and proportioning sections;
b. SKS furnace system;
c. Blast & fuming furnace system;
d. Copper dross treatment system;
e. Precious metal plant; and
f. Lead electrolysis refinery.

Effective hygiene ventilation system with properly designed collection hoods, high capacity suction fans and bag filter system is envisaged at all potential points of lead / particulate matter emission. Also effective scrubbing / purification measures have been considered to treat the fumes & process off-gases from the plant.

a. Raw Material Handling and Proportioning Sections

Dedicated Hygiene ventilation system using network of collection hoods, ducts, high capacity fans and bag filters have been provided to control the dust at source, to primarily cover the following areas:

- Receiving point of raw material;
- Loading point of raw material;
- Transfer point of raw material from the bin to belt conveyor; and
- Transfer point of lead concentrate from one belt conveyor to another belt conveyor.

Apart from that necessary design measures have been considered to keep the lead raw material in a completed covered storage shed with no possibility of cross ventilation. All the conveyors shall be designed with covered top and sides to avoid spill and carry over of raw material.

b. SKS Furnace Plant

The furnace off gas is taken by negative suction to sulphuric acid plant through waste heat recovery boiler and hot electro-static precipitator where almost all the dust and heat in the off-gas is removed. The dry cleaned gas is sent to wet gas cleaning plant for further dust removal. The dust free gas moist gas is sent to acid plant towers for acid production. After SO_2 absorption in the Acid plant, the gas will be directed to tail gas treatment section for removing any SO_2 present and to ensure SO_2 emissions are well within the permitted emission levels. The gas from tail gas treatment section is vented to atmosphere through a stack of adequate height as per statutory design requirements.

Apart from the primary process off-gas handling system, the SKS furnace system will be provided with a dedicated hygiene ventilation system comprising of hygiene suction hood, ducting, hygiene fan with bag filter to cover the secondary emission from the following points:

- Charging ports of the furnace;
- Lead tapping system;
- Bullion casting machine;
- Slag tapping system; and
- Slag casting machine.

The fugitive emission collected from all these locations will pass though bag filters for the removal of particulate matter and the purified gas will be discharged

through stack of adequate height. The dust collected by the bag filter will be returned to the raw material bin for feeding back to the furnace.

c. Blast furnace and Fuming Furnace Plant

The blast furnace off gas is collected by negative suction to cooling ducts (some dust is removed in these ducts) and then to bag filter for complete dust removal. The dust free gas is sent to tail gas treatment section for removal of trace SO_2 in the off-gas.

The fuming furnace off gas is collected by negative suction to waste heat recovery boiler, cooling ducts (some dust is removed in WHRB and Cooling ducts) and then to bag filter for complete dust removal. The dust free gas is sent to tail gas treatment section.

Enclosed collection hood and suction arrangement shall be provided at all the following locations:

- Top of each material bin where rich lead slag, coke and flux will be unloaded by the conveyor.
- Under each material bin where material will be unloaded to measuring hopper through electric vibrating feeder.
    - Lead tapping system
    - Slag tapping system
    - Bullion casting machine

The dust collected from all these locations will pass though bag filters and the cleaned gas will be discharged through stack of adequate height. The dust collected by the collector will be returned to the raw material bin.

d. Copper Dross Treatment Plant

The Reverberatory furnace off gas is taken by negative suction to bag filter for complete dust removal. The dust free gas is sent to Tail Gas treatment section for treatment of trace SO_2 in the off-gas.

Enclosed collection hood and negative suction arrangement has been provided at all the following locations:

- Charging port of the furnace
- Copper matte tapping port
- Lead tapping port

The fugitive emission collected from all these locations will pass though bag filters and the cleaned gas will be discharged through stack of adequate height. The dust collected by the collector will be returned to the raw material bin.

e. Precious Metal Plant

The Noble lead and Cupel furnaces off gas is taken by negative suction to Cooling Ducts (some dust is removed in Cooling ducts) and then to bag filter for complete dust removal. The dust free gas is discharged through stack of adequate height.

Enclosed hood and suction arrangement shall be provided at all the following locations in the Cupel furnaces and noble lead furnace.

- Charging port
- Metal Tap ports
- Slag Tap ports

The off-gas after cooling will be cleaned in bag filter. The cleaned gas will be passed through stack of adequate height.

f. Lead Electrolysis Plant

Dedicated off-gas collection system shall be provided for every three kettles. The dust collection system shall consist of collection hoods, fans and bag filters. The collected dust will be returned to the raw material storage bin. The dust free gas shall be vented through stack of adequate height.

Emissions of lead and particulate occur in varying amounts from nearly every process and process component within primary lead smelter, and SO_2 is also emitted from several sources.

The mitigation measures proposed for Lead Smelter for controlling the air pollution well within the values specified by Central/ State Pollution Control Board are described below

Control of Particulate Matter Emission

The Lead Smelter will be equipped with Bag filters and scrubbers to effectively maintain the SPM emission with in 100 mg/Nm^3. The dust outlet from ESPs shall be limited and eliminated in the Wet ESP of Acid Plant Area.

Control of Sulphur Dioxide

The height of the stack will be decided, taking in to consideration of the maximum allowable Ground level concentration of the SOx in the worst conditions, as per the guidelines stipulated by Ministry of Environment.

Tail Gas Treatment (TGT) plant

After SO_2 absorption in the Acid plant, the gas will be directed to tail gas treatment section for removing any SO_2 present and to ensure SO_2 emissions are well within the permitted emission levels. The gas from tail gas treatment section

is vented to atmosphere through a stack of adequate height as per statutory design requirements.

Control of Nitrogen Oxides

The NOx fumes released during the electrolyte preparation for silver refining is extracted by hygiene fan. They are then scrubbed by sodium hydroxide solution in towers, before letting out to atmosphere through vents of appropriate height.

Emission of NOx from the other processes of Lead smelter shall be minimal and shall meet the emission norms of the Central/State Government of India.

Control of Fugitive Dust Emissions

Dust nuisance due to feed material and Coal handling will be minimized by providing suitable dust suppression/extraction systems at suitable locations as per requirements. Hygiene systems will be provided at metal and slag tapping areas and off-gas handling area of furnaces dross removal kettles in refinery.

Adequate ventilation systems will be provided in various buildings to reduce the Air Pollution. In addition, Personal Protective Equipments will also be used by personnel working to reduce the effects of air pollution on Individuals.

- **Captive Power Plant**

In power plant coal requirement for the power generation is 3320 TPD. Ash content of the coal will be 35%. PM emissions will be restricted to 100 mg/Nm^3 by providing ESP having 8 fields with 99.875% efficiency.

Flue gas cleaning equipments will be used in the power plant to achieve maximum cleaning of flue gas. The flue gas cleaning is done.

- to reduce the stack emissions;
- to confirm to statutory requirements;
- to fulfill a moral obligation and civic responsibility; and
- to reduce wear on ID fans.

In the proposed CPP, electrostatic precipitators will be installed and the flue gas will pass through ESP before sending it to the stack.

The ash content in the coal is around 35%. When coal is fired in the boiler, ashes are liberated and are carried along with the flue gas. If these ashes are allowed to atmosphere, it will create air pollution and thereby resulting in health hazards. Generation of ash will be around 800 TPD. 85-90% of the ash becomes the part of flue gasses. Most of the ash is carried away by flue gas (fly ash). The remaining ash (15% of the ash) will be drawn from the combustion chamber as bottom ash. Hence, flue gas cleaning becomes necessary to have effective control of PM emissions through stack.

In the proposed CPP, electrostatic precipitators will be installed and the flue gas will pass through ESP before sending it to the stack. NOx emissions will be restricted to 750 mg/Nm^3 by using low NOx burners. Stack of 165-m height will be provided for better dispersion of the pollutants. Coal will be transported through rakes/ covered trucks and fly ash will be transported in closed bulkers. Coal storage area will be provided with water sprinkling system to arrest dust and all transfer points are provided with bag houses. FO/LSHS/LDO/HSD will be used for starting of Roaster, CPP & Pre-heater in the Sulphuric Acid plants and for operation of DG sets. The requirement of the fuel (FO/LSHS/LDO/HSD) is 4060 KL/year. The emissions from combustion of these fossil fuels are only during emergency/start up and will be routed through stack of adequate height. Stacks attached to Roaster (Start up stack) and Pre-heater are of 50-m & 45 m respectively and that of for CPP of 165-m height for adequate dispersion of the pollutants (CO, NOx, SO2 and PM). In most cases, transfer of intermediates and raw materials will be done by conveyors or electrically operated over head cranes avoiding fossil fuel using machinery. All these measures will ensure the effective management of emissions from use of fossil fuels.

Fugitive Dust Emissions

The other sources of dust emissions are coal yard and ash disposal yard. For control of these dust emissions effective wetting system (sprinkler system) will be installed. Covered coal conveyors with water sprinkling system using waste water to avoid spillage of coal.

Bag filters to restrict dust emission will be provided at each coal transfer point,, crushers, and fly ash silos.

Control of Sulphur Dioxide

The coal used as a fuel will have sulphur and ash as major impurities. During the combustion of the coal, sulphur gets oxidized to SO_2 and becomes the part of flue gas.

Sulphur Dioxide concentration will be controlled by limiting sulphur content in the coal. The sulphur content in the coal will be restricted to 1.5%. For better dispersion of the gas tall concrete stack of 165-m height (internal brick lining, single flue, platform with walkable staircase at monitoring location) along with continuous monitoring equipment to measure particulate matter like carbon monoxide, Sulphur dioxide, Oxides of nitrogen, temperature and oxygen content of flue gas etc will be provided. Adequate velocity will be maintained at the exit point of the stack to aid in the dispersion.

Other Gas Emissions

The other impurities in the flue gases are Carbon Monoxide and oxides of Nitrogen gases. Excess air will be supplied for complete combustion of the coal resulting in low Carbon Monoxide emissions. Oxides of Nitrogen will be controlled

by using low NOx burners. The plant is designed to control the emissions of CO and NOx below the permissible regulatory limits.

The stack will be fitted with online sensor to measure SO_2, PM, O_2 emission levels. Adequate interlocking system will be developed to stop the plant in case of non-conformities.

- **Impact of Lead Emissions on Surrounding Environment and Lead Balance**

Lead occurs naturally in the environment. Lead itself does not decompose, however lead compounds are changed by sunlight, air and water. Lead may be released as particles into the atmosphere or as dissolved compounds in water. Lead is also released from natural sources such as windblown dusts and forest fires. Most lead released to air, water, sediment, and soil strongly attaches to other particles, and may remain there for many years.

Lead usually adheres to the soil. Movement to groundwater will depend on the type of lead compound and characteristics of the soil. Over time, lead accumulates in living tissues (a process called bioaccumulation) and is persistent in water.

Lead can affect almost every organ and system in the body. Lead toxicity mostly affects the nervous system. Exposure to lead may also cause paralysis in fingers, wrists or ankles. Lead exposure can also cause small increases in blood pressure and may cause anaemia, malnutrition, abdominal pain and colic. High levels of lead can severely damage the brain and kidneys in adults and may cause death.

In pregnant women, exposure to high levels of lead may cause miscarriage. Lead can affect a child's mental and physical growth. Unborn children can be exposed through their mothers. Harmful effects include premature birth, smaller babies, decreased mental ability in the infant, learning difficulties and reduced growth in young children. Some effects may persist beyond childhood.

As with humans, exposure to lead can lead to death of animals, birds or fish and death or low growth rate in plants. In soft water, lead is highly poisonous to plants, birds or land animals, long term effects on animal life are shortened lifespan, reproductive problems, lower fertility and changes in appearance or behavior. As lead bioaccumulates, it is expected that fish tissues will contain lead from polluted waters.

The lead balance for the plant is shown in **Figure-4.3.8.**

Effective measures have been considered and planned in the proposed lead smelter in regard to Hygiene ventilation, dust collection and control of dust emission at source. This has been done based on the rich experience of HZL operating team and the vast experience of the technology provider.

100% of lead in the ore will be utilized and only 0.32% of lead will be lost in the slag.

It is worth mentioning that in the Hazardous waste (Management, Handling & Trans boundary movement) Rules, 2008 the slag has been deleted from the category of hazardous waste. The water leachability test of heavy metals and results indicated that leachability of metal is negligible and utilisation for roads would be environmental friendly practice.

- **Mines**

The Rajpura Dariba mine is about 50-m below the ground and ore is being mined out by underground mining hence there is no land degradation and therefore, no significant effect of mining activity on the environment.

The possible sources of pollution are due to handling, storage and transportation of waste and ore above ground and due to plying vehicles.

The DG sets serve as standby power requirement of mine. They function only when there is no power supply from RSEB grid.

The crushing, screening and stock piling promotes formation of dust particles. At the sites of operation dust suppression by water sprinkling and collection arrangements exist.

The tailing from tailing thickener is pumped to tailing dam after classification. The tailing is pumped to the tailing dam continuously hence major area of tailing dam remains wet and there is limited dust generation occurs in dry months only when the surface becomes dry and the particles get entrapped with blowing wind. For controlling the dust pollution, in the vicinity of tailing dam plantation has been carried out.

Some dust emitted from crushing, screening and stock piling tends to deposit in the mine area. The vehicular movement tends to raise the dust. In order to prevent dust pollution roads in the vicinity of beneficiation plants are cleaned regularly and water is sprinkled daily for suppression of dust.

The coarser material in the form of boulders and large fragments of waste rock are stacked at the designated waste dump in the industrial premises. There is little chance of formation of dust from waste dump. Plantation has been done on the inactive waste dump to stabilize the dump and prevent the dust generation.

Dust and gaseous emissions are expected during blasting. The blasting will be carried out at depth of more than 50-m below ground level. The dust generated will be trapped within the mining area and only finer particles will escape from the ventilation along with gaseous pollutants. Blasting will be instantaneous and occasional activity.

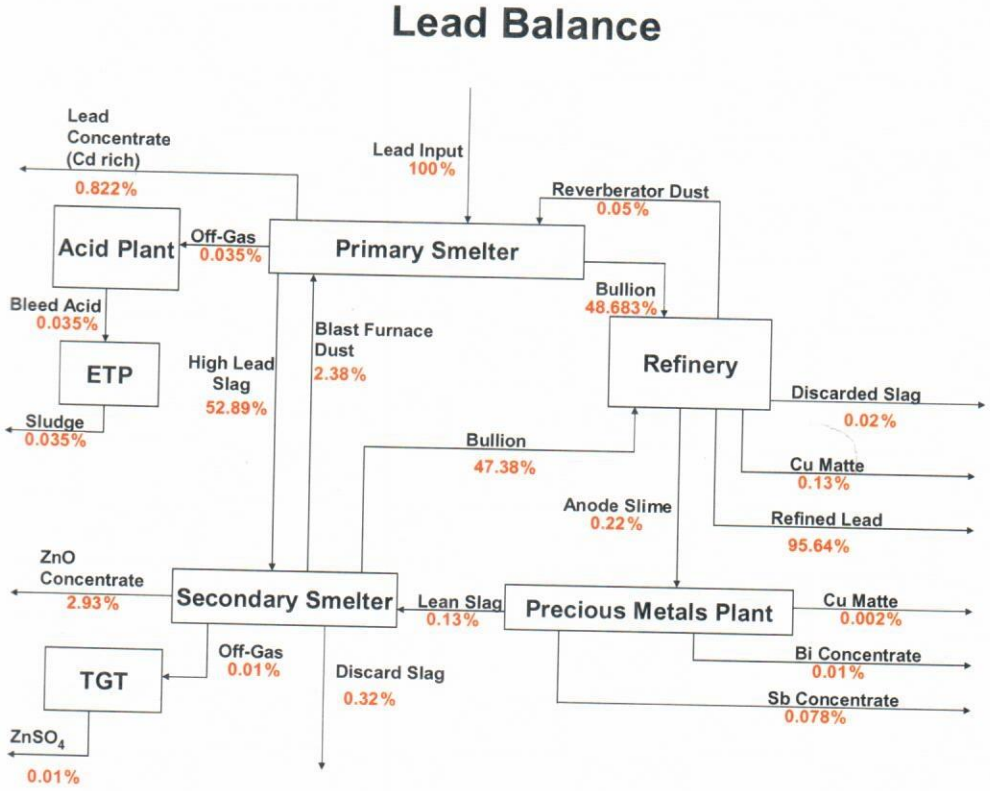


FIGURE-4.3.8
LEAD BALANCE

The dumping and grading operations at the dumpsites will also be another source of dust generation. There will be generation of dust while dumping the waste rock and ore and movement of dumpers. Although the wastes rock and ore brought out of the mine will carry about 3% moisture, by changing the dumping procedures, the dust generation have been reduced. The waste rock and ore can be dumped by giving less aerial lift and grading can be done by gradual dozing. This will help in reduction of dust generation.

Most of the underground mining machineries are of either compressed air operated or electrically operated and do not emit any toxic gases. Adequate ventilation is provided to maintain clean work zone as per DGMS guidelines. In underground mining operation, water-sprinkling arrangement have been provided at the location of loading and mucking to suppress the dust. Dust masks have been provided to persons working in these areas. Adequate arrangements, like water spraying at the incline and ramp portals, are provided to suppress the dust and keep air quality within permissible limits. Adequate arrangements like, wet scrubbing system attached with crusher, water spraying at crusher side and on roads are provided to suppress the dust and keep air quality within permissible limits.

➢ **Impact on Air Quality Calculation by Modelling**

- ***Details of Mathematical Modelling***

Prediction of impacts on air environment has been assessed by employing, **USEPA** approved **Fugitive Dust Model (FDM)** and **Industrial Source Complex (ISC3)** dispersion mathematical models.

The impact on air quality is assessed based on emissions of the proposed Integrated Complex comprising Zinc Smelter, Lead Smelter, CPP, Beneficiation plant and underground mining project. Suspended Particulate Matter (SPM) and Sulphur dioxide (SO_2), will be the important pollutants emitting from the proposed Integrated complex.

- **Impact from Beneficiation Plant, Lead and Zinc Smelters and CPP (Point Source)**

Industrial Source Complex (ISC3) dispersion model based on a steady state Gaussian plume dispersion, designed for multiple point sources for short term has been used for predicting the ground level concentrations due to beneficiation plant, smelters and CPP. The computations deal with major pollutants viz., Sulphur dioxide, SPM, and Oxides of Nitrogen.

- ***Model Input Data***

The details of emissions from point sources are given in **Table-4.3.10**.

- ***Meteorological Data***

The hourly meteorological data recorded at site for the period from 1st December 2007 to 31st May 2008 and 1st October to 31st November 2008 covering Winter season 2007-2008, Pre-Monsoon and Post-Monsoon seasons 2008 is converted to the mean meteorological hourly data as specified by CPCB and the same has been used in the model. The mean meteorological data recorded at the site has been used for the modelling.

In addition to the above, there are some stacks/vents in the process, which will be provided for ventilation purpose only. These small stacks/vents are not considered for dispersion modeling as these will emit only air saturated with water. The detailed emission rate and stack height calculations are presented in **Annexure-X.**

- **Scenarios of Operation**

It may be noted that during the operation of the plant, all the units will not be in operation simultaneously. However, for the purpose of calculating the worst case impact, all the units are considered to be working simultaneously with the maximum emission limits. In actual practice, the stack emissions and the impact will be much less than the predicted values.

➢ **Presentation of Modeling Results**

The simulations were done to evaluate SO_2, NOx and SPM likely to be contributed by the proposed facility.

For the short term simulations, the concentrations were estimated around 1200 receptor points chosen to obtain an optimum description of variations in concentrations over the site in 10-km radius covering 16 directions. The incremental concentrations are estimated for each season.

TABLE-4.3.10
DETAILS OF PROPOSED STACK EMISSIONS

Details	Co-ordinate		Diameter (m)	Stack Height (m)	Exit velocity (m/s)	Temperature (°C)	Volumetric flow rate (Nm^3/s)	SPM (g/s)	SO_2 (g/s)	NOx (g/s)
ZINC SMELTER-1	X	Y								
Acid Plant	-337	-421	2.5	100	7.2	75	30.3	-	15.6	-
Roaster Plant (start up)#	-368	-469	1.8	50	21.6	30	54.0	5.4	0.1	6.8
Zinc Dross milling bag filter	-361	-667	0.5	30	20.9	50	3.8	0.4	-	-
Pre-heater #	-350	-418	1.15	45	7.4	230	4.5	0.5	0.1	7.8
Zinc Melting furnace bag filter	24	-691	1.2	30	33.6	100	30.4	3.0	-	-
Zinc Atomizing bag filter (zinc dust)	-175	-472	0.6	31	36.1	75	8.7	0.9	-	-
Calcine handling unit	-275	-591	0.6	30	8.78	75	2.1	0.2	-	-
ZINC SMELTER – 2										
Acid Plant	-448	-421	2.5	100	7.2	75	30.4	-	15.6	-
Roaster Plant (start up)#	-478	-469	1.8	50	21.6	30	54.0	5.4	0.1	6.8
Zinc Dross milling bag filter	-361	-667	0.5	30	20.9	50	3.8	0.4	-	-
Pre-heater#	-461	-418	1.15	45	7.4	230	4.5	0.5	0.1	7.8
Zinc Melting furnace bag filter	24	-775	1.2	30	33.6	100	30.4	3.0	-	-
Zinc Atomizing bag filter (zinc dust)	-467	-896	0.6	31	36.1	75	8.7	0.9	-	-
Calcine handling unit	-566	-778	0.6	30	8.8	75	2.1	0.2	-	-
LEAD PLANT										
Tail Gas Treatment plant	309	-556	2	100	1.5	40	4.5	-	6.7	-
SKS furnace	250	-637	2	75	5.2	300	8.5	0.9	-	-
Precious metal plant	130	-498	1.2	40	4.3	120	3.7	0.4	-	-
Blast furnace	482	-565	2.2	75	5.3	120	15.3	1.5	-	-
CPP plant										
Plant 1 &2	0	0	4	165	25	140	226.3	22.6	791	170
Plant – 3	105.47	-10.9	2.9	165	18.1	140	86.1	8.6	395	64.8
BENEFICIATION PLANT										
Crushing Plant	1237	-2072	0.6	8	11	29	3.0	0.3	-	-

Note:

 # Stacks would run for 48 hrs/year for roaster start-up & Pre-heater stack during start up only, hence these are not considered for air modelling. There will be eight DG sets to be used only standby. Hence, not considered for air modelling

The predicted incremental ground level concentrations (GLCs) for SO_2, NOx and SPM likely to be contributed by the proposed zinc smelter plant, lead smelter and CPP are presented in **Table-4.3.11**. The isopleth depicting Short-term 24 hourly incremental GLCs of SO_2 for winter season in 10 km radius are shown in **Figure-4.3.9**.

TABLE-4.3.11
SHORT TERM INCREMENTAL CONCENTRATIONS (GLCs)

Parameter	Concentration ($\mu g/m^3$)	Distance (km)	Direction
Winter Season			
SPM	5.1	2.2	ENE
SO_2	37.4	2.2	ENE
NOx	6.3	2.2	ENE
Pre-Monsoon Season			
SPM	4.9	2.8	NE
SO_2	34.6	2.8	NE
NOx	5.8	2.8	NE
Post Monsoon Season			
SPM	4.7	2.8	E
SO_2	33.7	2.8	E
NOx	5.4	2.8	E

➢ **Discussion of the Modeling Results**

Winter Season

The maximum incremental concentrations of SPM, SO_2, NOx predicted due to the proposed zinc smelter, lead smelter and CPP complex is 5.1, 37.4 and 6.3 $\mu g/m^3$ respectively occurs at a distance of 2.2-km in ENE direction.

Pre-monsoon Season

The maximum incremental concentrations of SPM, SO_2, NOx predicted due to the proposed zinc smelter, lead smelter and CPP complex is 4.9, 34.6 and 5.8 $\mu g/m^3$ respectively occurs at a distance of 2.8-km in NE direction.

Post-monsoon Season

The maximum incremental concentrations of SPM, SO_2, NOx predicted due to the proposed zinc smelter, lead smelter and CPP complex is 4.7, 33.7 and 5.4 $\mu g/m^3$ respectively occurs at a distance of 2.8-km in E direction.

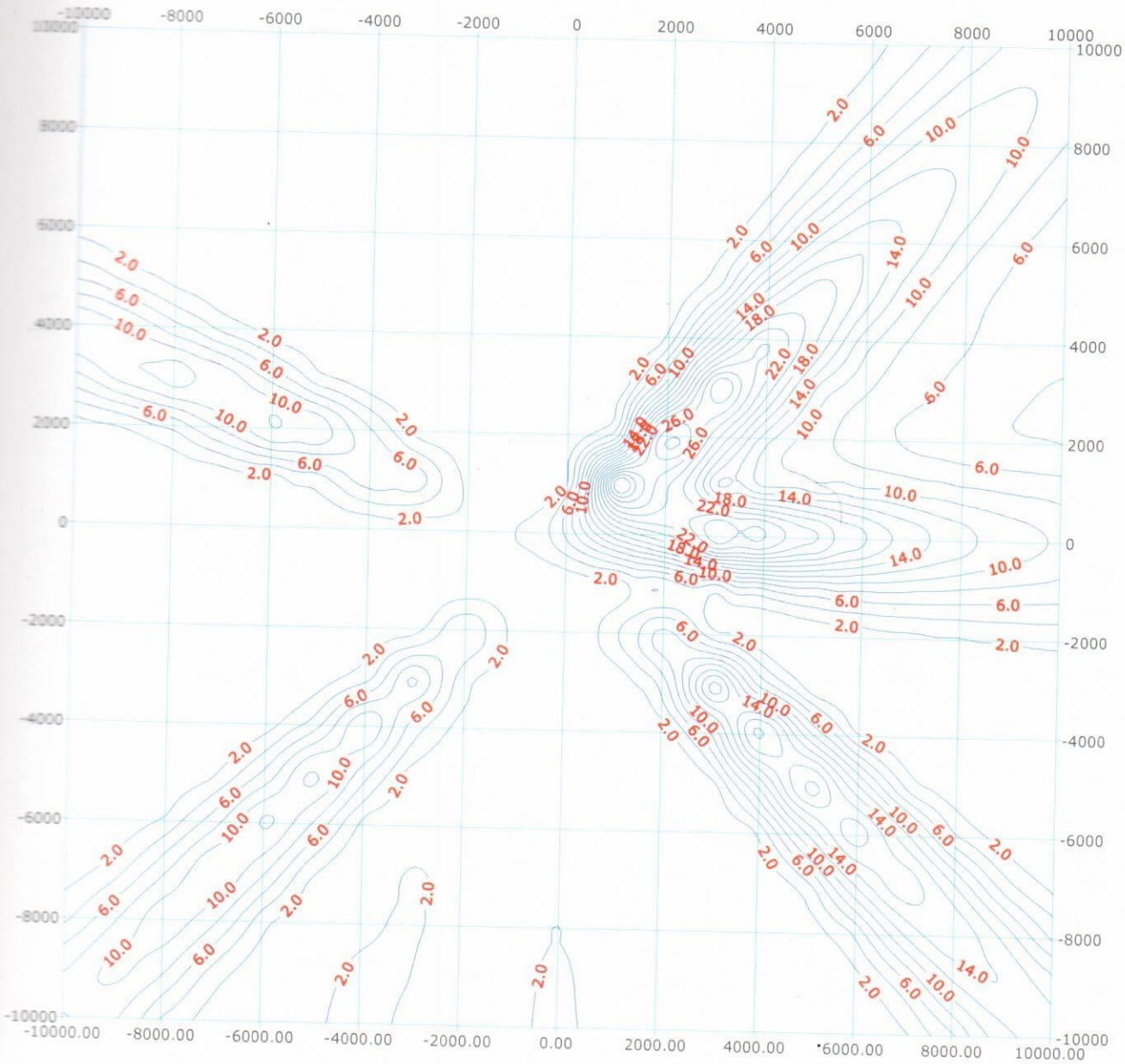


FIGURE-4.3.9
SHORT TERM 24 HOURLY INCREMENTAL GLCs OF SO2 – WINTER SEASON

- **Impact from Mining Operations**

Prediction of impacts on air environment has been assessed by employing, **USEPA Fugitive Dust Model (FDM)** dispersion mathematical model.

Fugitive Dust Model is a computerized air quality model specifically designed for computing concentration and analysis of the dispersion of fugitive dust. The sources may be point, line or area sources. The model is generally based on the well-known Gaussian Plume formulation for computing concentrations, but the model has been specifically adapted to incorporate an improved gradient-transfer deposition algorithm. Gravitational setting velocity and a deposition velocity are calculated by FDM for each class. Concentration and deposition are computed at all user-selectable receptor locations.

For the short-term simulations, the concentrations were estimated around 445 receptor points including village receptors are chosen to obtain an optimum description of variations in concentrations over the site in 10-km radius and AAQ locations covering 16 directions.

- ***Model Input Data***

The modelling has been carried to predict the impacts of the mining operations using the input as given in **Table-4.3.12.**

TABLE-4.3.12
EMISSION FACTORS USED FOR FDM MODEL

Sr. No.	Activity	Units	Emission Factors used for Modeling
1	Vehicle movement while loading	g/km/sec	2.69
2	Dumper loading	g/sec	0.0018
3	Wind erosion	$g/m^2/sec$	0.0001

- ***Meteorological Data***

The hourly meteorological data at site during winter and pre-monsoon seasons is converted to the mean hourly meteorological data as specified by CPCB and the same has been used in the model. Site specific Sodar study, at proposed project site has been done for three months period (19 December, 2008 to 20 March, 2009) by M/s Global Environmental Technologies Ltd, New Delhi, and the mixing height data from the study has been used in the modeling studies.

- ***Presentation of Results***

For the short-term simulations, the concentrations were estimated for receptor points chosen to obtain an optimum description of variations in concentrations over the mine site in 2-km radius for modelling of particulate sources from mining activity. Concentration of 16.9 $\mu g/m^3$ resulted at about 500-m ENE of mine lease for winter season and 12.4 $\mu g/m^3$ resulted at about 500-m NE of mine lease for summer season.

Overall Impact due to the Mine

As discussed above, there will be increase in terms of dust load due to mining operations. However, it can be noted that most of the activities are to be operated below ground. The above surface activities too cause insignificant emissions and will be confined to the lease area only and will not have any adverse impact on the outside community.

➢ Predicted Post-Project Ambient Air Quality

The cumulative concentrations (baseline + incremental) after the implementation of the project are tabulated below in **Table-4.3.13.** The maximum occurring baseline concentration in the study area has been considered as recommended by CPCB for the cumulative impact. The incremental concentrations of SPM and SO_2 at all the monitoring locations are evaluated and resultant concentrations are calculated.

TABLE-4.3.13
RESULTANT CONCENTRATION DUE TO INCREMENTAL GLCs

Season/ Pollutant	Maximum Baseline Concentration Recorded (µg/m³)	Maximum Incremental Concentration due to the Project (µg/m³)	Resultant Concentration (µg/m³)
Winter			
SPM	215.2	5.1	220.3
SO_2	16.6	37.4	54.0
NOx	17.8	6.3	24.1
Pre-Monsoon			
SPM	242.6	4.9	247.5
SO_2	15.1	34.6	49.7
NOx	17.3	5.8	23.1
Post-Monsoon			
SPM	150.6	4.7	155.3
SO_2	11.9	33.7	45.6
NOx	13.4	5.4	18.8

➢ Site Specific Inversion Height Study

Site specific Sodar study, at proposed project site has been done for three months period (19 December, 2008 to 20 March, 2009) by M/s Global Environmental Technologies Ltd, New Delhi.

Analysis of the data obtained during the entire study period (19 December, 2008 to 20 March, 2009) shows that average of maximum inversion level considering maximum cooling period (0300-0500 hours) is 213 m during night time. The maximum mixing height pertaining to maximum ground heating period at around noon hours (1200-1400 hours) is 1737 m. The maximum day time mixing height is seen to be more than 2-Km on several days which is fairly a good.

Chapter-5
Environment Management Plan

5.0 ENVIRONMENT MANAGEMENT PLAN

5.1 Objective

The industrial development in the study area needs to be intertwined with judicious utilization of natural resources within the limits of permissible assimilative 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 natural, physico-chemical and biological processes. The Environment Management Plan (EMP) is required to ensure sustainable development in the area of the proposed new zinc smelter plant, new lead smelter plant, captive power plant and expansion of mines and beneficiation plant of HZL. Hence, it needs to be an all encompassive plan for which the proposed industry, Government, Regulating agencies likes Pollution Control Board working in the region and more importantly the affected population of the study area need to extend their co-operation and contribution. The identification and quantification of impacts based on scientific and mathematical modeling and the mitigation measures has been presented in Chapter-4.0. At the industry level, pollution control measures include in-built process control measures and also external control measures at the end of the pipeline before they are discharged into the receiving bodies.

The proposed project is likely to provide new economical fillip, not only for the study area but also for the region as a whole. Mitigation measures at the source level and an overall Management Plan for the study area are elicited so as to improve the supportive capacity of the study area and also to preserve the assimilative capacity of the receiving bodies.

The Management Action Plan aims at controlling pollution at the source level to the possible extent with the best available technology followed by treatment measures before they are discharged.

In order to ensure a sustainable development in the region of the proposed project site, suitable mitigative measures shall be taken-up. The mitigative measures shall be both at the source level as well as at the end-of-the-pipeline stage. In addition, optimum utilization of resources and adoption of low and non-waste technologies in the process shall be adopted as much as feasible in order to achieve waste minimization and optimum utilization of the raw material.

Environment Management Plan (EMP) is required to be implemented by the plant management in order to achieve better environmental viability of the project.

The main objectives of the EMP include:

- To minimize the pollution levels in the environment;
- Optimum utilization of resources like raw materials, water and energy thus helping in resource conservation; and

- Improvement in the quality of life resulting in indirect benefit of improvement in the productivity as a whole.

The potential environmental impacts to be regulated from the proposed facilities are summarized below:

- Air pollution due to the operation of the plant which causes the emission of Suspended Particulate Matter, Sulphur Dioxide and Oxides of Nitrogen;
- Wastewater generation due to various process operations;
- Solid waste generation from the process; and
- Noise pollution due to various noise generating equipment.

In order to minimize these adverse impacts and to ensure that the environment in and around the project site as well as in the neighborhood are well protected, an effective Environmental Management Plan (EMP) is developed for the proposed project facilities. The EMP is provided for both construction phase and for the operational phase of the proposed facilities.

5.2 EMP during Construction Phase

The construction phase involves site preparation, transportation of construction materials & equipment and construction of the infrastructure. During this phase, it is imminent that workers/labourers would be staying on site till the completion of construction. However, this is not a long-term impact as this is a temporary phase.

From the above activity, it is envisaged that there would be some effect on the existing environment. The project proponents, in order to minimize these impacts would undertake the required preventive and remedial measures, which are outlined hereunder.

The following factors shall be considered during the construction phase:

5.2.1 Land Environment

The following management measures shall be adopted:

- During the construction phase, as soon as construction is completed, the surplus earth shall be utilized to fill up the low lying areas, the rubbish is to be cleared and all un-built surfaces be reinstated;
- The top soil from the excavated areas shall be preserved in separate stacks for re-use during the plantation;

- The proposed green belt shall be integrated with the existing plantation and locally available and sustainable species shall be chosen for plantation;
- Green belt development shall be taken up along with the construction work so that plantation will grow to adequate height by the time of plant commissioning. Thus, green belt will be effective in containing the pollutants due to the plant operation;
- Entire plant shall be aesthetically landscaped and as much as feasible natural gradient shall be maintained;
- There shall be minimum concreting of the top surfaces such that there is a scope for maximum ground water recharge due to rainfall; and
- The contractor shall arrange for free supply of kerosene/firewood to the construction workers for their cooking needs to prevent the damage to trees.

5.2.2 Air Environment

At the site construction activities will be carried out by water sprinkling. Ambient air levels of SO_2 and NOx are likewise expected to increase due to operation of construction machinery such as bulldozers, pay loaders, trucks etc. However, these levels are expected to be insignificant since these emission sources will in large be operated intermittently. More over most of the items are movable. Hence, there will not be any concentration of emissions at any single point. It shall be ensured that both gasoline and diesel powered construction vehicles are properly maintained to minimize smoke in the exhaust emissions. Additional recommendations include the following:

- Sprinkling of water shall be done at frequent intervals by preferably using truck-mounted sprinklers;
- Construction equipment shall be maintained and serviced regularly such that the gaseous emissions from these equipment are maintained within the design specifications;
- Since electrical power is available within the existing plant, attempts shall be made to utilize the electrically powered machinery to the extent possible to minimize the emissions of SO_2 and NOx during construction; and
- Construction activities shall be restricted to daytime only as much as possible to minimize disturbance during night time.

5.2.3 Noise Environment

Generation of noise during construction phase is due to operation of heavy equipment and increased frequency of vehicular traffic in the area. Vibration levels will also increase due to these activities. However, these impacts will be short term and intermittent in nature. The nearest village from the plant site is

Anjana, which is located at about 0.6 km. The noise effect on the nearest inhabitants during the construction activity will be negligible, as the noise levels will be dissipated within the existing plant area itself. Nevertheless, the following mitigation measures shall be adopted:

- The on-site workers shall be made to use noise protection devices like ear muffs;
- Provision for insulating caps and aids at the exit of noise source on the machinery;
- Inlet and outlet mufflers shall be provided which are easy to design;
- Noise prone activities shall be restricted to the extent possible during night time, particularly during the period between 10 PM to 6 AM in order to have minimum environmental impact on the workers as well as on the neighborhood;
- The construction equipment shall be maintained and serviced regularly such that the equipment based noise standards are maintained as per the design specifications; and
- Further, no worker shall be allowed to expose to more than 90 dB (A) in an 8-hour shift and under no circumstance the noise level from any equipment shall be greater than 115 dB (A).

5.2.4 Water Environment

The water environment is susceptible to change due to the construction activity because of the effluents from sanitary facilities for the construction workers, washing of vehicles and spillage of fuels. Following mitigation measures shall be adopted:

- Suitable treatment measures like septic tank and soak pits shall be provided in the construction site;
- The vehicle maintenance area shall be located in such a manner as to prevent contamination of surface and ground water sources by accidental spillage of oil;
- The washing effluents from the vehicle maintenance area are likely to contain suspended solids and oil & grease. Hence, a grease trap followed by settling tank shall be provided for the treatment of these effluents; and
- The waste oil collected in the grease collection pits is hazardous and shall be sold to authorized parties for off-site recycling.
- The rain water of the some buildings shall be collected in storm water pond.

5.2.5 Sanitation

The construction site shall be provided with sufficient and suitable toilet facilities for workers to meet the proper standards of hygiene. These facilities shall be connected to a septic tank and maintained to ensure minimum environmental impact.

5.2.6 Socio-Economics & Demography

Normally, the construction activity will benefit the local populace in a number of ways, which include the requirement of construction labourers - skilled, semi-skilled and un-skilled, tertiary sector employment and provision of goods and services for daily needs including transport. In line with the above some more recommendations are given below:

- Local people shall be given preference;
- All the guidelines under the Labour Act and Safety Rules as specified under Factories Act, 1948 shall be implemented during the construction work to avoid any accidents;
- The contractor shall be instructed to provide fire wood/kerosene to the workers to prevent damage to trees. This shall be part of the contractual agreement between the HZL and the contractor engaged for construction; and
- The construction site shall be secured with fencing and shall have guarded entry points.

5.2.7 Storage of Hazardous Material

The hazardous materials used during the construction may include petrol, diesel, welding gas and paints. These materials shall be stored and handled as per the guidelines specified under Hazardous Wastes (Storage, Handling and Transportation) Management Rules of EPA, 2003 Act.

Some of the precautions of storage include the following:

- Dyked enclosures shall be provided so as to contain complete contents of the largest tank;
- Diesel and other fuels shall be stored in separate dyke enclosures;
- Tanks having a diameter of more than 30 m shall be separated by fire insulating walls from other storage tanks; and
- The distance between the storage tanks shall be at least half their height.

5.2.8 Site Security

Adequate security arrangement shall be made to ensure that the local inhabitants and the stray cattle are not exposed to the potential hazards of construction activities.

5.2.9 Migrant Laborers

Safe and secure camping area shall be provided for the migrant laborers during the construction period. Adequate arrangements shall be made for water supply, sanitation and cooking fuels.

5.2.10 Facilities to be Provided by the Labour Contractor

The contractor shall be asked to provide following facilities to construction work force:

First Aid: At work place, first aid facilities shall be maintained at a readily accessible place where necessary appliances including sterilized cotton wool etc. shall be available. Ambulance facilities shall be kept readily available at workplace to take injured person to the nearest hospital.

Potable Water: Sufficient supply of cold water fit for drinking shall be provided at suitable places.

Sanitary Facility: Within the precinct of work place, latrines and urinals shall be provided at accessible place. These shall be cleaned at least twice during working hours and kept in a good sanitary condition. The contractor shall conform to sanitary requirement of local medical and health authorities at all times.

Canteen: A canteen on a moderate scale shall be provided for the benefit of workers.

Security: HZL shall provide necessary security to work force in co-ordination with State authorities.

Facilities for Women: Facilities as per Factory Rules of the State government shall be provided to the women working force. Separate toilets for women shall be provided and marked in a vernacular language with conspicuous letters for women only. A poster showing the figure of a man and woman shall also be exhibited at the entrance to toilets.

5.3 Environmental Management Plan in Existing Mines

the summarized environmental management plan for the mines is as given in **Table-5.1**.

TABLE-5.1
SUMMARIZED ENVIRONMENTAL MANAGEMENT PLAN FOR MINES

Particulars	Proposals, as per approved mining scheme (2005-06 to 2009-10)	Proposals for the Mine Plan period
Top soil storage, preservation and utilisation.	No change, anticipated in top soil due to under ground mining.	Same shall be followed.
Land reclamation and rehabilitation.	10 hect. of plantation to build green belt in acquired area.	Green belt will be developed in vacant places. Not anticipated before closure.
Waste dump management	Waste used for filling voids in the mine, leveling and other construction work within acquired area.	Proposed for same uitlisation.
Afforestration pro-gramme with pre-cautions proposed for survival and protection of plantation.	Regular monitoring of the afforested area.	Same shall be followed
Quality of air	Mining activity does not emit any toxic gases, thus there is no gaseous pollution. SPM is to be monitored regularly for keeping the level within permissible limits.	Proposed the same.
Quality of water including surface & ground.	No effect of mining activity on source of water. Quality is regularly monitored.	Same shall be followed.
Noise level	Very low and within permissible limits.	Same shall be followed.
Blast Vibration	No impact of Blast vibration on ground due to mining activity.	Same shall be observed.
Treatment of mine water and effluent/ toxic substances before discharge.	Re-circulation of mill and mine water after lime treatment. Extra water is collected in a nearby tank after treatment.	Re-circulation of mill & mine water for beneficiation plant and maintained zero discharge of industrial water.

5.4 Environmental Management Plan during Operation Phase of Smelter & CPP

The most effective pollution prevention option is to choose a process that entails lower energy usage and lower emissions. Modern flash-smelting processes save energy, compared with the conventional sintering and blast furnace process. Process gas streams containing over 5% sulfur dioxide are usually used to manufacture sulfuric acid.

HZL's goal for the plants is high resource recovery, lower energy consumption and environmentally friendly processes by adopting the reinforced smelting processes

with rich oxygen, and also the off-gas produced from the processes is transferred to acid by adopting the advanced acid producing system featuring double contact and adsorption stages. Care is being taken for the total lead recovery upto 97%, whilst sulphur utilization to be greater thann 95%, and the recycling of other valuable metals upto 95%. The application of clean production technology will facilitate efficient reduction of environmental pollution from smelters head stream.

The EMP in the design stage endeavors to mitigate the problems related to health, safety and environment at the process technology selection stage and at the design stage. The proposed New Zinc Smelter Plant, New Lead Smelter Plant and Captive Power Plant has been designed taking into account all the applicable standards/norms both for regulatory and safety purpose.

Environment management at design stage includes all the steps undertaken at the design stage by the project proponents to meet the statutory requirements and towards minimizing environmental impacts.

The design basis for all process units has laid special emphasis on measures to minimize effluent generation and emission control at source. The specific control measures related to gaseous emissions, liquid effluent discharges, noise generation, solid waste disposal *etc.* are described below:

5.4.1 Air Pollution Management

5.4.1.1Air Pollution Control Schemes

air pollution control schemes and techniques are suggested which shall be used to further minimize and control the emission of air pollutants as well as their effective dispersion into the atmosphere as given in Chapter-4.

- ***Stack Design***

All stacks with adequate height as discussed in Chapter-4 shall be provided to ensure adequate dispersion of the flue gas into the atmosphere. This design will ensure the ground level concentration of the pollutants (NOx and SO_2) to not only comply with the ambient air quality standards stipulated by CPCB but also keep them low.

Adequate ventilation systems will be provided in various buildings to reduce the Air Pollution. In addition, Personal Protective Equipments will also be used by personnel working to reduce the effects of air pollution on Individuals.

Technological Assessment for Reducing Lead

In the lead smelter SKS lead smelting process will be utilized. The China ENFI Engineering Corporation has independently and successfully developed the SKS lead smelting process, where the horizontal turning furnace is adopted. Thus SKS

lead smelting process produces less pollution compared to the conventional smelter process.

- Dust emissions are controlled by using enclosed conveyors dust extraction & dust suppression systems. ESPs and bag filters are used for product recovery and for the control of particulate emissions in the furnace off gas dust collection systems.
- Using doghouse enclosures where appropriate; using hoods to collect fugitive emissions.
- Doghouse enclosures and canopies at appropriate places to prevent dust contamination.
- Hygiene hoods and bag filter system to control fugitive emission from furnaces, melting pots etc. and thus reducing ambient lead level.
- Pneumatic dust conveying system is used to transfer re-cycle dust which eliminates manual handling and thus reduces the lead dust hazard to plant personnel.
- Plant control rooms will have double door entry system to prevent dust entry and thus lead contamination is reduced.
- Wash house system to reduce lead contamination.

Additional Recommendations

- Adequate green belt shall be provided within the plant premises, along the plant boundary. The density of existing trees shall be increased to be more effective in arresting the fugitive emissions;
- Good house keeping shall be maintained in the plant premises; and
- The trucks and other vehicles shall be maintained and serviced regularly to reduce air emissions.

5.4.1.2 Stack Gas Monitoring

The emissions from the stacks shall be regularly monitored for exit concentration of Sulphur dioxide, Oxides of Nitrogen and Particulate Matter. Sampling ports shall be provided in the stacks according to CPCB guidelines.

5.4.1.3 Ambient Air Quality Monitoring

The concentration of SPM, SO_2 and NOx in the ambient air outside the project boundaries and in the adjoining villages shall be monitored under post project

monitoring. HZL is already monitoring ambient air quality in the surrounding villages and the same shall be continued.

5.4.2 Noise Pollution Management

5.4.2.1 Overview

The impact of noise generated due to plant operations has been estimated in Chapter-4. The ambient noise levels in the region are within permissible limits and are envisaged to be within the permissible limits even after commissioning of the proposed facilities. However, the following mitigation/management measures shall be adopted to further reduce the impact:

5.4.2.2 Noise Attenuation Measures

➢ ***In Plant Control Measures***

- All the design/installation precautions as specified by the manufacturers with respect to noise control shall be strictly adhered to;
- High noise generating sources like Turbines shall be insulated adequately by providing suitable enclosures;
- Other than the regular maintenance of the various equipment, ear plugs are recommended for the personnel close to the noise generating units;
- All the openings like covers, partitions shall be designed properly; and
- Inlet and outlet mufflers shall be provided which are easy to design and construct.

➢ ***Noise Control at the Community Level***

Green belt with rich canopy shall be developed around the perimeter of the plant and in all open spaces wherever feasible to attenuate the noise emitted by the various sources in the plant.

5.4.3 Water Pollution Management

The main sources of wastewater generation and their impacts have been discussed in Chapter-4.

Waste water generated from the various streams of operations will be taken to integrated ETP followed by RO plant for treatment for treating waste water from smelters as well as from CPP. The treated water will confirm to the stipulated norms.

During heavy rainfall, initial run-off will be taken in Run-off Basin in storm water pond. This basin is emptied over the next 24 hours to recover entrained solids. Any excess run-off will bypass the Basin and be discharged from the site.

Zero discharge of water is being maintained from tailing dam and shall be maintained.

Sewage in plant area will be collected in septic tanks followed by soak pits. Sewage collected from residential colony will be treated in Sewage Treatment Plant. Treated water will be used for horticulture works. Zero discharge will be maintained.

To augment ground water in study area HZL proposes to harvest rain water.

Apart from this various water conservation initiatives shall be taken to reduce the fresh water consumption at the source like:

- Reduction in Specific water consumption by process optimization
- Increasing the CoC (Cycle of Concentration) of cooling tower water by using the chemical additives.
- By using treated water for various purposes like
    - Road & floor washing
    - Dust suppression
    - Lime slurry preparation
    - Arresting water leakages
    - Greenbelt development etc

5.4.4 Solid Waste Management

the details of solid waste generated and the the mitigation measures are mentioned in Chapter-4.

5.4.5 Energy Conservation

Jubmo cell house is adopted in Hydrometallurgical plant which will have lesser power consumption as compared to the conventional technology. Conventional technology normally consumes 3400 kwh/tonne of cathode production whereas Jumbo cell house consumes about 3000 kwh/ tonne of cathode production keeping the current density (400 amps/ m^2) and other parameters same.

Thermally autogenous process with power generation (2 x 4 MW) from waste heat.

The heat exchanger system is designed in order to reduce the amount of energy (steam) to heat the SO_2-rich liquid to the desorption temperature and to reduce the amount of cooling water necessary to cool down the SO_2-free liquid to the absorption temperature

Variable frequency drives (VFDs) will be used appropriately for energy conservation.

Right size of motors will be used for energy conservation.

5.5 Greenbelt Development

Implementation of afforestation program is of paramount importance for any industrial development. In addition to augmenting present vegetation, it will also check soil erosion, make the eco-system more complex and functionally more stable, make the climate more conducive and restore water balance. It can also be employed to bring areas with special problems under vegetal cover and prevent further land deterioration. The main objective of the green belt is to provide a barrier between the plant and the surrounding areas. The green belt helps to capture the fugitive emissions and to attenuate the noise generated in the plant apart from improving the aesthetics of the plant site.

Geometry of planting of tree is more important in order to have effective wind break by the plantation. For an effective green belt, a mixture of tree species is necessary and some shrubs and grasses shall be inter-cropped. As far as possible, there shall be no gaps in the green belt. Where opening is imperative, alignments to roads shall be such that open gaps are prevented to overcome funneling action of wind.

- The density of the existing green belt shall be increased by gap filling so that the green belt becomes more effective for noise attenuation as well as arresting the fugitive emissions if any.

- The proposed green belt shall be integrated with the existing plantation and locally available and sustainable species shall only be chosen for plantation;

- Green belt development shall be taken up along with the construction work so that plantation will grow to adequate height by the time of plant commissioning. Thus, green belt will be effective in containing the pollutants due to the plant operation;

- Entire plant shall be aesthetically landscaped and as much as feasible natural gradient shall be maintained;

The main purpose of green belt development is to contribute to the following factors:

- To attenuate noise levels generated from the plant;
- To improve the aesthetics of the plant area;
- To trap the vehicular emissions and fugitive dust emissions;
- To act as pollution sink for gaseous emissions;
- To maintain ecological balance;
- To prevent soil erosion and to protect the natural vegetation; and
- To utilize the treated effluents.

5.5.1 Design of Green Belt

The following guidelines shall be considered in green belt development.

- Shrubs and trees shall be planted in encircling rows around the project site;
- The short trees (<10-m height) shall be planted in the first rows of the green belt. The tall trees (>10 m height) shall be planted in the outer rows.
- Planting of trees in each row shall be in staggered orientation (Triangular form);
- In the front row, shrubs consisting of Albizia sp., Peltoforum etc. shall be grown;
- Since the trunks of the tall trees are generally devoid of foliage, it will be useful to have shrubs in front of the trees so as to give coverage to this portion;
- The spacing between the trees shall be maintained slightly less than the normal spaces, so that the trees may grow vertically and slightly increase the effective height of the green belt;

The proposed green belt plan is shown in **Figure-5.1.**

5.5.2 Plant Species for Green Belt

While selecting the plant species for the proposed green belt, the following points have been taken into consideration:

- Should be a fast growing type;
- Should have a thick canopy cover;
- Should be perennially green;
- Should be preferably of native origin; and
- Should have a large leaf area index.

The various plant species to be grown at HZL plant site complex include:

- Timber yielding trees like Acacia auriculiformis, Albezza, Acacia sp., Bambosa sp., Bhendi, Casuarina, Dalbergia, Tectona grandis, Azardirachta indica etc.;
- Fruit yielding trees like Guava, Lemon, Mango, Oranges and sapota etc.;
- Ornamental trees like Bengal almond, bottle brush, Dellinea indica, Gulmohar etc.; and
- Religious trees like Wad, Peepal, Kadamba, Champa, Bakul, flowering Asoka, Hirda, Behada, Mahuwa, Bengal almond etc.

➢ **Criteria for Selection of Species:**

Species to be selected shall fulfill the following specific requirements of the area:

- Tolerance to specific conditions or alternatively wide adaptability to eco-physiological conditions;
- Rapid growth;
- Capacity to endure water stress and climate extremes after initial establishment;
  - Differences in height and growth habits;
  - Pleasing appearances;
  - Providing shade;
  - Large bio-mass and leaves number to provide fodder and fuel;
  - Ability of fixing atmospheric Nitrogen;
  - Improving waste lands; and
  - Improve landscape aesthetics.

To undertake plantation on site for different purposes, following steps will be involved:

- Raising of seedlings in nursery;
- Preparation of pits and preparing them for transfer of seedlings; and
- After-care.

➢ **Raising of Seedlings in Nursery**

Seedlings shall be raised in nurseries. Adequate number of surplus seedlings shall be available considering 10% mortality in seedlings. Healthy seedlings shall be ready for transfer to permanent location before rainy season.

➢ **Preparation of pits and preparing them for transfer of seedlings**

- Standard pit size would be 1 m x 1 m x 1 m;
- The distance between pits would vary depending on their location;
- The pits shall be filled using good soil from nearby agricultural fields (3 parts) and farm yard manure (1 part);
- Rhizobium commercial preparation (1 kg/1000 kg);
- BHC powder, if the soil inhabits white ants (Amount variable); and
- The pits shall be watered prior to plantation of seedlings.

NOTE:-

1. 498.300 = +2.000 FFL, 498.3
   ALL THE ELEVATIONS SHALL CO
2. MINIMUM DISTANCE FROM HIGH

HOLD LIST :-

1. CPP AREA
2. UTILITY AREA & DG SET = ADD
3. LEACHING PLANT, CELL HOUSE
4. STORE, CENTRAL LAB & CANTE
5. STORM WATER PONDS
6. WEIGH BRIDGE-1, 2 & MAIN G
7. TRUCK WASHING AREA & CROSS
8. COOLING TOWER (LOCATION) FO
9. LPG BULLET = LOCATION & LA
10. COMPRESSOR HOUSE
11. TG BUILDING LAYOUT

UNIT LIST
TECHNOLOGICAL L

1.	RMH
2.	ROASTER
3.	GAS CLEARING PLANT
4.	ACID PLANT
5.	SULPHURIC ACID STORAGE
6.	LEACHING PLANT
7.	CELL HOUSE
8.	MELTING & CASTING UNIT
9.	COSS BUILDING
10	SWITCH YARD
11	POWER PLANT
12	REVERSE OSMOSIS PLANT (RO
13	EFGLUENT TREATMENT PLANT
14	WATER TREATMENT PLANT (WT
15	RAW WATER STORAGE

LEGENDS

1.	BOUNDARY
2.	BUND
3.	FENCING
4.	NALA
5.	TBM
6.	ROAD
7.	STONE
8.	BUILDING
9	TOWER
10	CULVERT
11	WELL
12	SLOPE
13	FINISH GROUND LEVEL
14	RAIWAY TRACK
15	PIPRACK BRIDGE

Time of Plantation

In general, trees are planted at the beginning of the monsoon. As the trees are benefited from the seasonal rains, so it is advised to avoid planting during the dry season as this will require heavy watering.

Preparation of Plantation Area

Plantation site will be cleared from all wild vegetation. This will help in surveying the land for assessing its resources and weak points. Suitable soil and water conservation measures will be adopted, if required.

The planting area should be divided into blocks inter-linked by paths laid out in such a way that every tree is accessible for all post plantation care.

Spacing between Trees

A tree requires sufficient space below and above the ground to spread its roots and branches. However, spacing varies with the type of tree, soil fertility, availability of moisture and purpose of plantation.

Marking and Digging of Pits

The location of each pit will be marked according to the design and distance of plantation. The size of the pits varies with type of trees. While digging the pit, care will be taken to place the top soil on one side and bottom soil on the other side. Dug out soil and pit would be exposed to weather for two to three months.

After exposing to the weather, pit would be filled two-third to three-fourth height with a mixture of top soil and well rotten farmyard manure.

Criteria for selection of Species

Species to be selected should fulfill the following specific requirements of the area.

- Tolerance to specific conditions or alternatively wide adaptability to eco-physiological conditions;
- Rapid growth;
- Capacity to endure water stress and climatic extremes after initial establishment;
- Differences in height and growth habits;
- Pleasing appearance;
- Providing shade;
- Ability of fixing atmospheric Nitrogen; and
- Improving waste lands.

Recommended Species for Plantation

Based on climate and soil characteristics of the study area, some species are recommended for plantation. The climate of the region is extreme, where there is less rainfall as well as extreme heat and soil temperature is very high in summer. Hence, in order to have a ground cover, some fast growing species, which do not require watering, have been recommended for mass plantation. However, experimental trial should be conducted for the suitability and sustainability of the recommended species. The detailed list of recommend plantation species for waste dumps and peripheral plantation are presented in **Table-5.2.**

TABLE-5.2
RECOMMENDED PLANTATION SPECIES
FOR WASTE DUMPS AND PERIPHERAL PLANTATIONS

Sr. No.	Name of Plant Species	Local Name	Distribution and Growth Rare
	Grasses		
1	*Agrostis tenuis*	Grass	Stabillazation of slopes, fast growth
2	A. *stolonifera*	Grass	Stabillazation of slopes, fast growth
3	*F. ruba*	Grass	Stabillazation of slopes, fast growth
4	*Agave Americana*	Agave	Waste land and slow growth
5	*Appluda mutica*	Grass	Grass
6	*Eragrostis curvula,*	Grass	Stabillazation of slopes, fast growth
7	*Cynodon* spp	Grass	Stabillazation of slopes, fast growth
8	*Cymboopogon flefxuosus*	Grass	Fast growth
9	*Cyanodon dactylon*	Grass	Fast growth
10	*Yucca gloriosa*	Agave	On slopes, fast growth
11	*Sansevera suevalens*	Agave	On slopes, fast growth
	Tree Species with Nitrogen Fixing Capacity		
1	*Acacia nilotica*	Acacia	Barren lands and Medium growth
2	*Aegle marmelos*	Bel	Barren land and medium growth
3	*Albizia chinensis*	Safed siris	Barren lands and Medium growth
4	*Albizia lebbek*	Siris	Medium growth
5	*Albizia procera*	Kala siris	Medium growth
6	*Alstonia scholaris*	Saptarni	Shrub
7	*Anogeissus pendula*	Dhokara	Medium growth
8	*Azadirachta indica*	Neem	Medium growth
9	*Bambusa arundanacea*	Bamboo	Medium growth
10	*Bauhinia racemosa*		Medium growth
11	*Butea monosperma*	Gadha palas	Medium growth
12	*Delonix regia*	Kachnar	Fast growing
13	*Dendrocalamus strictus*	Bamboo	Medium growth
14	*Emblica officinalis*	Amla	Medium growth
15	*Mangifera indica*	Aam	Medium growth
16	*Melia azadirachta*	Bakain	Medium growth
17	*Moringa oleifera*	Drumstick	Fast growing

Sr. No.	Name of Plant Species	Local Name	Distribution and Growth Rare
18	*Pithocolobium dulce*	Jungle jelebi	Medium growth
19	*Sesbania sesban*	Kanui churthel	Medium growth
20	*Ziziphus jujuba*	Ber	Medium growth
21	*Ziziphus mauritiana*	Ber	Medium growth
22	*Dalbergia sisoo*	Sisham	Fast growth
23	*Millingtonia hartensis*	Akashneem	Fast growh
24	*Leucena leucophloe*	Sabubal	Fast growth
25	*Peltoforrum ferrussinum*	Copper pod	Fast growth
26	*Parkinsonia aculeulata*	Pakinsonia	Medium growth
27	*Pongamia pinnata*	Karanj	Medium growth
28	*Cassia fistula*	Amaltas	Fast growh

TABLE-5.3
PROPOSED GREENBELT DEVELOPMENT PROGRAMME

Year	New area of plantation (ha)	Plantation in new area (Nos)	Gap Filling in existing plantation area (Nos)	Total Plantation (Nos)
2009-2010	5.0	10000	3000	13000
2010 - 2011	5.0	10000	3000	13000
2011 - 2012	5.0	10000	3000	13000
2012-2013	5.0	10000	3000	13000
2013-2014	5.0	10000	3000	13000
Total	25.0	50000	15000	65000

Tree Density will be progressively improved in the existing plantation area.

Greenbelt plan along with choice of species for dust control, sulphur absorption, pollution abatement and noise attenuation along with plantation techniques will be prepared as part of EIA.

5.6 Socio-Economic Development

5.6.1 Management of Public Interests

Based on the analysis of the socio-economic profile of the study area along with the prediction and evaluation of likely impacts arising out of the proposed activity, it has been possible to prepare a feasible environmental management plan. It is felt that this would help in minimizing the adverse impacts on the socio-economic environment to a considerable extent, while at the same time addressing to large extent the aspirations of the community.

For the recruitment of semi-skilled and un-skilled workers particularly during construction, preference shall be given to the local people.

HZL is involved in number of social welfare measures in the nearby villages like providing tube wells for drinking water, conducting cattle health-checks, providing

fodder during droughts, extending fire fighting facilities etc. The same will be continued and strengthened further.

5.7 Implementation Schedule of Mitigation Measures

5.7.1 Introduction

The mitigation measures as delineated above shall be implemented so as to reduce the impact on environment due to the operations of the proposed plants and expansion. In order to facilitate easy implementation, mitigation measures are phased as per the priority implementation as given in **Table-5.4**.

TABLE-5.4
IMPLEMENTATION SCHEDULE

Sr. No	Recommen-dations	Time Requirement (Months)	Immedi ate	Progre-ssive	Depending on the discretion of the management of the proposed plant
1	Air pollution control Measures	Before commissioning of respective units	*	--	--
2	Water Pollution Control Measures	Before commissioning of the plant	*	--	--
3	Noise Control Measures	Along with the commissioning of the plant	*	--	--
4	Ecological Preservation and Upgradation	Stage-wise implementation	*	*	--

Note (*) indicates implementation of recommendations

5.8 Institutional Arrangements for Pollution Control

5.8.1 Organizational Structure

The existing facilities and organization for environmental management shall be utilized for the proposed facilities also after augmentation if required. Presently, a Senior Manager (Env) is in-charge of the Environment Management cell supported by engineers and chemists and horticulturist along with other technicians.

The department shall be the nodal agency to co-ordinate and provide necessary services on environmental issues during construction and operation of the project. This environmental group is responsible for implementation of environmental management plan, interaction with the environmental regulatory agencies, reviewing draft policy and planning. This department interacts with MoEF, Central Pollution Control Board (CPCB) and other environment regulatory agencies. The department shall also interact with local people to understand their problems and to formulate appropriate community development plan.

The proposed organization set up of Environmental Management cell is shown in **Figure-5.2**.

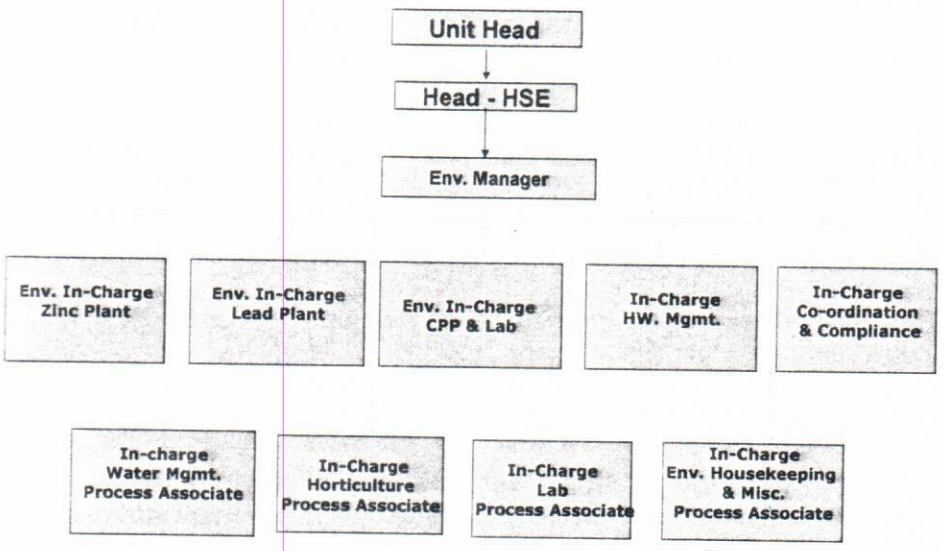


FIGURE-5.2
ORGANIZATION STRUCTURE FOR ENVIRONMENT MANAGEMENT

5.9 Environmental Monitoring

Environmental monitoring is being conducted on regular basis by HZL to assess the pollution level in the surrounding area. The same will be continued with further improvement in future for the proposed expansion project.

Usually, as in the case of the study, an impact assessment study is carried over short period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environment. The objective of monitoring is:

- To verify the result of the impact assessment study in particular with regards to new developments;
- To follow the trend of parameters which have been identified as critical;
- To check or assess the efficacy of the controlling measures;
- To ensure that new parameters, other than those identified in the impact assessment study, do not become critical through the commissioning of new installations or through the modification in the operation of existing facilities;

- To check assumption made with regard to the development and to detect deviations in order to initiate necessary measures; and

- To establish a database for future Impact Assessment Studies for new projects.

The attributes, which merit regular monitoring, are specified underneath:

1] Air quality;
2] Water and wastewater quality;
3] Noise levels;
4] Soil quality; and
5] Ecological preservation and afforestation.

The post project monitoring to be carried out at the industry level is discussed below:

5.9.1 Monitoring and Reporting Procedure

Regular monitoring of important and crucial environmental parameters is of immense importance to assess the status of environment during plants operation. With the knowledge of baseline conditions, the monitoring programme can serve as an indicator for any deterioration in environmental conditions due to operation of the plants and suitable mitigatory steps could be taken in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring. The following routine monitoring programme would therefore be implemented.

A comprehensive monitoring program is suggested in **Table-5.5**.

The environmental attributes shall be monitored as given below:

➢ **Air Pollution and Meteorological Aspects**

- The ambient air quality shall be monitored twice in a week in line with the guidelines of Central Pollution Control Board at four locations for SPM, RPM, SO_2, NOx and CO. The dust fall measurement shall be done for one month in every season excluding monsoon season to assess the dust deposition and the level of lead, zinc and cadmium concentration.

- On line stack emissions monitoring shall be carried out for parameters SPM, SO_2, NOx and CO. In addition, flow rate, temperature, velocity shall also be monitored for better interpretation of the results;

- Automatic weather monitoring shall be carried out within the plant premises. The frequency of monitoring shall be one hourly. The parameters shall include wind speed, wind direction, temperature, relative humidity, atmospheric pressure, rainfall, evaporation rate, solar radiation and cloud cover.

- To check assumption made with regard to the development and to detect deviations in order to initiate necessary measures; and

- To establish a database for future Impact Assessment Studies for new projects.

The attributes, which merit regular monitoring, are specified underneath:

1] Air quality;
2] Water and wastewater quality;
3] Noise levels;
4] Soil quality; and
5] Ecological preservation and afforestation.

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- Automatic weather monitoring shall be carried out within the plant premises. The frequency of monitoring shall be one hourly. The parameters shall include wind speed, wind direction, temperature, relative humidity, atmospheric pressure, rainfall, evaporation rate, solar radiation and cloud cover.

➢ **Water and Wastewater Quality**

- The observatory wells need to be drilled around the Secured Land Fill (SLF) and the water shall be tested on monthly basis. The wells in the villages shall be identified based on the ground level contours and ground water flow and water quality shall be monitored on monthly basis.

➢ **Noise Levels**

- Noise levels in the work zone environment such as Acid plant blower, turbine, boiler, cooling tower and compressors shall be monitored. The frequency shall be once in three months in the work zone. Similarly, ambient noise levels at four locations shall be monitored on a seasonal basis.

➢ **Soil Quality**

Soil quality shall be monitored in the industrial area and also in the buffer zone in 10-km radius study area. The parameters shall include physico-chemical parameters and heavy metals.

The environmental monitoring cell shall co-ordinate all monitoring programmes at site and data thus generated shall be regularly furnished to the State regulatory agencies and to the Regional office of MoEF.

TABLE-5.5
MONITORING SCHEDULE FOR ENVIRONMENTAL PARAMETERS

Sr. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
I	**Air Pollution & Meteorology**				
	Air Quality				
	A	**Stack Monitoring**			
	1	Acid Plant Stack	Continuous	On-line	SO_2
	2	Zinc melting furnace bag filter stack	Once in a month	Iso-kinetic	SPM
	3	Zinc dross milling bag filter stack	Once in a month	Iso-kinetic	SPM
	4	Zinc atomizing furnace bag filter stack	Once in a month	Iso-kinetic	SPM
	5	Calcine Handling Stack	Once in a month	Iso-kinetic	SPM
	6	Tail Gas Treatment plant	Once in a month	Iso-kinetic	SPM
	7	SKS furnace	Once in a month	Iso-kinetic	SPM
	8	Precious metal plant	Once in a month	Iso-kinetic	SPM
	9	Blast furnace	Once in a month	Iso-kinetic	SPM
	10	Captive Power Plant	Continuous	On-line	SPM, SO_2, NOx, CO
	B	**Ambient Air Quality Monitoring**			
		1. Plant site 2. Rajpura Dariba 3. Sindesar Khurd	Twice in a week	24 hr. continuously	SPM, RPM, SO_2, NO_x and CO.
		Dustfall	One month in	One month	Dust, Lead, Zinc and

Sr. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
		At ambient air quality locations	every season	continuously	Cadmium in dust.
	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	Sanitary effluents	Once in a month	24 hr composite	As per EPA Rules, 1986.
	B	**Industrial Effluents**			
		Out let of the ETP	Once in a month	24 hr composite	As per EPA Rules, 1986
		Outlet of the Blowdown tank	Once in a month	24 hr composite	As per EPA Rules, 1986
	C	**Ambient Water quality**			
		Surface Water 1) Gosunda dam at the intake point 2) Matrikundia dam at the intake point 3) Mansiwakal dam at the intake point **Ground Water** 1) Piezo wells around tailing dam 2) Piezo wells around Secured Land Fill (SLF)/ Jarofix disposal yard/ slag yard	once in a month	Grab	Parameters specified under IS:2296 (Class C) and IS:10500, 1986 Heavy metals
III	**Industrial Noise Levels**				
	1	Near administrative office	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	2	Roaster Blower	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	3	Acid plant blower	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	4	Turbine, boiler and cooling tower of Captive Power Plant	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	5	Compressor	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	6	Near Oxygen Plant Building	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	7	Near Blower House Bldg	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	8	Near Blast & fuming furnace bldg	Once in 6 months	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	Ambient Noise Levels				
	1	On the Plant Boundary in Eight directions	Once in three months for the	24 hr continuous with one hr	Noise levels in dB(A)

Sr. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
	2 3	Rajpura Dariba village Sindesar Khurd village	industry Once in each season for ambient noise levels	interval	
IV		**Soil Quality**			
		1] Adjacent to Secured Land Fill (SLF) 2] Plant site 3] Rajpura Dariba	Once in every six months	Grab	Physic-chemical parameters and metals covering Zn, Pb, Cd, As, Hg, Cu, Ni, Mn etc. or as per the parameters prescribed by MoEF.

Note: Lead Levels

The blood lead level of the personnel working in Lead smelter will be monitored regularly. The frequency shall be once in every six months.

5.10 Infrastructure for Environmental Protection

5.10.1 Monitoring Equipment and Consumables

a) Air Quality and Meteorology

Following equipment and consumable items are available with HZL. The facilities can be utilized by augmenting:

- Respirable Dust samplers;
- Stack monitoring equipment (on line);
- Spectrophotometer (visible range);
- Single pan balance;
- Gas Chromatograph (GC);
- Atomic Absorption Spectrophotometer (AAS); and
- Relevant Chemicals

b) Water and Wastewater Quality

The sampling shall be done as per the standard procedures laid down by IS:2488. Following equipment are available which can be augmented if required.

- BOD incubator;
- COD reflex set-up;
- Refrigerator;
- Oven;
- Stop watch;
- Thermometer;
- pH meter;
- Distilled water plant;
- Pipette box;

- Titration set;
- Dissolved oxygen analyzer; and
- Relevant chemicals.

c) Noise Levels

Noise monitoring shall be done utilizing an integrating sound level meter to record noise levels in different scales like A-weighting with slow and fast response options.

d) Soil Quality

The analysis of soil quality parameters require following additional equipment.

- Augur;
- Sieve apparatus;
- Infiltrometer; and
- Relevant chemicals.

5.10.2 Environmental Budget

The cost of environmental control equipment/measures integrated in the basic design of the plant is about ***Rs. 230.0 crores*** as shown in **Table-5.6**. Expenditure incurred on plantation, plantation maintenance, preparation of water channels, monitoring and analysis of ambient air, effluent water and soil etc is as shown in **Table-5.7**.

TABLE-5.6
COST OF ENVIRONMENTAL PROTECTION MEASURES

Sr. No.	Unit	Amount (Rs.)
1	Smelter & CPP	225.5
2	Mine & Beneficiation plant	4.5
Total		**230.0**

TABLE-5.7
COST OF ENVIRONMENTAL PROTECTION MEASURES INCURRED

Sr. No.	Year	Amount (Rs.)
1	2000-01	1809494
2	2001-02	1741777
3	2002-03	882588
4	2003-04	749300
5	2004-05	865660
6	In future per year	1000000

The recurring cost of the environmental measures will be approximately Rs. 1520 lakhs/annum on control measures and about Rs.60 lakhs/annum on environmental monitoring and Rs.100 lakhs/annum on ecological preservation.

Chapter-6

Risk Assessment and Disaster Management Plan

6.0 RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

Risk involves the occurrence or potential occurrence of some accident consisting of an event or sequence of events. Risk (R) can be mathematically expressed as R = f.D where R is the risk (individual or societal), f is the frequency of occurrence of an undesired event and D is the expected damage distance due to likely occurrence of that unfortunate event. The main objectives of the study are as follows:

i. Identification of hazard prone area and estimation of damage distance for the Maximum Credible Accident scenarios visualized for storages.
ii. Computation of frequency of occurrence of hazards and evaluation of risk.
iii. Based on the studies, suggest risk mitigation measures and arrive at guidelines for Disaster Management and Emergency Preparedness Plan (DMP and EPP).

6.1 Risk and Hazards

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that exist in the proposed complex. On the other hand, risk analysis deals with the identification and quantification of risks, the plant equipment and personnel are exposed to, due to accidents resulting from the hazards present in the complex.

Hazard and risk analysis involve very extensive studies and require very detailed design and engineering information. The various hazard analysis techniques that may be applied are hazard and operability studies, fault-tree analysis, event-tree analysis and failure and effects mode analysis.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring population are exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

In the sections below, the identification of various hazards, probable risks in the proposed project (lead smelter, zinc smelter, CPP, mines expansion, and beneficiation expansion), Maximum Credible Accident (MCA) analysis, consequence analysis are addressed, which gives a broad identification of risks involved in the plant. Based on the risk estimation for fuel and chemical storage Disaster Management Plan (DMP) has been presented.

6.1.1 Scope of Present Study

The principal objective of the present risk assessment study is to identify and quantify the major hazards and the risks associated with the various operations of the proposed lead smelter, zinc smelter, CPP, mines expansion, and beneficiation expansion, which may lead to emergency consequences (disasters) affecting the

public safety and health. Based on this information, an Emergency Preparedness Plan (EPP) is developed to mitigate the consequences:

- Identification of the major chemical, electrical, thermal and mechanical hazards associated with the main plant and the auxiliary operations;
- Short-listing of the major accident scenarios with potential off-site consequences for consequence analysis;
- Maximum credible accident and consequence analysis for short-list scenario;
- Mapping of vulnerable zones for the worst case scenarios; and
- Development of an emergency preparedness plan for the mitigation of consequences.

6.2 Process Description And Inventory At Site

The process description of the various activities at DSC site has been presented & given in Chapter-2. The inventory at the project site is given in the **Table-6.1**

TABLE-6.1
INVENTORY AT PROJECT SITE

Sr. No.	Material	No. of Tanks	Design Capacity (Total)	Classification
1	H_2SO_4	3+1	3 x 5000 T and 1 x 5000 T	Corrosive
2	LDO	2+1	2x 420 KL + 1x 25 KL	Flammable
3	LPG/Propane	2 +2 bullets	2x10 + 2x10 MT	Flammable
4	LSHS	2+2	2x200 KL + 2x25 KL	Flammable
5	Chlorine	1+1	1=1 Tonne	Toxic
6	Copper Sulphate	2	2x 30 MT	Corrosive solid
7	Caustic Soda	2	2x 5 MT	.

6.3 Hazard Identification & Preliminary Hazard Analysis

6.3.1 Introduction to Hazard Identification

Identification of hazards in an industry is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals and process. A classical definition of hazard states that hazard is in fact the characteristic of system/plant/process that presents potential for an accident. Hence, all the components of a system/plant/ process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

6.3.2 Identification of Major Hazardous Units

Hazardous substances may be classified into three main classes:

- Flammable substances,
- Unstable substances and
- Toxic substances

Identification of hazards in the proposed lead smelter, zinc smelter, CPP, mines expansion, and beneficiation expansion project is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals and process. A classical definition of hazard states that hazard is in fact the characteristic of system/plant/process that presents potential for an accident. Hence, all the components of a system /plant /process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The following two methods for hazard identification have been employed in the study:

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (GOI Rules, 1989); and

- Identification of hazardous units and segments of plants and storage units based on relative ranking technique, viz. Fire-Explosion and Toxicity Index (FE&TI).

Summary table on the inventories of the major fuels and chemicals that are used in the plant are listed in the **Table-6.2.**

TABLE-6.2
SUMMARY TABLE ON THE INVENTORIES

Chemical	Codes/ Label	TLV	FBP	MP	FP	UEL	LEL
			°C			%	
H_2SO_4	Corrosive	1 mg/m^3	-	-	-	-	-
LDO	Flammable	5 mg/m^3			66		
LPG	Flammable	1000 ppm	-	-	104.4	9.5	1.9
LSHS	Flammable	5 mg/m^3	-	-	60	-	-
Chlorine	Toxic		-34	-101.0	-	-	-

TLV : Threshold Limit Value
FBP : Final Boiling Point
MP : Melting Point
FP : Flash Point
UEL : Upper Explosive Limit
LEL : Lower Explosive Limit

6.3.3 Classification of Major Hazardous Units

Hazardous substances may be classified into three main classes namely flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. The major hazardous materials to be stored, transported, handled and utilized within the facility have been summarized in the **Table-6.3** and **Table-6.4** and the details are shown in **Figure-6.1**.

STACK LOCATION AT DSC LAYOUT

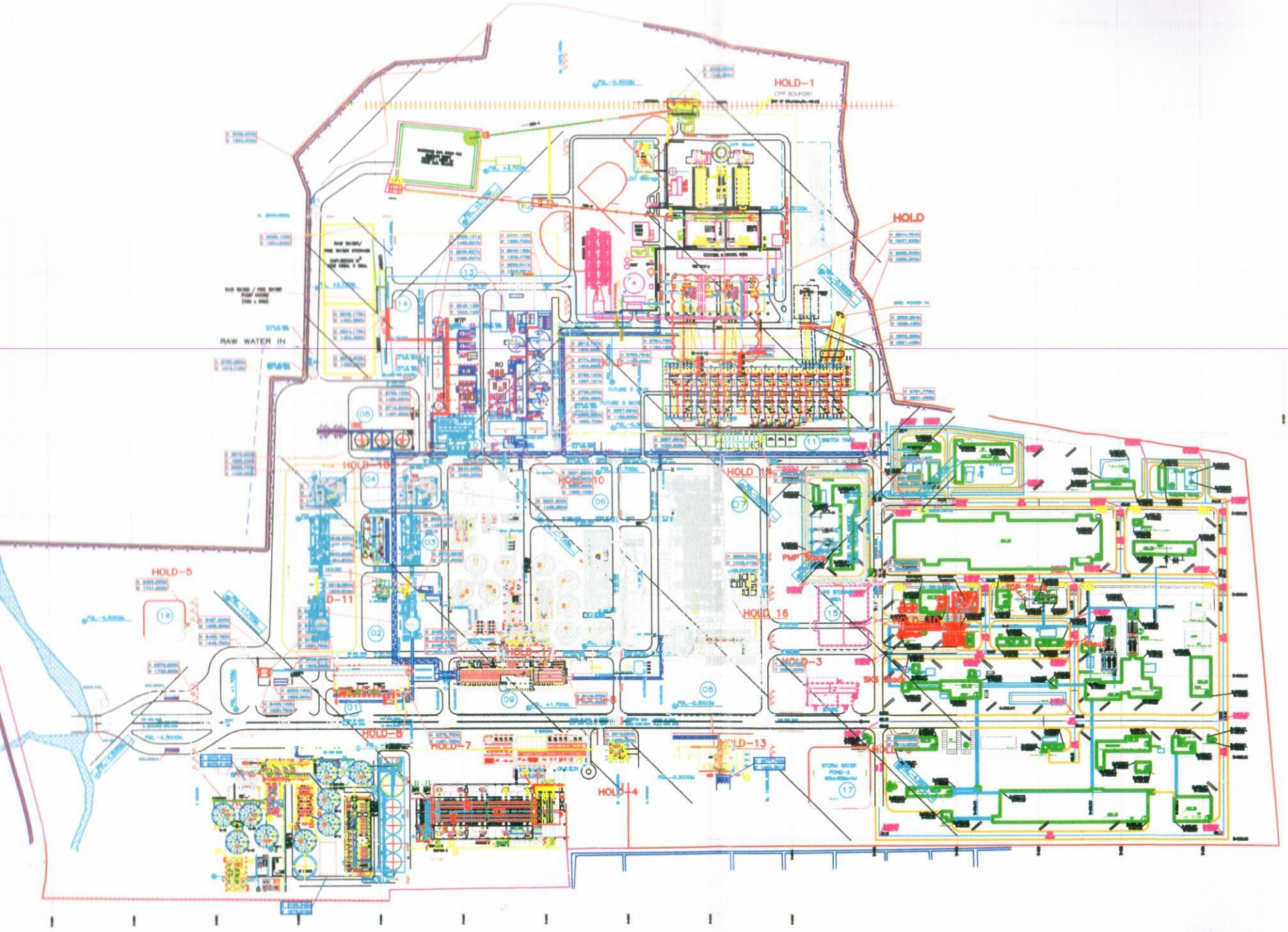

FIGURE-6.1

TABLE-6.3
HAZARDOUS MATERIALS STORED, TRANSPORTED AND HANDLED IN SMELTERS

Materials	Hazardous Properties
Chlorine	UN No. 1017 UN Hazard Class 2.3 – Toxic Gas UN Subsidiary Risk 8 – Corrosive substance
Fluorosilicic Acid	UN No. 1778 UN Hazard Class 8 – Corrosive substance UN Subsidiary Risk 3 & 6.1 – Flammable Liquid, Toxic Substance
Hydrazine	UN No. 2029 UN Hazard Class 8 – Corrosive substance UN Subsidiary Risk 3 & 6.1 – Flammable Liquid, Toxic Substance
Hydrogen Chloride	UN No. 1050 UN Hazard Class 2.3 – Toxic Gas UN Subsidiary Risk 8 – Corrosive substance
Morpholine	UN No. 2054 UN Hazard Class 8 – Corrosive substance UN Subsidiary Risk 3 – Flammable Liquid
Nitric Acid	UN No. 2031 UN Hazard Class 8 – Corrosive substance UN Subsidiary Risk 5.1 – Oxidizing Agent
Sodium Nitrate	UN No. 1498 UN Hazard Class 5.1 – Oxidizing Agent
Sodium Hydroxide	UN No. 1823 UN Hazard Class 8 – Corrosive substance
Sulphuric Acid	UN No. 1830 UN Hazard Class 8 – Corrosive substance
Vanadium Pentoxide	UN No. 2862 UN Hazard Class 6.1 – Toxic Substance

TABLE-6.4
HAZARDOUS MATERIALS STORED, TRANSPORTED AND HANDLED IN COMPLEX

Materials	Hazardous Properties
LDO	UN 1203. Dangerous Goods class 3 – Flammable Liquid
Diesel Fuel	UN 1202. Dangerous Goods class 3 – Flammable Liquid

6.3.4 Classification based on Inventory NFPA Rating

In order to ensure a steady supply of raw materials, process chemicals and fuels, adequate inventory of all these materials is maintained. The quantities stored and the degree of hazard in terms of NFPA ratings are given below. The National Fire

Protection Agency, USA (NFPA), on scale 0 to 4 (least to worst), hazard rating is used as a tool to assess the preliminary hazard potential of a material as given in **Table-6.5**.

TABLE-6.5
PROPERTIES OF THE FUELS EMPLOYED

Sr. No.	Raw Material	N_h	N_f	N_r	UEL	LEL	TLV	LD_{50}
01	HSD	0	2	0	7.5	0.6	5mg/m^3	-
02	LDO	2	2	0	-	-	5 mg/m^3	7500
03	Petrol	2	4	2	7.4	1.4	890	-
	Process Emissions							
06	Sulphurdioxide	2	0	0	NP	NP	5 mg/m^3	NL

6.3.5 Conclusion

From the above table it can be inferred that

i. Petrol falls under "Very High" Category of flammability index with Nf=4, HSD, and LDO fall under the "Moderate" category of flammable liquids with Nf=2

ii. Sulphuric acid falls under the category of "HIGH" health index with Nh being 3 and LDO, Sulphur dioxide fall under "Moderate" category of health index with Nh=2,

iii. Sulphuric Acid fall under " Moderate" Category of reactivity index with Nr=2,

6.3.6 Identification of Major Hazard Installations Based on GOI Rules, 1989 and the amended rules in October '1994

Following accidents in the chemical industry in India over the past few decades a specific legislation covering major hazard activities has been enforced by Govt. of India in 1989 in conjunction with Environment Protection Act, 1986. This is referred here as GOI rules 1989. For the purpose of identifying major hazard installations the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals. The indicative criteria adopted by the rules are listed in **Table 6.6**.

TABLE-6.6
INDICATIVE CRITERIA FOR IDENTIFICATION OF TOXIC, FLAMMABLE AND EXPLOSIVE CHEMICALS (GOI RULES, 1989)

a. Toxic Chemicals

Chemicals having the following values of acute toxicity and which, owing to their physical and chemical properties, are capable of producing major accident hazards

Sr. No.	Degree of Toxicity	Medium lethal dose by the oral route (oral toxicity) LD 50 (mg/Kg body weight of test animals)	Medium lethal dose by the dermal route (dermal toxicity) LD 50(mg/Kg body weight of test animals)	Medium lethal concentration by inhalation route (four hours) LC50 (mg/L inhalation in test animals)
1.	Extremely toxic	1-50	1-200	0.1-0.5
2.	Highly toxic	51-500	201-2000	0.5-2.0

b. Flammable Chemicals

i.	Flammable gases: Chemicals which in the gaseous state at normal pressure and when mixed with air become flammable and the boiling point of which at normal pressure is 20°C or below;
ii.	Highly flammable liquids: Chemicals, which have a flash point, lower than 23°C and he boiling point of which at normal pressure is above 20 °C.
iii.	Flammable liquids : Chemicals which have a flash point lower than 65°C and which remain liquids under pressure, where particular processing conditions, such as high pressure and high temperature, may create major accident hazards

c. Explosives

Chemicals which may explode under the effect of flame, heat or photo-chemical conditions or which are more sensitive to shocks or friction than dinitrobenzene.

Besides a list of hazardous substances with their threshold quantities are provided in Part II of Schedule I of the rules

Schedule II of the rules sets out the threshold quantities for isolated storage units

Schedule III gives a list of hazardous chemicals with their threshold quantities. In this schedule different chemicals are classified into distinct groups viz. Group 1 - Toxic substances, Group 2, Toxic substances, Group 3-Highly reactive substances, Group 4 - Explosive substances and Group 5 - Flammable substances

Schedule IV of the rules indicate various operations which are hazardous during production, processing or treatment of organic and inorganic chemicals

A systematic analysis of the chemicals and their quantities of storage of chemicals has been carried out, to determine threshold quantities as notified by GOI Rules, 1989 and **amended rules in 1994** and the applicable rules are identified.

Based on the indicative criteria inventory (liquids/fuels) stored at DSC project site have been analyzed for applicability of GOI rules (**Table-6.7**) and the results are summarized in **Table 6.8**.

TABLE 6.7
DESCRIPTION OF APPLICABLE PROVISIONS OF GOI RULES'1989 AS AMENDED IN 1994

GOI Rules	Description
1	• Identify Major accident Hazards • Take adequate steps to prevent major accidents • Provide information to persons working onsite. • Impart training, provide equipment and antidotes
2	Notification of major accidents to concerned authority If any major accident occurs, occupier to inform. Concerned authority as listed in SC-5, and submit report as per the format in SC-6 (applies after commencing of the activity)
3	Notification of site to competent authority
4	Updating of site notification following changes in threshold quantity
5	Transitional provision for the existing activity
6	Preparation of safety reports for commencement of activity
7	Updating of safety reports based on modification
8	Provision of further information on safety reports to the authority
9	Preparation of onsite emergency plan by the occupier
10	Preparation of offsite emergency plan by the occupier
11	Information to be given to persons liable to be effected by a major accident
12	Collection development and dissemination on hazardous chemicals employed by the occupier
13	Occupier shall develop information in the form of safety data sheet as specified in SC-9 Every container of the hazardous chemical should be labeled with name of the manufacturer or importer of the hazardous chemical

TABLE-6.8
APPLICABILITY OF GOI RULES TO STORAGES

Sr. No.	Chemical/ Fuel	Listed in Schedule	Total Quantity	Threshold Quantity (T) for Application of Rules	
				5,7-9,13-15	10-12
1	H_2SO_4	1 (part II)	20000 T	-	-
2	LDO	3(1)	865 KL	25 MT	200 MT
3	LPG	3(1)	40 T	25 MT	200 MT
4	LSHS	3 (1)	450 KL	25 MT	200 MT
5	Chlorine	2	2 T	-	-

6.3.6.1 Conclusion

From the above table it can be inferred that

i. LDO and Sulphuric acid attract the GOI rules as they are listed in various schedules of the rules

ii. LDO with storage quantity of 865 KL attract rules 5, 7-9 and 13-15 as the stored quantity is more than that of the stipulated threshold quantity of 25 t.

6.4 Hazards in Power Generation Systems

- Fire and explosion hazard due to the storage and handling of the fuel oil;
- Internal explosion hazard in the steam generator due to high-pressure steam;
- Electrical hazards due to high voltage current;
- General mechanical hazards in the turbine-generators; and
- There will not be any effect of high wind on the flame, since the boiler is closed and flame is not exposed to atmosphere.

6.5 Short Listed Hazards

Based on the preliminary hazard analysis, the following scenarios are short-listed for consequence analysis to quantify the risks involved. The nature of Hazards that could occur at DSC are presented in the **Table-6.9** along with the sources:

TABLE-6.9
SHORT LISTED HAZARDS

Nature of Hazards	Sources & Location
Fire Hazards	i. HSD, Petrol, & LDO Storage area ii. HSD Storage & handling in DG Power House iii. LDO Storage and handling in Zinc dust plant iv. Hot Liquid metal handling in Zinc melting plant, Zinc dust unit
Toxic Hazards	i. Release of SO_2/ SO_3 gas in roaster and acid plant ii. Reaction of sulfuric acid with water to produce heat, toxic & corrosive fumes.
Explosion Hazard	i. Zinc dust explosion in Zinc dust plant.
Asphyxiation	i. Release of SO_2/ SO_3 gas in roaster and acid plant
Fire / explosions due to spillage of liquid metal	i. Spillage / transfer of liquid metals/ spillage of water over liquid metals in zinc melting plant/ zinc dust plant
Heat radiation due to hot metal handling	i. Spillage of liquid metal in zinc melting plant/ zinc dust plant .
Accidents due to material handling equipment	i. Connected with all material handling activities and equipment
Acid burns	i. Storage and handling of concentrated Sulfuric acid

Toxic fumes	i. Zinc electrolysis plant, acid storage and handling in leaching and control laboratory
Dust hazard	i. Storage and handling in zinc concentrate storage yard
High voltage electrical hazard	i. DG Power house, switch yard, HT Motors/ lines
Fall from height	i. Civil construction works, welding and other hot jobs done at height.

Rajpura Dariba mine has underground operations with proposed expansion of ore processing/beneficiation/smelter/power plant operations. The major hazards are more likely to be in the mining operations and the storage/handling of chemicals used in beneficiation/smelter/power plant operations. In the Metalliferrous Mines Regulations (1961), possibility of occurrence of hazards and the mitigation measures are spelt out in detail. Accident or hazardous situation may arise due to occurrence of any one of the following causes.

- Out break of fire;
- An influx of noxious gases;
- An irruption of water;
- Premature collapse of any part of workings;
- An accident due to the explosives;
- A fracture or breakage of any essential part of winding system;
- Bursting of any equipment at high pressure;
- Air blast &
- Subsidence.

The causes for above and preventive measures are discussed below.

6.5.1 Out break of fire

Some precautions and remedial measures proposed to be adopted to prevent fires are:

- Inflammable material shall not be stored in underground except in fireproof containers;
- To avoid surface fire, all structure with 10-m of shaft, ramp and incline to be constructed of incombustible material;
- Surface workshop, diesel filling station, compressor house and electric sub-station shall be provided with fire fighting equipments and to be maintained regularly;
- Dry vegetation shall not be present within a distance of 15-m from any entrance to the mine;
- Regular inspection will be done to remove accumulation of greasy material cotton waste, old conveyor pieces, waste hose pipes, wooden scrap, wood cuttings etc. shall be removed regularly;
- A proper alarm system shall be installed to warn under ground worker about out break of fire;
- Electric apparatus, electric cables etc. shall be checked regularly;

- Adequate number of persons will be trained in fire fighting. Mock drills will be conducted on regular basis.
- Availability of Fire Tender at all times, in case of fire on surface.

On the appearance of signs indicating that a fire has broken out, all persons other than those whose presence in the mine is deemed necessary for dealing with the fire shall be immediately withdrawn from the mine.

Fire fight operations would be carried out under the supervision of competent persons along with trained fire fighting personnel.
Sufficient supply of sand or incombustible dust or sufficient portable fire extinguishers shall be provided at every entrance to a mine, at every landing and the bottom of every shaft or winze in use, at every engine room and at every other place where timber, canvas, grease, oil or other inflammable material is stored. Water hydrants will be provided at all necessary locations. Suitable types of fire extinguishers will be provided at different locations to deal with different types of fire.

6.5.2 Influx of Noxious Gases

No such hazard is perceived at Rajpura Dariba mine. However, following precautionary measures will be observed:

- Inflammable gas shall be deemed to have been detected when it is indicated by the lowered flame of a flame safety lamp or where methane indicators are used they indicate one and a quarter per cent or more of inflammable gas;
- When any person detects the presence of inflammable gas, he shall immediately withdraw from the place and shall inform his superior official about the same;
- When inflammable or noxious gas is detected, all persons shall be evacuated from the place, and the place shall be immediately fenced of so as to prevent persons inadvertently entering the same;
- No person shall be re-admitted in to the place where the gas was detected until a competent person has examined the place and has reported that the place is free from gas;
- In long drives or blind workings, a flame safety lamp will be always maintained;
- Persons will be trained in the use of flame safety lamps. The competent person will take steps to remove the gases by improving ventilation

6.5.3 Irruption of Water

As there is no surface river, pond nallah etc. above the mine hence possibility of danger from surface water inundation is not envisaged.

A water danger plan showing the following features will be maintained as required by regulations.

(1) The position of the workings below ground;
(2) Every borehole and shaft (with depth) drive, crosscut, winzes, raise, excavation and air passage connected therewith;
(3) The position of every dyke fault and other geological disturbance, with the amount and direction of throw;
(4) 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;
(5) 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;
(6) 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;
(7) Surface contour lines drawn at vertical intervals shall not exceed five meters; and
(8) The highest flood level of the area.

6.5.4 Premature collapse of any part of workings

Based on the rock quality assessment and the chosen method of mining, no premature collapse of any part of working is anticipated. However, following precautionary measures will be observed.

- To prevent premature collapse of any workings, effective supports will be erected based upon the geotechnical mapping. All workings will be systematically supported to eliminate any possibility of premature collapse;
- Numerical modeling techniques will be used to determine the stable spans;
- The hang wall and crown pillar will be instrumented with multi point boreholes extensometer and stress meter for ground monitoring on regular basis.

6.5.5 Accident due to the Explosives

Detailed guidelines have been provided in the regulations and various circulars. The measures proposed are:

- Explosives will be issued only to the authorized persons;
- Explosives and detonators will be transported in separate boxes under lock and key;
- The person holding the statutory certificates will carry out the blasting operations;
- Large diameter blasting would be carried out after withdrawing all persons from below ground;

- A register will be maintained at the gate checker office, where all section foremen will countersign indicating the removal of persons from their sections before carrying out large hole diameter blasting;
- The blaster will ensure that all persons have taken proper shelter before blasting the charge.
- The Blasting site would be inspected after blasting by competent person so as to ensure that no charged explosive is left out.

6.5.6 Breakage of any Essential part of Winding System

- Detailed provisions exist in the mine regulation for transportation of men and materials in shaft;
- The statutory provisions shall be complied along with the manufacturers recommendations; and
- Statutory qualified personnel will be appointed for operation and maintenance of winding facilities.
- Periodic non-destructive testing (NDT) of critical parts of winder installation will be carried out.
- Daily checking and condition monitoring of cage, skip, counterweight, wire ropes, attachments & critical parts of winder by competent person with proper records thereof.

6.5.7 Bursting of any Equipment at High Pressure

- All apparatus used as or forming part of the equipment of mine, which contains or produce air at a pressure greater than atmosphere pressure shall be so constructed, installed and maintained as to obviate any risk of fire, bursting explosion or collapse or the production of noxious gases;
- Every air receiver forming part of a compressing plant shall be fitted with a safety valve and an air gauge, which shows pressure in excess of the atmospheric pressure;
- Before an air receiver commissioned, the engineer or other competent person shall subject it to a hydraulic test at pressure at least one and a half times the maximum permissible working pressure; and
- A similar test shall be made after every three years. Proper records will be maintained.

The supply of air for air compressors shall be drawn from a source free from dust and fumes.

6.5.8 Precautions against Air Blast

Any large scale collapse of wall rocks into voids may displace the air in violent manner and cause accidents. No such danger is anticipated. However, the following precautionary measures will be observed in case of eventuality:

- Persons will be trained to deal with situations arising out of Air blasts;
- Air blast shelter would be established at suitable locations; and
- The drawal points in the stopes would not be totally emptied.

6.5.9 Surface Subsidence

- Subsidence-Prediction and Prevention

A detailed study has been carried out on the ground stability at Rajpura Dariba, using both Empirical and Numerical modeling method. The objective of the study was to find out if there is a possibility of any sort of physical disturbance of the ground surface in the mining area due to the mining activity below ground.

Empirical Mathew's Stability Graph method has shown that all the stope walls are fully stable during the entire period of mining .The detailed analysis report is enclosed as **Annexure-IX**.

Numerical modeling analysis has been carried out using geo-mechanics software FLAC-3D ,considering yielding /plasticity failure conditions which are allowed to be transferred to surface, enabling identification of any possible surface disturbance. The modeling results have indicated that the immediate hanging wall of the stopes are stable and local ground displacements adjacent to stop wall do not exceed 7mm up to a maximum depth 3m.It also show that surface ground do not experience any subsidence. Detailed analysis and relevant modeling-result drawings are annexed.

Both the analysis show that the surface subsidence and horizontal strain are negligible. The core area of mining will be free from subsidence and it will not have any appreciable effect on surface. No point on surface will have subsidence greater than 5mm which is very negligible and not measurable.

- Subsidence Management Plan

The core area of mining is not likely to have appreciable subsidence and tensile strain on the surface. Therefore, no subsidence plan is being suggested. However, regular monitoring of subsidence at the surface shall be carried out.

Surface subsidence shall be monitored in the area at the nodes of grid formed by lines at 100 m interval. The readings shall be recorded at 3 months interval. Locations having subsidence greater than 0.25 mm shall be carefully looked into and the subsidence survey shall be carried out at those locations on monthly basis.

6.6 Prediction of Impact on Ground Vibration due to Blasting

Central Mining Research Institute (CMRI), Dhanbad studied and completed prediction of ground vibration due to blasting and its environmental impacts during mining expansion operations proposed to be conducted at Rajpura Dariba Underground Lead-Zinc mine Project. The study involved blast vibration

prediction for the safety of the houses/structures at Rajpura Dariba village and its surrounding due to proposed underground expansion mining operations.

The results of prediction of blast vibration and recommendations, made thereof, are summarised below:

- The maximum predicted vibration level on the surface during the development of drives comes to 12.91 mm/s, when blast will be performed at 50 m below ground with explosives weight per delay of 8.4 kg. Such level of vibration should not cause any damage to the surface structures above the blasting face.

- The frequency of blast vibration generated due to underground blasting at Rajpura Dariba lead-zinc mine would be more than 25 Hz. So, the threshold limit of vibration for the safety of surface structures would be 15 mm/s as per DGMS standard.

- The amount of explosive weight per delay to be detonated in a delay at various depth of cover to generate vibration level of 15 mm/s. In-hole-delay detonator should be used to maintain specified charge weight per delay for safe and efficient blasting operations.

- The centre initiation should be preferred due to its proper energy distribution as compared to the bottom initiation of the charge in a hole. There are many disadvantages in putting booster at lowest charged position of a blast hole.

- It is recommended that the Nonel initiation system should be preferred to initiate the explosives. The ANFO should be used only in dry hole whereas the emulsion/slurry explosives should be used is dry/watery holes.

- The recommended blast designs should be followed for day-to-day blasting operations for safe and efficient blasting operations.

- The blast designs will generate blast induced ground vibration well within the statutory limits as prescribed by the Director General of Mines Safety (DGMS) and therefore will ensure the safety of surface structures and the nearest residential property beyond 50 m of the blasting face. As such, there will be no environmental impacts at the nearest residential property.

6.7 Care and maintenance during temporary discontinuance

Mine will take all due care and maintenance in case of any situation arising of such nature. In case of discontinuance of mine production and beneficiation, the dewatering of mine and activities related to maintenance of plant and machineries will be carried out continuously in that period to keep them ready for future production activity at the time of resumption. Also mine will ensure to comply related statutory requirements.

6.8 Preliminary Hazard Analysis

The various hazards listed in **Table-6.10** are identified primarily based on the physical and chemical properties of the materials handled, and the nature of operations carried out in the plant. No quantitative analysis is made, and therefore it is not implied that undesired events and undesired consequences will necessarily result from these hazards.

In order to determine whether any undesired events with emergency consequences are probable from these hazards, a preliminary hazard analysis is carried out. For this, the data available from the past accident analysis in similar installation, engineering judgment and the proposed built-in safety systems in the plant design are taken into consideration.

Based on the preliminary hazard analysis, the following conclusions are made:

- The electrical and mechanical hazards present in the various sections of the plant do not lead to any emergency consequences. They will be mostly localized;
- The internal explosion hazard for the steam generator due to high pressure steam is unlikely to lead to any major consequences owing to the built-in fail-safe protective system;
- The fire and explosion hazard is more severe in the bulk fuel storage area than in any other section of the plant. This is because of the quantities of the flammable materials handled in the bulk storage area are much larger than those at any other section;
- Emergency consequences are probable from the fire hazard present in the bulk fuel storage area, in case of a major accident; and

In the following section, the various credible accident scenarios and their probable consequences are analyzed.

TABLE 6.10
HAZARDOUS AREAS AND POTENTIAL HAZARDS

Hazardous Areas	Potential Hazards
Steam turbine generator Area	Internal explosion, electrical, general mechanical
Transfer area and switch yard	Electrical
Fuel storage and handling Areas	Fire and explosion
Sodium hydroxide storage area	Corrosive
Digestors	Corrosive
Precipitators	Corrosive

6.9 Hazard Associated with Coal Storage and Handling System

6.9.1 Hazards in Coal Handling System

The major stages involved in coal handling are:

- Unloading of coal;
- Transport through conveyor belts to coal yard; and
- Crushing and pulverization of coal into small particles and conveyed to the coal feeders.

Basically, these are all mechanical operations and should not result in any major hazard. However, coal being combustible, can burn, given the right environment and conditions, such as smaller particle size, air, ignition sources etc. The average particle size of the coal unloaded at the plant is approximately 50-mm and should not result in fire or explosion. When crushed to less than 20-mm, it could result in fire and/or explosion if sufficient percentage of dust exists. However, dust explosions are only probable if a significant percentage of the particles less than 75 microns exist.

An elaborate and effective fire protection system will be provided in the plant. Further, water spray will be done during the summer on the coal yard. All the precautions as per Factory Act and guidelines of Tariff Advisory Committee (TAC) will be followed.

6.9.2 Coal Storage

Coal storage piles are subject to fires caused by spontaneous heating of the coal. The coal most susceptible to self heating is those with high pyretic content and high intrinsic moisture and oxygen content, such as low rank coals. The mixing of high pyretic coals with high moisture and oxygen coals increases self heating.

There are measures that can be taken to lessen the likelihood of coal pile fires. These measures are dependent on the type of coal. Among the more important are:

a. Short duration, active, or "live" storage piles should be worked to prevent dead pockets of coal a potential source of spontaneous heating;
b. Coal piles should not be located above sources of heat, such as steam lines, or sources of air, such as manholes;
c. Coal placed in long term storage should be piled in layers, appropriately spread, and compacted prior to the addition of subsequent layers to reduce air movement and to minimize water infiltration into the pile;
d. Different types of coal that are not chemically compatible should not be stored in long term storage piles; and
e. Access to coal storage piles should be provided for fire fighting operations and for pulling out hot pockets of coal.

6.9.3 Coal Handling by Belt Conveyors

a. Injuries from pinch points. Employees could be pulled in when their hands, clothing, or tools are caught in the pinch point;
b. Injuries from pieces of material falling from moving conveyors;
c. Injuries and deaths to workers crushed against stationary objects by moving conveyors;
d. Injuries to workers who reach in around guards at heads and tail pullys that are running;
e. Injuries to workers who service moving conveyor belts;
f. Injuries to workers who fall while trying to cross over conveyors where there is no crosswalk;

g. Fires from friction, overheating, or static or other electrical sources;
h. Explosions of coal dust raised by combustible materials at transfer points, where belts are loaded or discharged;
i. Hazards to health and vision from irritating dusts;
j. Electrical shock from ungrounded or improperly installed controls or conductors; and
k. These injuries and hazards may be reduced by proper guards and environmental controls on bulk material handling conveyors.

6.9.4 Recommendations

6.9.4.1 Coal Storage

Coal storage piles are subject to fires caused by spontaneous heating of the coal. The coals most susceptible to self heating are those with high pyretic content and high intrinsic moisture and oxygen content, such as low rank coals. The mixing of high pyretic coals with high moisture and oxygen coals increases self heating. There are measures that can be taken to lessen the likelihood of coal pile fires. These measures are dependent on the type of coal. Among the more important are:

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d. Different types of coal that are not chemically compatible should not be stored in long term storage piles; and
e. Access to coal storage piles should be provided for fire fighting operations and for pulling out hot pockets of coal.

6.9.4.2 Dust Suppression and Control

Coal dust generated due to coal handling constitutes a fire and explosion hazard that should be controlled by one or more of the following methods.

a. Dust collection system (de-dusting system);
b. Dust suppression system (water spray)/dry fog system; and
c. Open air construction.

Where dust collection or suppression systems are installed to prevent dust concentration, appropriate electrical and mechanical interlocks should be provided to prevent the operation of coal handling systems prior to the starting and sustained operations of the dust control equipment.

a. Dust suppression systems usually consist of spray systems using water and/or surfactants to reduce the dust generation of coal handling operations. The

sprays are normally applied at or near those locations where the coal is transferred from one conveyor to another;

b. Dust collection hoppers should be emptied prior to shutting down dust removal systems to reduce the likelihood of collector fires originating from spontaneous heating in the dust hopper; and
c. High level detection with annunciate alarms should be provided for the dust hoppers.

6.9.4.3 Handling Coal Fires

When fire occurs, and its location and extent have been determined, the best procedure is to dig out and remove the coal in the heated zone as promptly as possible. Drench the hot coal with water as it is exposed. During a coal fire, carbon monoxide and carbon dioxide are formed. It is recommended that canister/cartridge for CO be provided to fire fighting personnel.

- **Coal Handling System**

a. All conveyors within walkway surface must have alternate passageways that comply with life safety code NFPA 101 requirements if the walkway is a means of egress. Frequently, a work platform on a movable conveyor tripper can be used as a crossover, if properly railed.

b. Conveyors running in tunnels, pits and similar enclosures should be provided with adequate drainage, lighting, ventilation guards, and escape ways wherever it is necessary for persons to work in or enter such areas. Sufficient side clearance should be provided to allow safe access way and operating space for essential inspection, lubrication, repair and maintenance operations.
c. Elevated conveyors should have access platforms or walkways on one or both sides. Handrails and platforms should be provided at appropriate locations. Flooring should be of checkered place or other non-slip surface, particularly on sloping walkways.
d. Crossovers or underpasses with proper safeguards should be provided for passage over or under conveyors, except where safe passageways are provided, should be prohibited. Riding on a conveyor should be absolutely forbidden.
e. Pull cord may be provided along the conveyor for emergency shutdown.

- **Operating Procedures**

a. The starter button or switch for a conveyor should be located so that the operator can see as much of the conveyor as possible. If the conveyor passes through a floor or wall, each area should be equipped with starting and topping devices, and the simultaneous operation of all starting buttons or switches should be required to start the conveyor. These start-stop devices should be marked clearly, and the area about them must be kept free of obstruction so they can be seen and reached easily. Electrical or mechanical interlocking devices should be provided, which will automatically stop a

conveyor, when following units are stopped or blocked, so that it cannot receive additional loads.

b. If two or more conveyors operate in series, controls should be designed so that, if one conveyor is stopped, all conveyors feeding it are also stopped.

c. Emergency stop devices should be located not more than 23 m apart along walkways by the conveyor. Alternatively, a good solution is to have a lever operated emergency stop device at the tail end of the conveyor, with a strong cord or wire strung on each side of the conveyor for its entire length. A pull on the cord or wire will stop the conveyor.

d. On conveyors, where there is a possibility of reversing or running away, anti runaway, a back stop devices can be provided on the conveyor track so that the load (or conveyor parts) cannot side or fall.

e. Fire on electrical motors providing motive power to the belts is another probability. The motor may be over loaded by excessive friction within the motor itself, obstruction in the driven belt, over loading the belt beyond the capacity of the motor etc. if any of these conditions cause overloading of the motor, heating will increase considerably resulting in the breakdown of insulation, melted soldered connections or bearings burning out. To safeguard the motor, it is recommended that overload relay opening circuit to the motor be frequently checked and should be maintained in a good working condition. In addition to the overload protection customarily provided for electric motors, there should be an overload device designed to protect the conveyor and mechanical drive parts, in the event of an overload, the device must shut off the electric power quickly, disconnect the conveyor or drive parts from the motive power, or limit the applied torque.

f. The loading and discharge points of a conveyor carrying material in fine or powdered form should be covered with exhaust hoods and should have good general ventilation, to prevent the formation of dust clouds. Dust removal must be carried out periodically.

g. Persons working near or on conveyors should wear close fitting clothing that cannot become caught in moving parts. Safety shoes are recommended. If the conveyor galleries are dusty, goggles and, if necessary, respirators should be worn.

h. Belts should be protected by automatic system of sprinklers or water spray all the way. The belt drive could be interlocked with the sprinkler system to effect a simultaneous shutdown.

i. To help earthing of static charges from belt conveyors, tinsel or needle point static collectors can be placed close to the out running sides of the drive pulleys and idlers which along with the shafting can be grounded through carbon or bronze brushes running on the shaft.

j. Wherever the worker have access to the conveyor it should be possible to switch off the installation by means of an emergency pull cord which follow the total route be restarted from another location except the control room. The overhead conveyor belt should have a collecting tray through out the route or at least at the road crossings to collect dropping.

6.9.4.4 Additional Precautions for Coal Conveyors

Each conveyor system should be arranged to automatically shut off driving power in the event of belt slowdown of greater than 20 percent or misalignment of belts. In addition, a complete belt interlock shutdown system should be provided so that, if any conveyor stops, the power to all conveyor systems feeding that belt would be shut down automatically.

6.9.4.5 Coal Conveying and Handling Structures

Coal conveying and handling structures and supports should be of non combustible construction.

Fire Protection

a. Automatic sprinkler or water spray system should be provided for coal handling structures. Sprinkler systems should be designed for a minimum of 0.25 gpm per sq.ft. (0.17 L/sec-m2)
b. If a sprinkler system is used to protect the coal conveyor, particular care must be exercised in locating closed sprinkler heads so that they will be in the path of the heat produced by the fire and still be in a position to provide good coverage of all belt surfaces along the conveyor.
c. Activation of water spray or sprinkler systems should shut down the conveyor belt.
d. Dust collectors and fans should automatically shut down along with other related equipment upon detection of fire.
e. Draft barriers installed at the end and midpoints of enclosed conveyors should be considered in the fire risk evaluation. Dust barrier will reduce the response time of installed automatic sprinkler or detection systems and minimize the chimney effects in the event of fire.
f. Static electricity hazards should be minimized by the permanent bonding and grounding of all equipment, including duct work, conveyor drive belts, pulley, idlers, take up reels, motor drives, dust collection equipment and vacuum cleaning equipments.

6.10 Consequence Analysis

Based on the preliminary hazard analysis, pool fire scenario is considered for the consequence analysis to quantify the risks involved in failure of LDO storage facility.

6.10.1 Fuel Oil Storage

Based on the storage and consumption of various fuels and chemicals 'Simultaneous failure of two tanks' of the proposed lead smelter, zinc smelter, CPP, mines expansion, and beneficiation expansion project have been identified for MCA analysis considering the maximum number of tanks stored in each dyke and the details are given in **Table-6.11**. The fuel properties considered in modeling are given in **Table-6.12.**

TABLE-6.11
SCENARIOS CONSIDERED FOR MCA ANALYSIS

Fuel/Chemical	Total Quantity	Scenarios Considered
Simultaneous Failure LDO tanks	2 x 420 KL	Pool fire

TABLE-6.12
PROPERTIES OF FUELS CONSIDERED FOR MODELING

Sr. No.	Fuel	Molecular Weight Kg/kg.mol	Boiling Point ^0F	Density Kg/m^3
1	LDO	114.2	369	840

6.10.2 Model used for Consequence Analysis of LDO

Radiation program **RADN** has been used to estimate the steady state radiation effect from Storage tanks at different distances. The model has been developed in-house by **VIMTA** based on the guidelines specified by **World Bank**, technical paper No. 55 [Techniques for Assessing Industrial Hazards, Technical, Limited]. The equations used for computations are described below:

- ***Pool Fires***

The model employed in the estimation of pool fires is derived from TNO (1979) and involves the use of classical empirical equations to determine burning rates, heat radiation and incident heat.

The spreading model given here is that of Shaw and Briscoe (1978). This assumes a cylindrical pool spreading on a smooth level surface. The pool radius is given as follows:

For an Instantaneous Spill

$r = [t/\beta]^{1/2}$ where $\beta = [\ \pi\rho 1/8gm]^{1/2}$

where,

r = Radius of pool;
t = Time;

β = Spread rate parameter;
$\rho 1$ = Liquid density;
g = Gravitational acceleration;
m = Mass

For a Continuous Spill

$r = [t/\beta]^{3/4}$ where $\beta = [\pi\rho 1/32gW]^{1/3}$

where,
W = Mass of material released

Given the radius, the evaporation rate at a given time can be calculated.

For a liquid with a boiling point above ambient temperature, the rate of burning of the liquid surface per unit area is given by:

$dm/dt = [0.001 H_c]/ C_p (T_b-T_a) + H_{vap}$

where,
H_c = Heat of combustion;
C_p = Specific heat at constant pressure;
T_b = Boiling point;

For a liquid with a boiling point below ambient temperature, the expression is:
$dm/dt = 0.001 H_c/H_{vap}$

The total heat flux from a pool of radius r is given by:
$Q = \{(\pi r^2 + 2\pi rH) [dm/dt]\eta H_c\}/72 [dm/dt]^{0.61} +1$

where ,
Q = Total heat flux;
r = Pool radius;
H = Flame height;
η = Efficiency factor in the range of 0.13 to 0.35 and in the absence of better data, the conservative value 0.35 should be used,
H_c = Heat of combustion

The flame height (H) is calculated from the total heat emitted from the flame surface, according to TNO (1980), as:

$H = 84 r [(dm/dt)/\rho a(2gr)^{1/2}]^{0.6}$

When the heat flux at the surface of pool fire has been calculated, the heat incident upon nearby objects may then be determined. A simplified method assumes that all the heat is radiated from a small vertical surface at the center of the pool.

For a ground pool, the heat incidence at a distance R from the pool center is given by:

$I = TQ/4\Pi R^2$

Where

I = Intensity of heat radiation;
T = Transitivity of the air path. In the absence of good data to the contrary, the transitivity is set to unity, this gives conservative results
Q = Release rate

In high winds the flame will tilt significantly, increasing radiation levels downwind of the pool and decreasing those upwind of the pool. The angle by which the flame is tilted from the vertical according to American Gas Association (1974) is:

$\phi = \cos^{-1} (u^{-1/2})$
Where 'u' is wind speed in m/sec.

LDO on Fire

Fire could occur due to the presence of ignition source at or near the source of spill or could occur due to flashback upon ignition of the traveling vapor cloud. LDO is stored in fixed roof tanks. Tank fires may occur due to the following:

- Ignition if rim seal leak leading to rim seal fire and escalating to full fledged tank fire. Lighting is a major source of ignition of tank fires; and
- Overflow from tank leading to spillage, vapor cloud formation and its subsequent long period. Ignition, which flashes back to the tank leading to tank fire. The chance of overflow should be less unless operator has grossly erred in receiving LDO into the respective tanks. Spillage due to overflow may result in a dike fire if ignition occurs after sufficiently long time.

6.10.3 Methodology

Tank at the storage facility is evaluated to assess the effect in the event of its catching fire. For the present study, the scenarios under consideration assume that the peak level of radiation intensity will not occur suddenly. Based on the past experience, it is found that 20-30 minutes time will be required before a tank fire grows to full size. For radiation calculations, full tank fire has been considered. From the above considerations, the criteria of **4.5 kW/m^2** have been selected to judge acceptability of the scenarios.

The assumptions for calculations are:

- It is not continuous exposure;
- There is not enough time available for warning the public and initiating emergency action;

- Secondary fire at public road and building is not likely to happen;
- The effect of smoke on reduction of source radiation intensity has not been considered; therefore hazard distance calculated tend to be conservative; and
- Shielding effect of intervening trees or other structures has not been considered. No lethality is expected from this level of intensity although burn injury takes place depending on time of exposure.

6.10.4 Release Rate Estimation

Leakage rates for various scenarios are estimated based on the storage facilities. These are given in **Table-6.13.**

TABLE-6.13
RELEASE RATE ESTIMATION

Scenarios	Release Rate/Quantity
Storage Tank on fire – LDO	2 x420 KL

Release rate from LDO tank is based on the quantity of fuel stored in the tank.

6.10.5 Damage Criteria

The fuel storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to an accidental release of any hydrocarbon arise from fire and explosion. The vapors of these fuels are not toxic and hence no effects of toxicity are expected.

Tank fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal tank pressure. Pool fire would occur when fuels collected in the dyke due to leakage gets ignited.

- **Fire Damage**

A flammable liquid in a pool will burn with a large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convected away by rising hot air and combustion products. The radiations can heat the contents of a nearby storage or process unit to above its ignition temperature and thus result in a spread of fire. The radiations can also cause severe burns or fatalities of workers or fire fighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of a flammable liquid pool likely to be created due to leakage or catastrophic failure of a storage or process vessel. This will help to decide the location of other storage/process vessels, decide the type of protective clothing the workers/fire fighters need, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for the nearby storage/process vessels. **Table-6.14** tabulates the damage effect on equipment and people due to thermal radiation intensity.

TABLE-6.14
DAMAGE DUE TO INCIDENT RADIATION INTENSITIES

Sr. No.	Incident Radiation (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	Damage to People
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	50% Lethality in 1 min. Significant injury in 10 sec.
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected adjoining equipment	--
4	12.5	Minimum energy to ignite with a flame; melts plastic tubing	1% lethality in 1 min.
5	4.5	--	Causes pain if duration is longer than 20 sec, however blistering is un-likely (First degree burns)
6	1.6	--	Causes no discomfort on long exposures

Source: *Techniques for Assessing Industrial Hazards by World Bank*

The effect of incident radiation intensity and exposure time on lethality is given in **Table-6.15.**

TABLE-6.15
RADIATION EXPOSURE AND LETHALITY

Radiation Intensity (kW/m^2)	Exposure Time (seconds)	Lethality (%)	Degree of Burns
1.6	--	0	No Discomfort even after long exposure
4.5	20	0	1^{st}
4.5	50	0	1^{st}
8.0	20	0	1^{st}
8.0	50	<1	3^{rd}
8.0	60	<1	3^{rd}
12.0	20	<1	2^{nd}
12.0	50	8	3^{rd}
12.5	--	1	--
25.0	--	50	--
37.5	--	100	--

6.10.6 Hazard Analysis Based on Engineering Judgment & Past Accidents.

Engineering judgment based on experience and past incidents provides a wealth of information on causes and prevention of accidents. Failures in chemical plants can lead to sudden release of hazardous materials. The consequences of such releases are generally in the form of heat radiation, explosions and toxic gas dispersions.

Vapour cloud explosions have been the predominant cause of the largest losses in the chemical and petro-chemical industries. More than hundred VCE's have been reported to have occurred from 1921 to 1991. Statistics of past incidents in VCE has shown that a number of VCE incidents have been reported involving hydrogen, naphtha, methane, etc.

6.11 Maximum credible accident analysis

Hazardous substances may be released as a result of failures or catastrophes, causing possible damage to the surrounding area. This chapter deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models.

A disastrous situation is generally due to outcome of fire, explosion or toxic hazards in addition to other natural causes, which eventually lead to loss of life, property and ecological imbalance.

Major hazards posed by hazardous chemical storages can be identified taking recourse to MCA Analysis. MCA analysis encompasses certain techniques to identify the hazards and calculate the consequent effects in terms of damage distances of heat radiation, toxic releases, vapour cloud explosion, etc. A host of probable or potential accidents of the major units in the complex arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed.

Various models for calculating the physical effects of the incidental release of hazardous substances are detailed subsequently. First, attention is paid to the factors, which are decisive for the selection of the models to be used in a particular situation, after which the various effect models are discussed.

6.11.1 Injuries Resulting from Flammable Liquids and Gases

In the case of flammable liquids and gases and immediate ignition a pool fire or BLEVE or a flare will occur. The injuries in this case are mainly caused by heat radiation. It is only in the case of a BLEVE that injuries may occur as a result of the shock wave or tank fragments flying about. Serious injuries as the result of the shock wave generally do not occur outside the fire ball zone. Fragmentation of the storage system can cause damage upto distance of over 1 km depending on the capacity of the affected storage tank. If the gas is not ignited immediately, it will disperse into the atmosphere. If the gas cloud ignites it is assumed that everyone present within the gas cloud will die as a result of burns or asphyxiation. Outside the gas cloud the duration of the thermal load will be too brief to cause any injuries. In the event of very rapid combustion of the gas cloud the shock wave may cause damage outside the limits of the cloud. Explosive combustion will only occur if the cloud is enclosed to some extent between buildings and obstacles. The mathematical models and analytical models for hazard analysis are given in **Table-6.16** and damage criteria in **Table-6.17** alongwith damage due to peak over pressure in **Table-6.18**.

TABLE-6.16
MATHEMATICAL MODELS AND ANALYTICAL MODELS FOR HAZARD ANALYSIS

Sr. No.	Phenomenon	Applicable Models
01	**Out Flow**	
	- Liquid	Bernoulli flow equation; phase equilibria, multiphase flow models; orifice/nozzle flow equations, gas laws, critical, flow criteria
	- Two phase mixtures	
	- Gas/vapour	
02	**Dispersions**	
	- Heavy Gas	i) Buoyancy dominated, stably Salified and passive dispersion models (Similarity)
		(ii) 3D Models based on momentum, mass and energy conservation
	Neutral gas	Gaussian Dispersion Models for neutrally buoyant plumes
	Atmospheric Stability	Boundary Layer theory (turbulence) Gaussian distribution models
03	**Heat Radiations**	
	Liquid Pool fires	Burning rate, heat radiation and incident heat correlations (semi-empirical) ; Flame propagation behavior models
	Jet fires	Jet Dispersion models
04	**Explosions**	
	- BLEVE	Fire ball and physical over pressure models
	- Vapour Cloud explosions	Deflagration and detonation models; 1D gas dimensional computations
05	**Vulnerability**	
		Probit functions; Non-Stochastic vulnerability models

TABLE-6.17
DAMAGE CRITERIA

Heat Radiation		Explosions		Toxic Gas Dispersion
Incident Flux kw/m^2	Damage	Peak overpressure (Bar)	Damage	
37.5	100% lethality, Heavy damage to equipment	0.3	Heavy - 90%	The extent of damage depends upon the concentration of the toxic compound in the atmosphere. The relation between percent of injuries and the toxic load is normally given in the form of probit function.
25	50% lethality, non piloted ignition	0.03	Damage of glass	
12.5	1% lethality, piloted ignition	0.01	Crack of windows	
4.5	Not lethal, 1 st degree burns			
1.6	No discomfort even after long exposure			

TABLE-6.18
DAMAGE DUE TO PEAK OVER PRESSURE

Human Injury		Structural Damage	
Peak Over Pressure (bar)	**Type of Damage**	**Peak Over Pressure (bar)**	**Type of Damage**
5.00 – 8.00	100% lethality	0.3	Heavy (90% damage)
3.50 – 5.00	50% lethality	0.1	Repairable (10% damage)
2.00 – 3.50	Threshold lethality	0.03	Damage of Glass
1.33 – 2.00	Severe lung damage	0.01	Crack of Windows
1.00 – 1.33	50% Eardrum rupture	-	-

Source: Marshall, V.C. (1977) ' How lethal are explosives and toxic escapes'.

6.12 Model Computations

The results of MCA analysis are tabulated indicating the distances for various damages identified by the damage criteria, as explained earlier. Calculations are done for radiation intensities levels of 37.5, 25, 12.5, 4.5 and 1.6-kW/m^2, which are presented in **Table-6.19** for different scenarios. The distances computed for various scenarios are from the center of the pool fire.

TABLE-6.19
OCCURRENCE OF VARIOUS RADIATION INTENSITIES- POOL FIRE

Radiation and Effect	Radiation Intensities (kW/m^2)/ Distances (m)					
	37.5	**25.0**	**19.0**	**12.5**	**4.5**	**1.6**
Failure of 2 LDO tanks (420 KL each)	15.5	19.6	22.9	29.0	52.0	93.7

- **Pool Fire Due to Simultaneous Failure of each LDO Storage Tank – Each of 420 KL**

The capacity of storage of LDO will be 2X420 KL. Total storage of LDO will be 840 KL. The most credible failure is the rupture of the largest pipe connecting the storage tank. As the worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition.

A perusal of the above table clearly indicates that 37.5 kW/m^2 (100% lethality) occurs within the radius of the pool which is computed at 15.5-m in case of one LDO tanks on pool fire. This vulnerable zone will damage fuel storage all equipment falling within the pool radius.

Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone in which the thermal fluxes above the threshold limit for first degree is restricted to 52-m in case of LDO tanks on pool fire.

6.12.1 Fire Explosion and Toxicity Index (FE&TI) Approach

Fire, Explosion and Toxicity Indexing (FE&TI) is a rapid ranking method for identifying the degree of hazard. The application of FE&TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information. Respective Material Factor (RMF), General Hazard Factors (GHF), Special Process Hazard Factors (SPHF) are computed using standard procedure of awarding penalties based on storage handling and reaction parameters.

For each separate plant process, which contains flammable or toxic substances, a fire and explosion index F and/or a toxicity index T may be determined in a manner derived from the method for determining a fire and explosion index developed by the Dow Chemical Company.

Dow's Fire and Explosion Index (F and E) is a product of Material Factor (MF) and hazard factor (F3) while MF represents the flammability and reactivity of the substances, the hazard factor (F3), is itself a product of General Process Hazards (GPH) and special process hazards (SPH). An accurate plot plan of the plant, a process flow sheet and Fire and Explosion Index and Hazard Classification Guide published by Dow Chemical Company are required to estimate the FE & TI of any process plant or a storage unit.

6.12.2 Computations and Evaluation of Fire and Explosion Index

The Fire and Explosion Index (F&EI) is calculated from the following formula:

F & EI = MF × (GPH) × (SPH)

The degree of hazard potential is identified based on the numerical value of F&EI as per the criteria given below:

F & EI Index range	Degree of Hazard	Toxicity Index	Degree of Hazard
0 – 65	Light	<6	Low
65 – 95	Moderate	6 - 10	Moderate
95 & above	Severe	> 10	Severe

6.12.3 Results of FE and TI for Storage/Process Units

Based on the GOI Rules 1989, the hazardous fuels and chemicals used by the DSC were identified. Fire and Explosion are the likely hazards, which may occur due to the fuel and chemical storage. Hence, Fire and Explosion index has been calculated for in plant storage. The maximum storage quantities of all the chemicals and detailed computation **(Table-6.20)**.

TABLE-6.20
FIRE EXPLOSION AND TOXICITY INDEX FOR STORAGE FACILITIES

Sr. No.	Chemical/ Fuel	Total Quantity (tones)	F&EI	Category	TI	Category
1	H_2SO_4	20000	-	-	4.5	I
2	LDO	865 KL	15.2	Light	-	-
3	LPG	40.0 MT	50.0	Light	-	-
4	LSHS	450 KL	30.2	Light	-	-
5	Chlorine	2 T	-	-	3.7	I

6.12.3 Results and Discussion: BLEVE-Fireball

The results of MCA analysis for BLEVE-Fireball are tabulated indicating the distances for various damages identified by the damage criteria. Calculations are done for radiation intensities levels of 37.5, 25, 19, 12.5, 4.5 and 1.6 kW/m^2, which are presented in **Table-6.21** for different scenarios. The distances computed for various scenarios are given in meters and are from the center of the fireball.

TABLE-6.21
OCCURRENCE OF VARIOUS RADIATION INTENSITIES- FIREBALL

Radiation and Effects Fuels	Capacity	Radiation Intensities (kW/m^2)/Distances (m)					
		37.5	25.0	19.0	12.5	4.5	1.6
Failure of LDO tank	25 KL	49.6	69.1	78.2	89.6	110.5	184.2
Failure of LDO tank	840 KL	106.9	148.8	168.4	193.1	238.1	396.9
Failure of LSHS tank	400 KL	164.5	229.0	259.1	297.2	366.4	542.8
Failure of LPG bullet	40 T	66.3	92.2	104.4	119.7	147.6	246.0

- **Fireball Due to Proposed LDO Storage (25 KL)**

The hazard distances for BLEVE-fireball of proposed LDO storage are tabulated above. This type of release will be un-confined fire or explosion.

A perusal of the above table clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 49.6 and 69.1 m in case of fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 89.6 m in case of LDO storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone occurs at 110.5 m in case of LDO tank BLEVE from the center of the fireball.

- **Fireball Due to Existing LDO Storage (840 KL)**

The hazard distances for BLEVE-fireball of existing LDO storage are tabulated above. This type of release will be un-confined fire or explosion.

A perusal of the above table clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 106.9 and 148.8 m in case of fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 193.1 m in case of LDO storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone occurs at 238.1 m in case of LDO tank BLEEVE from the center of the fireball.

- **Fireball Due to Existing LSHS Storage**

The hazard distances for BLEVE-fireball of LSHS storage are tabulated above. This type of release will be un-confined fire or explosion.

A perusal of the above table clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 164.5 and 229.0 m in case of fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 297.2 m in case of LSHS storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone occurs at 366.4 m in case of LSHS tank BLEEVE from the center of the fireball.

- **Fireball Due to Existing LPG Bullet Storage**

The hazard distances for BLEVE-fireball of LPG bullet storage are tabulated above. This type of release will be un-confined fire or explosion.

A perusal of the above table clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 66.3 and 92.2 m in case of LPG bullet fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 119.7 m in case of LPG bullet storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, and this vulnerable zone occurs at 147.6 m in case of LPG bullet BLEEVE from the center of the fireball. The people are likely to be affected with first-degree burns, who fall in this zone.

6.13 Risk Related to Chlorination Plant

Liquid Chlorine will be brought in 1 ton bullets. Two such bullets will be connected to pipeline out of which one is discharged at a time. Chlorination plant at the site will consist of three chlorinator evaporator sets of 150 kg/hr each. All the three chlorinators would be located in a common building. Leakage of chlorine may occur due to many reasons, a few situations could be:

- Failure of pipeline and/or equipment [e.g. corrosion, fatigue erosion of pipes etc.] used for transfer of liquid chlorine;
- Accident while handling chlorine tonners by crane; and
- Operator errors.

The probable scenario is a one ton tonner leaking as if releasing liquid chlorine at full throw through an open valve. Worst scenario, however, would be two tonners discharging simultaneously, due to operator error and leakage through pipelines, equipment or two tonners involved in an accident while handling.

But the spread of cloud of chlorine formed by leakage on ground would be time dependent on the wind direction and its speed. A computer model gives spread of chlorine and its concentrations for different discharge rates of chlorine in kg/min for continuous release. The details of the model input data is presented below in the following sections.

*** Input Data Considered for Estimations**

The model was run for different scenarios of chlorine storage:

- Continuous gas [1 Tons of Chlorine]

Meteorological Data

Temperature (Deg C)	45.0
Wind direction (Deg)	45
Wind speeds (m/s)	1.5
Ground condition (wet or Dry)	Dry
Stability class (Unstable/neutral/stable)	F

Details of Source

Height of leak above ground (m)	1.5 m
Emission rate (kg/min)	99.6 for 1 Tons 199.8 for 2 Tons
Total time of Release (min)	10.0

Selected Concentration Contours

The concentration contours for 140, 60 and 15 ppm were selected based on the effect on the people. The consequences of chlorine for various concentrations are given below:

Concentrations of 140 ppm of Chlorine or more

a) Lethal for 50% of active healthy people in case of 30 minute exposures.
b) Inside the building, the concentrations may be more than 300 ppm and may be fatal, after a few breaths.

Concentrations of Chlorine more than 60 ppm but less than 140 ppm

Fatal for more vulnerable people and dangerous for all.

Concentrations of Chlorine between 15 ppm to 60 ppm

Dangerous - immediate irritation of nose, throat and eyes with cough and lachrymation.

- **Results and Discussions**

The predicted hazard distances for 1 ton and 2 tons release of chlorine are given in **Table-6.22.**

TABLE-6.22
AREA LIKELY TO BE AFFECTED DUE TO THE RELEASE OF CHLORINE

Concentration of Chlorine in ppm	Distance(m)/Direction from Source of Release of Chlorine		
	1 Bullet	2 Bullet	Direction
140	292	429	NE
60	467	681	NE
15	995	1460	NE

It is observed that the chlorine may spread over a large area of the proposed plant depending mainly on wind direction. Actual direction and the likely affected area will depend on the prevailing wind direction and speed at the time of the accident (**Figure-6.2**).

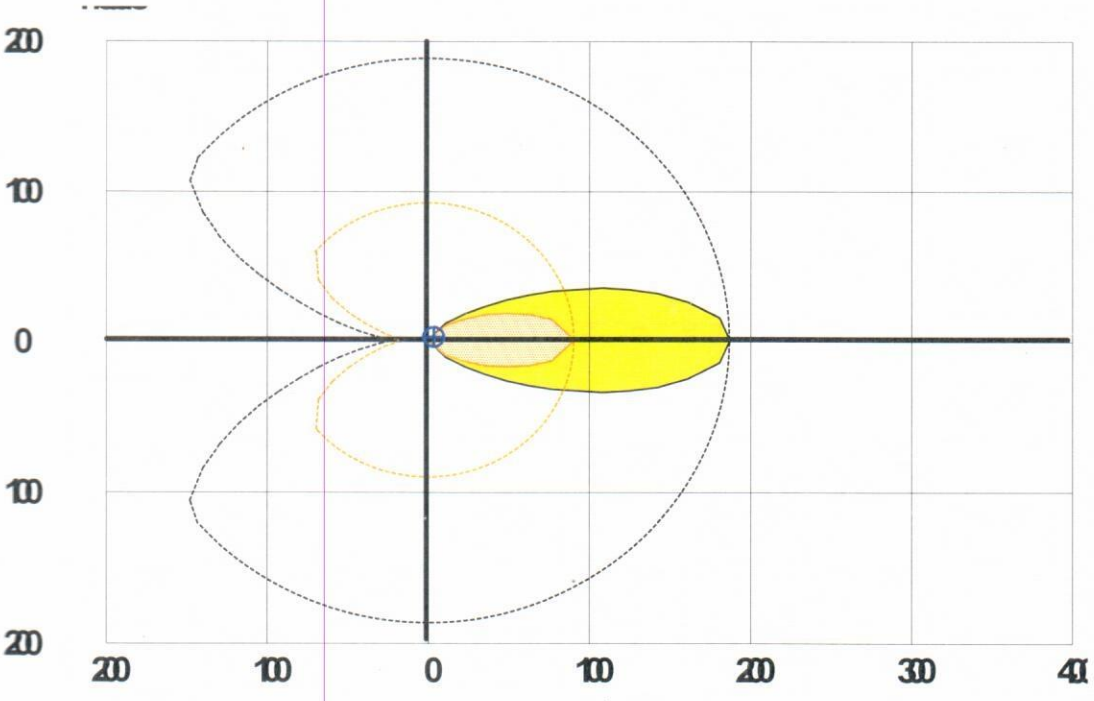

FIGURE-6.2
CHLORINE GAS DISPERSION SCENARIO (DISTANCE IN METERS)

Leakage of toxic gases and preventive measures are listed in **Table 6.23**.

TABLE-6.23
LEAKAGE OF TOXIC GASES AND PREVENTIVE MEASURES

Sr.No.	Type of Disaster	Properties of Material	Effects of Disaster	Departments	Preventive measures	Facilities	Remarks
1	Chlorine (Cl_2)	i. Greenish yellow in colour and acutely irritating in odour ii. Reacts slowly with water to form HCl. Most Cl_2 are therefore corrosive to most metals. ii. Under sunlight it reacts explosively with H_2 to form HCl v. It irritates the mucous membranes. In extreme cases suffocation can occur resulting to death. v. Exposure to Cl_2 causes burning of eyes and nose vi. Non-combustible in air but most combustible materials will burn in Cl_2 as they do in oxygen. Flammable gases & vapors from explosive mixture with Cl_2 ii. Reacts explosively or forms explosive compounds with many common chemicals such as acetylene, turpentine, hydro-carbons, hydrogen and finely divided metals	i. If exposed to heat or fire, the cylinder may explode violently releasing the contents. This will result into disaster causing wide spread fire and suffocation ii. Since it reacts violently to form explosive mixture with C_2H_2, H_2 etc. hence it can cause disaster iii. In case of leakage, it will react with body moisture to form acid and at high concentration it will act as asphyxiant and cause wide spread fatalities	warehouse & Roaster plant	i. Welding, cutting or any other hot work on the equipment of Cl_2 will be done only after the system is purged with steam and dried with hot air. ii. Contact with combustible substances, Hydrogen, Acetylene shall be prevented ii. Indoor storage, handling and use areas shall be properly ventilated with cool and dry atmosphere v. Cylinders stored in upright position with enough room between them to permit accessibility in case of emergency v. Cylinders will be used on a FIFO basis vi. Since the Cl_2 store is a part of the building used for other purposes the following care will be taken ii. Store will be of non-combustible material. ii. Separated from other part of the building by fire resisting walls and doors x. The vapor is heavier than air and travels along the ground, therefore the exhaust fans will be located near the floor of the store. The switches outside Cl_2 area	i. Proper system will be developed for storage handling and transportation ii. Trained personnel iii. Breathing apparatus and gas masks iv. First aid v. Sensors vi. Sprinklers vii. Fire and explosion proof fittings viii. Provision of fiberglass hood to direct the leaking gas into the neutralization tank ix. Neutralization tank with lime dosing facility	i. Periodical medical check up of all the concerned employees exposed to Cl_2 will be mandatory. The medical examination to have emphasis on eyes, respiratory tract, teeth, skin and pulmonary functions at least once in a year

6.14 Hazards in Storage and Handling

Hazards identified from the knowledge of physical characteristics of the chemical, NFPA rating and Material Safety Data Sheets (MSDS) many of hazards can be identified during storage and handling of materials. Such as:

- Leakages of oil from storages and piping systems, fire and explosions etc;
- Generation of flammable vapor;
- Presence of incompatible material; and
- Decomposition of chemicals.

In order to control the hazards, an elaborate and effective fire protection system will be provided in the plant. Dyke walls will be constructed around the storage areas. Properties of the fuel and chemicals used are presented in **Table-6.24.**

TABLE-6.24
PROPERTIES OF THE CHEMICALS USED

Sr. No.	Chemical/Fuel	N_h	N_f	N_r
1	Aluminium Chloride	2	0	0
2	Aluminium Sulphate	2	0	0
3	Calcium Carbonate	2	0	0
4	Calcium Hydroxide	2	0	0
5	Chlorine	4	0	0
6	Hydrazine	3	3	2
7	Hydrochloric Acid	3	0	2
8	Manganese Dioxide	2	0	0
9	Morpholine	3	3	0
10	Nitric Acid	3	0	0
11	Sodium Bicarbonate	1	0	0
12	Sodium Hydroxide	3	0	2
13	Sodium Nitrate	2	0	0
14	Sodium Sulphate	2	0	0
15	Vanadium Pentoxide	3	0	0
16	Sulphuric Acid	3	0	2
17	Conc. Sulphuric Acid	3	0	2
18	Coal	2	0	0

N_h - Health hazard **N_r - Reactivity hazard** **N_f - Fire hazard**

Key

0-Insignificant
1-Slight
2-Moderate
3-High
4-Extreme

6.15 HZL Safety Policy

Safety of both men and materials is accorded maximum priority in HZL. A occupational health and safety policy has been framed with the following objectives:

- To develop a culture conducive to safe working in the mines, mill, CPP and smelters;
- To improve working conditions and environment;
- To propagate safety measures and create safety consciousness among workmen, supervisors and officials;
- To train workmen as well as the supervisors in their respective fields of operations;
- To reduce the scope of accidents and to aim at accident free performance;
- To adopt measures for improvement in health standards;
- To ensure that no long term ill effects on health due to smelting and industrial environment; and
- To ensure that all statutory provisions relating to safety are followed.

6.16 Set up for Execution of Policy

The present set up at corporate level consists of General Manager (HSE) reporting to CEO. In addition an internal safety organization exists, comprising of AGM(Mining), Manager (Safety), Manger(Maintenance) and Senior Manager (Electrical) in compliance of the recommendations of Fifth safety conference.

The ISO is responsible to locate, define, and remove permanent weaknesses in the system that contributes accident. The ISO formulates the safety policies of the company, hold discussions with the General Manager of different working units for the coordination and communication of safety matters channelise the research in safety matters, and maintains close liaison with the inspectorate, the district mining authorities, etc. ISO makes policy for safety training, safety campaigns, maintenance of safety statistics, accident analysis, etc. and also arranges for Safety Audit of the mines.

6.17 Appointment of Qualified Persons

In the metalliferrous mines regulations, elaborate guidelines are laid down for appointment of Manager, Asst Managers, Engineers, Surveyors, and competent persons. Statutory qualified personnel of adequate number will be deployed to ensure compliance with regulations at all times.

Duty and responsibilities of various officials and competent persons are also well defined in the regulations. Duties of persons working in the mines are also well defined in the regulations. The persons will be made aware of their responsibilities from time to time.

6.18 Safety Education & Training

Safety education is considered an important means in pursuit of accident prevention. Before induction, workmen will be provided vocational training in the training center of Rajpura Dariba Mines.

Basic training shall be provided by faculty from training center to the qualified persons. The skilled category workmen will be provided specialized training in their respective areas of work. Training will also be arranged for supervisory categories. Specialized training will be provided to all the new entrants in fire fighting and first aid. Certain selected persons will also be trained in Rescue work.

Besides above Refresher trainings are also arranged at periodic intervals.

6.19 Pit Safety Committee

A Pit Safety Committee (PSC) will be constituted at the mine level, with the sole objective of promoting safety in the mine. To serve as a forum for communication on safety and occupational health matters. The PSC will consist of Mines manager, five officials of the mine, five workmen nominated by the workmen of the mine and workmen's inspector. Safety officer of the mine shall act as Secretary to the committee.

The committee will discuss remedial measures against the unsafe conditions and practices in the mine, the reports of inquiry into accidents, and make appropriate recommendations. PSC shall formulate and implement appropriate safety campaigns based on the analysis of accidents and will take active part in organizing and observing Mine Safety Week and other safety competitions. It may undertake publicity and propaganda work at the mine for creating safety consciousness.

Similarly, a Central safety committee and plant-wise safety committee will be constituted in smelter project which will meet at regular frequency to promote safety culture and safety level in the respective plants and critical issues pertaining to overall general safety.

6.20 Safety Audit

Safety audit is essential to assess the safety standards in a mine, the utilization of the safety appliances, to assist the mine by pointing out the salient areas where efforts are to be directed to achieve maximum safety, to maintain a constant awareness to face an emergency in the mine, to analyze the causes of accidents, and to suggest measures to prevent any recurrence and to suggest advance action to prevent emergence of any situation leading to a disaster.

The audit team will comprise of statutorily qualified engineers of various disciplines. ISO will organize safety audit of the mine once in a year.

6.21 Disaster Management Plan

6.21.1 Disasters

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can be divided into two main groups. In the first, the disasters are resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, avalanches, landslides, and forest fires. The second group includes disastrous events occasioned by man, or by man's impact upon the environment.

There can be no set criteria for assessing the gravity of a disaster in the abstract since this depends to a large extent on the physical, economic and social environment in which it occurs. What would be consider a major disaster in a developing country, ill equipped to cope with the problems involved, may not mean more than a temporary emergency elsewhere. However, all disasters bring in their wake similar consequences that call for immediate action, whether at the local, national or international level, for the rescue and relief of the victims. This includes the search for the dead and injured, medical and social care, removal of the debris, the provision of temporary shelter for the homeless food, clothing and medical supplies, and the rapid re-establishment of essential services.

6.21.2 Objectives of Disaster Management Plan [DMP]

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training through rehearsals/drills.

The Disaster Management Plan shall reflect the probable consequential severalties of the undesired event due to deteriorating conditions or through 'Knock on' effects. Further the management shall be able to demonstrate that their assessment of the consequences uses good supporting evidence and is based on currently available and reliable information, incident data from internal and external sources and if necessary the reports of out side agencies.

To tackle the consequences of a major emergency inside the factory or immediate vicinity of the factory, a Disaster Management Plan has to be formulated and this planned emergency document is called "Disaster Management Plan".

The objective of the Industrial Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

1. Minimize damage to property and the environment;
2. Initially contain and ultimately bring the incident under control;

3. Identify any dead;
4. Provide for the needs of relatives;
5. Provide authoritative information to the news media;
6. Secure the safe rehabilitation of affected area; and
7. Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.
8. Effect the rescue and medical treatment of causalities;
9. Safeguard other people;

In effect, it is to optimize operational efficiency to rescue, rehabilitation and render medical help and to restore normalcy.

6.22 Emergencies

6.22.1 General and Industrial Emergencies

The emergencies that could be envisaged in the plant and tank farm are as follows:

1. A situation of fire at the tank farm of all storages;
2. Slow isolated fires;
3. Fast spreading fires;
4. Structural failures;
5. Contamination of food/water; and
6. Sabotage/Social disorder.

6.22.2 Specific Emergencies Anticipated

- **Fire and Explosion**

Fire consequences can be disastrous, since they involve huge quantities of fuel either stored or in dynamic inventory in pipe lines or in nearby areas. Toxic releases can affect persons working around. Estimation can be made by using various pool fire, tank fire consequence calculations. During the study of Risk Assessment, the nature of damages is worked out and probability of occurrence of such hazards is also drawn up. Therefore, the risk assessment report is to be essentially studied in conjunction with disaster management plan.

6.23 Emergency Organization

As highlighted in the Disaster management plan of HZL, the DSC has already setup an Emergency Organization. As per the General Organization chart, General Manager (Plant) is designated as the Site Controller. The Senior Managers are designated as Incident Controller. All the Incident Controllers would be reporting to the Site Controller.

All the Department Heads, Fire & Security Officer, Communication Officer and Personal manager are reporting to the Incident Controller. This team is responsible for controlling the incidence with the personnel under their control. Shift In charge is the reporting officer, who would bring the incidence to the notice of the Incidence

Controller and Site Controller. The team co-ordinates during eventualities and responsible for fire fighting, rescue, rehabilitation, transport and provide essential and support services. For this purposes, Security In charge, Personnel Department, Essential services personnel are engaged. All these personnel are designated as Key personnel.

In each shift, electrical supervisor, electrical fitters, pump house in charge and other maintenance staff are drafted for emergency operations. In the event of power or communication system failure, some of staff members in the office/plant offices are drafted and their services would be utilized as messengers for quick passing of communications.

6.23.1 Emergency Communication

Whoever notices an emergency situation such as fire, growth of fire, leakage etc. informs his immediate superior and Emergency Control Center. The person on duty in the Emergency Control Center, will appraise the Site Controller. Site Controller verifies the situation from the Incident Controller of that area or the Shift In charge and takes a decision about an impending On Site Emergency. This would be communicated to all the Incident Controllers, Emergency Co-ordinators. Simultaneously, the emergency warning system would be activated on the instructions of the Site Controller.

6.24 Emergency Responsibilities

The responsibilities of the key personnel are appended below:

6.24.1 Site Controller

On receiving information about emergency he would rush to Emergency Control Center (ECC) and take charge of ECC and the situation and:

- Assesses the magnitude of the situation on the advice of incident Controller and decides;
- Whether the effected area needs to be evacuated;
- Whether personnel who are at assembly points need to be evacuated;
- Declares Emergency and orders for operation of emergency siren;
- Organizes announcement by public address system about location of emergency;
- Assesses which areas are likely to be affected, or need to be evacuated or are to be alerted;
- Maintains a continuous review of possible development and assesses the situation in consultation with Incident Controller and other Key Personnel as to

whether shutting down the plant or any section of the plant required and if evacuation of persons is required;

- Directs personnel for Rescue, rehabilitation, transport, fire, brigade, medical and other designated mutual support systems locally available, for meeting emergencies;
- Controls evacuation of affected areas, if the situation is likely to go out of control or effects are likely to go beyond the premises of the factory, informs to District Emergency Authority, Police, Hospital and seeks their intervention and help;
- Informs Inspector of Factories, Deputy Chief Inspector of Factories, RSPCB and other statutory authorities;
- Gives a public statement if necessary;
- Keeps record of chronological events and prepares an investigation report and preserves evidence; and
- On completion of On Site Emergency and restoration of normalcy, declares all clear and orders for all clear warning.

6.24.2 Incident Controller

- Assembles the incident control team;
- Directs operations within the affected areas with the priorities for safety to personnel, minimize damage to the plant, property and environment and minimize the loss of materials;
- Directs the shutting down and evacuation of plant and areas likely to be adversely affected by the emergency;
- Ensures that all key personnel help is sought;
- Provides advice and information to the Fire and Security Officer and the Local Fire Services as and when they arrive;
- Ensures that all non-essential workers/staff of the affected areas evacuated to the appropriate assembly points, and the areas are searched for causalities;
- Has regard to the need for preservation of evidence so as to facilitate any inquiry into the caused and circumstances which caused or escalated the emergency;
- Co-ordinates with emergency services at the site;
- Provides tools and safety equipments to the team members;

- Keeps in touch with the team and advise them regarding the method of control to be used; and
- Keeps the Site Controller of Emergency informed of the progress being made.

6.24.3 Emergency Coordinator - Rescue, Fire Fighting

- On knowing about emergency, rushes to ECC;
- Helps the incident Controller in containment of the emergency;
- Ensure fire pumps in operating conditions and instructs pump house operator to ready for any emergency with standby arrangement;
- Guides the fire fighting crew i.e. firemen, trained plant personnel and security staff;
- *Organizes shifting the fire fighting facilities to the emergency site, if required;*
- Takes guidance of the Incident Controller for fire fighting as well as assesses the requirements of outside help;
- Arranges to control the traffic at the gate and the incident area;
- Directs the security staff to the incident site to take part in the emergency operations under his guidance and supervision;
- Evacuates the people in the plant or in the nearby areas as advised by Site Controller;
- Searches for casualties and arranges proper aid for them;
- Assembles search and evacuation team;
- Arranges for safety equipments for the members of this team;
- Decides which paths the evacuated workers shall follow; and
- Maintains law and order in the area, and if necessary seeks the help of police.

6.24.4 Emergency Coordinator-Medical, Mutual Aid, Rehabilitation, Transport and Communication

In the event of failure of electric supply and thereby internal telephone, sets up communication point and establishes contact with the ECC.

- Organizes medical treatment to the injured and if necessary will shift the injured to near by hospitals.

- Mobilizes extra medical help from outside, if necessary.
- Keeps a list of qualified first aiders of the factory and seek their assistance.
- Maintains first aid and medical emergency requirements.
- Makes sure that all safety equipment are made available to the emergency team.
- Assists Site Controller with necessary data and to coordinate the emergency activities.
- Assists Site Controller in updating emergency plan, organizing mock drills verification of inventory of emergency facilities and furnishing report to Site Controller.
- Maintains liaison with Civil Administration.
- Ensure availability of canteen facilities and maintenance of rehabilitation center.
- He will be in liaison with Site Controller/Incident Controller.
- Ensure transportation facility.
- Ensures availability of necessary cash for rescue/rehabilitation and emergency expenditure.
- Controls rehabilitation of affected areas on discontinuation of emergency.
- Makes available diesel/petrol for transport vehicles engaged in emergency operation.

6.24.5 Emergency Coordinator-Essential Services

- He would assist Site Controller and Incident Controller.
- Maintains essential services like Diesel Generator, Water, Fire Water, Compressed Air/Instrument Air, power supply for lighting.
- He would plan alternate facilities in the event of power failure, to maintain essential services such as lighting, refrigeration plant etc.
- He would organize separate electrical connections for all utilities and emergency services so that in the event of emergency or fires, essential services and utilities are not affected.
- Gives necessary instructions regarding emergency electrical supply, isolation of certain sections etc. to shift in-charge and electricians.
- Ensures availability of adequate quantities of protective equipment and other emergency materials, spares etc.

6.24.5 General Responsibilities of Employees During an Emergency

During an emergency, it becomes more enhanced and pronounced when an emergency warning is raised, the workers if they are in-charge of process equipment, shall adopt safe and emergency shut down and attend any prescribed duty as essential employee. If no such responsibility is assigned, he shall adopt a safe course to assembly point and await instructions. He shall not resort to spread panic. On the other hand, he must assist emergency personnel towards objectives of DMP.

6.25 Emergency Facilities

6.25.1 Emergency Control Center (ECC)

For the time being Office Block is identified as Emergency Control Center. It would have external Telephone, Fax, Telex facility. All the Site Controller/ Incident Controller Officers, Senior Personnel would be located here. Also, it would be an appropriate place. Various other material that are to be maintained in the ECC are:

The following information and equipment are provided at the ECC:

- Intercom, telephone;
- P and T telephone;
- Safe contained breathing apparatus;
- Fire suit/gas tight goggles/gloves/helmets;

- Hand tools, wind direction/velocities indications;
- Public address megaphone, hand bell, telephone directories;
- (internal, P and T) factory layout, site plan;
- Emergency lamp/torch light/batteries;
- Plan indicating locations of hazard inventories, plant control room, sources of safety equipment, work road plan, assembly points, rescue location vulnerable zones, escape routes;
- Hazard chart;
- Emergency shut-down procedures;
- Nominal roll of employees;
- List of key personnel, list of essential employees, list of Emergency Co-ordinators;
- Duties of key personnel;
- Address with telephone numbers and key personnel, emergency coordinator, essential employees; and
- Important address and telephone numbers including Government agencies, neighboring industries and sources of help, out side experts, chemical fact sheets population details around the factory.

6.25.2 Assembly Point

Number of assembly depending upon the plant location would be identified wherein employees who are not directly connected with the disaster management would be

assembled for safety and rescue. Emergency breathing apparatus, minimum facilities like water etc. would be organized.

In view of the size of plant, different locations are ear marked as assembly points. Depending upon the location of hazard, the assembly points are to be used. In the existing plant following points are earmarked for assembly points;

1. Area near time office/Main Gate
2. Area near gate No.2 (Slag Gate)
3. Raw Water storage Reservoir area
4. Near Canteen

The same assembling points can be considered during emergencies in future. The tankers and trucks will be moved out through slag gate during emergency.Two assembly points are to be declared according to wind direction in case of emergency/Disaster.

Designated persons would take charge of these assembly points and mark presence of the people assembling at the point. Department & shift wise, list of employees, are available at these points and roll call would be taken by the designated person.

6.25.3 Emergency Power Supply

Plant facilities would be connected to Diesel Generator and would be placed in auto mode. Thus water pumps, plants lighting and emergency control center. Administrative building and other auxiliary services are connected to emergency power supply. In all the blocks flame proof type emergency lamps would be provided.

6.25.4 Fire Fighting Facilities

First Aid Fire Fighting equipment suitable for emergency are maintained in each section in the Complex. This is as per statutory requirements as well as per TAC Regulations. The fire hydrant line covering major areas are laid. The fire water system is available where water is allocated exclusively for fire fighting.

DSC has full fledged fire station under security. Trained fire fighting personnel are available at DSC. The details of fire fighting personnel are given in **Table-6.25.**

TABLE-6.25
FIRE FIGHTING PERSONNEL IN DSC

Sr. No.	Particulars	Number
1	Fire Supervisior	1
2	Fireman	6
23	Fire Tenders	1
4	Drivers & Firefighters	2
5	Pump Operator	2
Total		**12**

Besides above one more Fire tender is maintained in Mines with trained fire fighting team

The fire fighting facilities available at DSC are listed in **Table-6.26.**

TABLE-6.26
PROPOSED FIRE FIGHTING FACILITIES IN DSC

Sr. No.	Description	Location	Quantity	Capacity	Remark
1	Multi- purpose fire tender (water, foam, DCP etc)	Fire Station	01	5000 lit	Foam, Water & DCP
2	Complete fire hydrant system	Plant area	1 lot	-	
3	Fire extinguishers- a. water type b. Dry chemical powder c. Carbon dioxide d. Carbon dioxide (trolley mounted) e. Mechanical foam f. Mechanical foam (trolley mounted)	Plant area and fire station	 20 50 65 8 20 5	 9 lit 5kg 4.5 kg 22.5 kg 9 lit 50 lit	
4	Automatic high velocity water spray system	Switchyard/ MCC	3		For 40 MVA transformer
5	Automatic high velocity water spray system	Switchyard/ MCC	3		For 50/60 MVA transformer
6	Automatic high velocity water spray system	Switchyard/ MCC	3		For 64 MVA transformer
7	Automatic medium velocity water spray system	plant	1 lot		
8	Analog addressable detection and fire alarm system	Plant	298		
9	Sprinkler system	LPG			Water
10	Sprinkler system	Switch yard			Water
11	Foam pouring system	LDO storage		1600 lit + 700 lit	Foam
12	Fire bucket	Plant area	100		
13	Fire water pump house (electric operated)	Fire pump house	03	273 m^3	For fire hydrants
14	Fire water pump house (electric operated)	Fire pump house	01	273 m3	For spray system
15	Fire water pump house (diesel operated)	Fire pump house	2	273 m3	in case o electricl failure
16	Jockey Pump Set	Fire Pump House	2	30 M3	-
17	Sensor for LPG	LPG plant	11		

6.25.5 Location of Wind Sock

On the top of the Main Gate, HGP area of Roaster, Acid Plant, Lead Plant, CDSS Building, TG building of CPP and LPG Storage, wind socks shall be installed to indicate direction of wind for emergency escape.

6.25.6 Emergency Medical Facilities

Stretchers, gas masks and general first aid materials for dealing with chemical burns, fire burns etc. are maintained in the medical center as well as in the emergency control room. Private medical practitioners help would be sought. Government hospital would be approached for emergency help.

Apart from plant first aid facilities, external facilities would be augmented. Names of Medical Personnel, Medical facilities in the area would be prepared and updated. Necessary specific medicines for emergency treatment of Burns Patients, and for those affected by toxicity would be maintained.

Breathing apparatus and other emergency medical equipment would be provided and maintained. The help of near by industrial management's in this regard would taken on mutual support basis.

First aid center with trained First Aid Assistants is available round the clock. Besides this, Government Hospital in Fatehnagar and Rail Magra (Nearby towns) will also be consulted in case of emergency.

6.25.7 Ambulance

An ambulance with driver availability in all the shifts, emergency shift vehicle would be ensured and maintained to transport injured or affected persons. Number of persons would be trained in first aid so that, in every shift first aid personnel would be available.

6.26 Emergency Actions

6.26.1 Emergency Warning

Communication of emergency would be made familiar to the personnel inside the plant and people outside. An emergency warning system would be established.

6.26.2 Emergency Shutdown

There are number of facilities which can be provided to help deal with hazardous conditions, when a tank is in fire. The suggested arrangements are:

1. Stop feed;
2. Dilute contents;
3. Remove heat;
4. Deluge with water; and
5. Transfer contents.

Whether a given method is appropriate depends on the particular case. Cessation of agitation may be the best action in some instances but not in others. Stopping of the feed may require the provision of by pass arrangements.

Methods of removing additional heat include removal through the normal cooling arrangements or use of an emergency cooling system. Cooling facilities, which use vapouring liquid may be particularly effective, since a large increase in vaporization can be obtained by dropping pressure.

6.26.3 Evacuation of Personnel

There could be more number of persons in the storage area and other areas in the vicinity. The area would have adequate number of exits, stair cases. In the event of an emergency, unconnected personnel have to escape to assembly point. Operators have to take emergency shutdown procedure and escape. Time Office maintains a copy of deployment of employees in each shift, at ECC. If necessary, persons can be evacuated by rescue teams.

6.26.4 All Clear Signal

Also, at the end of an emergency, after discussing with Incident Controllers and Emergency Co-ordinators, the Site Controller orders an all clear signal. When it becomes essential, the Site Controller communicates to the District Emergency Authority, Police, Fire Service personnel regarding help required or development of the situation into an Off-Site Emergency.

6.27 General Information

6.27.1 Employee Information

During an emergency, employees would be warned by raising siren in specific pattern. The siren will sound continuously for 10 seconds for 5 times with 5 seconds interruption. The alarm code followed is as follows;

Sound	Stop	Sound	Stop	Sound	Stop	Sound	Stop	Sound	Stop
10	5	10	5	10	5	10	5	10	5

Employees would be given training of escape routes, taking shelter, protecting from toxic effects. Employees would be provided with information related to fire hazards, antidotes and first aid measures. Those who would designated as key personnel and essential employees shall be given training to emergency response.

6.27.2 Public Information and Warning

The industrial disaster effects related to this plant may mostly be confined to the plant area. The detailed risk analysis has indicated that the pool fire effects would not be felt outside. However, as an abundant precaution, the information related to chemicals in use would be furnished to District Emergency Authority for necessary dissemination to general public and for any use during an off site emergency. Factories of this size and nature are in existence in our state since long time.

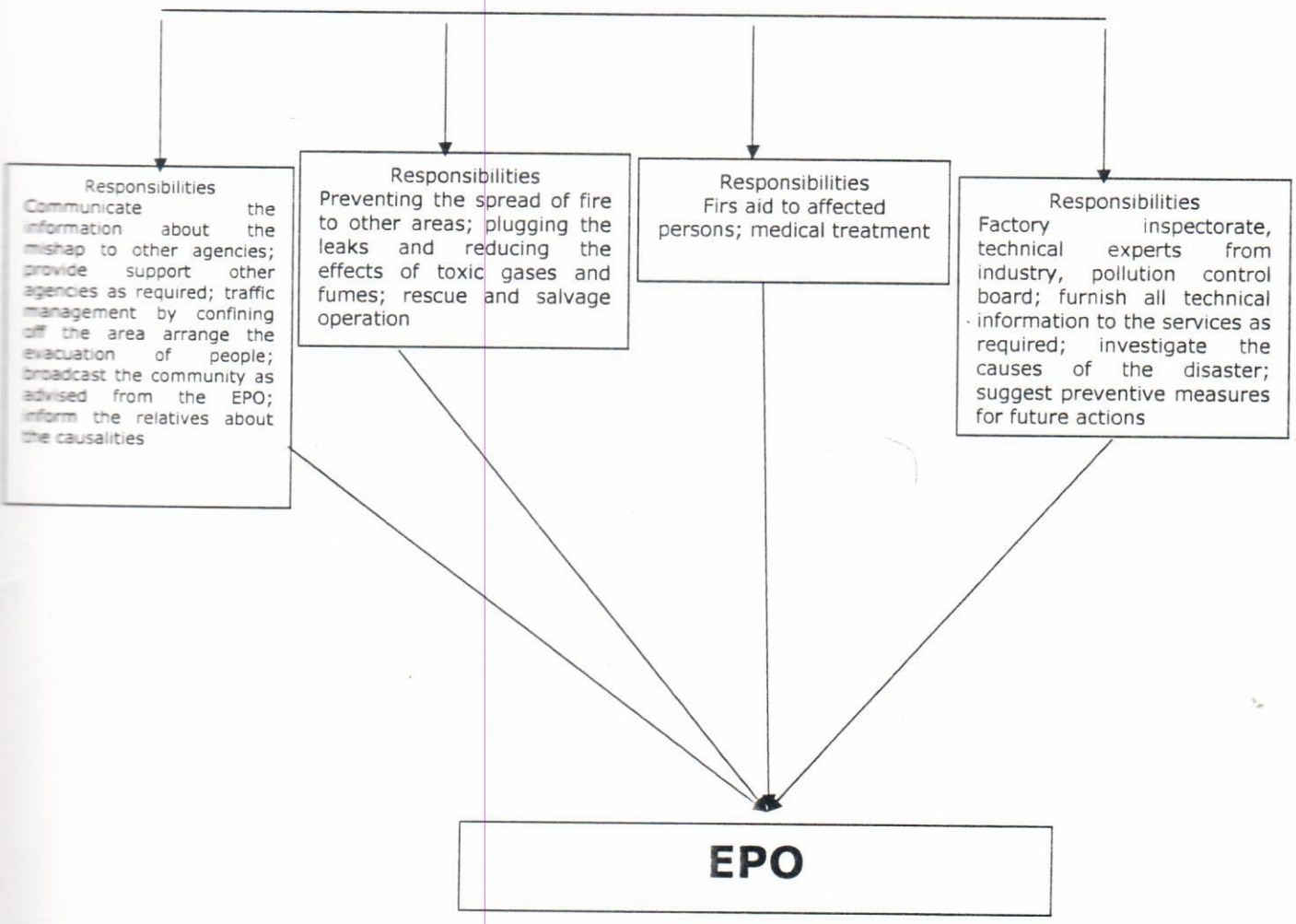

FIGURE-6.3
ONSITE EMERGENCY ORGANIZATION CHART

TABLE-6.27
KEY PERSONNEL

Category	Key Personnel	Alternate Key Personnel
Site Controller Mobile Internal	General Manager 09829297037 6001 (O)	AGM (Process) 09829911181 6041 (O)
Incident Controller Mobile Internal	AGM (P) 09928366320	AGM (Engg.) 09799299572 6002 (O)
Communication Officer Mobile Internal	A. G.M. (Adm.) 09784598459 6141	A.G.M (EOHS). 09950706381 6181
Safety Officer Mobile Internal	Asso. Mgr. (Safety) 09929604866 6122	Safety Officer 09799496099 6126
Fire Officer Mobile Internal	Chief Security Officer 09929109284 6142	Inspector (Fire) 09799496099 6126
Personnel/Administrative Officer. Mobile Internal	AGM (HR) 09928371242	Executive (HR) 09829095015 6123
Medical Officer Mobile Internal	Chief Medical Officer 09414757277	Medical Supdt. 09414757277
Security Officer Mobile Internal	Chief Security Officer 09929109284 6142	Inspector

6.27.8 Emergency Procedures adopted in handling of Hazardous Chemicals

DSC has standardized the emergency procedures for safe handling of hazardous chemicals and fuel.

6.27.8.1 Safe handling of Sulphuric Acid

It is highly corrosive liquid and it is very dangerous when it is improperly handled. It has got strong affinity for water, which it removes from organic material and thus chars and destroy plant or animal tissue.

Sulphuric Acid by itself is not flammable but concerned acid may cause ignition by contact with organic materials, metal powder carbides, nitrates and chlorates.

Dilute sulphuric acid is very much corrosive to mild steel. When it is stored in tanks or drums hydrogen may generate inside them and it may form dangerous air hydrogen explosive mixture. As such no open light or sparks and smoking should be permitted near the container of sulphuric acid.

Violent agitation and spurting are produced when water is added to concentrated acid. Addition of acid into water while diluting the acid in laboratory is to be followed.

While handling sulphuric acid, protective safety appliances i.e. gum boots, rubber gloves, face shield or goggles and rubber aprons should be worn. Incase of contact with sulphuric acid, the affected area should be immediately flushed with large quantity of water.

The physical and hazardous properties of Sulphuric acid are as follows:

Boiling Point	290^0 C
Melting /Freezing Point	$10/3^0$C
Sp. Gravity (water=1)	1.84 at 20^0C
Appearance	Colorless, oily
Odour	Odourless
Corrosive material	Yes
Effect of exposure/ Symptons	May injure lungs, swallowing may cause death, contact with skin or eye severe burn.
Emergency Treatment	Move to fresh air, Give artificial respiration. Remove cloth and shoes. Don't use oil/ointment Flush affected area with plenty of water. Give plenty of water to drink. Do not induce vomiting.

6.27.8.2 Safe Handling of LPG

LPG is normally stored in tanks called bullets in liquid form. The main hazard associated with the storage and handling is of leakage of LPG from the storage tank, cylinder or pipeline, which can lead to fire and explosion. This can be very disastrous.

LPG is liquefied compressed colorless gas and is a mixture of propane, Butane and Propylene. Mercaptone is added for odour warning in case of leakage. The emergency procedures will be practiced at DSC in handling of LPG is discussed below;

1. In case of leakage, clear all the personnel except those involved in emergency operations, from the area affected.
2. The personnel should proceed up wind and at a right angle to wind direction.
3. Only specially trained and fully equipped personnel should be permitted in the area.
4. Shut off all the ignition sources in the area surrounding the leakage.
5. Isolate the leaking equipment of pipeline by shutting off the relevant valves.
6. If the leak is from small cylinder, shift the cylinder to an open, well- ventilated area taking all the precautions.
7. Shut off leak if possible without risk.
8. Start water sprinkler on the leaking as well as the adjoining tanks containers.
9. Keep the storage tanks cool by directing water by hose and nozzle from a long distance.

10. Try to stop leak, if it is not possible, transfer the material from the affected tank to a standby storage tank by controlled method.
11. In case fire breaks out, never go near the tank for fear of explosion. Keep the leaking and the adjacent tank cool by water spray.
12. Use dry chemical powder fire extinguisher for fighting fires.

It should be noted that utmost care is necessary during stoppage of leakage or transfer of material from the leaking container to a standby container to ensure that there is no ignition source in the surrounding area, which can cause fire. Once the fire is started, no emergency operations of stopping leakage or transfer of material could be carried out as the risk of explosion is very high.

6.27.8.3 Protective Equipments

Self contained breathing apparatus for high concentration of LPG. Rubber or PVC gloves and suit for hand and body protection from liquid contact.

6.27.8.4 First Aid

1. If inhales :

a) Remove from exposure area to fresh air immediately
b) Loosen the clothes and remove the shoes
c) If breathing has not stopped, place the patient on his back with head and back elevated and keep him warm and at rest.
d) If breathing has apparently ceased, give artificial respiration. Administer oxygen (by qualified personnel) if available.
e) Treat symptomatically and supportively.

2. Incase the skin contact, remove contaminated clothing and shoes immediately. Wash affected area with large amounts of water for at least 15 minutes.

3. Incase of eye contact, wash eyes immediately with large amounts of water for at least 15 minutes.

6.27.8.5 Safe handling of Chlorine

Chlorine under ordinary conditions of temperature and pressure is a greenish yellow gas with a characteristic pungent and suffocating odour. Gaseous chlorine is approximately 2.5 times heavier than water. Chlorine is only slightly soluble in water.

Chlorine reacts readily with lime and caustic soda to form hydrochlorides. Hence lime and caustic soda solutions are generally used for handling chlorine leaks.

Chlorine gas is primarily a respiratory irritant. It is extremely irritating to the mucous membrane, the eyes and respiratory tract. The threshold limit value of chlorine is 1 ppm or 3 mg/m^3 of air. If the duration of exposure or the concentration of chlorine is excessive, it will cause restlessness, throat irritation, sneezing and copious salivation. In extreme cases, lung tissues may be attacked resulting in pulmonary edema.

a. Emergency Procedure

1. Evacuate the people from the affected area as quickly as possible.
2. People should move in the up wind direction or at right angle to the wind direction.
3. Don't panic, walk, don't run and keep a handkerchief on the mouth. Keep breathing as normal as possible.
4. Before going to attend the leakage, wear self-contained breathing apparatus or a canister gas mask, whichever is suitable.
5. At least two persons should go to attend leakage.
6. Identify the leak with the help of ammonia solution, if available,
7. If the leakage is from the profess system, stop the supply of chlorine to the process.
8. If the leakage is from the pipe line close the valves at both end of the leakage and the header valve.
9. Make an attempt to put suitable clamps etc.
10. If the leakage is from the tonner, bring the leaking point in the upper most position, so that the leakage is not in the liquid phase but in the gaseous phase.
11. Stop the leakage by using an emergency kit.
12. Utilize the remaining chlorine from the tonner in process.
13. If above is not possible, neutralize the chlorine in caustic soda, soda ash or hydrated lime solution ensuring that the unabsorbed chlorine gas is not coming out.
14. If the leakage develops during transportation, the vehicle should be properly removed to an isolated remote place.
15. The immediately contact the filler or the consignor as the case may be.

b. Neutralization Procedure

1. If all efforts to control the leak fails and the leakage continues, neutralize the chlorine by passing it into a solution of caustic soda, soda ash or hydrated lime through a suitable pipeline with a perforated distributor. Caustic Soda is recommended as it absorbs chlorine more readily.
2. Never emerge the leakage container in the tank containing alkaline solution or water.

c. Protective Equipment

1. Protection from chlorine gas must be provided first of all to the respiratory system, followed closely by protection for the eyes. A self-contained breathing apparatus or airline respiratory with full-face mask or canister gas mask should be used depending upon the concentration of chlorine in the atmosphere.
2. Protection for rest of the body (by wearing impervious clothing) becomes necessary if the chlorine gas concentration is high and the exposure poured is extended.

d. Emergency Equipments

1. Ammonia Torch
2. Chlorine emergency kit

e. Symptoms

f. Exposure to chlorine causes irritation to the mucous membrane of eyes, nose and throat and later on to the chest.
g. Cough develops, which may lead to vomiting.
h. If duration and concentration is high, it may cause restlessness, throat irritation, sneezing and copious salivation.
i. In extreme cases lung tissues may be attacked resulting in pulmonary edema, fall at blood pressure and cardiac arrest in a few minutes.

⇒ **First aid**

1. Remove victim to a well ventilated area.
2. Loosen the clothes and remove the shoes.
3. Keep him warm using blankets.
4. Place the patient on his back with the head and back elevated.
5. Rest is a must.
6. Cough syrup and common throat iozonges can be given for soothing the throat irritation.
7. Milk, buttermilk, lime juice, fresh water may be given.
8. If breathlessness persists administer medical oxygen under low pressure using a pulmotor or similar type of vital equipment.
9. Bronchi dilators can be given under medical advice.

6.28 Off-Site Emergency Preparedness Plan

The task of preparing the Off-Site Emergency Plan lies with the district collector. However, the off-site plan shall be prepared with the help of the local district authorities. The proposed plan shall be based on the following guidelines.

The off-site plan in detail will be based on those events, which are most likely to occur, but other less likely events, which have severe consequance will also be considered. Incidents, which have very severe consequences yet have a small probability of occurrence, shall also be considered during the preparation of the plan. However, the key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who will be involved in the implementation of an off-site plan are described below. Depending on local arrangements, the responsibility for the off-site plan shall be either rest with the works management or, with the local authority. Either way, the plan shall identify an emergency co-ordinating officer, who would take the overall command of the off-site activities. As with the on-site plan, an emergency control center shall be setup within which the emergency co-ordinating officer can operate.

An early decision will be required in many cases on the advice to be given to people living "within range" of the accident - in particular whether they shall be evacuated or told to go indoors. In the latter case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors:

a. In the case of a major fire but without explosion risk (e.g. LPG storage tank), only houses close to the fire are likely to need evacuation, although a severe smoke hazard may require this to be reviewed periodically;

b. If a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people shall be advised to stay indoors and shield themselves from the fire. This latter case particularly applies if the installation at risk could produce a fireball with vary severe thermal radiation effects (e.g.LPG storage);

c. For release or potential release of toxic materials, limited evacuation may be appropriate down wind if there is time. The decision would depend partly on the type of housing "at risk". Conventional housing of solid construction with windows closed offers substantial protection from the effects of a toxic cloud, while shanty house, which can exist close to factories, offer little or no protection.

The major difference between releases of toxic and flammable materials is that toxic clouds are generally hazardous down to much lower concentrations and therefore hazardous over greater distances. Also, a toxic cloud drifting at, say 300 m per minute covers a large area of land very quickly. Any consideration of evacuation shall take this into account. Although the plan will have sufficient flexibility built in to cover the consequences of the range of accidents identified for the on-site plan, it will cover in some detail the handling of the emergency to a particular distance from each major hazard works.

6.28.1 Aspects Proposed to be Considered in the Off-Site Emergency Plan

The main aspects, which shall be included in the emergency plan are:

- **Organization**

Details of command structure, warning systems, implementation procedures, emergency control centers.

Names and appointments of incident controller, site main controller, their deputies and other key personnel.

- **Communications**

Identification of personnel involved, communication center, call signs, network, lists of telephone numbers.

- **Specialized knowledge**

Details of specialist bodies,firms and people upon whom it may be necessary to call e.g. those with specialized chemical knowledge, laboratories.

- **Voluntary Organizations**

Details of organizers, telephone numbers, resources etc.

- **Chemical Information**

Details of the hazardous substances stored or procedure on each site and a summary of the risk associated with them.

- **Meteorological Information**

Arrangements for obtaining details of weather conditions prevailing at the time and whether forecasts.

- **Humanitarian Arrangements**

Transport, evacuation centers, emergency feeding treatment of injured, first aid, ambulances, temporary mortuaries.

- **Public Information**

Arrangements for a] dealing with the media/ press office; b] informing relatives, etc.

- **Assessment**

Arrangements for: (a) collecting information on the causes of the emergency; (b) reviewing the efficiency and effectiveness of all aspects of the emergency plan.

6.28.2 Role of the Emergency Co-ordinating Officer

The various emergency services shall be co-ordinated by an emergency co-ordinating officer (ECO), who will be designated by the district collector. The ECO shall liaise closely with the site main controller. Again depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control shall be passed to a senior local authority administrator or even an administrator appointed by the central or state government.

6.28.3 Role of the Local Authority

The duty to prepare the off-site plan lies with the local authorities. The emergency-planning officer (EPO) appointed shall carry out his duty in preparing for a whole range of different emergencies within the local authority area. The EPO shall liaise with the works, to obtain the information to provide the basis for the plan. This liaison shall ensure that the plan is continually kept upto date.

It will be the responsibility of the EPO to ensure that all those organizations, which will be involved off site in handling the emergency, know of their role and are able to accept it by having for example, sufficient staff and appropriate equipment to cover their particular responsibilities. Rehearsals for off-site plans shall be organized by the EPO.

6.28.4 Role of Police

Formal duties of the police during an emergency include protecting life and property and controlling traffic movements.

Their functions shall include controlling bystanders evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death or injury.

6.28.5 Role of Fire Authorities

The control of a fire shall be normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer shall also have a similar responsibility for other events, such as explosions and toxic release. Fire authorities in the region shall be apprised about the location of all stores of flammable materials, water and foam supply points and fire-fighting equipment. They shall be involved in on-site emergency rehearsals both as participants and, on occasion, as observers of exercises involving only site personnel.

6.28.6 Role of Health Authorities

Health authorities, including doctors, surgeons, hospitals, ambulances, and so on, shall have a vital part to play following a major accident, and they shall form an integral part of the emergency plan.

For major fires, injuries shall be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this in all but extreme cases may be generally available in most hospitals. For major toxic releases, the effects vary according to the chemical in question, and the health authorities shall be apprised about the likely toxic releases from the plant which will unable then in dealing with the aftermath of a toxic release with treatment appropriate to such casualties.

Major off-site incidents are likely to require medical equipment and facilities additional to those available locally, and a medical " mutual aid " scheme shall exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

6.28.7 Role of Government Safety Authority

This will be the factory inspectorate available in the region. Inspectors are likely to want to satisfy themselves that the organization responsible for producing the off-site plan has made adequate arrangements for handling emergencies of all types

including major emergencies. They may wish to see well-documented procedures and evidence of exercise undertaken to test the plan.

In the event of an accident, local arrangements regarding the role of the factory inspector will apply. These may vary from keeping a watching brief to a close involvement in advising on operations in case involvement in advising on operations. In cases where toxic gases may have been released, the factory inspectorate may be the only external agency with equipment and resources to carry out tests.

The action plan for handling of Off-site emergencies has been tentatively prepared by DSC. The same action plan will be finalized & implemented during emergency in future. The action plan is given in **Table-6.28.**

TABLE-6.28
OFF-SITE ACTION PLAN

Sr. No.	Action required to be taken to mitigate disaster by aid giving agency	Responsible agencies for taking action	Equipments/material facilities required at site to mitigate emergency
A1	Arrangements for evacuation/rescue of persons from zone of influence to predetermined camps	Police Department	Self Breathing apparatus with pare cylinder Chemical gas mask with spare canister Vehicle with PA system Transportation for evacuation of people
2	Caution to public by announcement		
3	Traffic and Mob control by cordoning of the area		
4	Law & order		
5	Request to railway authority for keeping Putholi railway gate open & to stop the up & down trains at the nearest railway station		
B1	Control of fire	District Fire Brigade	Self breathing apparatus with spare cylinders Foam/water fire tenders Gas mask with spare canisters Lime Neck to toe complete asbestos suit, PVC hand gloves, gumboots, safety goggles Mobile scrubbing system along with suction arrangement.
2	Containment of spilled chlorine and its neutralization		
3	Scrubbing of the flashed of gas cloud with water curtain		
4	To rescue trapped persons		
5	If fire is big due to LPG, keep surrounding area cool by spraying water		
6	Communication to RSEB to continue or cut off electric supply		
7	Communication to water supply department for supplying water		
C1	Medical facilities for affected parsons (first aid and treatment)	Hospital and public health	Ambulance with onboard resuscitation unit first aid, antidotes for toxicity, stretchers
D1	Identification of concentration of gas in zone of influence	Pollution control board	Gas detector
2	Communication to PHED for		

Sr. No.	Action required to be taken to mitigate disaster by aid giving agency	Responsible agencies for taking action	Equipments/material facilities required at site to mitigate emergency
	decontamination of affected water		
E1	Removal of debris and damaged structures	Municipal corporation	Provide bulldozers Provide cranes
F1	Monitor the incoming and out going transports	Transport department	Provide traffic police at site Provide emergency shifting vehicles at site Provide stock of fuel for vehicles
02	Arrange emergency shifting of affected persons and non affected person to specified area		
03	Arrange diesel/petrol for needed vehicles		
G1	Give all information related to meteorological for safe handling of affected area for living beings	Meteorological Department	Provide wind direction and velocity instruments with temperature measure Mobile van for meteorological parameter measurements
02	Forecast if any important weather change		
H1	Representative of all department are in local crisis group therefore it is expected to render services available with them since it is a group of experts and authority, the mitigating measures can be implemented in speed up way. The representative from locals are also there so communication with local people is easy and fast		Must have all resources at hand, specially disaster management plan and is implementation method. All relevant information related to hazardous chemical industry are generally available with crisis group News paper editor is a part of the group so right and timely media released can be done
02	The district emergency or disaster control officer is the president and he is used to mock drill etc. so action can be taken in right direction in time		
I1	Collector is the President of District Crisis Group therefore all district infrastructure facilities are diverted to affected zone	District Crisis group	All necessary facilities available at district can be made available at affected zone Control of law and order situation
02	All other functions as mentioned in local crisis group		

The off-site emergency organization chart for major disaster is tabulated as **Table-6.23.**

6.29 Occupational Health and Safety

Large industries, where multifarious activities are involved during construction, erection, testing, commissioning, operation and maintenance, the men, materials and machines are the basic inputs. Along with the boons, the industrialization generally bring several problems like occupational health and safety.

The industrial planner, therefore, has to properly plan and take the steps to minimize the impacts of industrialization and to ensure appropriate occupational health, safety including fire plans. All these activities again may be classified under construction and erection, and operation and maintenance.

6.29.1 Occupational Health

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

- **Construction and Erection**

The occupational health problems envisaged at this stage can mainly be due to constructional accident and noise.

To overcome these hazards, in addition to arrangements to reduce it within TLV's, people protective equipments shall also be supplied to workers.

- **Operation and Maintenance**

The problem of occupational health, in the operation and maintenance phase is due to noise hearing losses. The personal protective equipments are given to all the workers..

The working personnel are 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;
- Canister Gas mask;
- Self contained breathing apparatus;
- Leather apron;
- Aluminized fiber glass fix proximity suit with hood and gloves;
- Boiler suit;
- 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.

The same will be supplied to workers and staff after expansion. Full-fledged hospital facilities are available round the clock for attending emergency arising out of accidents, if any. All working personnel are 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.

6.29.2 Safety Plan

Safety of both men and materials during construction and operation phases is of concern. Safety plan has been prepared and implemented in the existing smelter plant. The same will be continued after the expansion of the smelter. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster in the plant is possible due to leakage of hazardous chemicals like chlorine, collapse of structures and fire/explosion etc.

Keeping in view the safety requirement during construction, operation and maintenance phases, DSC has already formulated the safety policy and the same will be further strengthen for the expansion project. The safety policy is based on 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 design, construction, operation and maintenance of plants, 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 types of occupation/processes involved in a project; and
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

In operation, the safety guidelines shall be framed in consultation with CIFB and were tested under their guidance. The same shall be implemented.

6.29.3 Safety Organization

- **Construction and Erection Phase**

A qualified and experienced safety officer shall be appointed. The responsibilities of the safety officers include identification of the hazardous conditions and unsafe acts of workers and advise 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 addition to employment of safety officer by HZL, every contractor, who employs more than 250 workers, shall also employ one safety officer to ensure safety of the worker, in accordance with the conditions of contract.

- **Operation and Maintenance Phase**

When the construction is completed the posting of safety officers shall be in accordance with the requirement of Factories Act and their duties and responsibilities shall be as defined there of.

6.29.4 Safety Circle

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

6.29.5 Safety Training

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

- Compartmentation of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations;

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

- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyor galleries;

- 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.

6.29.6 Health & Safety Monitoring Plan

The health of all employees shall be monitored once in a year for early detection of any ailment/ abnormality due to exposure to heat and hazardous chemicals.

The Rajpura Dariba mines has a well-defined DMP (Disaster Management Plan) in place and made for risk assessment of all probable risks with mitigation measures.

The organization is capable of handling any adverse situation arising out of unforeseen circumstances. At RDM there is well trained rescue persons and required equipments in sufficient number to deal with any emergency including fire. A fire tender is also maintained at the unit.

The unit has integrated certification for **QMS ISO 9001**, **EMS 14001** and **OHSAS 18001**.
The detailed DMP is as given below.

6.29.7 Safety Management- Mines

Safety management for mining operations is governed by a very well defined set of rules, regulations etc. framed by Government of India and modified from time to time.

6.29.7.1 Legislative Frame Work

All the operations in any metalliferrous mines are carried out under the Mines Act, 1952 and rules and regulations framed under it. Metalliferrous mines Regulations is a comprehensive legislation framed under the mines act and it takes care of the technical and safety aspects of the mining operations.

Mining legislations have been modified from time to time to meet the challenge of the new risks from newer technology and technical advancements for ensuring better safety standards in mines to ensure compliance with the relevant regulation. Government of India has also constituted an inspectorate under the Ministry of Labour (Directorate General of Mines Safety - DGMS). The officers of DGMS carry out periodic inspections to ensure that mining operations are in conformity with the law. Permission of DGMS is obtained for various activities as required.

The organizational requirements for ensuring safety, as laid down in the different regulations, are built into the overall Organisation of HZL and the same requirements are also proposed to be adopted for Rajpura Dariba Mine. These are briefly described hereunder.

6.29.7.2 Disaster Management Plan-Underground Mine

A situation is potentially a "Disaster", if it entails any one or more of the following:

- Loss of property as a consequence of the incident is over 1 million and or bears a potential to above.
- A situation which goes beyond the control of the available resource of the mine.
- Whose long-term severity could cause loss of life, production and property.

Causes which may lead to a disaster/accident in or about the mine are as under:

1 Fire in
a) Oil storage areas.
b) Conveyors or other rubber items.
c) Electrical substation or panels.
d) Wooden or other combustible materials.

2 Major fall of rock below ground or rock burst.
3 Sudden in rush of water and slurry.
4 Air blast
5 Fall of heavy material into the shaft.
6 Short-circuiting in electric installations and equipments.
7 Equipment failure
8 Other unforeseen causes.

- ***Disaster Management Committee (DMC)- Mines***

1. Unit Head – As Chairperson
2. A.G.M. (MP) / Agent
3. A.G.M. (Maintenance)/ Head - Maintenance
4. Manager (Safety & Training)- V.T.C
5. Dy. Director (Mine Safety) for RD Mine
6. Senior Manager (HR)

7. Chief Medical Officer/ I/C, Hospital
8. Senior Vice President/ Senior Secretary of DKMS

The DMC members will ensure to meet in every three months in order to keep liaison with one another and to check the "DISASTER MANAGEMENT PREPAREDNESS" of the mine. Such meetings shall be convened and organized by A.G.M/Agent in consultation with the Chairperson

During a disaster, the DMC shall meet regularly in order to assess the progress of rescue/recovery operations & decide further strategy & guidance to be given to Rescue-Recovery Committee (RRC). The RRC will give instructions to Rescue team regarding the situation of Disaster Place, likely to have the atmospheric condition on the spot. Rescue team will equip with suitable apparatus/appliances to deal with the situation.

- ***Disaster Information System/Flow***

If any information about a disaster/accident comes to the knowledge of any official, he shall immediately inform to Mine Manager and or Agent/ A.G.M. (MP) who in turn shall communicate to Unit Head, after making confirmation and assessment of the situation Mine Manager/Agent shall decide whether Mobilization of DMC is required or not. If decided to take the services of DMC, the same will be communicated to the Unit Head. As soon as request has been made the Unit head will instruct the DMC to take control of Rescue Operations immediately.

- ***Emergency Signal***

The Manger (HR) after receiving information from the unit Head shall immediately make arrangements for emergency signal, i.e. blow of the hooter/siren giving a long un-interrupted sound for 5 minutes. On getting any information or hearing the emergency signal, all the members of Rescue Team, Fire Fighting team & In-charge of the safety and training will immediately rush to the mine and will wait for instructions. All mine officials and Supervisors will also proceed to the Mine Manager's office for his assistance.

Assembly Point – Main Shaft Area/ Auxillary Shaft Area,
Only Concerned Persons Shall Assemble

- ***Emergency Head Quarters (EH)***

An Emergency headquarters shall be set up in the Administrative Block ear-marked for the purpose and shall be manned round the clock during the emergency by A.G.M (Geology)/ A.G.M. (Planning) or any other person decided by the Unit head. It will be equipped with at least two internal Phone and one external phone. All public relation work connected with the disaster such as answering enquiries and giving information to the head office, press, public etc, shall be done from here so as to avoid mis-information.

- ***Organization at the Mine***

The basic function of the emergency organization is to save lives and this should be the main concern of one and all. The main features of this organization are as follows:

- ***Rescue Recovery Committee (RRC)***

This committee will be responsible for overall direction of all the operations connected with the rescue/recovery work and will function in close contact with DMC. The RRC will consist of:

1) Agent- Chief Coordinator
2) Mine Manager
3) Dy. Director (DGMS) for RD Mine
4) Engineer Incharge
5) Head of UG Electrical Department
6) Sr. Vice President/Sr. Secretary, D.K.M.S.

Henceforth, all the activities connected with the rescue and recovery operations will be done as per the direction of the RRC. The Mine Manager will instruct all his officials and supervisors to report to RRC for further orders/instructions. The PRC will make arrangements for manning the RRC room in the back shifts for smooth operations of rescue and recovery work. All necessary instruction and guide lines will be displayed on the notice board/black board.

As soon as the RRC is setup, all persons who are required for rescue/recovery work must first obtain authorization from the RRC. A record of such persons shall be maintained in the RRC room.

- ***Rescue-Recovery Committee Room***

Depending upon the location of the accident a Rescue Recovery committee room will be set up on the surface. It will be equipped with one external and two internal telephones, a large table for display of plans and sections, a black board for technical guidelines, almirah to hold plans, emergency tokens, telephones call lists, log books registers etc., In addition, another room should be made available for accommodation of these rescue team.

- ***Checking of Persons***

As soon as the RRC is set up, all persons who are required to go underground must first obtain authorization from the RRC. Each persons authorized will be given an envelope containing two tokens with a common number but different colours. The name of the persons receiving the envelope will be recorded.

The red token must be handed over to the gate-checker before entering the cage. The copper token must be worn suspended from the neck whilst underground. On

returning to the surface all persons must collect their tokens from the gate checker and hand over the same to the RRC.

- ***Duties of Persons in Emergency***

1) Mine Manager

- As soon as the mine manager gets the information of any serious nature, he will immediately inform the agent and unit head and sent an urgent call for mine officials and supervisors. He will instruct them to attend essential works prior to the set up of RRC and subsequently ask them to report to RRC for further instructions.

- He will make all necessary arrangements for the functioning of RRC and office accommodations will all necessary facilities to take the charge of rescue work.

- He will ensure that all affected persons are evacuated in the best possible ways and only those persons shall be allowed to proceed to the affected area who will be needed for rescue and recovery work.

- Immediately after withdrawal of work persons from belowground, he shall ensure to carry out head counts through gate checker's office or by concerned shift mine officials in order to know the exact number of persons trapped in the disaster.

- He will take necessary steps so as to get deployed all other work force in other areas, except those needed by RRC for rescue work.

- In addition to the above, Mine Manager shall take necessary actions independently as warranted for situation without loss of time.

2) Assistant Manager/ Under Manager/ Other Officials

- Depending upon the nature and severity of the accident, the RRC, will make a duty distribution chart and the same shall be immediately displayed on the notice board. All officials/ supervisors will be briefed by RRC about their duty timings, place of work and nature off job assigned to them.

- All officials will keep close liaison with the RRC and half-hourly report of any new development will be given to RRC on regular basis.

- The persons shall be relieved at the site.

- All necessary steps should be taken to make a telephone arrangement and first aid station as near to the affected area as possible.

- All critical activities e.g. pumping, ventilation, fencing of dangerous areas, monitoring of any section of activities as instructed by RRC shall be done as per guide lines and all findings and actions taken shall be recorded in a

bounded paged book kept in the RRC from and duly signed by them with date and time.

- They will keep all necessary liaison for quick shifting of the affected persons to surface and if felt necessary, send the information for sending rescue/medical team which will be in ready state on surface.

- They will ensure that all persons engaged for rescue work are safely withdrawn at the end of the shift and marked out in the gate checker register and in register kept for the purpose in RRC room.

- Engineer in-charge should ensure that the restoration of pumping, ventilation fan and man winding system of the shafts etc. at the earliest if conditions warrant. The engineer in charge shall also take necessary actions for arrangement of spares for dewatering pumps and installation of additional or replacement of pumps in underground. If required, the matter may be consulted with Mine Manager.

- In-charge of UG Electrical department shall take necessary action for restoration of power if tripped during emergency, taking consideration of all safety measures and the matter may be consulted with Mine Manager.

- ***Rescue Room Incharge***

For the purpose of coordinating fire-fighting activities and to enforce all regulations for preventions of fire : and

a) To extricate persons from debris
b) To hand over casualties and injured persons to first aid parties
c) To take immediate steps as may be necessary for the temporary supports or demolition of buildings and structures, the collapse of which is likely to endanger life of obstruct traffic.
d) To cut off supplies to damaged structures etc.
e) In case of underground workings, the rescue team shall perform rescue and recovery operations as may be required under the direction of the agent/Mine Manager in accordance with the provisions of the Mines Rescue Rules, 1985
f) To keep his rescue/fire fighting teams in ready state in the place assigned by RRC
g) To divide his team in such a fashion so that the rescue team is readily available round the clock
h) To ensure to make all necessary arrangements for timely refilling of oxygen cylinders of breathing apparatus and will ensure that all other rescue equipments are available in ready and good order.

➢ **Safety/Ventilation Office**

a) He will keep a close watch over the running of main ventilating fan and any unusual variance shall immediately be reported to RRC and should be recorded in a Register.

b) In case of fire, he will ensure the stoppage and reversal of main fan as per the instructions of Mine Manager/ RRC. However, he shall take necessary action for re-coursing as per the requirement in consultation with Mine Manager

- **Survey Officer**

He will prepare all the relevant plans and sections of the affected areas and shall be ready with sufficient number of plans and sections.

- **Medical Superintendent/ In- Charge Hospital**

a) He will summon all the Doctors and medical staff. He will give the necessary instructions to deal with the affected persons and keep the mortuary ready for post mortem and identification.
b) He will keep the ambulance, first aid and equipments ready with the necessary staff at the pit top or at the place proposed by RRC
c) He will arrange for sufficient beds and other facilities for the treatment of injured persons.
d) He will ensure to maintain at all times minimum stock of oxygen and other medicines to meet out any emergency. However, he shall make all arrangements for additional requirements during disaster/accident depending upon the gravity of the situation.
e) He will inform nearby hospitals and will ensure that in case of emergency, the injured persons can be immediately shifted and given necessary treatment.
f) He will arrange for recording causalities by putting the label on each patient seen, treated and transported which would bear the particulars about the name, date of accident, details of injury conditions of the patient and treatment. The following 3 types of labels are to be used for different type of causalities.

WHITE : For walking patient with minor injury
GREEN: For moderately injured
RED : For seriously injured

- **Gate Checker**

a) He will keep record of the persons going below ground and coming out from the underground. Immediately after the withdrawal of work persons, he shall make a head-count and report to the Mine Manager.
b) He will permit only those persons to proceed for below ground, who have been authorized by Mine Manager/RRC for rescue work

c) In case of any relevant information received from underground he will immediately inform the RRC

- **Bellman**

a) He will allow only those persons to proceed below ground who have got clearance from the gate-checker. Once RRC is in action, persons going below

ground are required to wear copper token on the neck and the same be checked by the bellman before allowing him into to cage

b) He shall ensure that the cage is not held up at any landing unnecessarily.

- **Manager (HR)**

a) On receiving information from the unit Head, he will arrange immediately for emergency signal
b) He will keep proper record of all injured persons and casualties. He will also deal with the relatives of the injured, state administration officials and other agencies.
c) In addition, he shall make all arrangements for lodging and boarding of outside agencies in the Guest house and transport facility if required.

- **Manager (Stores)/ In- charge Central Stores**

He will make necessary arrangements to keep the stores open round the clock for issue of material and make available sufficient stock of materials needed during the course of rescue and recovery operations. He will be in close contact with the RRC for any material requirements.

- **Canteen Incharge/Welfare Officer**

He will make necessary arrangements and organization for the additional food supplies to meet out of the emergency

- **Incharge of Garage and Central Workshop**

He will make arrangements for availability of transport facility round the clock. The central workshop facilities shall be available as per the requirements.

- **Stocking of Tools and Materials**

All tools, materials & safety items needed for the rescue/recovery operations will be stored in a safe place near the RRC room so that the work is not affected for want of any such material. A store Officer/Mine Engineer will be made in-charge to look into the arrangements of the materials & to keep the RRC informed.

To deal with such exigency, certain materials as listed in **Table 6.29** shall be kept at a centralized place near old security gate. Room adjacent to Personnel Dept. building will be used for storage of the required materials.

TABLE 6.29
LIST OF MATERIALS TO BE KEPT IN CENTRALIZED PLACE

Sr. No.	Materials		Number
I.	Safety belts		10
II.	Hand gloves (rubber & leather)		50
III.	Rubber tubes		6
IV.	Safety goggles		25
V.	Stretcher	Vertical type	1
		Ordinary type	4
VI.	Manila rope (1/2" & ¾")		20m each
VII.	Hanging ladder way		20m, 2 sets
VIII.	Submersible pump (complete set)		1 set
IX.	Pipe fitting & valve (1", 2"' 3" & 4")		Sufficient numbers
X.	Iron pans, pick axe, spades		15 no.s each
XI.	Screw props		5
XII.	Wire rope slings & clamps (1/2", 2")		5 sets
XIII.	Hose pipe (1/2" & 1")		50m each
XIV.	Standby winch on surface at main shaft in ready condition		
XV.	Hose fittings and clamps of all size		Lot
XVI.	Chain pulley block of 1, 2 & 10 tone capacity. One each		
XVII.	Eye bolts		6
XVIII.	Tripod		2
XIX.	Loose bars (3', 5' & 8')		5 no.s each
XX.	Carry strip roll		1
XXI.	Helmets		15
XXII.	Blasting cable roll		1
XXIII.	Telephone instrument		1
XXIV.	First aid box		1
XXV.	Hand shovels		10

- **Training of Persons**

All the rescue and fire fighting teams must be properly trained to carry out their duties in an emergency. Practice drills shall be carried out once in every six months to ensure that persons are fully conversant with their duties and can carry them out efficiently when the need arises. A record of all such drills and meetings will be maintained.

- **Security Incharge**

The chief of CISS is the commanding officer of the security staff. On the instruction of Manager (P&A) the commanding officer shall arrange to record the entry of outside personnel at the main gate to avoid and hindrance during the course of rescue recovery operations. The Chief of CISS shall keep close liaison within local police and district authorities too.

a) Control the vehicular/personnel traffic in and around the mine
b) Help local police in controlling the area of the mine, if necessary
c) Assist in Transporting injured persons

d) The security personnel on duty shall ensure that all roads at the scene of fire/emergencies are kept clear from obstruction. Persons arriving by motor transport at the scene of fire/emergency are not permitted to park their vehicles within 100 meters of fire, near fire hydrants, at road junctions and access roads. The ignition key should be left in the vehicles.
e) Assist local police in patrolling in township and work out adequate arrangements for protection of property.
f) Ensure separate entries of different materials received from external agencies for coping up emergency operations.

6.29.7.3 Disaster Management Plan-Mill/Surface Departments

A situation is potentially a "Disaster", if it entails any one or more of the following:

a) Risk of loss of human lives-10 or more in one single situation.
b) Loss of property as a consequence of the incident is over 1 million and or bears a potential to above.
c) A situation which goes beyond the control of the available resource of the mine.
d) Whose long-term severity could cause loss of life, production and property.

Causes which may lead to a disaster/accident in or about the mine are as under:

1. Fire in

a) Oil storage tank.
b) Conveyors or other rubber items.
c) Electrical substation or panels.
d) Wooden or other combustible materials.

2. Sudden in rush of water and slurry.
3. Collapse of major structure
4. Short-circuiting in electric installations and equipments.
5. Equipment failure
6. Other unforeseen causes.

Disaster Management Committee - Surface

1. Unit Head – As Chairperson
2. AGM (O.D.)/In-charge Mill
3. AGM (Maintenance)/In-charge- Central Services
4. Manager (Safety & Training)- V.T.C
5. A.GM (Safety)
6. Dy. Director (Mine Safety) for RD Mine
7. Sr. manager (HR)
8. Deputy Chief Medical Officer/ I/C, Hospital
9. Senior Vice President/ Senior Secretary of DKMS

The DMC members will ensure to meet in every three months in order to keep liaison with one another and to check the "DISASTER MANAGEMENT PREPAREDNESS" of the mill/surface depts. Such meetings shall be convened and organized by AGM (O.D.)/ In- charge- Mill in consultation with the Chairperson

During a disaster, the DMC shall meet regularly in order to assess the progress of rescue/recovery operations & decide further strategy & guidance to be given to Rescue-Recovery Committee (RRC). The RRC will give instructions to Rescue team the situation of Disaster Place, likely to have the atmospheric condition on the spot. Rescue team will equip with suitable apparatus/appliances to deal with the situation.

- ***Disaster Information System/Flow***

If any information about a disaster/accident comes to the knowledge of any official, he shall immediately inform to Mine Manager and or Agent/Dy. G.M (MP) who in turn shall communicate to Unit Head, after making confirmation and assessment of the situation AGM (O.D.)/In-charge Mill shall decide whether Mobilization of DMC is required or not. If decided to take the services of DMC, the same will be communicated to the Unit Head. As soon as request has been made the Unit head will instruct the DMC to take control of Rescue Operations immediately.

- ***Emergency Signal***

The Manger (HR) after receiving information from the unit Head shall immediately make arrangements for emergency signal, i.e. blow of the hooter/siren giving a long un-interrupted sound for 5 minutes. On getting any information or hearing the emergency signal, all the members of Rescue Team, Fire Fighting team & In-charge of the safety and training will immediately rush to the mine and will wait for instructions. All mine officials and Supervisors will also proceed to the AGM (O.D.) /In -charge Mill office for his assistance.

ASSEMBLY POINT – MAIN SHAFT AREA/ AUXILLARY SHAFT AREA, (To be checked ONLY CONCERNED PERSONS SHALL ASSEMBLE

- ***Emergency Head Quarters (EH)***

An Emergency headquarters shall be set up in the Administrative Block ear-marked for the purpose and shall be manned round the clock during the emergency by AGM (Geology)/AGM (Planning) or any other person decided by the Unit head. It will be equipped with at least two internal Phone and one external phone. All public relation work connected with the disaster such as answering enquiries and giving information to the head office, press, public etc, shall be done from here so as to avoid mis-information.

- ***Organization At The Mill/Surface Depts***

The basic function of the emergency organization is to save lives and this should be the main concern of one and all. The main features of this organization are as follows:

- ***Rescue Recovery Committee (RRC)***

This committee will be responsible for overall direction of all the operations connected with the rescue/recovery work and will function in close contact with DMC. The RRC will consist of:

1) A.G.M. (O.D.) - Chief Coordinator
2) Mill Manager
3) Dy. Director (DGMS) for RD Mine
4) Engineer In-charge
5) Head of Electrical Department - Mill
6) Sr. Vice President/Sr. Secretary, D.K.M.S.

The above committee is for underground and not for surface / Mill. To be reviewed accordingly.

Henceforth, all the activities connected with the rescue and recovery operations will be done as per the direction of the RRC. The AGM (O.D.)/In-charge Mill will instruct all his officials and supervisors to report to RRC for further orders/instructions. The PRC will make arrangements for manning the RRC room in the back shifts for smooth operations of rescue and recovery work. All necessary instruction and guide lines will be displayed on the notice board/black board.

As soon as the RRC is setup, all persons who are required for rescue/recovery work must first obtain authorization from the RRC. A record of such persons shall be maintained in the RRC room.

- ***Rescue-Recovery Committee Room***

Depending upon the location of the accident a Rescue Recovery committee room will be set up on the surface. It will be equipped with one external and two internal telephones, a large table for display of plans and sections, a black board for technical guidelines, almirah to hold plans, emergency tokens, telephones call lists, log books registers etc., In addition, another room should be made available for accommodation of these rescue team.

- ***Duties of Persons in Emergency***

1) A.G.M. (O.D.)

a) As soon as the A.G.M. (O.D.)/In-charge Mill gets the information of any serious nature, he will immediately inform the agent and unit head and sent

f) He will arrange for recording causalities by putting the label on each patient seen, treated and transported which would bear the particulars about the name, date of accident, details of injury conditions of the patient and treatment. The following 3 types of labels are to be used for different type of causalities.

WHITE : For walking patient with minor injury
GREEN: For moderately injured
RED : For seriously injured

- ***Manager (HR)***

a) On receiving information from the unit Head, he will arrange immediately for emergency signal
b) He will keep proper record of all injured persons and casualties. He will also deal with the relatives of the injured, state administration officials and other agencies.
c) In addition, he shall make all arrangements for lodging and boarding of outside agencies in the Guest house and transport facility if required.

- ***Manager (Stores)/ In-charge Central Stores***

He will make necessary arrangements to keep the stores open round the clock for issue of material and make available sufficient stock of materials needed during the course of rescue and recovery operations. He will be in close contact with the RRC for any material requirements.

- ***Canteen Incharge/Welfare Officer***

He will make necessary arrangements and organization for the additional food supplies to meet out of the emergency

- ***In-charge of Garage and Central Workshop***

He will make arrangements for availability of transport facility round the clock. The central workshop facilities shall be available as per the requirements.

- ***Stocking of Tools and Materials***

All tools, materials & safety items needed for the rescue/recovery operations will be stored in a safe place near the RRC room so that the work is not affected for want of any such material. A store Officer/Mine Engineer will be made In-charge to look into the arrangements of the materials & to keep the RRC informed.

To deal with such exigency, certain materials as listed in **Table 6.1** shall be kept at a centralized place near old security gate. Room adjacent to Personnel Dept. building will be used for storage of the required materials.

- ***Training of Persons***

All the rescue and fire fighting teams must be properly trained to carry out their duties in an emergency. Practice drills shall be carried out once in every six months to ensure that persons are fully conversant with their duties and can carry them out efficiently when the need arises. A record of all such drills and meetings will be maintained.

- ***Security Incharge***

The chief of Security is the commanding officer of the security staff. On the instruction of Manager (HR) the commanding officer shall arrange to record the entry of outside personnel at the main gate to avoid and hindrance during the course of rescue recovery operations.

The Chief of Security shall keep close liaison within local police and district authorities too.

a) Control the vehicular/personnel traffic in and around the mine

b) Help local police in controlling the area of the mine, if necessary

c) Assist in Transporting injured persons

d) The security personnel on duty shall ensure that all roads at the scene of fire/emergencies are kept clear from obstruction. Persons arriving by motor transport at the scene of fire/emergency are not permitted to park their vehicles within 100 meters of fire, near fire hydrants, at road junctions and access roads. The ignition key should be left in the vehicles.

e) Assist local police in patrolling in township and work out adequate arrangements for protection of property.

f) Ensure separate entries of different materials received from external agencies for coping up emergency operations.

Chapter-7
Alternative Technologies

7.0 ALTERNATIVE TECHNOLOGIES

Lead and zinc can be produced pyrometallurgically or hydrometallurgically, depending on the type of ore used as a charge. The different methods adopted for lead smelting are briefly explained below.

7.1 Lead Smelter

7.1.1 Conventional Lead Smelting Process

The conventional pyrometallurgical primary lead production process consists of four steps:

- Sintering of lead concentrate
- Smelting of sinter in blast furnace
- Drossing of copper from lead bullion
- Pyro Refining of lead bullion

7.1.2 Direct Smelting Processes

In this technology, smelting of lead concentrate is done directly to produce lead bullion and discardable slag. Lead bullion to be tapped from the furnace periodically and to be sent to the lead refinery to refine it further to produce refined lead. An oxygen plant is also to be installed to meet the oxygen requirement of the operation.

AUSMELT, QSL, SKS, Kivcet, and ISASMELT are some of the direct reduction processes.

'AUSMELT' lead smelting is a pyro-metallurgical route based on Top Submerged Lance Technology designed by M/s Ausmelt, Australia. This technology implies batch production of lead, which involves three stages

- Smelting of lead concentrate with supply of oxygen
- Reduction of lead oxide slag to lead bullion
- Fuming of zinc rich slag into zinc oxide.
- Refining of Lead bullion

All these are stages takes place in a single furnace. The off gases are cleaned and the % of SO_2 rich off gas is stabilized in the Absorption and Regeneration system. The SO_2 rich gas is then converted to Sulphuric acid in the conventional DCDA type Sulphuric acid plant.

7.1.3 Imperial Smelting Process

Imperial Smelting Process enables simultaneous production of zinc and lead metals through pyro-metallurgical process route. The main sections for this process route are Sinter, Imperial Smelting Furnace (ISF) and Refineries. The various process steps in this process is comprise of;

- Sintering of lead-zinc concentrates and oxides in updraft sinter machine;
- Reduction of sinter to lead bullion and furnace zinc in ISF;
- Pyro-refining of Zinc
- Pyro-refining of Lead
- Recovery of Cadmium
- Recovery of Copper
- Processing of SO2 gases from Sinter Plant to produce Sulphuric acid
- Recovery of Silver
- Integrated Effluent Treatment

7.1.4 Summary of Adverse Impact of each Alternative

The principal air pollutants emitted from the processes are particulate matter and sulfur dioxide (SO_2). Fugitive emissions occur at furnace openings and from launders, casting molds, and ladles carrying molten metal, which releases sulfur dioxide and volatile substances into the working environment. Additional fugitive particulate emissions occur from materials handling and transportation of ores and concentrates. Some vapors are produced in hydrometallurgy and in various refining processes. The principal constituents of the particulate matter are lead/zinc and iron oxides, but oxides of metals such as arsenic, antimony, cadmium, copper, and mercury are also present, along with metallic sulfates. Dust from raw materials handling contains metals, mainly in sulfidic form, although chlorides, fluorides, and metals in other chemical forms may be present. Off-gases contain fine dust particles and volatile impurities such as arsenic, fluorine, and mercury. Air emissions for processes with few controls may be of the order of 30 kilograms lead or zinc per metric ton (kg/t) of lead or zinc produced.

The presence of metals in vapor form is dependent on temperature. Leaching processes will generate acid vapors, while refining processes result in products of incomplete combustion (PICs). Emissions of arsine, chlorine, and hydrogen chloride vapors and acid mists are associated with electrorefining.

Wastewaters are generated by wet air scrubbers and cooling water. Scrubber effluents may contain lead/zinc, arsenic, and other metals. In the electrolytic refining process, by-products such as gold and silver are collected as slimes and are subsequently recovered. Sources of wastewater include spent electrolytic baths, slimes recovery, spent acid from hydrometallurgy processes, cooling water, air scrubbers, washdowns, and stormwater.

The larger proportion of the solid waste is discarded slag from the smelter. Discard slag may contain 0.5–0.7% lead/zinc and is frequently used as fill or for sandblasting. Slags with higher lead/ zinc) content—say, 15% zinc—can be sent for metals recovery. Leaching processes produce residues, while effluent treatment results in sludges that require appropriate disposal. The smelting process typically produces less than 3 tons of solid waste per ton of lead/zinc produced.

7.1.5 Selection of Alternative

Based on our prior experience and recent information from the market the following process technology options were evaluated.

1. Ausmelt Technology (Single Furnace Philosophy) - Australia
2. Ausmelt Technology (Twin furnace philosophy) - Australia
3. SKS Technology – China

The comparison between the Ausmelt technology & SKS technology is tabulated in **Table 7.1**.

TABLE 7.1
COMPARISON BETWEEN THE AUSMELT TECHNOLGY & SKS TECHNOLOGY

Parameters	Ausmelt	SKS
Plant Availability	75%	90%
Recovery of minor metals	Limited to Silver	Good recovery of Zinc, Silver, Antimony, Bismuth & Copper
Cost of Production	More as compared to SKS	Less
SO_2 Concentration	Varies based on stages of smelting & Inconsistent.	Steady SO_2 to SAP hence better acid quality and better plant performance
Smelting process	Complex	Simple
Water Consumption	Less	More

Based on the evaluations done and to get higher recovery of minor metals like silver, copper, antimony and bismuth, the SKS technology of China has been proposed. The plant shall be installed on turnkey basis by a major non-ferrous group of China.

7.2 Zinc Smelter

In the most common hydrometallurgical process for zinc manufacturing, the ore is leached with sulfuric acid to extract the lead/zinc. These processes can operate at atmospheric pressure or as pressure leach circuits. Lead/zinc is recovered from solution by electro-winning, a process similar to electrolytic refining. The process most commonly used for low-grade deposits is heap leaching. Imperial smelting is also used for zinc ores.

7.2.1 Distinctive Features of Process Technology Adopted

- Selection of Roast-Leach-Electrowinning (RLE) route which is a well-proven technology for zinc production;
- Process of roasting is thermally autogenous (self-sustaining) with steam generation to meet plant heating requirements;

- High-efficiency gas cleaning and acid conversion/absorption process to emit clean gases;
- Selection of leaching process with residue treatment option to enable high recovery of zinc;
- High solution purity combined with optimum electrolytic cell size and current density resulting in low power consumption;
- Optimum level of automation in the plant leading to low power consumption, high operational efficiencies and high metal recoveries;
- Incorporation of secure landfill for solid waste disposal; and
- Incorporation of ventilation systems and bag filters in various plant areas to enable clean working environment.

7.2.2 Selection of Alternative

Considering various process options available such as Pyro-metallurgical ISF route & Hydrometallurgical route, HZL proposed smelter at Dariba through conventional hydro-metallurgical route through roast-leach-electro-winning operations for the following reasons:

1. Higher recovery of Zinc and other byproducts
2. Production of Special high grade quality Zinc (SHG)

Also, there is no plant operating in the world on pyro-metallurgical route with capacity more than 1,20,000 MTPA. The comparison between the Hydro Metallurgical Zinc Plant & Pyro- Metallurgical Zinc Plant is tabulated on the following page.

Conventional hydro-metallurgical route for zinc extraction is through "Roast-Leach-Electrowinning" operations. The raw material for the zinc smelter is zinc concentrate, which contains about 54% zinc in the form of zinc sulphide. The zinc concentrate containing zinc & other impurities is roasted to convert it into zinc oxide, which is leached in dilute sulphuric acid to produce a raw zinc sulphate solution. The impurities like copper, cadmium, nickel, cobalt etc also get dissolved in the solution as sulphates. The solution is filtered off to remove the insoluble impurities and the filtrate is purified by addition of zinc dust / powder and activators. The purified zinc sulphate solution is then electrolysed to obtain zinc cathodes, which are then melted and cast into zinc metal ingots. The filter cakes obtained during purification are sent to cadmium section. The leached residue obtained from leaching section is subjected to further treatment in residue treatment section for zinc recovery and elimination of iron as jarosite. The lime and cement is mixed in the Jarosite to convert into stabilized non-leachable product called Jarofix.

The comparison between the Hydro-Metallurgical Zinc Plant & Pyro metallurgical Zinc Plant is tabulated in **Table-7.2.**

TABLE 7.2
COMPARISON BETWEEN THE HYDRO-METALLURGICAL ZINC PLANT & PYRO METALLURGICAL ZINC PLANT

Parameters	Hydro Metallurgy	Pyro Metallurgy
Capacity	Single stream upto 200,000	Single stream upto 120,000
Recovery of Zinc	97%	93%
Quality of Zinc Produced	SHG	PWG
Cost of Production	Less	More as compared to Hydro
Power Consumption	More (Plant is Auto-thermal)	Less as compared to Hydro (but fuel consumption is high)
SO_2 Concentration	High Concentration and Steady SO_2 to SAP hence better acid quality and better plant performance	Low concentration and Fluctuating flow of SO_2 to SAP
Quality of Sulphuric Acid	White-Marketable	Black-reagents to be added for making marketable grade
Flexibility in terms of capacity utilization	More flexibility in operation	Less flexible
Flexibility in terms of feed material	Less flexible	More flexible (residues & secondary can be treated)
Final waste	Jarosite is a Hazardous material, can be stabilized by lime and cement	Slag which is Inert
Consistency	Commissioning/ Stabilization curve will be less	Commissioning/ Stabilization curve will be more
Operating Conditions	Good working environment	Operation at high temperature environment
World Scenario	88%	12%

Based on the above facts and figures the zinc plant on hydro-metallurgical route has been selected for the proposed new zinc smelter.

Chapter-8
Public Consultation

8.0 PUBLIC CONSULTATION

8.1 Public Hearing

The public hearing for the proposed expansion of Lead-Zinc Underground Mine and proposed Integrated Smelter Complex consisting of Zinc smelter of 2 x 0.25 MTPA capacity, Lead smelter of 1 x 0.125 MTPA capacity, Captive Power Plant of 3 x 85 MW capacity along with enhancement of ore production capacity from 0.63 MTPA to 0.9 MTPA and beneficiation capacity from 0.9 to 1.2 MTPA at Rajpura Dariba, Rajsamand District, Rajasthan was conducted on 12th February 2009 at 11 a.m. at Rajpura Dariba Mine Location as per Environment Impact Assessment Notification dated 14th September 2006.

The press notification indicating date and venue of the public hearing was issued by Regional Officer, Rajasthan State Pollution Control Board, Udaipur on 10.01.2009 in prominent Hindi news papers Viz. Rajasthan Patrika and Dainik Bhasker with project details inviting suggestions, views, comments and objections from the public regarding establishment proposed expansion of Lead-Zinc Underground Mine and proposed Integrated Smelter Complex consisting of Zinc smelter of 2 x 0.25 MTPA capacity, Lead smelter of 1 x 0.125 MTPA capacity, Captive Power Plant of 3 x 85 MW capacity along with enhancement of ore production capacity from 0.63 MTPA to 0.9 MTPA and beneficiation capacity from 0.9 to 1.2 MTPA at Rajpura Dariba, Rajsamand District, Rajasthan. The copies of the notification issued in newspapers for public hearing are given below.

The EIA reports along with Executive Summary in English and Hindi were displayed and made available from 10.01.2009 onwards at the following places:

- Office of District Collector, Rajsamand;
- Zilla Parishad, Rajsamand;
- Zilla Udhyog Kendra, Rajsamand;
- Regional Office, Ministry of Environment and Forests, GoI, Lucknow,
- Regional Officer, Rajasthan State Pollution Control Board, Udaipur
- Rajasthan State Pollution Control Board, Jaipur

Public hearing meeting was convened by Mr. Veer Singh Brijwasi, Regional Officer, RSPCB, Udaipur and chaired by Mr. T.C.Bohra, Additional District Collector, Rajsamand District.

About 1200 people attended the public hearing. The list of people signed in public hearing is given in **Annexure-XIII**.

The Regional Officer briefed the public about the purpose of organizing the hearing and asked the project proponent to explain the salient features of project and specific reference to the impacts on environment and its management.

NOTICE FOR PUBLIC HEARING – DAINIK BHASKAR (RAJSAMAND EDITION) (HINDI DAILY) (10/01/2009)

क्षेत्रीय कार्यालय एवं प्रयोगशाला
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, उदयपुर

राप्रनिम/उ/राजसमंद/एच-111/ दिनांक : 09.01.09

पर्यावरण स्वीकृति हेतु लोक सुनवाई के लिये आम सूचना

सर्व साधारण को सूचित किया जाता है कि मै. हिन्दुस्तान जिंक लि. लेड-जिंक इनटिग्रेटेड कॉम्प्लेक्स (जिंक स्मेलटर 2 x 0.25 MTPA, लेड स्मेल्टर 1 x 0.125 MTPA केप्टीव पावर प्लान्ट, 3 x 85 MW, भूमिगत खान परियोजना एम.एल नं. 2/89, का विस्तार 0.63 MTPA से 0.9 MTPA और बेनिफिसियेशन क्षमता का विस्तार 0.9 MTPA से 1.2 MTPA जिसका लीज नवीनीकरण दिनांक 30.05.2010 को होना है) राजपुरा दरीबा, तहसील-रेलमगरा, जिला राजसमंद का प्रस्ताव राजस्थान राज्य प्रदूषण नियंत्रण मण्डल को पर्यावरण स्वीकृति के सम्बन्ध में प्रस्तुत किया गया है और चूंकि मण्डल द्वारा उक्त परियोजना हेतु वन एवं पर्यावरण मंत्रालय, नई दिल्ली द्वारा जारी अधिसूचना संख्या एस.ओ. 1533 दिनांक 14.9.2006 के अनुसार लोक सुनवाई हेतु इस आशय की सूचना जारी कर 30 दिवस का नोटिस दिया जाना आवश्यक है।

उक्त परियोजना से सम्बन्धित EIA रिपोर्ट एवं संक्षिप्त कार्यपालक सार निम्न कार्यालयों में उपलब्ध है :-

1. कार्यालय जिला कलेक्टर, राजसमन्द
2. जिला परिषद, राजसमन्द
3. जिला उद्योग केन्द्र, राजसमन्द
4. क्षेत्रीय कार्यालय, पर्यावरण एवं वन मंत्रालय भारत सरकार, पंचम तल, केन्द्रीय भवन, सेक्टर एच अलीगंज, लखनऊ।
5. क्षेत्रीय कार्यालय, राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, एफ-470, मेवाड़ औद्योगिक क्षेत्र, मादड़ी उदयपुर (राज.)
6. राजस्थान राज्य प्रदूषण नियंत्रण, मण्डल, 4, संस्थानिक क्षेत्र, झालाना डूंगरी, जयपुर

अतः सर्व साधारण को सूचित किया जाता है कि उक्त परियोजना के पर्यावरणीय स्वीकृति से सम्बन्धित प्रकरण के निपटारे के लिये जनसुनवाई दिनांक 12.02.2009 को माईन्स स्थल, (राजपुरा दरीबा खान परिसर) तहसील रेलमगरा, जिला राजसमन्द में प्रातः 11.00 बजे उपस्थित होकर अपने आक्षेप प्रस्तुत कर सकते है। इस सम्बन्ध में लिखित/मौखिक सुझाव/आक्षेप इस सूचना के प्रकाशन की तिथि से 30 दिवस के अन्दर राजस्थान राज्य प्रदूषण नियंत्रण, मण्डल, क्षेत्रीय कार्यालय, उदयपुर में भी प्रस्तुत किये जा सकते है।

(वी.एस. बृजवासी)
क्षेत्रीय अधिकारी
रा.प्र.नि.म., उदयपुर

NOTICE FOR PUBLIC HEARING – RAJASTHAN PATRIKA (RAJSAMAND EDITION) (HINDI DAILY) (10/01/2009)

क्षेत्रिय कार्यालय एवम् प्रयोगशाला

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, उदयपुर

दिनांक : 09.01.09

राप्रनिम/उ/राजसमंद/एच-111/

पर्यावरण स्वीकृति हेतु लोक सुनवाई के लिये आम सूचना

सर्व साधारण को सूचित किया जाता है कि **मै. हिन्दुस्तान जिंक लि. लेड-जिंक इनटिग्रेटेड कॉम्पलेक्स (जिंक स्मेल्टर, 2x0.25 MTPA, लेड स्मेल्टर 1x0.125 MTPA केप्टीव पावर प्लान्ट, 3x85 MW, भूमिगत खान परियोजना एम.एल. न. 2/89, का विस्तार 0.63 MTPA से 0.9 MTPA और बेनिफिसियेशन क्षमता का विस्तार 0.9 MTPA से 1.2 MTPA जिसका लीज नवीनीकरण दिनांक 30.05.2010 को होना है) राजपुरा दरीबा, तहसील-रेलमगरा, जिला राजसमंद** का प्रस्ताव राजस्थान राज्य प्रदूषण नियंत्रण मण्डल को पर्यावरण स्वीकृति के सम्बन्ध में प्रस्तुत किया गया है और चूंकि मण्डल द्वारा उक्त परियोजना हेतु वन एवं पर्यावरण मंत्रालय, नई दिल्ली द्वारा जारी अधिसूचना संख्या एस.ओ. 1533 दिनांक 14.9.2006 के अनुसार लोक सुनवाई हेतु इस आशय की सूचना जारी कर 30 दिवस का नोटिस दिया जाना आवश्यक है।

उक्त परियोजना से सम्बन्धित EIA रिपोर्ट एवं संक्षिप्त कार्यपालक सार निम्न कार्यालयों में उपलब्ध है :-

(1) कार्यालय जिला कलेक्टर, राजसमंद
(2) जिला परिषद, राजसमंद
(3) जिला उद्योग केन्द्र, राजसमंद
(4) क्षेत्रीय कार्यालय, पर्यावरण एवं वन मंत्रालय भारत सरकार, पंचम तल, केन्द्रीय भवन, सेक्टर एच अलीगंज, लखनऊ।
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(6) राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, 4 संस्थानिक क्षेत्र, झालाना डूंगरी, जयपुर

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रा.प्र.नि.म., उदयपुर

PHOTOGRAPHS SHOWING PUBLIC HEARING

Additional district collector and Regional officer at the public hearing

PUBLIC AND OTHER OFFICIALS IN THE PUBLIC HEARING

PROJECT OFFICIALS AT THE PUBLIC HEAING

PUBLIC QUERIES DURING THE PUBLIC HEARING

RESPONSE OF THE MANAGEMENT

After briefing the public about the project details by representative of M/s. Hindustan Zinc Ltd, Rajpura Dariba mines, the Regional Officer invited the public to express their concerns, views and suggestions on this proposal. The minutes of the public hearing is enclosed as **Annexure-XIII**.

8.2 Issues Raised during Public Hearing and Commitment

Action Plan to address the issues raised during public hearing along with time frame and financial allocations are discussed below.

8.3 Conclusion on Public Hearing

As there is no further representation from the Public present during public hearing, Mr. Veer Singh Brijwasi summed up the Proceedings of the Public hearing and declared the Public Hearing as over, with due permission of the Additional District Collector, Rajsamand. The details of people attended, representations received in writing during the public hearing are enclosed along with the minutes of the public hearing.

TABLE-8.1
DETAILS OF ACTION PLAN FOR THE ISSUES RAISED DURING THE PUBLIC HEARING

Sr. No.	Issues	Action Plan	Time frame	Fina
1	Local people be given priority in the employment	Out of the total unskilled, semiskilled and skilled vacancy of workmen approx. 70% will be taken from local area who fulfills eligibility criteria. Remaining 30%, basically highly skilled workmen which are not available in local area will be taken form out side the local area	Sept-2011	Will prevail gover
2	Welfare and developmental activities be enhanced in the nearby villages	Company will accelerate need based CSR activities in nearby villages. The thrust areas are: 1. Augmentation of School Building 2. Supply of Drinking Water 3. Development of Road 4. Training of rural youth for self employment 5. Farming accessories to poor farmers 6. Implementation of Nirmal Gram Yojana 7. Child education 8. Health Camps for villagers and live stocks	Continuous	Rs.50
3	Impact on ground water since the mining will be under ground.	The hydro-geological studies indicate that there will not be adverse impact on the surrounding ground water. Further, to maintain the ground water level, rain water harvesting will be implemented. Only surface water will be utilized for proposed project.	Oct-2010	Rs.

Sr. No.	Issues	Action Plan	Time frame	Financial Allocation
4	Widening of the road to cope up the future increased traffic	Already proposal for widening of the road with public-private partnership is in active stage of consideration with Govt. of Rajasthan. Likely to be approved by Aug'09.	Nov-2011	Rs. 1500 lacs
5	Mitigation of impact of tailing dam on land and water, if any.	Study conducted by NEERI in march 2008 indicated that the tailing dam site at RDM has low groundwater pollution potential. Due to the poor leachability of the tailings, the present practice of tailing management at RDM may not pose significant danger to the existing groundwater resources in the area.	Continuous	
6	Identity cards of the outside labors be provided with due verification from police station so that there doesn't remain any suspicion about criminal offences	All the workmen will be employed only after police verification and will be issued photo identity card.	Continuous	Rs. 2 lacs

Chapter-9
Project Benefits

9.0 PROJECT BENEFITS

Hindustan Zinc limited is keen in its corporate social responsibility activities the focal areas of the CSR activities are Health, Education, Sustainable Livelihood, Social Mobilization, Infrastructure Development, Water Harvesting, Agriculture, Animal Husbandry and Environment Conservation.

The major developmental activities to be carried out under the proposed project are discussed below.

9.1 Improvements in the Physical Infrastructure

About 37.5-km stretch of Fatehnagar- Dariba- Relmagara- Khandel road is propose to strengthen by widening the same with the support of Rajasthan state government. The Road is adjacent to the proposed mine lease boundary and the project would be on public and private partnership scheme on 50% of cost sharing.

In addition to the above, the other infrastructural developmental activities like development of school buildings, village roads, construction of water tanks, renovation and development of other infrastructural facilities would be carried out on the basis of requirement and suggestions received from the surrounding villagers.

9.2 Improvement of Social Infrastructure

Social infra structure like Health centers, Community halls, development of temples etc are also be taken up as a part of the social community development in the surrounding villages of the proposed mine lease area.

9.3 Employment Potential

A workforce of 700 persons is employed on company roll and 425 numbers direct contractual labour are engaged to support various operations of the mine. Besides this large number of persons are supporting the other allied activities. The total manpower requirement for the Integrated complex is 1600.

In addition to the above man power requirement of 1600 personnel, there will be a tremendous source of indirect employment near by the proposed mine lease and integrated lead zinc smelter complex by means of mechanical sheds, hotels and restaurants, housing, provisional stores and allied units to meet the requirement of the need of upcoming population.

9.4 Other Tangible Benefits

In addition to the above mentioned benefits, also the chance of other benefits will involve with the proposed mine lease and integrated lead zinc smelter complex. The overall socioeconomic development will improve the life style in and around the project area.

HZL has carried out various community development projects in the surrounding villages benefiting the population.

Annexure-I

Copy of Terms of Reference

ANNEXURE-I
COPY OF TERMS OF REFERENCE

Rec'd on 28/11/2008

F. No. J-11011/380/2008- IA II (I)
Government of India
Ministry of Environment and Forests
(I.A. Division)

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi - 110 003

E-mail : pb.rastogi@nic.in
Telefax : 011: 2436 7668

Dated 3rd November, 2008

To,

Shri S. R. Srinivasan
Associate Vice President-Projects
Hindustan Zinc Limited
Yashad Bhawan
Udaipur-313 001. Rajasthan

E-mail : sr.srinivasan@vedanta.co.in / csr.mehta@vedanta.co.in
Fax No.: 0461-2340203

Subject : Zinc smelter (5,00,000 TPA), Lead smelter (1,25,000 TPA), Captive power plant (255 MW) and expansion of Rajpura Dariba Mine (6,31,000 to 9,00,000 TPA) alongwith Beneficiation Plant (9,00,000 to 12,00,000 TPA) at Village Dariba, Tehsil Relmagra, District Rajsamand, Rajasthan by M/s Hindustan Zinc Limited - TORs reg.

Ref. : **Your letter no. DSC/EC/08/01 dated 26th April, 2008.**

Sir,

Kindly refer your letter no. DSC/EC/08/01 dated 26th April, 2008 alongwith project documents including Form-I, Pre-feasibility Report and draft 'Terms of Reference' as per the EIA Notification, 2006. It is noted that proposal is for the Zinc smelter (5,00,000 TPA), Lead smelter (1,25,000 TPA), Captive power plant (255 MW) and expansion of Rajpura Dariba Mine (6,31,000 to 9,00,000 TPA) alongwith Beneficiation Plant (9,00,000 to 12,00,000 TPA) at Village Dariba, Tehsil Relmagra, District Rajsamand, Rajasthan by M/s Hindustan Zinc Limited. Following will be the products and by-products from the proposed smelter complex:

S. N.	Products	Proposed Production Capacity (TPA)
Zn Smelter :		
	Zinc (SHG)	5,00,000
	Continuous Galvizing Grade (CGG) Zinc	80,000
Lead Smelter :		
	Lead	1,25,000
	Lead Alloy (Pb-Sb & Pb-Ca) (Out of 1,25,000 TPA Lead)	50,000
Captive Power Plant :		
	Power	255 MW

ANNEXURE-I
COPY OF TERMS OF REFERENCE

Mines & Beneficiation Enhancement :		
	Pb-Zn Ore Production	6,31,000 to 9,00,000 TPA
	Pb-Zn Ore Beneficiation	9,00,000 to 12,00,000 TPA
By-Products :		
1	Sulphuric acid	7,44,000
2	Lead-Silver compound	80,000
3	Zinc Oxide compound	20,000
4	Lead concentrate (Oxide)	5,000
5	Copper as copper cement/sulphate/matte/concentrate (equivalent metal)	1,900
6	Cadmium metal / Sponge (equivalent metal)	1,600
7	Antimony as Antimony compounds (equivalent metal)	850
8	Silver	400
9	Calomel	44
10	Bismuth as Bismuth compounds	16

Draft Terms of Reference (TOR) have been discussed and finalized during the 85th Meeting of the Expert Appraisal Committee (Industry) held during 23rd to 25th September, 2008 for preparation of EIA/EMP. Following are the 'TORs':

TORs for Zinc & Lead Smelter and CPP :

1. Revised form-1 along with the earlier questionnaire for including and mining sectors should be submitted while submitting EIA/EMP.
2. Present land use should be prepared based on satellite imagery.
3. Location of national parks / wildlife sanctuary within 10 km. radius should specifically be mentioned.
4. Permission and recommendations of the State Forest Department regarding impact of proposed Smelter Plants alongwith Captive Power Plant and Mine on surrounding reserve forests.
5. Major projects located in 30 km radius and probable impact on these industries.
6. Source of coal, status of environmental clearance and approval from the State Govt. etc should be covered.
7. A chapter on the best available technology for the Zinc and Lead Smelter alongwith the reasons for the selection of the same should be included.
8. Process details of the technology for Smelter Plants alongwith Captive Power Plant should be incorporated. Air pollution control measures proposed for the smelter plant and CPP should be included.
9. Site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall should be collected.
10. Ambient air quality at 8 locations within the study area of 10 km (aerial) from project site and base line data for the lead in the ambient air should be included.
11. Action plan for monitoring Lead in ambient air and technological assessment for reducing Lead should be included.
12. Determination of atmospheric inversion level at the project site and assessment of ground level concentration of pollutants from the stacks based on site-specific meteorological features should be incorporated.
13. Air quality modeling for Smelter plants for specific pollutants and location of one ambient air quality monitoring station in downwind direction is necessary. Measures proposed for the control of SO_2 emissions should specifically be covered.

ANNEXURE-I
COPY OF TERMS OF REFERENCE

14. Location of stacks for smelter plants and captive power plant should be included.
15. Impact of Lead emissions on surrounding environment and Lead balance should be provided.
16. One year data for gaseous emissions for the existing plant should be incorporated.
17. One season data for air emissions for the winter season.
18. A note on secondary fugitive emission control, assessment, preventive methods, control and monitoring etc. should be included
19. Impact of the transport of raw material and finished product on the transport system should be assessed and provided.
20. Water balance data including quantity of effluent generated recycled and reused and discharged should be included.
21. Surface water quality of nearby water bodies and other surface drains at eight locations must be determined and included.
22. A chapter on hydrology study around the project sit and tailing region may be included.
23. Ground water quantity monitoring minimum at eight locations and also near the solid waste disposal site should be included
24. Permission for the drawl of water for the Smelter Plant and CPP from the concerned Department should be included.
25. Geological features and Geo-hydrological status of the study area is a must and the ecological status (Terrestrial and Aquatic) must be provided.
26. Monitoring of water upstream and downstream of Jarosite pond secured landfill should be included.
27. Solid waste generation, storage, utilization and disposal must be explained in detail. Action Plan for the disposal/utilization of solid waste and integrated Ash Management Plan for the utilization of fly ash as per Fly Ash Notification should be included. MOU signed with Cement industries for the disposal of fly ash should form part of the report.
28. Design details of solid waste disposal area i.e. secured landfill (SLF) as per the CPCB guidelines with garland drains of at least for 10 years capacity. Land availability and earmarked for the SLF and possibility of reutilization of the solid waste should also be incorporated.
29. Risk assessment and damage control should be included.
30. Occupational health of the workers have to be detailed. Base line data for Lead and Cadmium in the workers and presence of Lead in ambient air and in bloods of human beings should be included.
31. Green belt development plan as per CPCB guidelines in 33 % area should be included.
32. A scheme for rainwater harvesting should be included.
33. Socio-economic development activities to be taken up should be spelt out indicating the time frame and cost.
34. Action plan to comply with recommendations mentioned in the CREP guidelines should be incorporated.
35. Detailed Environment management Plant (EMP) with specific reference to air pollution control system, water management, solid waste disposal, green belt development, monitoring frequency, responsibility and time bound implementation plan
36. EMP should include the concept of waste minimization, recycle / reuse / recover techniques, energy conservation, and natural resource conservation.

TORs for Mines:

1. The study area should comprise of 10 km zone around the mine lease from lease periphery.

ANNEXURE-I
COPY OF TERMS OF REFERENCE

2. Land use of the study area delineating forest area, agricultural land, grazing land, wildlif sanctuary and national park, migratory routes of fauna, water bodies, human settlement and other ecological features should be included.
3. Land use plan of the mine lease area should be prepared to encompass pre-operationa operational and post operational phases.
4. Location of National Parks, Sanctuaries, Biosphere Reserves, Reserve Forest, Wildlif corridors, within 10 km of the mine lease should be clearly indicated. A location ma duly authenticated by Chief Wildlife Warden should also be provided. Necessar clearance, if any, as may be applicable to such projects due to proximity of th ecologically sensitive areas as mentioned above should be obtained from the Stat Wildlife Department/ Chief Wildlife Warden under the Wildlife (Protection) Act, 1972 an copy furnished.
5. A detailed biological study for the study area [core zone and buffer zone (10 km radius o the periphery of the mine lease)] shall be carried out. Details of flora and fauna, dul authenticated, separately for core and buffer zone should be furnished based on fiel survey clearly indicating the Schedule of the fauna present. In case of any scheduled- fauna found in the study area, the necessary plan for their conservation should b prepared in consultation with State Forest and Wildlife Department and details furnished Necessary allocation of funds for implementing the same should be made as part of the project cost.
6. Impact of change of land use particularly agriculture land and gaucher / grazing land, i any, should be included.
7. Rehabilitation and resettlement plan alongwith compensation details for the projec affected people, if any should be included.
8. Collection of one season (non-monsoon) primary base-line data on ambient air quality, water quality, noise level, soil and flora and fauna is necessary. Site-specific meteorological data should also be collected. The location of the monitoring stations should be justified.
9. Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.
10. The water requirement for the project, its availability and source to be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should also be indicated.
11. Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the project should be included.
12. Details of water conservation measures proposed to be adopted in the project should be included.
13. Impact of the project on the water quality both surface and groundwater should be assessed and necessary safeguard measures, if any required should be included.
14. Details of rainwater harvesting proposed, if any, in the project area should be included.
15. Information on site elevation, working depth, groundwater table should be provided both in AMSL and BGL. A schematic diagram may also be provided for the same. In case the working will intersect groundwater table, a detailed hydro-geological study should be undertaken and report furnished.
16. Quantity of solid waste generation to be estimated and details for its disposal and management should be included.

ANNEXURE-I
COPY OF TERMS OF REFERENCE

5

17. The reclamation plan, post mine land use and progressive greenbelt development plan should be prepared in tabular form (prescribed format) and included.
18. Impact on local transport infrastructure due to the project. Projected increase in truck traffic as a result of the project in the present road network (including those outside the project area) and whether it is capable of handling the increased load. Arrangement for improving the infrastructure, if contemplated including action to be taken by other agencies such as State Government, if any, should be covered.
19. Details of the infrastructure facilities to be provided for the mine workers should be included.
20. Conceptual post mine land use and reclamation of mined out area (with plans and with adequate number of sections) should be included.
21. Phase-wise plan of green belt development, plantation and compensatory afforestation clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be included.
22. Occupational health impact of the project should be incorporated.
23. Measures of socio economic influence to the local community proposed to be provided by project proponent. As far as possible, quantitative dimension should be included.
24. Detailed environmental management plan to mitigate the environmental impacts which, should inter-alia also include the impact due to change of land use, due to loss of agricultural land and grazing land, if any, besides other impacts of the projects should be provided.
25. The issues raised and commitment made to the public during Public hearing / public consultation with time bound action plan to implement the same should be provided.
26. Any litigation pending against the project and /or any direction / order passed by any Court of Law against the project, if so, details thereof should be included.

These 'TORs' should be considered for the preparation of draft EIA / EMP report for the Zinc smelter (5,00,000 TPA), Lead smelter (1,25,000 TPA), Captive power plant (255 MW) and expansion of Rajpura Dariba Mine (6,31,000 to 9,00,000 TPA) alongwith Beneficiation Plant (9,00,000 to 12,00,000 TPA) at Village Dariba, Tehsil Relmagra, District Rajsamand, Rajasthan in addition to all the relevant information as per the 'General Structure of EIA' given in Appendix III and IIIA in the EIA Notification, 2006. The draft EIA/EMP as per TORs should be submitted to the Chairman, Rajasthan Pollution Control Board (RPCB), Rajasthan for public consultation. The RPCB shall conduct the public hearing/public consultation as per the provisions of EIA notification, 2006.

You are requested to kindly submit the final EIA/EMP prepared as per TORs and incorporating all the issues raised during Public Hearing / Public Consultation to the Ministry for considering the proposal for environmental clearance.

(Dr. P.B. Rastogi)
Director

Copy to : The Chairman, Rajasthan Pollution Control Board, 4, Institutional Area, Jhlana, Doongri, Jaipur, Rajasthan.

(Dr. P.B. Rastogi)
Director

Annexure-II

Coal Linkage Application Letter

ANNEXURE-II
APPLICATION FOR COAL LINKAGE

vedanta

HINDUSTAN ZINC LIMITED
Regd. Office : Yashad Bhawan, Udaipur-313
Tel : (91-294) 2420810-19, Fax : (91-294)
Website : www.hindustanzinc.com

To

The Under Secretary (CPD)
Ministry of Coal, Shastri Bhawan
New Delhi

Attn : Mr G Srinivasan

Date 06-06-08

Sub: Application for long term coal linkage for 160 MW (2X80) CPP at Dariba Smelter Complex, Hindustan Zinc Ltd., Rajpura Dariba Mines, Rajsamand, Rajasthan

Dear Sir,

Hindustan Zinc Ltd (HZL) is setting up new Captive Power Plant of 160 MW (2X80) at Dariba Smelter Complex, Rajpura Dariba Mines, in Rajasthan. We therefore request you to grant long term coal linkage to above mentioned plant from SECL area/ WCL / MCL.

We have already achieved following mile stones for the plant as per the new coal policy.

1. HZL Board has approved setting up the plant and funding for it in its 287th meeting dated 23/01/08 and 288th meeting dated 13/03/08.
2. Land already in possession.
3. LOI given to BHEL for supplying the plant on 18-03-2008. EPC contract is being finalized.
4. Environment clearance applied to MoEF on 26-04-08.

You are requested to kindly consider our case for grant of long term coal linkage.

Thanking You,

Yours faithfully,

For Hindustan Zinc Ltd.

S K Agrawal
Vice President (Commercial)

Encl -

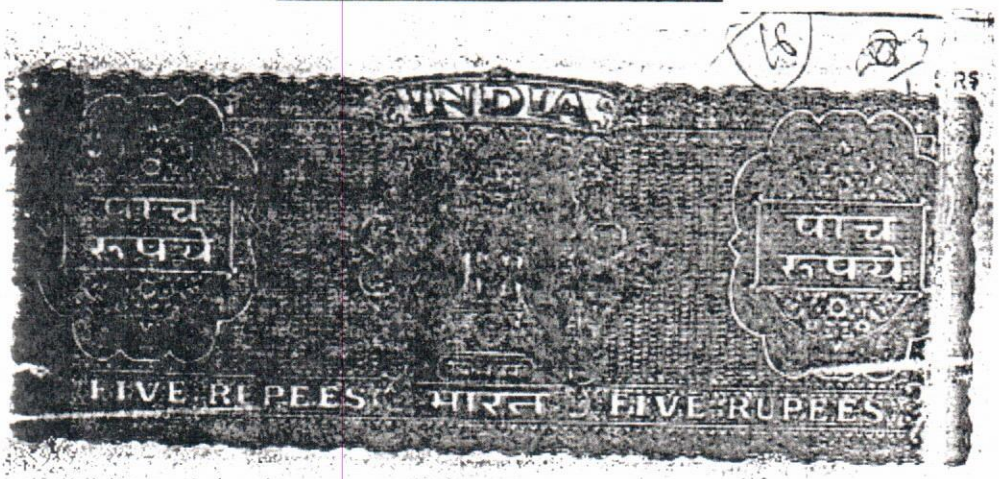
1 Demand Draft of Rs 320000 (@ 20 no 432004, ICICI Bank Udaipur Branch)
2 Application in prescribed format (Three copies)
3 Copy of Board meetings for setting up the plant and funding
4 Land possession papers
5 Copy of LOI given to BHEL for supplying the plant.

Annexure-III

Water Allocation Letter

WATER ALLOCATION FROM MATRIKUNDIA DAM

ANNEXURE-III
WATER ALLOCATION LETTERS



AGREEMENT FOR THE SUPPLY OF WATER FROM MATRIKUNDIA PICK-UP-WEIR (UNDER CONSTRUCTION) TO RAJPURA DARIBA GROUP OF MINES

AGREEMENT

THIS AGREEMENT, made this day of March 1990 between the 'Governor' of State of Rajasthan (hereinafter referred to as 'The Government') which expression shall unless repugnant to the contest shall include his heirs, successors of assignee of the 'FIRST PARTY' and the Hindustan Zinc Limited, A/ Govt. of India Enterprise, registered under Indian Companies Act 1956, having its registered office at Yashad Bhawan, Yashad Garh, Udaipur (hereinafter referred to as 'Consumer') which expression where the contest so requires include, its successors, liquidators and assignees of the 'other party'.

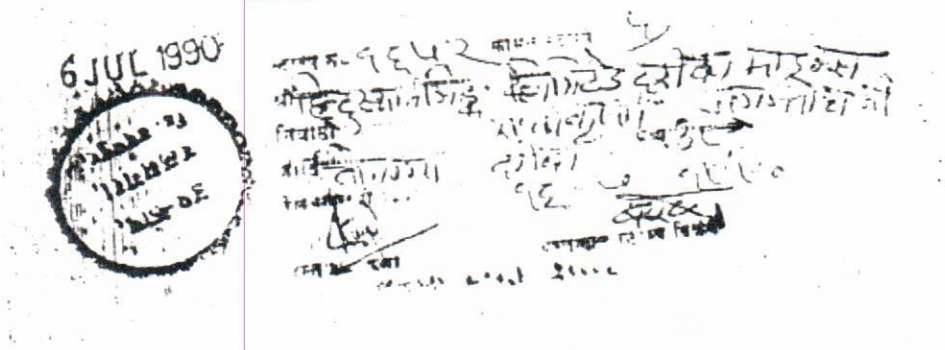
WHEREAS the consumer has applied to the Government for the supply of water form Matrikundia pick up weir for mining and processing of "Zinc Lead Ore" near village Rajpura-Dariba, Tehs.l Railmagra, Distt. Udaipur in the state of Rajasthan, AND WHEREAS Government has agreed to supply the same on the terms and conditions hereinafter enumerated. Now this agreement witnesseth as follows:

01. That the Govt. shall reserve water at Matri-Kundia pick-up-weir for Hindustan Zinc Ltd., for Mining & processing of 'Lead Zinc Ore' etc at Rajpura-Dariba. The Consumer shall take such water throughout the year as per their requirement, subject to maximum withdrawal of 213 M.Cft. (117 M.Cft. + 96 M.Cft. losses) per annum.

The water requirement has been bifurcated in two periods is:

	Requirement	Losses	
(i)	From 1st Nov. to 30th June	78 M.Cft.	94 M.Cft. = 172 M.Cft. Available at EL 464.00M on 1st Nov. (losses calculation as per enclosed statement).

ANNEXURE-III
WATER ALLOCATION LETTERS



(ii) From 1st July to 31st Oct. : 39 M.Cft. 2 M.Cft. = 41 M.Cft.
Proportionate share of losses (as per enclosed statement)

NOTE: (a) During the period from 1st July to 30th Sept. both the parties will withdraw the water from the Reservoir. thus, this period will be common for both Supplier and Consumer. Under such circumstances, the losses involved would be proportionately shared as per withdrawal by each party during that period. Total losses during this period will be 120 M.Cft. Department share of losses are 118 M.Cft. and 2 M.Cft. for Hindustan Zinc Limited.

(b) 172 M.Cft. storage is available at R.L. 464.55 which will be the level at which water will be reserved in case Reservoir gets higher storage than 172 M.Cft.

(c) To safeguard against excess diversion of water during the period from 1st July to 31st Oct. the Consumer shall maintain record of daily meter readings.

02. THAT the water will be conveyed to the Mines Site from the pick-up-weir through a pipeline to be laid and maintained by the Consumer at their own cost. The Consumer shall be allowed to construct a pumping station of required capacity at suitable site as per direction of the Govt. or its authorised representative.

03. THAT the Government shall charge at the rate of Rs. 10/- per 1000 Cft. of water on the total reservation (actual withdrawal plus losses) made for Hindustan Zinc Limited. The Govt. shall be free to revise water rate from time to time and the same shall be acceptable to the Consumer.

(a) THAT in case of natural calamities and failure of monsoon, if water is not stored in the Reservoir, the Govt. shall not be responsible for non-storage or partial storage of water and shall not accept any claim for non-storage or partial storage of water in the Reservoir. Priority will always be of drinking water.

(b) THAT under no circumstances any claim whatsoever on account of non-supply of water will accrue.

अधिशासी अभियन्ता
जल-प्रबन्धन, चित्तौड़गढ़

04. THAT the Department will raise the bill for the total quantity (maximum upto 213 M.Cft.) reserved for the year in the month of Sept. and the consumer shall pay the bill within a period of one month after presentation of bill, failing which the Govt. shall have a right to discontinue the supply and also charge interest at the rate of 18% per annum for the period after lapse of one month.

05. THAT this Agreement shall remain in force for a period of 30 years. Thereafter, it needs renewal on mutually agreed terms and conditions.

06. THAT in case Consumer fails to utilise the reserved quantity of water, the Govt. is not liable to refund any amount due to less consumption of water.

07. THAT the statement on the basis of which losses have been worked out will form part of the agreement.

In witness where of the parties have signed this Agreement on the date and month aforementioned.

WITNESS:

(1) For & On behalf of
Hindustan Zinc Limited

(J.R.K. BOTH
SECRETARY
Hindustan Zinc Limited
Yashad Bhawan, Yashad
UDAIPUR-313 004.

(2) Secretary,
Hindustan Zinc Ltd., Udaipur

WITNESS:

(1) For & On behalf of the
Govt. of Rajasthan

(2) Secretary to the Govt.
Irrigation Deptt.,
Govt. of Rajasthan

ANNEXURE-III
WATER ALLOCATION LETTERS

BASIC FOR [illegible]

1/ Losses have been worked out as per guide line of C.W.C.

2/ The following assumption have been considered for average condition of reservoir from July to Oct.

(i) In July, the water level in the reservoir assumed at R.L. 460.30 i.e.(Crest level).

(ii) At beginning of August reservoir assumed at RL 460.30 i.e. Crest level.

(iii) On 1st Sept., the water level in the reservoir assumed at [illegible] meter above crest level.

(iv) As per drawl & evaporation losses upto Sept. the water level in the reservoir on 1st Oct. will be RL 464.10.

(v) Diversion to Nada reservoir considered as [illegible] Mcum. i.e. [illegible] Mcft. during July to [illegible] feeder.

(vi) Evaporation losses from July to Oct. have been shared on water withdrawl basis.

3/ The evaporation losses have been worked out on above assumption as under head:-

	Requirement	Losses
Nov. to June :	[illegible]	3.671 Mcum (.54 Mcft)
	Hence total requirement of [illegible] from 1st Nov. to [illegible] Mcum or 172 Mcft.	
July to Oct.	Withdrawl [illegible]	- 1.1 Mcum or .39Mcft.
	Withdrawl by Sept. 79.97Mcum, on through feeder	2810 Mcft.
	Total losses during-3.086 Mcum. or [illegible] period (as per) 10% Mcft. [illegible] line)	

Irrigation wise share of losses:-

[illegible] : [illegible] Mcft.

[illegible] : 30% Mcft.

Requirement of [illegible] = 39+2=41 Mcft.

[illegible] total requirement = 172.41 = 215 Mcft.

Hence water to be received from 1st Nov. at RL 464.55.

ANNEXURE-III
WATER ALLOCATION LETTERS

WATER ALLOCATION FROM MANSI WAKAL DAM

ANNEXURE-III
WATER ALLOCATION LETTERS

Engineering Department, Rajasthan, Jaipur, communicated that the work related to implementation of **Mansi Wakal Stage-I Project** situated in Tehsil, Jhadol of Udaipur District for water supply alongwith repair of tunnel of Dewas Stage-I Project shall be implemented by Hindustan Zinc Limited.

The scope of work shall be following :-

- Construction of Dam
- Water conveyance system from dam site to Dewas Stage-I
- Revival of Dewas Stage-I tunnel
- 132 KVA transmission line from RSEB grid sub station near Udaipur to dam site

The implementation of the project by HZL will be on the following terms and conditions :

1. That the water so diverted from the Mansi Wakal Stage-I Project, 30% of water available at off-take point of the common carrier system shall be made available to HZL.

2. At a future date in case HZL decides to lay a dedicated pipeline for its share of water from a point between outlet of Dewas Stage-I tunnel or Nandeshwar Dam or Pichola Lake to Zinc Smelter, Debari, the State Government will give permission for

laying of pipeline, provide right of way and acquire land for the same, if required/necessary, and HZL will bear all the financial liabilities.

The estimated cost of the project is Rs.60.00 Crores based on June, 1996 prices (Annexure A). Cost shall be shared by State Government and Hindustan Zinc Limited in the ratio of 70:30 when HZL share works out to Rs.18 Crores. Similarly, the operational/maintenance cost of the scheme as far as it is common to both the State Government and HZL shall be shared in the proportion of 70:30, except for power charges which shall be charged on actual consumption basis and proportionate to withdrawal of water by HZL.

4 The water cess will be charged from Hindustan Zinc Limited @ Rs.2.00 per thousand cft. The State Government can also decide to revise the water cess for all captive dams for industries in the State including above, however, such revision shall not be more than the proportionate revision that State Government may make for industrial use of water in the State.

5 Detail design of dam will be carried out through Central Water Commission, New Delhi. In case certain data/information is required from the State Government, the same shall be made

available by the Additional Chief Engineer, Irrigation Department, Udaipur.

6 Model studies will be conducted at Gujarat Engineering Research Institute, Baroda and for geological and foundations grade finalisation, Engineering Wing of Geological Survey of India will be appointed.

7. Land for the project shall be acquired by State Government. The cost of land so acquired shall be adjusted against the Government share of the project cost.

8 To maintain the schedule of construction, timely availability of funds is essential. The delay in release of fund by Government and consequent delay in the royalty amount deposited by HZL will not attract any interest and or penalty, whatsoever.

9. For power arrangement, 132 KVA transmission line will be laid by Rajasthan Electricity Board from nearest grid station.

10 For liason with Government, Additional Chief Engineer, PHED/Irrigation Department stationed at Udaipur will be contact officer.

11. An Irrigation Engineer will be provided on deputation to HZL for construction supervision at usual terms of State Government.

12. The environmental clearance from statutory bodies or permission for construction of Dam, submergence of forest land, service road, power line and development of quarries etc. shall be obtained by Government of Rajasthan. Hindustan Zinc Limited will extend all necessary help.

13. Scheme after completion will be operated and maintained by Public Health Engineering Department.

14. Rehabilitation of oustees will be the responsibility of the State Government.

15. In the event of any dispute or difference arising between the parties hereto as to the interpretation of the terms of this MOU or the rights, duties or obligations of the parties aforesaid or any matter arising out of or concerning and/or touching this MOU or in case the parties hereto fail to come to mutual agreement in respect of any matter falling under the scope of this MOU or connected thereto the matter shall be referred to Arbitration as per provisions contained in the Government of India Cabinet Secretariat, Department of Cabinet Affairs Circular No. 53/3/1/75-CF dated 19.12.75 as amended from time to time.

IN WITNESS whereof the parties have executed and signed this MOU on the date and month aforementioned in the presence of witnesses named hereunder :

SIGNED AND DELIVERED BY :

SMT. KRISHNA BHATNAGAR
PL. SECRETARY TO THE GOVT.
PUBLIC HEALTH ENGG.DEPTT.,

For and on behalf of Government Rajasthan,
In witness whereof :

1. _____

2. _____

SIGNED AND DELIVERED BY :

SHRI K.V.K. SESHAVATARAM
CHAIRMAN

For and on behalf of Hindustan Zinc Limited

In witness whereof :

1. _____

2. _____

ANNEXURE-III
WATER ALLOCATION LETTERS

Annexure - A

ABSTRACT COST ESTIMATES

AUGMENTATION OF UDAIPUR WATER SUPPLY

(MANSI WAKAL DAM)

SL. NO.	PARTICULARS	(Rupees in Lacs)	
	PART : A - DAM		
01.	Dam (Mansi Wakal Stage-I)	2,635.00	
		2,635.00	2,635.00
	PART : B - CONVEYANCE SYSTEM		
01.	Land	10.00	
02.	Communication (Roads & Vehicles)	188.35	
03.	Supply of Pipes 11.3 Kms. (800 mm. Dia)	626.32	
04.	Pipeline Laying, treatment and fittings.	626.32	
05.	Repairs of Tunnel of Dewas Stage-I. L.S.	204.00	
		1,654.99	1,654.99
	PART : C - POWER TRANSMISSION LINE & EQUIPMENT		
01	Pump House & Other Buildings	41.59	
02.	Grid Sub Station, Transmission line etc.	1,053.60	
03.	Equipments	134.32	
		1,229.51	1,229.51
	Total (A + B + C)		5,519.50
	Contingencies at 5%		275.98
	Engineering and Project Management at 2%		165.59
		Total	5,961.06
		Say	Rs.60.00 Crores
	Government of Rajasthan's share @ 70%		Rs.42.00 Crores
	HZL's Share @ 30%		Rs.18.00 Crores

WATER ALLOCATION FROM GOSUNDA DAM

WATER ALLOCATION FROM GOSUNDA DAM

ANNEXURE-III
WATER ALLOCATION LETTERS

No.F.2(70)Energy/86-IV/ Dated November 19,1994

ANNEXURE II

To,

Shri A.C. Kedhevan,
Chairman & Managing Director,
Hindustan Zinc Ltd.,
UDAIPUR.

Sub:- Setting up of Thermal Power Station at Chittorgarh by M/s CTIL.

Dear Sir,

The State Government has taken following decisions regarding setting up of Thermal Power Station of 500 MW capacity at Chittorgarh by M/s Century Textile and Industries Ltd.(CTIL).

1. The allocation of water from Gosunda Dam would be as follows:-

1. HZL = 1500 MCFT/
2. CTIL = 1500 MCFT/
3. PHED = 300 MCFT/
4. Reserved = 300 MCFT/

In case CEA indicates that the water requirement of CTIL for 1x500 MW Coal Based TPS is more than 1500 MCFT, the reserved portion or a part thereof, would be allotted to CTIL.

2. The Dam would be constructed by the point upto which the work has been done by HZL by the Irrigation Department.

3. The total cost of the Dam including, the cost already incurred by HZL(present day cost) and the cost required for acquiring the land in sub-mergence and rehabilitation etc., due to raising of the Dam upto full reserve level would be borne by HZL, CTIL and PHED in proportion to allocation of water. The cost already incurred by HZL would be proportionately increased for arriving at the present day cost.

4. It was decided that the present capacity of the dam i.e. 450 MCFT would be credited to HZL. HZL would have first charge on 450 MCFT of water and in lieu thereof

would pay for the proportionate cost of construction of 400 MCFT capacity in full. The sharing of cost mentioned at point 3 above would be after deducting the cost calculated for 400 MCFT capacity.

5. In case of defficiency in storage of water due to inadequate rainfall etc., first 400 MCFT water in the dam would be reserved and allocated to HZL. Excess water over and above 400 MCFT would be allocated proportionately amongst HZL, GTTL and PHED as per allocation mentioned at point 1.

6. The Gosunda Dam shall be handed over by HZL to the Irrigation Department at appropriate time so that further construction could be started by Irrigation Department.

7. Land has been acquired upto EL 420 m level and is being acquired upto EL 422 m level by Mines Department for HZL. Land would be acquired by Energy Department beyond EL 422 m for construction of dam by Irrigation Department.

8. Irrigation Department would undertake the survey and investigation work for acquisition of land and properties likely to come under sub-mergence and rehabilitation of oustees either departmentally or through RAPCOS. Suitable staff would be provided to Irrigation Department for this purpose.

9. Irrigation Department would also undertake construction of piers and gates of the dam. Immediate action in this regard would be initiated by the Irrigation Depar ent. A PERT Chart would be prepared by the Irr ion Department by 15.11.94 regarding items 8 & 9.

10. The only Governmental Department which would ob. e water from the Gosunda dam being PHED, PHED would make suitable budget provision during the current financial year to take care of the initial expenditure to be incurred by the Irrigation Department.

11. GTTL would deposit a sum of Rs.75 crores an advance towards the construction/completion of Gosunda dam with the State Government as soon as the project is cleared by GOI.

12. The maintenance and operation of the dam would be done by the Irrigation Department, each party making its

ANNEXURE-III
WATER ALLOCATION LETTERS

own arrangement for pumping its requirements. The cost of operation and maintenance of the Dam will also be shared by the user organisations in the proportion of allocation, mentioned at point 1 above.

13. The Irrigation Department would furnish the required data to CWC/CEA for clearance of the project.

14. RSEB would ensure that the proposals for transmission system for evacuation and utilisation of power to be generated at Chittorgarh TPS are cleared by the Central Electricity Authority(CEA) immediately.

15. Coal linkage: CTIL would immediately tie up with Government of India for development of dedicated mine in north Karanpura for Coal linkage for the project.

16. Issue of Notification under section 29 of the Electricity(supply) Act,1948:- Notification under Section 29 of the Electricity(supply) Act,1948 saying that the Chittorgarh TPS would now be set up by CTIL instead of RSEB and that the capacity of the power station would be 1x500 MW instead of 2x210 MW notified earlier may be issued by the Energy Department.

Immediate action may kindly be taken regarding the points concerning your Department/Organisation so that this long pending power project can be established.

Yours faithfully,

(R.K. Agarwal)
Spl. Secretary to Govt.

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

WINTER SEASON 2007-08										
AAQ-1: Mine lease area										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
05.12.2007	143.5	53.1	14.4	13.1	0.11	0.25	BDL	218	202	183
07.12.2007	215.2	67.1	15.9	14.7	0.16	0.16	BDL	393	380	376
12.12.2007	136.2	50.4	14.5	16.9	0.17	0.29	BDL	215	194	190
14.12.2007	162.7	60.2	15.5	13.3	0.14	0.22	BDL	331	292	250
19.12.2007	152.6	56.5	10.5	15.2	0.18	0.24	BDL	324	279	244
21.12.2007	168.2	62.2	11.3	12.5	0.19	0.19	BDL	221	207	193
26.12.2007	145.8	53.9	11.6	15.6	0.11	0.16	BDL	284	312	335
28.12.2007	155.6	57.6	13.6	14.4	0.21	0.25	BDL	334	307	272
02.01.2008	178.4	66.2	15.4	12.8	0.23	0.22	BDL	363	332	295
04.01.2008	164.4	60.8	11.3	16.1	0.12	0.18	BDL	399	379	374
09.01.2008	139.3	51.5	14.8	17.8	0.11	0.31	BDL	388	378	363
11.01.2008	173.4	64.2	10.6	15.6	0.18	0.24	BDL	213	183	176
16.01.2008	152.2	56.3	12.4	14.5	0.19	0.16	BDL	442	430	398
18.01.2008	136.5	50.5	15.8	16.6	0.14	0.24	BDL	216	200	194
23.01.2008	143.6	63.1	14.6	15.7	0.11	0.25	BDL	259	235	234
25.01.2008	193.2	71.5	15.3	16.5	0.21	0.27	BDL	308	272	242
30.01.2008	198.4	73.4	13.2	17.5	0.11	0.19	BDL	292	251	241
01.02.2008	128.4	47.5	12.1	16.2	0.15	0.21	BDL	340	338	320
06.02.2008	156.2	57.8	15.7	15.8	0.15	0.22	BDL	282	248	239
08.02.2008	163.9	60.6	16.6	14.6	0.13	0.18	BDL	280	248	235
13.02.2008	183.2	67.8	10.6	13.4	0.18	0.27	BDL	226	224	210
15.02.2008	174.1	64.4	11.6	12.7	0.11	0.17	BDL	222	218	204
20.02.2008	192.3	71.2	11.2	12.9	0.20	0.19	BDL	375	361	355
22.02.2008	158.4	58.6	11.8	16.2	0.17	0.26	BDL	217	191	184
27.02.2008	139.2	51.5	15.2	12.6	0.21	0.17	BDL	246	229	219
29.02.2008	142.8	59.8	10.9	12.6	0.18	0.25	BDL	234	225	205
Maximum	**215.2**	**74.3**	**16.6**	**17.8**	**0.23**	**0.31**	**BDL**	**442**		
Minimum	**128.4**	**47.5**	**10.5**	**12.5**	**0.11**	**0.16**	**BDL**	**176**		
Average	**161.5**	**59.9**	**13.3**	**14.8**	**0.16**	**0.22**	**BDL**	**275**		
98th %le	**206.8**	**72.4**	**16.3**	**17.7**	**0.22**	**0.30**	**BDL**	**413**		
All units are in $\mu g/m^3$										
AAQ-2: Rajpura										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
05.12.2007	192.2	59.8	7.6	9.9	<0.1	0.12	BDL	265	227	211
07.12.2007	162.9	57.1	7.4	9.7	<0.1	0.11	BDL	352	246	231
12.12.2007	161.2	55.6	7.9	9.6	0.10	0.11	BDL	229	221	228
14.12.2007	173.5	53.4	8.6	9.5	0.15	0.12	BDL	328	239	227
19.12.2007	153.9	57.4	8.4	9.8	0.12	0.14	BDL	286	235	207
21.12.2007	161.3	42.4	8.2	10.6	<0.1	0.18	BDL	369	251	235
26.12.2007	163.1	56.2	8.8	11.3	<0.1	0.13	BDL	288	249	192
28.12.2007	167.7	35.8	8.9	11.6	<0.1	<0.1	BDL	268	257	232
02.01.2008	171.7	52.5	9.6	11.4	0.10	0.11	BDL	396	284	273
04.01.2008	154.8	58.4	9.4	11.5	<0.1	0.12	BDL	298	269	266
09.01.2008	155.8	55.1	9.7	12.8	<0.1	0.13	BDL	375	298	264
11.01.2008	158.9	56.3	9.2	13.1	<0.1	0.12	BDL	247	245	229
16.01.2008	158.7	45.4	10.2	12.5	<0.1	0.11	BDL	285	241	199
18.01.2008	164.6	58.6	10.6	11.8	<0.1	<0.1	BDL	395	282	219
23.01.2008	159.1	58.4	11.3	10.8	0.14	0.12	BDL	275	253	242
25.01.2008	172.3	66.5	11.5	11.7	0.14	0.12	BDL	292	241	213
30.01.2008	154.2	64.3	10.9	10.4	<0.1	0.19	BDL	316	233	226
01.02.2008	125.2	59.7	11.6	12.9	<0.1	0.11	BDL	356	228	223
06.02.2008	174.8	55.9	10.7	12.2	<0.1	0.12	BDL	384	235	203
08.02.2008	156.6	62.2	9.9	9.7	0.10	0.12	BDL	285	239	231
13.02.2008	103.9	62.7	10.5	12.6	<0.1	0.14	BDL	297	267	261
15.02.2008	187.6	63.2	9.1	12.7	<0.1	0.11	BDL	282	262	242
20.02.2008	162.5	66.1	9.3	11.1	<0.1	0.12	BDL	289	258	254
22.02.2008	165.4	62.9	10.8	12.5	<0.1	0.14	BDL	296	217	194
27.02.2008	175.3	56.1	11.7	13.2	<0.1	0.12	BDL	302	256	225
29.02.2008	185.4	56.5	11.2	12.4	0.13	0.11	BDL	281	254	244
Maximum	**192.2**	**66.5**	**11.7**	**13.2**	**0.15**	**0.19**	BDL	**396**		
Minimum	**103.9**	**35.8**	**7.4**	**9.5**	**0.10**	**0.11**	BDL	**192**		
Average	**162.4**	**56.9**	**9.7**	**11.4**	**0.12**	**0.13**	BDL	**263**		
98th %le	**189.9**	**66.3**	**11.7**	**13.2**	**0.15**	**0.19**	BDL	**389**		

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-3: Makhanpuriya

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
05.12.2007	99.1	35.5	8.1	14.3	BDL	BDL	BDL	354	250	228
07.12.2007	123.9	44.4	11.8	10.7	BDL	BDL	BDL	252	175	163
12.12.2007	133.0	47.6	11.1	9.4	BDL	BDL	BDL	292	203	188
14.12.2007	100.2	35.9	7.9	13.4	BDL	BDL	BDL	263	191	147
19.12.2007	143.2	51.3	12.3	10.2	BDL	BDL	BDL	290	185	143
21.12.2007	106.9	39.0	8.9	11.8	BDL	BDL	BDL	309	199	156
26.12.2007	93.9	33.8	10.3	12.7	BDL	BDL	BDL	276	178	166
28.12.2007	134.0	48.0	8.6	14.1	BDL	BDL	BDL	293	205	155
02.01.2008	102.3	36.7	7.8	9.1	BDL	BDL	BDL	307	193	163
04.01.2008	118.7	42.5	10.9	10.2	BDL	BDL	BDL	322	237	207
09.01.2008	127.7	45.7	9.7	14.2	BDL	BDL	BDL	268	202	156
11.01.2008	141.2	50.6	8.4	9.5	BDL	BDL	BDL	347	253	158
16.01.2008	91.1	32.7	10.5	13.8	BDL	BDL	BDL	301	216	167
18.01.2008	151.3	36.8	11.3	13.1	BDL	BDL	BDL	227	179	146
23.01.2008	142.6	51.1	8.5	9.2	BDL	BDL	BDL	329	247	209
25.01.2008	95.4	34.1	12.2	14.6	BDL	BDL	BDL	248	162	150
30.01.2008	138.4	49.5	9.1	10.4	BDL	BDL	BDL	287	185	157
01.02.2008	141.9	46.7	8.8	12.2	BDL	BDL	BDL	309	219	199
06.02.2008	92.4	33.1	11.4	9.4	BDL	BDL	BDL	342	195	224
08.02.2008	146.4	52.4	8.5	9.1	BDL	BDL	BDL	220	177	142
13.02.2008	104.3	37.4	10.1	12.7	BDL	BDL	BDL	254	187	163
15.02.2008	120.8	43.3	10.8	11.4	BDL	BDL	BDL	345	228	202
20.02.2008	94.5	33.9	12.4	9.9	BDL	BDL	BDL	230	172	148
22.02.2008	91.7	32.9	7.8	12.4	BDL	BDL	BDL	334	245	215
27.02.2008	127.7	45.8	8.7	13.3	BDL	BDL	BDL	315	203	183
29.02.2008	113.9	40.8	12.1	10.5	BDL	BDL	BDL	223	161	144
Maximum	**151.3**	**52.4**	**12.4**	**14.6**	BDL	BDL	**BDL**	**354**		
Minimum	**91.1**	**32.7**	**7.8**	**9.1**	BDL	BDL	**BDL**	**142**		
Average	**118.3**	**41.6**	**9.9**	**11.6**	BDL	BDL	**BDL**	**221**		
98th %ile	**148.9**	**51.9**	**12.4**	**14.4**	BDL	BDL	**BDL**	**346**		

All units are in $\mu g/m^3$

AAQ-4: Sunariya Khera

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
05.12.2007	169.8	57.2	10.9	9.3	BDL	BDL	BDL	258	221	165
07.12.2007	138.2	44.2	12.5	14.4	BDL	BDL	BDL	266	242	164
12.12.2007	132.6	45.6	8.2	10.6	BDL	BDL	BDL	251	205	144
14.12.2007	128.3	41.1	9.2	11.3	BDL	BDL	BDL	276	224	156
19.12.2007	132.2	42.3	9.4	12.5	BDL	BDL	BDL	245	201	186
21.12.2007	133.1	45.8	10.4	13.4	BDL	BDL	BDL	281	222	152
26.12.2007	98.3	31.5	11.4	14.6	BDL	BDL	BDL	238	210	149
28.12.2007	108.4	34.7	12.5	15.4	BDL	BDL	BDL	246	218	162
02.01.2008	115.3	36.9	11.7	12.3	BDL	BDL	BDL	235	205	138
04.01.2008	126.2	38.5	10.5	9.4	BDL	BDL	BDL	314	283	195
09.01.2008	156.1	46.8	12.3	11.8	BDL	BDL	BDL	275	253	186
11.01.2008	83.8	29.7	9.8	13.9	BDL	BDL	BDL	293	271	185
16.01.2008	123.9	39.6	9.9	11.7	BDL	BDL	BDL	267	246	184
18.01.2008	133.4	42.7	11.3	15.5	BDL	BDL	BDL	255	235	182
23.01.2008	134.7	46.3	12.6	12.2	BDL	BDL	BDL	275	242	175
25.01.2008	148.4	47.9	11.5	13.8	BDL	BDL	BDL	265	238	173
30.01.2008	122.8	39.4	11.9	12.9	BDL	BDL	BDL	292	226	169
01.02.2008	120.6	38.6	10.2	10.5	BDL	BDL	BDL	262	235	168
06.02.2008	121.4	38.8	10.9	10.8	BDL	BDL	BDL	310	285	269
08.02.2008	116.5	37.3	12.4	14.5	BDL	BDL	BDL	295	263	263
13.02.2008	104.2	33.3	8.5	13.3	BDL	BDL	BDL	325	278	261
15.02.2008	132.8	42.5	8.7	12.1	BDL	BDL	BDL	315	265	235
20.02.2008	130.3	41.8	11.6	10.9	BDL	BDL	BDL	286	271	226
22.02.2008	138.6	47.6	9.4	9.8	BDL	BDL	BDL	294	263	235
27.02.2008	118.4	37.9	10.6	14.8	BDL	BDL	BDL	284	262	224
29.02.2008	126.1	40.4	10.3	12.6	BDL	BDL	BDL	275	254	216
Maximum	**169.8**	**57.2**	**12.6**	**15.5**	BDL	BDL	**BDL**	**325**		
Minimum	**83.8**	**29.7**	**8.2**	**9.3**	BDL	BDL	**BDL**	**138**		
Average	**126.7**	**41.1**	**10.7**	**12.5**	BDL	BDL	**BDL**	**237**		
98th %ile	**163.0**	**52.6**	**12.6**	**15.5**	BDL	BDL	**BDL**	**314**		

All units are in $\mu g/m^3$

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-5: Chothpura										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
05.12.2007	83.2	29.1	11.4	9.5	BDL	BDL	BDL	251	226	191
07.12.2007	92.5	32.4	11.9	9.2	BDL	BDL	BDL	249	215	207
12.12.2007	110.2	38.6	8.3	16.4	BDL	BDL	BDL	285	223	182
14.12.2007	100.2	35.1	9.5	11.3	BDL	BDL	BDL	266	210	186
19.12.2007	97.2	34.3	10.6	15.6	BDL	BDL	BDL	294	222	165
21.12.2007	112.6	49.4	11.2	13.5	BDL	BDL	BDL	245	218	163
26.12.2007	100.6	35.2	12.8	14.5	BDL	BDL	BDL	264	203	155
28.12.2007	142.6	49.9	11.7	14.2	BDL	BDL	BDL	256	209	161
02.01.2008	125.6	44.2	7.8	13.6	BDL	BDL	BDL	295	247	218
04.01.2008	127.1	44.5	8.4	13.7	BDL	BDL	BDL	294	217	177
09.01.2008	133.5	46.7	10.6	15.5	BDL	BDL	BDL	293	236	206
11.01.2008	132.9	46.5	10.4	16.3	BDL	BDL	BDL	235	206	158
16.01.2008	128.6	45.6	11.3	12.6	BDL	BDL	BDL	313	216	193
18.01.2008	131.7	46.1	11.9	11.1	BDL	BDL	BDL	286	225	175
23.01.2008	125.3	43.9	9.5	11.6	BDL	BDL	BDL	285	214	192
25.01.2008	138.6	45.8	8.7	11.9	BDL	BDL	BDL	284	263	174
30.01.2008	130.7	45.7	7.6	10.9	BDL	BDL	BDL	281	213	199
01.02.2008	112.5	39.4	8.2	12.3	BDL	BDL	BDL	276	218	179
06.02.2008	130.5	47.7	9.3	15.4	BDL	BDL	BDL	295	212	158
08.02.2008	122.6	42.9	10.4	9.8	BDL	BDL	BDL	273	221	168
13.02.2008	135.6	47.5	11.5	10.4	BDL	BDL	BDL	292	211	198
15.02.2008	125.7	44.6	11.3	15.2	BDL	BDL	BDL	272	251	167
20.02.2008	123.6	43.3	10.8	16.1	BDL	BDL	BDL	265	241	178
22.02.2008	102.3	35.8	11.6	10.3	BDL	BDL	BDL	283	239	164
27.02.2008	112.8	39.5	7.9	12.5	BDL	BDL	BDL	263	249	221
29.02.2008	105.9	37.1	8.8	11.8	BDL	BDL	BDL	275	241	171
Maximum	**142.6**	**49.9**	**12.8**	**16.4**	BDL	BDL	**BDL**	**313**		
Minimum	**83.2**	**29.1**	**7.6**	**9.2**	BDL	BDL	**BDL**	**155**		
Average	**118.6**	**42.0**	**10.1**	**12.9**	BDL	BDL	**BDL**	**227**		
98th %le	**140.6**	**49.7**	**12.4**	**16.4**	BDL	BDL	**BDL**	**295**		
All units are in $\mu g/m^3$										

AAQ-6:East of ML area										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
05.12.2007	102.5	33.8	8.3	8.6	BDL	BDL	BDL	336	218	205
07.12.2007	172.5	58.6	8.1	8.5	BDL	BDL	BDL	348	226	210
12.12.2007	104.3	34.4	7.9	8.9	BDL	BDL	BDL	317	246	209
14.12.2007	166.6	32.5	12.3	14.5	BDL	BDL	BDL	346	225	207
19.12.2007	107.4	35.4	8.5	11.3	BDL	BDL	BDL	296	224	196
21.12.2007	101.1	33.4	10.6	13.2	BDL	BDL	BDL	335	272	206
26.12.2007	96.5	31.8	12.4	12.4	BDL	BDL	BDL	343	222	205
28.12.2007	156.6	29.2	13.6	14.3	BDL	BDL	BDL	309	212	188
02.01.2008	92.5	30.5	11.5	12.8	BDL	BDL	BDL	328	261	186
04.01.2008	101.4	33.5	11.7	13.5	BDL	BDL	BDL	308	209	184
09.01.2008	106.7	35.2	11.6	14.1	BDL	BDL	BDL	317	279	183
11.01.2008	109.4	56.1	12.5	11.6	BDL	BDL	BDL	295	268	172
16.01.2008	112.5	37.1	9.9	10.8	BDL	BDL	BDL	330	216	194
18.01.2008	98.6	32.5	9.8	12.7	BDL	BDL	BDL	327	286	193
23.01.2008	93.8	31.0	8.7	12.2	BDL	BDL	BDL	320	215	173
25.01.2008	92.2	27.2	13.9	13.1	BDL	BDL	BDL	316	244	203
30.01.2008	96.3	31.8	8.2	15.8	BDL	BDL	BDL	327	214	190
01.02.2008	102.4	53.8	8.6	11.8	BDL	BDL	BDL	312	203	181
06.02.2008	109.3	36.1	12.2	10.6	BDL	BDL	BDL	342	252	189
08.02.2008	100.7	33.2	9.3	10.4	BDL	BDL	BDL	331	291	204
13.02.2008	108.5	35.8	9.4	9.5	BDL	BDL	BDL	341	221	202
15.02.2008	96.7	31.9	9.5	9.4	BDL	BDL	BDL	335	220	200
20.02.2008	162.4	55.8	12.6	9.6	BDL	BDL	BDL	324	219	198
22.02.2008	110.3	36.4	8.2	9.2	BDL	BDL	BDL	332	218	178
27.02.2008	106.4	35.1	12.3	9.9	BDL	BDL	BDL	315	217	196
29.02.2008	101.6	53.5	8.4	10.1	BDL	BDL	BDL	333	247	195
Maximum	**172.5**	**58.6**	**13.9**	**15.8**	BDL	BDL	**BDL**	**348**		
Minimum	**92.2**	**27.2**	**7.9**	**8.5**	BDL	BDL	**BDL**	**172**		
Average	**111.9**	**37.5**	**10.4**	**11.5**	BDL	BDL	**BDL**	**252**		
98th %le	**169.6**	**57.4**	**13.8**	**15.2**	BDL	BDL	**BDL**	**344**		
All units are in $\mu g/m^3$										

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-7:Lunera										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
05.12.2007	120.4	39.7	7.5	7.8	BDL	BDL	BDL	319	257	241
07.12.2007	118.2	39.2	9.5	7.9	BDL	BDL	BDL	302	253	195
12.12.2007	155.3	48.6	7.9	8.4	BDL	BDL	BDL	263	225	165
14.12.2007	108.5	35.8	8.4	8.2	BDL	BDL	BDL	284	213	177
19.12.2007	112.8	37.2	7.8	8.9	BDL	BDL	BDL	293	212	174
21.12.2007	81.2	38.4	8.5	9.6	BDL	BDL	BDL	258	211	171
26.12.2007	91.2	25.9	8.9	9.2	BDL	BDL	BDL	257	209	168
28.12.2007	114.8	37.9	9.4	9.9	BDL	BDL	BDL	245	204	164
02.01.2008	122.3	50.4	11.5	10.2	BDL	BDL	BDL	292	244	156
04.01.2008	119.8	49.5	13.1	12.6	BDL	BDL	BDL	290	226	194
09.01.2008	117.5	38.8	11.8	13.1	BDL	BDL	BDL	307	225	193
11.01.2008	110.2	36.4	11.2	15.4	BDL	BDL	BDL	288	262	192
16.01.2008	113.6	37.5	11.3	12.8	BDL	BDL	BDL	283	222	190
18.01.2008	158.2	39.5	10.6	13.4	BDL	BDL	BDL	279	218	189
23.01.2008	115.3	38.2	10.8	9.5	BDL	BDL	BDL	275	217	186
25.01.2008	119.2	49.3	13.2	15.6	BDL	BDL	BDL	262	216	184
30.01.2008	125.2	41.3	9.6	10.4	BDL	BDL	BDL	272	226	179
01.02.2008	124.4	41.1	9.7	11.6	BDL	BDL	BDL	268	215	189
06.02.2008	123.2	40.7	11.7	11.8	BDL	BDL	BDL	329	320	307
08.02.2008	165.4	57.8	10.5	11.2	BDL	BDL	BDL	328	318	317
13.02.2008	119.1	39.3	12.1	12.4	BDL	BDL	BDL	318	301	290
15.02.2008	115.2	38.6	12.3	12.9	BDL	BDL	BDL	322	293	283
20.02.2008	118.9	49.2	11.6	12.7	BDL	BDL	BDL	320	283	273
22.02.2008	125.4	41.4	11.4	11.5	BDL	BDL	BDL	316	272	258
27.02.2008	120.2	39.7	11.1	14.6	BDL	BDL	BDL	315	266	256
29.02.2008	122.4	40.4	10.7	11.3	BDL	BDL	BDL	309	265	245
Maximum	**165.4**	**57.8**	**13.2**	**15.6**	BDL	BDL	**BDL**	**329**		
Minimum	**81.2**	**25.9**	**7.5**	**7.8**	BDL	BDL	**BDL**	**156**		
Average	**120.7**	**41.2**	**10.5**	**11.3**	BDL	BDL	**BDL**	**250**		
98th %le	**161.8**	**54.1**	**13.2**	**15.5**	BDL	BDL	**BDL**	**325**		
All units are in $\mu g/m^3$										
AAQ-8: Chawandiya										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
05.12.2007	95.6	31.5	7.7	9.5	BDL	BDL	BDL	305	282	258
07.12.2007	96.4	31.8	8.6	9.4	BDL	BDL	BDL	324	277	256
12.12.2007	91.2	30.1	9.2	8.9	BDL	BDL	BDL	302	275	254
14.12.2007	96.3	45.8	10.7	9.6	BDL	BDL	BDL	311	274	253
19.12.2007	99.8	32.9	11.2	11.3	BDL	BDL	BDL	299	271	248
21.12.2007	123.5	40.8	11.3	13.1	BDL	BDL	BDL	308	262	247
26.12.2007	112.6	37.2	11.8	14.2	BDL	BDL	BDL	293	258	243
28.12.2007	127.5	48.7	12.3	14.3	BDL	BDL	BDL	289	253	234
02.01.2008	123.6	50.7	8.5	12.9	BDL	BDL	BDL	315	239	218
04.01.2008	134.8	49.4	7.9	13.7	BDL	BDL	BDL	275	226	185
09.01.2008	136.7	45.1	9.5	12.6	BDL	BDL	BDL	286	216	168
11.01.2008	125.7	41.5	8.4	13.4	BDL	BDL	BDL	264	212	152
16.01.2008	134.5	44.4	9.9	11.4	BDL	BDL	BDL	243	165	146
18.01.2008	138.4	45.7	7.7	11.9	BDL	BDL	BDL	185	154	145
23.01.2008	112.1	46.9	11.4	12.5	BDL	BDL	BDL	323	313	296
25.01.2008	119.8	39.5	10.6	13.8	BDL	BDL	BDL	288	256	199
30.01.2008	125.8	41.5	10.5	12.4	BDL	BDL	BDL	316	311	288
01.02.2008	136.2	48.2	11.6	13.3	BDL	BDL	BDL	321	306	282
06.02.2008	128.5	49.3	11.1	14.1	BDL	BDL	BDL	305	305	275
08.02.2008	137.7	46.1	10.8	11.6	BDL	BDL	BDL	314	304	273
13.02.2008	133.1	36.9	9.7	12.8	BDL	BDL	BDL	323	302	268
15.02.2008	132.1	43.6	9.6	13.9	BDL	BDL	BDL	331	295	267
20.02.2008	131.2	49.9	8.7	14.4	BDL	BDL	BDL	302	286	265
22.02.2008	118.6	39.1	7.8	12.7	BDL	BDL	BDL	311	296	254
27.02.2008	126.5	48.3	8.3	13.2	BDL	BDL	BDL	299	285	264
29.02.2008	136.8	44.5	8.8	11.7	BDL	BDL	BDL	306	283	262
Maximum	**138.4**	**50.7**	**12.3**	**14.4**	BDL	BDL	**BDL**	**331**		
Minimum	**91.2**	**30.1**	**7.7**	**8.9**	BDL	BDL	**BDL**	**145**		
Average	**122.1**	**42.7**	**9.8**	**12.4**	BDL	BDL	**BDL**	**267**		
98th %le	**138.1**	**50.3**	**12.1**	**14.4**	BDL	BDL	**BDL**	**323**		
All units are in $\mu g/m^3$										

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-9: Chhapari

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
05.12.2007	132.8	38.4	9.6	9.7	BDL	BDL	BDL	284	269	171
07.12.2007	117.3	39.4	11.9	12.3	BDL	BDL	BDL	292	258	170
12.12.2007	123.5	32.1	12.4	9.9	BDL	BDL	BDL	274	246	165
14.12.2007	138.9	37.2	11.8	13.1	BDL	BDL	BDL	299	256	158
19.12.2007	139.4	35.2	11.7	13.7	BDL	BDL	BDL	293	254	150
21.12.2007	132.2	34.9	11.5	12.9	BDL	BDL	BDL	272	248	165
26.12.2007	89.3	35.1	10.4	13.4	BDL	BDL	BDL	289	237	162
28.12.2007	129.2	35.9	11.6	12.8	BDL	BDL	BDL	267	246	162
02.01.2008	133.5	35.4	12.1	9.5	BDL	BDL	BDL	275	233	160
04.01.2008	137.2	36.6	10.2	11.9	BDL	BDL	BDL	259	254	156
09.01.2008	129.5	30.9	10.6	12.6	BDL	BDL	BDL	249	234	149
11.01.2008	135.4	34.2	10.5	13.5	BDL	BDL	BDL	288	243	155
16.01.2008	125.4	39.6	12.3	9.6	BDL	BDL	BDL	225	212	141
18.01.2008	131.4	37.5	10.1	10.8	BDL	BDL	BDL	258	241	153
23.01.2008	126.4	31.8	12.5	11.7	BDL	BDL	BDL	248	221	153
25.01.2008	138.6	37.3	9.8	12.4	BDL	BDL	BDL	285	237	152
30.01.2008	136.4	33.3	11.4	13.3	BDL	BDL	BDL	253	228	151
01.02.2008	134.7	39.6	10.8	13.9	BDL	BDL	BDL	287	247	151
06.02.2008	131.2	31.6	11.3	9.4	BDL	BDL	BDL	298	266	149
08.02.2008	125.6	28.7	12.6	10.2	BDL	BDL	BDL	279	253	155
13.02.2008	132.3	36.2	12.8	13.2	BDL	BDL	BDL	296	281	186
15.02.2008	127.4	35.3	10.7	14.1	BDL	BDL	BDL	283	279	184
20.02.2008	136.7	36.5	9.7	13.8	BDL	BDL	BDL	291	257	179
22.02.2008	120.3	37.9	12.9	13.6	BDL	BDL	BDL	288	276	174
27.02.2008	136.9	30.5	12.2	12.5	BDL	BDL	BDL	277	273	173
29.02.2008	122.3	46.4	12.7	13.7	BDL	BDL	BDL	285	271	172
Maximum	**139.4**	**46.4**	**12.9**	**14.1**	BDL	BDL	**BDL**	**299**		
Minimum	**89.3**	**28.7**	**9.6**	**9.4**	BDL	BDL	**BDL**	**141**		
Average	**129.4**	**35.7**	**11.4**	**12.2**	BDL	BDL	**BDL**	**230**		
98th %le	**139.2**	**43.0**	**12.9**	**14.0**	BDL	BDL	**BDL**	**297**		

units are in $\mu g/m^3$

AAQ-10: Gawardi

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
05.12.2007	135.2	47.9	8.9	8.7	BDL	BDL	BDL	283	232	239
07.12.2007	120.5	36.4	8.3	9.5	BDL	BDL	BDL	265	248	232
12.12.2007	125.6	42.4	11.4	13.8	BDL	BDL	BDL	279	258	227
14.12.2007	126.2	46.2	10.2	12.6	BDL	BDL	BDL	297	245	224
19.12.2007	129.4	39.3	11.6	12.8	BDL	BDL	BDL	275	253	223
21.12.2007	125.7	38.1	11.7	11.5	BDL	BDL	BDL	269	225	181
26.12.2007	135.7	37.3	9.1	11.6	BDL	BDL	BDL	255	231	212
28.12.2007	132.5	36.8	8.7	11.8	BDL	BDL	BDL	271	248	201
02.01.2008	125.2	33.3	12.4	10.7	BDL	BDL	BDL	264	238	217
04.01.2008	132.4	47.1	10.7	12.7	BDL	BDL	BDL	273	246	215
09.01.2008	132.8	33.8	11.2	9.4	BDL	BDL	BDL	258	225	211
11.01.2008	104.1	34.4	12.3	9.6	BDL	BDL	BDL	268	243	212
16.01.2008	109.3	36.1	10.6	12.5	BDL	BDL	BDL	256	232	222
18.01.2008	101.4	33.5	11.5	12.2	BDL	BDL	BDL	264	237	208
23.01.2008	98.6	32.5	11.3	11.2	BDL	BDL	BDL	293	266	216
25.01.2008	107.1	35.3	12.5	10.5	BDL	BDL	BDL	263	226	203
30.01.2008	111.3	34.7	8.4	10.6	BDL	BDL	BDL	245	233	202
01.02.2008	98.3	32.4	8.6	11.1	BDL	BDL	BDL	274	228	198
06.02.2008	106.5	35.1	8.1	11.4	BDL	BDL	BDL	241	222	186
08.02.2008	98.7	32.6	11.9	11.7	BDL	BDL	BDL	239	225	192
13.02.2008	103.4	34.1	9.2	12.7	BDL	BDL	BDL	227	218	189
15.02.2008	110.5	36.5	10.9	8.9	BDL	BDL	BDL	248	214	175
20.02.2008	87.5	28.9	9.6	9.9	BDL	BDL	BDL	222	204	157
22.02.2008	95.1	33.6	9.9	9.7	BDL	BDL	BDL	284	276	255
27.02.2008	93.2	30.8	8.2	9.3	BDL	BDL	BDL	293	269	242
29.02.2008	96.1	31.7	8.8	8.3	BDL	BDL	BDL	287	268	241
Maximum	**135.7**	**47.9**	**12.5**	**13.8**	BDL	BDL	**BDL**	**297**		
Minimum	**87.5**	**28.9**	**8.1**	**8.3**	BDL	BDL	**BDL**	**157**		
Average	**113.2**	**36.2**	**10.2**	**10.9**	BDL	BDL	**BDL**	**238**		
98th %le	**135.5**	**47.5**	**12.5**	**13.3**	BDL	BDL	**BDL**	**293**		

All units are in $\mu g/m^3$

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

Moblie Locations WINTER DATA RD MINES MOBILE LOCATIONS

Date	TSPM ug/m³	RPM ug/m³	SO_2 ug/m³	NOx ug/m³	LEAD	ZINC	CADMIUM	CO I	CO II	CO III
Larapacha										
13.01.2007	118.6	46.5	10.7	7.8	0.15	0.15	BDL	265	228	228
17.01.2008	143.1	25.9	11.9	13.3	0.16	0.23	BDL	281	232	236
21.02.2008	82.7	38.3	9.5	11.2	0.13	0.19	BDL	310	256	247
Maximum	**143.1**	**46.5**	**11.9**	**13.3**	**0.16**	**0.23**	**BDL**	**310**		
Minimum	**82.7**	**25.9**	**9.5**	**7.8**	**0.13**	**0.15**	**BDL**	**228**		
Average	**123.4**	**36.9**	**10.7**	**10.8**	**0.15**	**0.19**	**BDL**	**254**		
98th %le	**139.4**	**46.2**	**11.9**	**13.2**	**0.16**	**BDL**	**BDL**	**305**		
Anjana										
13.01.2007	161.2	46.5	10.5	13.1	0.10	0.18	BDL	242	245	246
17.01.2008	158.9	49.5	12.6	14.1	0.13	0.14	BDL	243	266	251
21.02.2008	118.2	27.1	10.2	11.6	0.11	0.10	BDL	293	274	258
Maximum	**161.2**	**49.5**	**12.6**	**14.1**	**0.13**	**0.18**	**BDL**	**293**		
Minimum	**118.2**	**27.1**	**10.2**	**11.6**	**0.10**	**0.10**	**BDL**	**242**		
Average	**122.7**	**41.0**	**11.1**	**12.9**	**0.11**	**0.14**	**BDL**	**258**		
98th %le	**145.0**	**49.4**	**12.5**	**14.1**	**0.13**	**0.18**	**BDL**	**290**		
Mahenduriya										
13.01.2007	145.3	45.6	12.2	15.5	BDL	BDL	BDL	242	295	246
17.01.2008	134.3	26.3	9.2	11.9	BDL	BDL	BDL	268	236	248
21.02.2008	104.1	37.6	10.2	12.2	BDL	BDL	BDL	298	262	257
Maximum	**145.3**	**45.6**	**12.2**	**15.5**	BDL	BDL	**BDL**	**298**		
Minimum	**104.1**	**26.3**	**9.2**	**11.9**	BDL	BDL	**BDL**	**236**		
Average	**129.5**	**36.5**	**10.5**	**13.2**	BDL	BDL	**BDL**	**261**		
98th %le	**159.2**	**45.3**	**12.1**	**15.4**	**BDL**	**BDL**	**BDL**	**298**		
Bera ka Khera										
13.01.2007	129.3	27.1	9.5	11.4	BDL	BDL	BDL	228	285	229
17.01.2008	96.5	40.6	9.1	11.8	BDL	BDL	BDL	235	234	232
21.02.2008	122.2	30.7	9.3	14.8	BDL	BDL	BDL	292	225	249
Maximum	**129.3**	**40.6**	**9.5**	**14.8**	BDL	BDL	**BDL**	**292**		
Minimum	**96.5**	**27.1**	**9.1**	**11.4**	BDL	BDL	**BDL**	**225**		
Average	**129.1**	**32.8**	**9.3**	**12.7**	BDL	BDL	**BDL**	**245**		
98th %le	**159.5**	**40.2**	**9.5**	**14.7**	**BDL**	**BDL**	**BDL**	**291**		
Kotari										
13.01.2007	168.4	58.9	10.9	12.6	0.22	0.32	BDL	356	236	254
17.01.2008	91.2	25.2	14.4	16.3	0.13	0.14	BDL	248	296	247
21.02.2008	155.1	55.1	9.2	12.2	0.16	0.18	BDL	232	285	234
Maximum	**168.4**	**58.9**	**9.4**	**16.3**	**0.22**	**0.32**	**BDL**	**356**		
Minimum	**91.2**	**25.2**	**8.9**	**12.2**	**0.13**	**0.14**	**BDL**	**232**		
Average	**131.4**	**46.4**	**11.5**	**13.7**	**0.17**	**0.21**	**BDL**	**265**		
98th %le	**161.2**	**58.7**	**14.3**	**16.2**	**0.22**	**0.31**	**BDL**	**346**		
Pipawas										
13.01.2007	139.8	48.3	8.7	12.5	0.18	0.22	BDL	235	222	245
17.01.2008	81.2	51.6	13.6	14.2	0.13	0.14	BDL	238	275	252
21.02.2008	92.5	26.7	8.6	12.9	0.12	0.13	BDL	243	295	321
Maximum	**139.8**	**51.6**	13.6	**14.2**	**0.18**	**0.22**	**BDL**	**321**		
Minimum	**81.2**	**26.7**	8.6	**11.4**	**0.12**	**0.13**	**BDL**	**222**		
Average	**126.9**	**42.2**	10.3	**13.2**	**0.14**	**0.16**	**BDL**	**258**		
98th %le	**162.1**	**51.5**	**13.4**	**14.1**	**0.18**	**0.22**	**BDL**	**317**		

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

PREMONSOON - 2008

AAQ-1: Mine lease area

Dates	TSPM	RPM	SO_2	NOx	Lead	Zinc	Cadmium	CO		
								I	II	III
04.03.2008	143.5	53.1	10.1	13.1	<0.1	0.32	BDL	372	331	274
06.03.2008	232.6	67.2	13.4	14.7	0.28	<0.1	BDL	321	302	253
11.03.2008	136.2	52.1	12.5	12.9	0.10	0.18	BDL	388	357	293
13.03.2008	222.8	82.4	12.5	13.3	<0.1	0.12	BDL	365	342	315
18.03.2008	152.6	56.5	10.5	15.2	<0.1	0.31	BDL	375	351	324
20.03.2008	168.2	62.2	11.3	12.5	0.11	0.31	BDL	344	295	206
25.03.2008	145.8	53.9	14.5	15.7	<0.1	0.22	BDL	391	354	317
27.03.2008	155.6	57.6	13.6	14.4	<0.1	0.32	BDL	378	335	291
01.04.2008	178.4	66.2	10.6	12.3	<0.1	0.21	BDL	413	398	359
03.04.2008	142.8	52.8	13.3	16.1	0.11	0.28	BDL	391	376	297
08.04.2008	139.4	51.6	14.8	17.3	<0.1	0.23	BDL	379	314	276
10.04.2008	173.4	64.2	13.1	15.6	<0.1	0.3	BDL	398	363	314
15.04.2008	152.4	56.4	12.4	14.5	<0.1	0.12	BDL	405	355	321
17.04.2008	136.5	75.6	13.9	13.6	<0.1	0.3	BDL	378	342	272
22.04.2008	143.2	53.4	11.6	12.4	<0.1	0.25	BDL	392	335	294
24.04.2008	193.2	71.5	13.5	16.7	<0.1	0.27	BDL	407	374	284
29.04.2008	198.4	73.4	13.2	16.5	<0.1	0.29	BDL	392	332	265
01.05.2008	242.6	85.6	12.1	16.6	<0.18	0.36	BDL	379	341	292
06.05.2008	156.2	57.8	10.9	15.8	0.10	0.24	BDL	402	371	318
08.05.2008	163.2	60.4	15.1	14.6	<0.1	0.21	BDL	393	338	297
13.05.2008	183.2	67.8	10.3	13.4	<0.1	0.23	BDL	368	345	285
15.05.2008	174.3	64.5	14.6	12.7	0.11	0.25	BDL	384	365	312
20.05.2008	192.3	71.2	11.2	12.1	<0.1	0.21	BDL	399	342	292
22.05.2008	158.4	58.3	11.8	13.5	0.11	0.30	BDL	371	325	284
27.05.2008	239.4	88.6	13.3	12.6	<0.1	0.11	BDL	366	315	276
29.05.2008	240.1	85.2	14.9	15.4	<0.1	0.25	BDL	385	324	222
Maximum	**242.6**	**88.6**	**15.1**	**17.3**	**0.28**	**0.36**	BDL		**413**	
Minimum	**136.2**	**51.6**	**10.1**	**12.1**	**0.18**	**0.24**	BDL		**206**	
Average	**175.6**	**65.0**	**12.7**	**14.4**	**0.1**	**0.2**	BDL		**338**	
98th %le	**241.4**	**87.1**	**15.0**	**17.0**	**0.3**	**0.3**	BDL		**406**	

All units are in $\mu g/m^3$

AAQ-2: Rajpura

Dates	TSPM	RPM	SO_2	NOx	Lead	Zinc	Cadmium	CO		
								I	II	III
04.03.2008	139.3	51.5	7.9	12.0	0.2	0.12	BDL	344	313	259
06.03.2008	218.4	67.2	8.9	10.3	0.17	0.14	BDL	316	275	224
11.03.2008	131.6	48.7	9.9	11.8	0.10	0.15	BDL	325	286	233
13.03.2008	138.5	51.2	7.8	11.0	0.15	0.13	BDL	305	266	212
18.03.2008	148.4	54.9	7.3	9.4	0.1	0.11	BDL	282	258	222
20.03.2008	163.3	60.4	10.2	11.4	0.18	0.12	BDL	299	243	231
25.03.2008	141.6	52.4	10.4	8.7	0.21	0.12	BDL	328	293	248
27.03.2008	151.4	56.2	7.2	10.2	0.21	0.12	BDL	303	279	215
01.04.2008	174.2	64.4	8.3	9.1	0.15	0.11	BDL	293	273	226
03.04.2008	138.6	51.3	10.1	9.5	0.17	0.11	BDL	315	292	212
08.04.2008	135.2	50.3	8.4	11.2	0.1	0.12	BDL	341	315	256
10.04.2008	169.2	62.6	9.2	9.6	0.13	0.15	BDL	282	252	221
15.04.2008	148.5	54.9	8.2	9.2	0.18	0.13	BDL	354	323	264
17.04.2008	132.3	48.9	7.6	10.4	0.16	0.12	BDL	322	305	272
22.04.2008	138.1	51.1	8.6	11.3	0.21	0.29	BDL	337	314	251
24.04.2008	188.7	69.8	9.3	8.8	0.23	0.21	BDL	317	301	264
29.04.2008	194.2	71.8	7.4	11.7	0.14	0.11	BDL	342	321	272
01.05.2008	134.2	49.6	10.5	8.4	0.21	<0.1	BDL	312	295	279
06.05.2008	151.2	55.9	7.5	9.3	0.16	0.12	BDL	329	289	266
08.05.2008	158.9	58.8	10.3	11.5	0.1	<0.1	BDL	307	276	263
13.05.2008	178.8	66.2	9.1	8.9	0.18	0.14	BDL	316	298	258
15.05.2008	170.1	48.1	9.7	10.0	0.2	0.14	BDL	326	286	247
20.05.2008	188.1	69.6	7.7	11.1	0.2	<0.1	BDL	304	274	236
22.05.2008	154.2	57.1	7.1	12.2	0.2	<0.1	BDL	311	285	246
27.05.2008	135.5	50.1	9.4	8.3	0.2	<0.1	BDL	298	268	233
29.05.2008	146.6	52.3	7.2	11.4	0.2	<0.1	BDL	348	313	256
Maximum	**218.4**	**71.8**	**10.5**	**12.2**	**0.23**	**0.29**	BDL		**354**	
Minimum	**131.6**	**48.1**	**7.1**	**8.3**	**0.1**	**<0.1**	BDL		**212**	
Average	**156.5**	**56.8**	**8.7**	**10.3**	**0.2**	**0.1**	BDL		**284**	
98th %le	**206.3**	**70.8**	**10.5**	**12.1**	**0.2**	**0.3**	BDL		**346**	

All units are in $\mu g/m^3$

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-3: Makhanpuriya										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**Lead**	**Zinc**	**Cadmium**	**CO**		
								I	II	III
04.03.2008	106.1	53.6	8.2	13.5	BDL	BDL	BDL	244	162	142
06.03.2008	107.0	41.1	11.5	10.5	BDL	BDL	BDL	265	162	112
11.03.2008	113.0	42.7	7.5	9.7	BDL	BDL	BDL	254	253	226
13.03.2008	117.4	51.3	7.8	12.6	BDL	BDL	BDL	239	248	224
18.03.2008	118.9	47.6	11.1	10.4	BDL	BDL	BDL	255	247	209
20.03.2008	119.8	55.8	8.8	11.9	BDL	BDL	BDL	231	242	207
25.03.2008	122.5	50.9	10.4	11.5	BDL	BDL	BDL	245	237	201
27.03.2008	123.9	44.9	8.4	12.3	BDL	BDL	BDL	264	226	199
01.04.2008	125.2	53.9	7.6	9.4	BDL	BDL	BDL	258	219	188
03.04.2008	127.4	58.6	10.8	10.3	BDL	BDL	BDL	262	216	182
08.04.2008	127.6	43.5	9.5	13.1	BDL	BDL	BDL	252	205	167
10.04.2008	146.6	45.7	8.5	9.6	BDL	BDL	BDL	247	233	156
15.04.2008	127.8	40.5	10.2	13.6	BDL	BDL	BDL	256	202	163
17.04.2008	129.8	50.3	7.7	13.2	BDL	BDL	BDL	261	221	153
22.04.2008	134.8	45.7	7.4	9.1	BDL	BDL	BDL	244	199	162
24.04.2008	154.7	51.6	11.6	13.8	BDL	BDL	BDL	234	215	158
29.04.2008	135.8	46.8	9.3	10.2	BDL	BDL	BDL	242	193	157
01.05.2008	139.8	45.6	8.6	12.1	BDL	BDL	BDL	259	221	165
06.05.2008	141.8	40.9	11.3	9.3	BDL	BDL	BDL	253	231	156
08.05.2008	144.1	59.3	9.4	9.2	BDL	BDL	BDL	223	185	142
13.05.2008	144.4	42.5	10.3	12.5	BDL	BDL	BDL	249	216	154
15.05.2008	154.3	39.1	10.7	11.2	BDL	BDL	BDL	212	179	148
20.05.2008	147.8	41.6	11.2	9.8	BDL	BDL	BDL	208	168	132
22.05.2008	148.8	51.9	6.6	12.2	BDL	BDL	BDL	262	217	174
27.05.2008	150.4	42.7	9.6	10.2	BDL	BDL	BDL	192	176	143
29.05.2008	156.8	57.2	9.2	10.8	BDL	BDL	BDL	248	172	124
Maximum	**156.8**	**59.3**	**11.6**	**13.8**	BDL	BDL	BDL	**265**		
Minimum	**106.1**	**39.1**	**6.6**	**9.1**	BDL	BDL	BDL	**112**		
Average	**133.3**	**47.9**	**9.4**	**11.2**	BDL	BDL	BDL	**207**		
98th %le	**155.8**	**59.0**	**11.6**	**13.7**	BDL	BDL	BDL	**263**		
All units are in $\mu g/m^3$										
AAQ-4: Sunariya Khera										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**Lead**	**Zinc**	**Cadmium**	**CO**		
								I	II	III
04.03.2008	134.2	48.3	7.2	9.2	BDL	BDL	BDL	264	214	183
06.03.2008	148.2	53.3	9.6	13.4	BDL	BDL	BDL	253	221	178
11.03.2008	111.3	40.1	8.2	12.5	BDL	BDL	BDL	274	234	164
13.03.2008	159.4	55.4	7.6	9.6	BDL	BDL	BDL	258	213	181
18.03.2008	121.2	39.6	10.3	14.1	BDL	BDL	BDL	267	207	157
20.03.2008	104.4	37.6	9.4	10.6	BDL	BDL	BDL	271	215	166
25.03.2008	160.3	57.7	7.1	11.5	BDL	BDL	BDL	263	223	155
27.03.2008	110.2	39.7	8.4	9.1	BDL	BDL	BDL	258	192	143
01.04.2008	127.9	46.0	11.1	8.6	BDL	BDL	BDL	275	231	153
03.04.2008	138.0	49.7	9.5	12.1	BDL	BDL	BDL	255	225	131
08.04.2008	150.3	54.1	8.5	11.3	BDL	BDL	BDL	267	248	146
10.04.2008	95.4	34.3	10.8	9.4	BDL	BDL	BDL	244	216	129
15.04.2008	155.6	56.0	7.5	12.4	BDL	BDL	BDL	282	227	145
17.04.2008	159.6	56.5	10.2	13.8	BDL	BDL	BDL	254	204	174
22.04.2008	105.6	43.2	7.3	9.5	BDL	BDL	BDL	281	212	162
24.04.2008	155.0	55.8	7.7	14.2	BDL	BDL	BDL	261	224	142
29.04.2008	144.7	52.1	10.9	10.2	BDL	BDL	BDL	249	199	132
01.05.2008	102.5	36.9	8.3	8.9	BDL	BDL	BDL	222	185	144
06.05.2008	163.7	52.5	8.9	13.1	BDL	BDL	BDL	257	208	136
08.05.2008	115.6	41.6	7.4	10.4	BDL	BDL	BDL	234	196	155
13.05.2008	133.5	48.1	8.6	11.4	BDL	BDL	BDL	242	219	133
15.05.2008	110.2	59.1	8.1	12.3	BDL	BDL	BDL	252	228	128
20.05.2008	103.4	37.2	8.8	13.2	BDL	BDL	BDL	275	251	202
22.05.2008	164.2	44.6	9.2	8.8	BDL	BDL	BDL	251	226	191
27.05.2008	129.1	46.5	8.7	10.5	BDL	BDL	BDL	265	241	203
29.05.2008	105.5	31.7	11.2	13.5	BDL	BDL	BDL	263	215	185
Maximum	**164.2**	**59.1**	**11.2**	**14.2**	BDL	BDL	BDL	**282**		
Minimum	**95.4**	**31.7**	**7.1**	**8.6**	BDL	BDL	BDL	**128**		
Average	**131.1**	**46.8**	**8.9**	**11.3**	BDL	BDL	BDL	**212**		
98th %le	**164.0**	**58.4**	**11.2**	**14.2**	BDL	BDL	BDL	**278**		
All units are in $\mu g/m^3$										

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-5: Chothpura

Dates	TSPM	RPM	SO_2	NOx	Lead	Zinc	Cadmium	CO		
								I	II	III
04.03.2008	103.5	37.3	10.6	8.9	BDL	BDL	BDL	271	233	186
06.03.2008	121.3	43.7	7.4	9.6	BDL	BDL	BDL	247	236	203
11.03.2008	144.2	51.9	9.4	13.1	BDL	BDL	BDL	263	225	192
13.03.2008	91.2	63.2	7.7	11.5	BDL	BDL	BDL	258	215	179
18.03.2008	128.5	45.2	8.3	12.4	BDL	BDL	BDL	276	254	212
20.03.2008	115.3	58.2	10.2	11.3	BDL	BDL	BDL	265	213	195
25.03.2008	99.2	35.7	8.6	8.4	BDL	BDL	BDL	254	231	172
27.03.2008	125.6	45.2	7.3	13.6	BDL	BDL	BDL	244	229	219
01.04.2008	146.2	49.6	7.9	9.8	BDL	BDL	BDL	261	242	217
03.04.2008	97.2	61.2	9.6	11.4	BDL	BDL	BDL	282	264	204
08.04.2008	145.8	52.5	8.2	8.5	BDL	BDL	BDL	262	235	198
10.04.2008	108.7	39.1	10.3	8.6	BDL	BDL	BDL	255	252	205
15.04.2008	93.5	33.7	9.3	11.9	BDL	BDL	BDL	273	223	192
17.04.2008	136.2	51.2	9.5	10.6	BDL	BDL	BDL	255	231	178
22.04.2008	103.2	37.2	7.8	9.3	BDL	BDL	BDL	234	194	153
24.04.2008	119.4	43.2	9.1	11.6	BDL	BDL	BDL	281	228	165
29.04.2008	128.6	36.2	7.2	12.3	BDL	BDL	BDL	278	254	171
01.05.2008	142.3	52.2	9.8	9.1	BDL	BDL	BDL	267	261	154
06.05.2008	131.2	31.5	9.9	13.2	BDL	BDL	BDL	283	252	183
08.05.2008	102.3	36.8	10.5	9.7	BDL	BDL	BDL	281	253	205
13.05.2008	138.9	59.2	8.5	9.2	BDL	BDL	BDL	265	256	221
15.05.2008	95.2	54.3	9.7	12.1	BDL	BDL	BDL	253	284	235
20.05.2008	132.5	47.7	10.4	9.9	BDL	BDL	BDL	272	236	172
22.05.2008	129.8	46.7	7.6	10.8	BDL	BDL	BDL	283	242	168
27.05.2008	93.2	33.6	7.5	11.8	BDL	BDL	BDL	233	261	185
29.05.2008	148.4	53.2	10.1	13.3	BDL	BDL	BDL	269	255	215
Maximum	**148.4**	**63.2**	**10.6**	**13.6**	BDL	BDL	BDL		**284**	
Minimum	**91.2**	**31.5**	**7.2**	**8.4**	BDL	BDL	BDL		**153**	
Average	**120.1**	**46.1**	**8.9**	**10.8**	BDL	BDL	BDL		**232**	
98th %le	**147.3**	**62.2**	**10.6**	**13.5**	BDL	BDL	BDL		**283**	

All units are in $\mu g/m^3$

AAQ-6:East of ML Area

Dates	TSPM	RPM	SO_2	NOx	Lead	Zinc	Cadmium	CO		
								I	II	III
04.03.2008	110.9	39.9	10.3	9.1	BDL	BDL	BDL	248	227	185
06.03.2008	158.5	57.1	7.8	13.9	BDL	BDL	BDL	259	226	152
11.03.2008	151.8	54.6	11.1	12.5	BDL	BDL	BDL	300	268	199
13.03.2008	125.4	47.6	8.2	8.9	BDL	BDL	BDL	269	241	181
18.03.2008	167.4	58.2	9.7	13.5	BDL	BDL	BDL	279	233	141
20.03.2008	120.7	43.4	10.9	9.7	BDL	BDL	BDL	303	226	191
25.03.2008	138.9	50.0	8.3	11.5	BDL	BDL	BDL	271	258	165
27.03.2008	109.5	39.4	9.3	8.7	BDL	BDL	BDL	286	265	172
01.04.2008	106.3	32.5	9.6	8.5	BDL	BDL	BDL	296	270	132
03.04.2008	146.0	52.6	10.5	12.3	BDL	BDL	BDL	281	259	166
08.04.2008	127.8	46.0	11.2	10.5	BDL	BDL	BDL	275	252	152
10.04.2008	115.2	41.5	7.9	9.9	BDL	BDL	BDL	251	195	204
15.04.2008	173.2	62.4	11.7	12.1	BDL	BDL	BDL	268	232	183
17.04.2008	153.3	55.2	9.4	12.8	BDL	BDL	BDL	291	269	135
22.04.2008	116.5	41.9	11.4	9.6	BDL	BDL	BDL	265	243	152
24.04.2008	160.3	57.7	9.8	13.2	BDL	BDL	BDL	258	233	178
29.04.2008	175.4	63.1	10.6	10.6	BDL	BDL	BDL	275	251	141
01.05.2008	110.3	42.5	11.6	8.8	BDL	BDL	BDL	269	244	138
06.05.2008	152.5	54.9	8.1	12.4	BDL	BDL	BDL	287	260	151
08.05.2008	184.5	59.2	9.4	9.8	BDL	BDL	BDL	271	245	131
13.05.2008	131.9	47.5	10.4	11.4	BDL	BDL	BDL	292	266	182
15.05.2008	143.2	47.2	8.5	12.2	BDL	BDL	BDL	274	240	148
20.05.2008	157.2	56.6	9.5	9.2	BDL	BDL	BDL	269	234	163
22.05.2008	165.2	37.8	8.4	8.2	BDL	BDL	BDL	282	268	149
27.05.2008	117.9	42.4	11.3	9.5	BDL	BDL	BDL	264	253	152
29.05.2008	160.0	57.6	9.1	12.6	BDL	BDL	BDL	294	271	165
Maximum	**184.5**	**63.1**	**11.7**	**13.9**	BDL	BDL	BDL		**303**	
Minimum	**106.3**	**32.5**	**7.8**	**8.2**	BDL	BDL	BDL		**131**	
Average	**141.5**	**49.6**	**9.8**	**10.8**	BDL	BDL	BDL		**228**	
98th %le	**180.0**	**62.7**	**11.7**	**13.7**	BDL	BDL	BDL		**298**	

All units are in $\mu g/m^3$

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-7:Lunera										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**Lead**	**Zinc**	**Cadmium**	**CO**		
								I	II	III
04.03.2008	97.2	36.9	7.3	12.6	BDL	BDL	BDL	282	239	211
06.03.2008	112.8	52.9	8.2	10.8	BDL	BDL	BDL	271	228	208
11.03.2008	118.4	45.1	6.9	7.5	BDL	BDL	BDL	256	174	144
13.03.2008	140.6	53.4	9.1	9.5	BDL	BDL	BDL	236	193	158
18.03.2008	130.9	49.8	8.3	8.6	BDL	BDL	BDL	227	188	167
20.03.2008	102.4	38.9	7.2	9.7	BDL	BDL	BDL	255	207	160
25.03.2008	107.9	35.2	8.8	10.4	BDL	BDL	BDL	265	222	202
27.03.2008	110.2	41.9	9.6	8.7	BDL	BDL	BDL	259	212	189
01.04.2008	104.7	34.2	9.7	7.3	BDL	BDL	BDL	245	228	183
03.04.2008	119.6	45.4	9.2	8.3	BDL	BDL	BDL	291	255	227
08.04.2008	124.7	47.4	8.4	12.1	BDL	BDL	BDL	266	224	145
10.04.2008	114.9	43.7	8.7	7.5	BDL	BDL	BDL	251	192	161
15.04.2008	172.6	64.4	7.9	11.6	BDL	BDL	BDL	276	186	156
17.04.2008	113.1	43.0	7.5	11.9	BDL	BDL	BDL	248	205	151
22.04.2008	129.4	42.5	8.1	7.1	BDL	BDL	BDL	264	212	168
24.04.2008	151.5	57.6	10.2	12.2	BDL	BDL	BDL	293	235	167
29.04.2008	134.3	51.0	11.5	8.2	BDL	BDL	BDL	248	204	166
01.05.2008	127.3	48.4	8.6	10.1	BDL	BDL	BDL	282	244	212
06.05.2008	105.2	40.0	7.4	7.4	BDL	BDL	BDL	267	223	205
08.05.2008	111.4	42.3	8.5	7.2	BDL	BDL	BDL	284	249	214
13.05.2008	108.9	41.4	7.7	10.5	BDL	BDL	BDL	243	179	148
15.05.2008	123.6	46.9	10.6	9.2	BDL	BDL	BDL	289	225	177
20.05.2008	125.4	47.7	11.2	7.8	BDL	BDL	BDL	277	181	149
22.05.2008	112.0	42.5	9.4	10.2	BDL	BDL	BDL	251	203	164
27.05.2008	113.0	42.9	8.9	11.2	BDL	BDL	BDL	285	197	153
29.05.2008	98.7	37.5	7.6	8.7	BDL	BDL	BDL	269	205	147
Maximum	**172.6**	**64.4**	**11.5**	**12.6**	BDL	BDL	BDL		**293**	
Minimum	**97.2**	**34.2**	**6.9**	**7.1**	BDL	BDL	BDL		**144**	
Average	**119.6**	**45.1**	**8.7**	**9.5**	BDL	BDL	BDL		**217**	
98th %le	**162.1**	**61.0**	**11.4**	**12.4**	BDL	BDL	BDL		**290**	
All units are in $\mu g/m^3$										
AAQ-8: Chawandiya										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**Lead**	**Zinc**	**Cadmium**	**CO**		
								I	II	III
04.03.2008	98.4	37.4	8.2	13.9	BDL	BDL	BDL	286	245	143
06.03.2008	108.2	41.1	11.6	10.5	BDL	BDL	BDL	262	226	188
11.03.2008	112.3	42.7	11.4	9.6	BDL	BDL	BDL	305	253	213
13.03.2008	92.3	38.1	7.8	13.8	BDL	BDL	BDL	279	219	158
18.03.2008	125.3	47.6	12.1	10.3	BDL	BDL	BDL	266	223	166
20.03.2008	94.2	37.8	6.8	11.9	BDL	BDL	BDL	309	262	146
25.03.2008	91.3	44.1	10.4	12.4	BDL	BDL	BDL	298	259	156
27.03.2008	118.2	44.9	8.4	14.3	BDL	BDL	BDL	274	242	201
01.04.2008	99.2	37.7	7.6	9.3	BDL	BDL	BDL	310	274	226
03.04.2008	104.3	39.6	10.8	10.4	BDL	BDL	BDL	264	229	162
08.04.2008	113.2	43.5	9.5	14.1	BDL	BDL	BDL	258	216	182
10.04.2008	120.3	46.7	8.5	9.7	BDL	BDL	BDL	236	196	148
15.04.2008	97.5	37.1	10.2	13.6	BDL	BDL	BDL	253	215	157
17.04.2008	132.4	50.3	11.2	13.3	BDL	BDL	BDL	285	253	213
22.04.2008	124.3	47.2	8.1	8.1	BDL	BDL	BDL	276	248	209
24.04.2008	103.2	48.5	11.9	14.2	BDL	BDL	BDL	248	212	147
29.04.2008	123.2	46.8	9.3	10.2	BDL	BDL	BDL	264	224	146
01.05.2008	120.1	45.6	8.7	12.1	BDL	BDL	BDL	235	217	154
06.05.2008	92.2	41.6	11.3	8.3	BDL	BDL	BDL	306	276	148
08.05.2008	155.3	59.3	8.3	9.2	BDL	BDL	BDL	291	251	165
13.05.2008	95.4	36.7	10.3	12.5	BDL	BDL	BDL	268	237	199
15.05.2008	106.3	40.4	10.7	11.2	BDL	BDL	BDL	292	248	155
20.05.2008	93.2	39.4	12.6	8.8	BDL	BDL	BDL	262	228	161
22.05.2008	96.5	36.7	7.4	12.2	BDL	BDL	BDL	285	245	224
27.05.2008	114.3	43.4	8.6	13.2	BDL	BDL	BDL	309	272	147
29.05.2008	97.8	37.2	12.0	10.8	BDL	BDL	BDL	276	248	209
Maximum	**155.3**	**59.3**	**12.6**	**14.3**	BDL	BDL	BDL		**310**	
Minimum	**91.3**	**36.7**	**6.8**	**8.1**	BDL	BDL	BDL		**143**	
Average	**108.8**	**42.7**	**9.8**	**11.5**	BDL	BDL	BDL		**230**	
98th %le	**143.9**	**54.8**	**12.4**	**14.3**	BDL	BDL	BDL		**309**	
All units are in $\mu g/m^3$										

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-9: Chappari

Dates	TSPM	RPM	SO_2	NOx	Lead	Zinc	Cadmium	CO		
								I	II	III
04.03.2008	125.4	45.1	9.6	8.4	BDL	BDL	BDL	267	251	190
06.03.2008	126.3	45.5	8.1	12.1	BDL	BDL	BDL	246	237	221
11.03.2008	129.4	46.6	9.5	11.9	BDL	BDL	BDL	265	242	211
13.03.2008	132.1	45.2	9.4	11.8	BDL	BDL	BDL	237	220	216
18.03.2008	132.8	47.8	9.2	12	BDL	BDL	BDL	246	230	197
20.03.2008	146.8	52.8	9.9	11.6	BDL	BDL	BDL	258	246	193
25.03.2008	138.4	51.8	10.1	12.2	BDL	BDL	BDL	227	208	186
27.03.2008	145.1	52.2	8.8	11.7	BDL	BDL	BDL	260	248	239
01.04.2008	128.4	46.2	10.2	12.3	BDL	BDL	BDL	268	244	220
03.04.2008	148.5	53.5	11.4	12.6	BDL	BDL	BDL	230	221	200
08.04.2008	96.5	38.4	10.1	8.8	BDL	BDL	BDL	249	235	170
10.04.2008	137.6	49.5	11.2	12.4	BDL	BDL	BDL	264	228	197
15.04.2008	124.2	44.7	10.8	12.7	BDL	BDL	BDL	221	212	183
17.04.2008	158.9	57.2	11.6	12.9	BDL	BDL	BDL	237	225	200
22.04.2008	134.2	48.3	10.5	8.3	BDL	BDL	BDL	258	239	221
24.04.2008	142.3	51.2	11.1	13.1	BDL	BDL	BDL	218	206	183
29.04.2008	152.1	54.8	11.5	12.5	BDL	BDL	BDL	228	221	177
01.05.2008	136.5	49.1	10.9	13.2	BDL	BDL	BDL	266	257	184
06.05.2008	158.5	57.1	10.3	7.8	BDL	BDL	BDL	208	198	176
08.05.2008	144.3	51.9	10.6	8.5	BDL	BDL	BDL	244	234	191
13.05.2008	122.3	44.3	10.7	12.5	BDL	BDL	BDL	261	247	211
15.05.2008	154.2	55.5	11.3	13.2	BDL	BDL	BDL	219	207	183
20.05.2008	132.3	51.7	9.8	8.6	BDL	BDL	BDL	235	225	174
22.05.2008	156.4	56.3	11.7	13.7	BDL	BDL	BDL	263	209	172
27.05.2008	138.9	50.0	7.3	12.8	BDL	BDL	BDL	229	204	198
29.05.2008	131.5	47.3	10.5	13.3	BDL	BDL	BDL	263	258	245
Maximum	**158.9**	**57.2**	**11.7**	**13.7**	BDL	BDL	BDL	**268**		
Minimum	**96.5**	**38.4**	**7.3**	**7.8**	BDL	BDL	BDL	**170**		
Average	**137.5**	**49.8**	**10.2**	**11.6**	BDL	BDL	BDL	**224**		
98th %ile	**158.7**	**57.1**	**11.7**	**13.5**	BDL	BDL	BDL	**266**		

units are in µg/m^3

AAQ-10: Gawardi

Dates	TSPM	RPM	SO_2	NOx	Lead	Zinc	Cadmium	CO		
								I	II	III
04.03.2008	106.8	38.4	9.8	9.1	BDL	BDL	BDL	156	130	115
06.03.2008	124.6	44.9	9.6	7.8	BDL	BDL	BDL	204	190	140
11.03.2008	98.5	35.5	10.2	12.3	BDL	BDL	BDL	226	215	164
13.03.2008	99.5	35.8	7.5	9.7	BDL	BDL	BDL	187	175	130
18.03.2008	131.8	47.4	9.4	11.6	BDL	BDL	BDL	200	183	137
20.03.2008	118.6	42.7	8.2	10.5	BDL	BDL	BDL	158	141	116
25.03.2008	102.5	36.9	7.6	9.6	BDL	BDL	BDL	168	161	125
27.03.2008	128.9	46.4	10.7	12.8	BDL	BDL	BDL	215	200	146
01.04.2008	139.5	52.2	9.2	9.5	BDL	BDL	BDL	235	221	178
03.04.2008	100.5	36.2	10.1	10.5	BDL	BDL	BDL	190	178	133
08.04.2008	149.1	53.7	7.7	9.9	BDL	BDL	BDL	203	188	139
10.04.2008	112.2	40.4	7.6	8.9	BDL	BDL	BDL	161	153	116
15.04.2008	97.1	35.0	8.1	11.1	BDL	BDL	BDL	182	164	128
17.04.2008	149.5	53.8	8.3	9.8	BDL	BDL	BDL	191	182	136
22.04.2008	106.5	38.3	9.1	8.5	BDL	BDL	BDL	211	199	146
24.04.2008	122.7	44.2	9.5	10.8	BDL	BDL	BDL	166	160	121
29.04.2008	131.9	47.5	10.3	11.5	BDL	BDL	BDL	188	177	132
01.05.2008	145.6	52.4	9.7	8.7	BDL	BDL	BDL	227	223	165
06.05.2008	97.7	35.2	8.6	12.5	BDL	BDL	BDL	161	142	117
08.05.2008	105.6	38.9	9.3	8.8	BDL	BDL	BDL	201	185	137
13.05.2008	142.2	51.2	8.9	8.6	BDL	BDL	BDL	217	203	148
15.05.2008	148.5	32.2	8.4	11.3	BDL	BDL	BDL	179	162	126
20.05.2008	135.8	48.9	8.5	7.5	BDL	BDL	BDL	191	179	133
22.05.2008	133.1	47.9	10.4	10.0	BDL	BDL	BDL	144	135	124
27.05.2008	99.8	35.9	7.8	11.2	BDL	BDL	BDL	163	159	118
29.05.2008	151.7	54.6	10.5	12.4	BDL	BDL	BDL	224	213	152
Maximum	**151.7**	**54.6**	**10.7**	**12.8**	BDL	BDL	BDL	**235**		
Minimum	**97.1**	**32.2**	**7.5**	**7.5**	BDL	BDL	BDL	**115**		
Average	**122.3**	**43.3**	**9.0**	**10.2**	BDL	BDL	BDL	**168**		
98th %ile	**150.6**	**54.2**	**10.6**	**12.7**	BDL	BDL	BDL	**226**		

All units are in µg/m^3

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

Moblie Locations - SUMMER RD MINES										
Date	TSPM ug/m³	RPM ug/m³	SO_2 ug/m³	NOx ug/m³	LEAD ug/m³	ZINC ug/m³	CD ug/m³	CO		
								I	II	III
Larapacha										
13.01.2007	166.2	56.3	10.7	12.2	0.16	0.21	BDL	293	262	235
17.01.2008	96.3	28.4	8.5	11.5	0.22	0.15	BDL	272	243	222
21.02.2008	156.3	54.4	9.5	6.6	0.19	0.31	BDL	264	232	212
Maximum	**166.2**	**56.3**	**10.7**	**12.2**	**0.22**	**0.31**	BDL	**293**		
Minimum	**96.3**	**28.4**	**8.5**	**6.6**	**0.16**	**0.15**	BDL	**212**		
Average	**130.5**	**47.7**	**9.4**	**10.9**	**0.18**	**0.19**	BDL	**248**		
98th %le	**186.5**	**66.7**	**11.8**	**14.2**	**0.23**	**0.30**	BDL	**290**		
Anjana										
13.01.2007	122.3	58.2	11.2	10.3	0.12	0.13	BDL	246	265	255
17.01.2008	179.2	35.3	10.2	12.8	0.19	0.22	BDL	239	246	255
21.02.2008	169.2	49.6	9.6	11.3	0.14	0.16	BDL	235	281	253
Maximum	**179.2**	**58.2**	**11.2**	**12.8**	**0.19**	**0.22**	BDL	**281**		
Minimum	**122.3**	**35.3**	**9.6**	**10.3**	**0.12**	**0.13**	BDL	**235**		
Average	**129.9**	**47.7**	**10.3**	**11.5**	**0.18**	**0.21**	BDL	**253**		
98th %le	**175.9**	**57.9**	**11.2**	**12.7**	**0.23**	**0.31**	BDL	**278**		
Mahenduriya										
13.01.2007	157.2	58.3	9.6	13.7	BDL	BDL	BDL	295	224	259
17.01.2008	113.5	55.2	7.8	10.5	BDL	BDL	BDL	272	245	252
21.02.2008	149.3	34.8	11.6	11.5	BDL	BDL	BDL	252	254	249
Maximum	**157.2**	**58.3**	**11.6**	**13.7**	BDL	BDL	BDL	**295**		
Minimum	**113.5**	**34.8**	**7.8**	**10.5**	BDL	BDL	BDL	**224**		
Average	**129.5**	**47.1**	**9.4**	**11.0**	BDL	BDL	BDL	**256**		
98th %le	**185.5**	**66.4**	**11.9**	**14.2**	BDL	BDL	BDL	**291**		
Bera ka Khera										
13.01.2007	152.1	59.6	9.3	12.6	BDL	BDL	BDL	243	215	251
17.01.2008	142.3	46.2	8.9	11.5	BDL	BDL	BDL	238	242	241
21.02.2008	118.4	36.2	7.4	10.2	BDL	BDL	BDL	232	289	231
Maximum	**152.1**	**59.6**	**9.3**	**12.6**	BDL	BDL	BDL	**289**		
Minimum	**118.4**	**36.2**	**7.4**	**10.2**	BDL	BDL	BDL	**215**		
Average	**129.8**	**47.1**	**9.4**	**11.0**	BDL	BDL	BDL	**242**		
98th %le	**184.5**	**65.3**	**11.9**	**14.2**	BDL	BDL	BDL	**283**		
Kotari										
13.01.2007	172.3	63.6	9.1	13.1	0.26	0.36	BDL	264	238	259
17.01.2008	109.6	73.6	8.2	14.1	0.17	0.19	BDL	254	315	254
21.02.2008	165.8	33.8	12.1	11.4	0.16	0.18	BDL	223	289	259
Maximum	**172.3**	**73.6**	**12.1**	**14.1**	**0.26**	**0.36**	BDL	**315**		
Minimum	**109.6**	**33.8**	**8.2**	**11.4**	**0.16**	**0.18**	BDL	**223**		
Average	**130.5**	**47.2**	**9.5**	**11.0**	**0.18**	**0.22**	BDL	**262**		
98th %le	**182.5**	**64.4**	**12.0**	**14.2**	**0.25**	**0.34**	BDL	**311**		
Pipawas										
13.01.2007	142.6	63.5	9.5	13.5	0.23	0.32	BDL	253	217	262
17.01.2008	113.2	37.6	7.9	10.8	0.13	0.14	BDL	241	308	256
21.02.2008	136.3	57.6	9.3	12.1	0.15	0.16	BDL	243	284	249
Maximum	**142.6**	**63.5**	**9.5**	**13.5**	**0.23**	**0.32**	BDL	**308**		
Minimum	**113.2**	**37.6**	**7.9**	**10.8**	**0.13**	**0.14**	BDL	**217**		
Average	**130.6**	**47.4**	**9.5**	**11.0**	**0.19**	**0.23**	BDL	**257**		
98th %le	**181.2**	**64.4**	**12.1**	**14.2**	**0.26**	**0.36**	BDL	**304**		

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

POST MONSOON 2008										
AAQ-1: Mine lease area										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
01.10.2008	100.5	26.1	10.1	9.2	BDL	0.16	BDL	153	141	128
03.10.2008	150.6	47.7	11.2	10.3	0.10	0.10	BDL	275	266	263
08.10.2008	95.3	24.7	10.3	13.4	0.11	0.19	BDL	150	136	133
10.10.2008	113.9	29.5	10.9	9.3	BDL	0.14	BDL	232	204	175
15.10.2008	106.8	27.7	7.4	10.6	0.12	0.16	BDL	227	196	171
17.10.2008	117.7	30.5	11.9	8.8	0.12	0.12	BDL	154	145	135
22.10.2008	102.1	26.4	8.1	10.9	BDL	0.10	BDL	198	219	235
24.10.2008	108.9	28.2	9.5	12.6	0.14	0.16	BDL	234	215	190
29.10.2008	124.9	46.3	10.8	9.6	0.12	0.14	BDL	254	232	207
31.10.2008	115.1	29.8	7.9	11.3	BDL	0.12	BDL	279	266	262
05.11.2008	97.5	25.3	10.4	12.5	BDL	0.20	BDL	272	265	254
07.11.2008	121.4	31.4	7.4	10.9	0.12	0.16	BDL	149	128	123
12.11.2008	106.5	27.6	8.7	10.2	0.11	0.10	BDL	309	301	278
14.11.2008	95.6	24.7	9.8	11.6	BDL	0.16	BDL	151	140	136
19.11.2008	100.5	44.2	10.2	11.0	BDL	0.16	BDL	181	164	164
21.11.2008	135.2	35.3	10.7	11.6	0.14	0.18	BDL	216	190	169
26.11.2008	88.3	28.3	9.3	11.3	BDL	BDL	BDL	193	178	151
28.11.2008	138.9	36.7	9.2	12.3	BDL	0.12	BDL	204	176	169
Maximum	**150.6**	**47.7**	**11.9**	**13.4**	**0.14**	**0.20**	**BDL**	**309**		
Minimum	**88.3**	**24.7**	**7.4**	**8.8**	**BDL**	**BDL**	**BDL**	**123**		
Average	**112.2**	**31.7**	**9.7**	**11.0**	**0.12**	**0.15**	**BDL**	**199**		
98th %le	**146.6**	**47.2**	**11.7**	**13.1**	**0.14**	**0.20**	**BDL**	**300**		
All units are in $\mu g/m^3$										
AAQ-2: Rajpura										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
01.10.2008	93.7	26.9	8.6	8.7	BDL	BDL	BDL	199	188	120
03.10.2008	82.1	27.6	10.7	11.1	BDL	BDL	BDL	204	181	119
08.10.2008	86.5	22.5	11.2	8.9	BDL	BDL	BDL	192	172	116
10.10.2008	97.2	26.3	10.6	11.8	BDL	BDL	BDL	209	179	111
15.10.2008	97.6	24.6	10.5	12.3	BDL	BDL	BDL	205	178	105
17.10.2008	92.5	24.4	10.4	11.6	BDL	BDL	BDL	190	174	115
22.10.2008	62.5	24.6	9.4	12.1	BDL	BDL	BDL	202	166	114
24.10.2008	90.4	25.1	10.4	11.5	BDL	BDL	BDL	187	172	113
29.10.2008	93.5	24.8	10.9	8.6	BDL	BDL	BDL	193	163	112
31.10.2008	96.3	25.6	9.2	10.7	BDL	BDL	BDL	181	178	109
05.11.2008	90.7	21.6	11.4	11.4	BDL	BDL	BDL	174	164	104
07.11.2008	94.8	23.9	9.5	12.2	BDL	BDL	BDL	202	170	109
12.11.2008	87.8	27.7	11.1	8.6	BDL	BDL	BDL	158	148	98
14.11.2008	92.7	26.3	9.1	9.7	BDL	BDL	BDL	181	169	107
19.11.2008	88.5	22.3	10.8	10.5	BDL	BDL	BDL	174	155	107
21.11.2008	97.3	26.1	8.8	11.2	BDL	BDL	BDL	200	166	106
26.11.2008	95.5	23.3	10.3	12.0	BDL	BDL	BDL	177	160	106
28.11.2008	94.3	27.7	9.7	12.5	BDL	BDL	BDL	201	173	105
Maximum	**97.6**	**27.7**	**11.4**	**12.5**	**BDL**	**BDL**	**BDL**	**209**		
Minimum	**62.5**	**21.6**	**8.6**	**8.6**	**BDL**	**BDL**	**BDL**	**98**		
Average	**90.8**	**25.1**	**10.1**	**10.9**	**BDL**	**BDL**	**BDL**	**157**		
98th %le	**97.5**	**27.7**	**11.3**	**12.4**	**BDL**	**BDL**	**BDL**	**205**		

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-3: Makhanpuriya

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
01.10.2008	69.4	24.9	7.3	12.9	BDL	BDL	BDL	248	175	160
03.10.2008	86.7	31.1	10.6	9.6	BDL	BDL	BDL	177	123	114
08.10.2008	93.1	33.3	10.1	8.4	BDL	BDL	BDL	205	142	132
10.10.2008	70.1	25.1	7.1	12.1	BDL	BDL	BDL	184	134	103
15.10.2008	100.2	35.9	11.1	9.2	BDL	BDL	BDL	203	130	100
17.10.2008	74.8	27.3	8.8	10.7	BDL	BDL	BDL	216	139	109
22.10.2008	65.7	23.7	9.3	11.4	BDL	BDL	BDL	193	125	116
24.10.2008	93.8	33.6	7.7	12.7	BDL	BDL	BDL	205	144	108
29.10.2008	71.6	25.7	11.5	8.2	BDL	BDL	BDL	215	135	114
31.10.2008	83.1	29.8	9.8	9.2	BDL	BDL	BDL	225	166	145
05.11.2008	89.4	32.3	8.7	12.8	BDL	BDL	BDL	187	141	109
07.11.2008	98.8	35.4	7.6	8.5	BDL	BDL	BDL	243	177	111
12.11.2008	63.8	22.9	9.5	12.4	BDL	BDL	BDL	211	151	117
14.11.2008	105.9	25.8	10.2	11.8	BDL	BDL	BDL	159	125	102
19.11.2008	99.8	35.8	7.7	8.3	BDL	BDL	BDL	230	173	146
21.11.2008	66.8	23.9	11.2	13.1	BDL	BDL	BDL	173	113	105
26.11.2008	71.1	37.5	7.6	9.1	BDL	BDL	BDL	233	173	137
28.11.2008	96.9	34.7	8.2	9.4	BDL	BDL	BDL	201	130	110
Maximum	**105.9**	**37.5**	**11.5**	**13.1**	**BDL**	**BDL**	**BDL**	**248**		
Minimum	**63.8**	**22.9**	**7.1**	**8.2**	**BDL**	**BDL**	**BDL**	**100**		
Average	**83.4**	**29.9**	**9.1**	**10.5**	**BDL**	**BDL**	**BDL**	**156**		
98th %ile	**104.0**	**36.9**	**11.4**	**13.0**	**BDL**	**BDL**	**BDL**	**242**		

All units are in $\mu g/m^3$

AAQ-4: Sunariya Khera

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
01.10.2008	58.2	20.4	10.3	8.6	BDL	BDL	BDL	176	158	134
03.10.2008	64.8	22.7	10.7	8.3	BDL	BDL	BDL	174	151	145
08.10.2008	77.1	27.7	7.5	12.7	BDL	BDL	BDL	200	156	127
10.10.2008	70.1	24.6	8.6	10.2	BDL	BDL	BDL	186	147	130
15.10.2008	68.3	25.8	9.5	11.6	BDL	BDL	BDL	206	155	115
17.10.2008	78.8	34.6	10.1	12.2	BDL	BDL	BDL	172	153	114
22.10.2008	70.4	24.6	11.6	9.6	BDL	BDL	BDL	185	142	109
24.10.2008	99.8	34.9	10.5	12.8	BDL	BDL	BDL	179	146	113
29.10.2008	87.9	30.9	7.1	12.2	BDL	BDL	BDL	207	173	153
31.10.2008	89.7	31.2	7.6	12.3	BDL	BDL	BDL	206	152	124
05.11.2008	93.5	32.7	9.5	11.5	BDL	BDL	BDL	205	165	144
07.11.2008	97.1	32.6	9.4	9.7	BDL	BDL	BDL	165	144	111
12.11.2008	90.5	31.9	10.2	11.3	BDL	BDL	BDL	219	151	135
14.11.2008	92.2	32.3	10.7	10.8	BDL	BDL	BDL	200	158	122
19.11.2008	87.7	30.7	8.6	10.4	BDL	BDL	BDL	200	150	134
21.11.2008	97.7	32.1	7.8	10.7	BDL	BDL	BDL	199	184	122
26.11.2008	91.5	23.7	6.8	9.8	BDL	BDL	BDL	197	149	139
28.11.2008	78.8	27.6	7.4	11.1	BDL	BDL	BDL	193	153	125
Maximum	**99.8**	**34.9**	**11.6**	**12.8**	**BDL**	**BDL**	**BDL**	**219**		
Minimum	**58.2**	**20.4**	**6.8**	**8.3**	**BDL**	**BDL**	**BDL**	**109**		
Average	**83.0**	**28.9**	**9.1**	**10.9**	**BDL**	**BDL**	**BDL**	**158**		
98th %ile	**99.1**	**34.8**	**11.3**	**12.8**	**BDL**	**BDL**	**BDL**	**206**		

All units are in $\mu g/m^3$

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-5: Chothpura

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
01.10.2008	84.3	27.8	7.3	13.3	BDL	BDL	BDL	223	180	169
03.10.2008	82.7	27.4	8.6	7.1	BDL	BDL	BDL	212	177	137
08.10.2008	108.7	34.3	7.5	12.6	BDL	BDL	BDL	184	158	116
10.10.2008	76.3	25.1	11.6	7.4	BDL	BDL	BDL	199	149	124
15.10.2008	79.7	26.7	8.5	12.8	BDL	BDL	BDL	205	148	122
17.10.2008	56.8	26.9	7.7	8.6	BDL	BDL	BDL	181	148	120
22.10.2008	63.8	18.1	8.0	8.3	BDL	BDL	BDL	180	146	118
24.10.2008	80.4	26.5	8.5	8.9	BDL	BDL	BDL	171	143	115
29.10.2008	85.6	35.3	10.4	9.2	BDL	BDL	BDL	204	171	109
31.10.2008	83.9	34.7	11.8	11.3	BDL	BDL	BDL	203	158	136
05.11.2008	82.3	27.2	10.6	11.8	BDL	BDL	BDL	215	158	135
07.11.2008	77.1	25.5	10.1	7.9	BDL	BDL	BDL	202	183	134
12.11.2008	79.5	26.3	10.2	11.5	BDL	BDL	BDL	198	155	133
14.11.2008	110.7	27.7	9.5	12.1	BDL	BDL	BDL	195	153	133
19.11.2008	80.7	26.8	9.7	8.6	BDL	BDL	BDL	192	152	130
21.11.2008	83.4	34.5	11.9	10.1	BDL	BDL	BDL	183	151	129
26.11.2008	87.6	28.9	8.6	9.4	BDL	BDL	BDL	190	158	125
28.11.2008	87.1	28.8	8.7	10.4	BDL	BDL	BDL	188	151	132
Maximum	**110.7**	**35.3**	**11.9**	**13.3**	**BDL**	**BDL**	**BDL**	**223**		
Minimum	**56.8**	**18.1**	**7.3**	**7.1**	**BDL**	**BDL**	**BDL**	**109**		
Average	**82.8**	**28.2**	**9.4**	**10.1**	**BDL**	**BDL**	**BDL**	**161**		
98th %le	**110.0**	**35.1**	**11.8**	**13.1**	**BDL**	**BDL**	**BDL**	**215**		

All units are in $\mu g/m^3$

AAQ-6:East of ML area

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
01.10.2008	134.5	41.9	10.6	9.2	BDL	0.11	BDL	186	159	148
03.10.2008	114.3	40.1	9.9	11.8	BDL	0.10	BDL	246	172	162
08.10.2008	112.8	38.9	10.4	8.9	BDL	0.10	BDL	160	155	160
10.10.2008	121.5	37.4	8.8	11.6	0.10	0.11	BDL	230	167	159
15.10.2008	107.7	40.2	7.8	9.1	0.11	0.13	BDL	200	165	145
17.10.2008	112.9	29.7	7.6	9.9	BDL	0.10	BDL	258	176	165
22.10.2008	114.2	39.3	8.2	10.5	BDL	0.12	BDL	202	174	134
24.10.2008	117.4	25.1	8.3	10.8	BDL	BDL	BDL	188	180	162
29.10.2008	120.2	36.8	8.9	10.6	BDL	0.10	BDL	277	199	191
31.10.2008	108.4	40.9	8.7	10.7	BDL	0.11	BDL	209	188	186
05.11.2008	109.1	38.6	9.2	11.9	BDL	0.12	BDL	263	209	185
07.11.2008	111.2	39.4	8.6	12.2	BDL	0.11	BDL	173	172	160
12.11.2008	111.1	31.8	9.5	11.6	BDL	0.10	BDL	200	169	139
14.11.2008	115.2	41.8	9.9	11.1	BDL	BDL	BDL	277	197	153
19.11.2008	111.4	40.9	10.5	10.8	0.11	0.11	BDL	193	177	169
21.11.2008	74.1	26.7	7.9	11.5	BDL	BDL	BDL	193	169	120
26.11.2008	120.6	46.6	10.7	10.9	0.10	0.11	BDL	204	169	149
28.11.2008	107.9	45.3	10.1	9.7	BDL	0.14	BDL	221	163	158
Maximum	**134.5**	**46.6**	**10.7**	**12.2**	**0.11**	**0.14**	**BDL**	**277**		
Minimum	**74.1**	**25.1**	**7.6**	**8.9**	**BDL**	**BDL**	**BDL**	**120**		
Average	**112.5**	**37.8**	**9.2**	**10.7**	**0.11**	**0.11**	**BDL**	**183**		
98th %le	**130.1**	**46.1**	**10.7**	**12.1**	**0.11**	**0.14**	**BDL**	**276**		

All units are in $\mu g/m^3$

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-7:Lunera

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
01.10.2008	66.9	22.1	6.9	8.6	BDL	BDL	BDL	214	197	181
03.10.2008	67.5	22.3	7.7	8.5	BDL	BDL	BDL	227	194	179
08.10.2008	63.8	21.1	8.3	12.7	BDL	BDL	BDL	211	193	178
10.10.2008	67.4	32.1	9.6	8.6	BDL	BDL	BDL	218	192	177
15.10.2008	69.9	23.3	10.1	10.2	BDL	BDL	BDL	209	190	174
17.10.2008	86.5	28.6	10.2	11.8	BDL	BDL	BDL	216	183	173
22.10.2008	78.8	26.7	10.6	12.8	BDL	BDL	BDL	205	181	170
24.10.2008	89.3	34.1	11.1	12.9	BDL	BDL	BDL	202	177	164
29.10.2008	86.5	35.5	7.7	11.6	BDL	BDL	BDL	221	167	153
31.10.2008	94.4	34.6	7.1	12.3	BDL	BDL	BDL	193	158	130
05.11.2008	95.7	31.6	8.6	11.3	BDL	BDL	BDL	200	151	118
07.11.2008	88.8	29.1	7.6	12.1	BDL	BDL	BDL	185	148	106
12.11.2008	94.2	31.1	8.9	10.3	BDL	BDL	BDL	170	116	102
14.11.2008	96.9	32.3	6.9	10.7	BDL	BDL	BDL	130	108	102
19.11.2008	78.5	32.8	10.3	11.3	BDL	BDL	BDL	226	219	207
21.11.2008	83.9	27.7	9.5	12.4	BDL	BDL	BDL	202	179	139
26.11.2008	88.1	29.1	9.5	11.2	BDL	BDL	BDL	221	218	202
28.11.2008	95.3	33.7	10.4	12.5	BDL	BDL	BDL	225	214	197
Maximum	**96.9**	**35.5**	**11.1**	**12.9**	**BDL**	**BDL**	**BDL**	**227**		
Minimum	**63.8**	**21.1**	**6.9**	**8.5**	**BDL**	**BDL**	**BDL**	**102**		
Average	**82.9**	**29.3**	**8.9**	**11.2**	**BDL**	**BDL**	**BDL**	**180**		
98th %ile	**96.5**	**35.2**	**10.9**	**12.8**	**BDL**	**BDL**	**BDL**	**226**		

All units are in µg/m³

AAQ-8: Chawandiya

Dates	TSPM	RPM	SO_2	NOx	LEAD	ZINC	CADMIUM	CO		
								I	II	III
01.10.2008	118.9	40.3	9.8	8.4	BDL	BDL	BDL	181	155	116
03.10.2008	96.7	30.9	11.3	10.8	BDL	BDL	BDL	186	169	115
08.10.2008	92.8	31.9	7.7	9.5	BDL	BDL	BDL	176	144	101
10.10.2008	89.8	28.8	8.3	10.2	BDL	BDL	BDL	193	157	109
15.10.2008	92.5	29.6	8.5	11.3	BDL	BDL	BDL	172	141	130
17.10.2008	93.2	32.1	9.4	12.1	BDL	BDL	BDL	197	155	106
22.10.2008	68.8	22.1	10.3	10.1	BDL	BDL	BDL	167	147	104
24.10.2008	75.9	24.3	11.3	12.5	BDL	BDL	BDL	172	153	113
29.10.2008	80.7	25.8	10.5	11.1	BDL	BDL	BDL	165	144	97
31.10.2008	88.3	27.7	9.5	8.5	BDL	BDL	BDL	220	198	137
05.11.2008	109.3	32.8	11.1	10.6	BDL	BDL	BDL	193	177	130
07.11.2008	58.7	20.8	8.8	12.4	BDL	BDL	BDL	205	190	130
12.11.2008	86.7	27.6	8.9	10.5	BDL	BDL	BDL	187	172	129
14.11.2008	93.4	29.9	10.2	12.2	BDL	BDL	BDL	179	165	127
19.11.2008	94.3	32.4	11.3	11.5	BDL	BDL	BDL	193	169	123
21.11.2008	103.9	33.5	10.4	12.4	BDL	BDL	BDL	186	167	121
26.11.2008	86.3	27.6	10.7	11.6	BDL	BDL	BDL	204	158	118
28.11.2008	84.4	37.5	9.2	9.5	BDL	BDL	BDL	183	165	118
Maximum	**118.9**	**40.3**	**11.3**	**12.5**	**BDL**	**BDL**	**BDL**	**220**		
Minimum	**58.7**	**20.8**	**7.7**	**8.4**	**BDL**	**BDL**	**BDL**	**97**		
Average	**89.7**	**29.8**	**9.8**	**10.8**	**BDL**	**BDL**	**BDL**	**156**		
98th %ile	**115.6**	**39.3**	**11.3**	**12.5**	**BDL**	**BDL**	**BDL**	**205**		

All units are in µg/m³

ANNEXURE-IV
AMBIENT AIR QUALITY LEVELS

AAQ-9: Chhapari										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
01.10.2008	71.8	23.7	11.5	8.7	BDL	BDL	BDL	235	153	144
03.10.2008	120.8	41.1	8.3	7.7	BDL	BDL	BDL	244	158	147
08.10.2008	73.0	24.1	7.9	8.9	BDL	BDL	BDL	222	172	146
10.10.2008	116.6	22.8	11.1	12.1	BDL	BDL	BDL	242	158	145
15.10.2008	75.2	24.8	10.7	10.2	BDL	BDL	BDL	207	157	137
17.10.2008	70.8	23.4	9.5	11.9	BDL	BDL	BDL	235	190	144
22.10.2008	67.6	22.3	11.2	11.2	BDL	BDL	BDL	240	155	143
24.10.2008	109.6	20.4	9.2	9.9	BDL	BDL	BDL	216	148	132
29.10.2008	64.8	21.4	10.4	11.5	BDL	BDL	BDL	230	183	130
31.10.2008	71.6	33.5	9.6	12.2	BDL	BDL	BDL	216	146	129
05.11.2008	74.7	24.6	10.9	11.6	BDL	BDL	BDL	222	195	128
07.11.2008	76.6	39.3	11.3	10.4	BDL	BDL	BDL	207	188	120
12.11.2008	78.8	26.0	8.9	9.7	BDL	BDL	BDL	231	151	136
14.11.2008	69.5	22.8	11.7	11.4	BDL	BDL	BDL	229	200	135
19.11.2008	65.7	21.7	10.6	9.8	BDL	BDL	BDL	224	151	121
21.11.2008	64.5	19.9	9.7	11.8	BDL	BDL	BDL	221	171	142
26.11.2008	67.4	22.3	11.4	12.6	BDL	BDL	BDL	229	150	133
28.11.2008	71.7	37.7	10.8	10.6	BDL	BDL	BDL	218	142	127
Maximum	**120.8**	**41.1**	**11.7**	**12.6**	**BDL**	**BDL**	**BDL**	**244**		
Minimum	**64.5**	**19.9**	**7.9**	**7.7**	**BDL**	**BDL**	**BDL**	**120**		
Average	**78.4**	**26.2**	**10.3**	**10.7**	**BDL**	**BDL**	**BDL**	**175**		
98th %le	**119.3**	**40.5**	**11.6**	**12.4**	**BDL**	**BDL**	**BDL**	**242**		
units are in $\mu g/m^3$										

AAQ-10: Gawardi										
Dates	**TSPM**	**RPM**	**SO_2**	**NOx**	**LEAD**	**ZINC**	**CADMIUM**	**CO**		
								I	II	III
01.10.2008	94.6	33.5	8.6	7.8	BDL	BDL	BDL	198	162	167
03.10.2008	84.4	25.5	7.5	8.6	BDL	BDL	BDL	186	174	162
08.10.2008	87.9	29.7	10.3	12.4	BDL	BDL	BDL	195	181	159
10.10.2008	88.3	32.3	9.2	11.3	BDL	BDL	BDL	208	172	157
15.10.2008	90.6	27.5	8.4	11.5	BDL	BDL	BDL	193	177	156
17.10.2008	88.7	26.7	10.5	10.4	BDL	BDL	BDL	188	158	127
22.10.2008	95.3	26.1	8.2	10.4	BDL	BDL	BDL	179	162	148
24.10.2008	92.8	25.8	7.8	10.6	BDL	BDL	BDL	190	174	141
29.10.2008	87.6	23.3	10.3	9.6	BDL	BDL	BDL	185	167	152
31.10.2008	92.7	33.6	9.6	11.4	BDL	BDL	BDL	191	172	151
05.11.2008	93.7	23.7	10.9	8.5	BDL	BDL	BDL	181	158	148
07.11.2008	72.9	24.1	10.1	8.6	BDL	BDL	BDL	188	170	148
12.11.2008	76.5	25.3	9.5	11.3	BDL	BDL	BDL	179	162	155
14.11.2008	71.3	23.5	10.4	12.1	BDL	BDL	BDL	185	166	146
19.11.2008	69.7	22.8	10.2	10.1	BDL	BDL	BDL	205	186	151
21.11.2008	75.3	24.7	10.7	9.5	BDL	BDL	BDL	184	158	142
26.11.2008	77.9	24.3	7.6	9.5	BDL	BDL	BDL	171	163	141
28.11.2008	68.8	22.7	7.7	10.7	BDL	BDL	BDL	192	160	139
Maximum	**95.3**	**33.6**	**10.9**	**12.4**	**BDL**	**BDL**	**BDL**	**208**		
Minimum	**68.8**	**22.7**	**7.5**	**7.8**	**BDL**	**BDL**	**BDL**	**127**		
Average	**83.8**	**26.4**	**9.3**	**10.2**	**BDL**	**BDL**	**BDL**	**169**		
98th %le	**95.1**	**33.6**	**10.8**	**12.3**	**BDL**	**BDL**	**BDL**	**205**		
All units are in $\mu g/m^3$										

Annexure-V

Ecological Details

ANNEXURE-V
ECOLOGICAL DETAILS

TABLE-1
LIST OF PLANT SPECIES RECORDED IN 10 KM RADIUS AROUND THE PROJECT SITE DURING THE STUDY PERIOD

Sr. No	Technical Name	Family	Local Name
I. Agricultural Crops			
1	*Hordium vulgare*	Poaceae	Jav
2	*Sorghum vulgare*	Poaceae	Jowar
3	*Triticum vulgare*	Poaceae	Gehun
4	*Zea mays*	Poaceae	Makka
5	*Oryza sativa*	Poaceae	Chaval
6	*Pennisetum typhoideum*	Poaceae	Bajra
II. Commercial Crops (including vegetables)			
7	*Abelomoschus indicus*	Malvaceae	Bhindi
8	*Allium cepa*	Liliaceae	Pyaas
9	*Allium sativum*	Liliaceae	Lassan
10	*Brassica oleracea var botrydis*	Cruciferae	Cauliflower
11	*Brassica oleracea* var capitata	Cruciferae	Cabbage
12	*Cajanus cajan*	Fabaceae	Dal
13	*Carica papaya*	Caricaceae	Papitha
14	*Catharanthes pusillus*	Compositae	Sankhupuli
15	*Cicer arietinum*	Fabaceae	Chana
16	*Citrus lemon*	Ruataceae	Nimbu
17	*Colacasia esculenta*	Areaceae	Arvi, Kachalu
18	*Coreandrum sativum*	Umbelliferae	Dhaniya
19	*Daucus carota*	Umbelliferae	Gajar
20	*Gossypium sp*	Malvaceae	Kapas
21	*Lycopersicum esculentus*	Solanaceae	Tamatar
22	*Mangifera indica*	Anacardiaceae	Aam
23	*Memordia charantia*	Cucurbitaceae	Bitter gouard
24	*Pisum sativum*	Fabaceae	Chanabatana
25	*Raphanus sativa*	Cruciferae	Muli
26	*Solanum tuberosum*	Solanaceae	Aalu
27	*Trichosanthes anguina*	Cucurbitaceae	Chachinda
III. Plantations			
28	*Acacia nilotica*	Mimosaceae	Babul
29	*Albizia lebbeck*	Mimosaceae	Siris
30	*Albizia odorattissima*	Mimosaceae	Kala siris
31	*Albizia procera*	Mimosaceae	Safed siris
32	*Azadirachta indica*	Meliaceae	Neem
33	*Bauhinia variegate*	Caesalpinaceae	Kachnar
34	*Bauhinia purpuria*	Caesalpinaceae	Khariwal
35	*Bambusa arundanaceae*	Poaceae	Bans
36	*Butea superba*	Caesalpinaceae	Palas
37	*Butea frondosa*	Caesalpinaceae	Palas
38	*Eucalyptus sp*	Myrtaceae	Neelagiri
39	*Delonix regia*	Caesalpinaceae	Gulmohar
IV. Natural Vegetation/Forest Type			
40	*Abutilon indicum*	Malvaceae	Kanghi
41	*Acacia fernacea*	Mimosaceae	Vilayati babul
42	*Acacia leucophloe*	Mimosaceae	Safed kikar
43	*Acacia Senegal*	Mimosaceae	Kumata
44	*Acanthospermum hispidum*	Compositae	-
45	*Achyranthes aspera*	Amaranthaceae	Latjira
46	*Aegle marmelos*	Rutaceae	Bel
47	*Aerva lanata*	Compositae	Dholimundi
48	*Agave wightii*	Agavaceae	Banskeora
49	*Ageratum conyzoides*	Compositae	Ghanera osadi
50	*Ailanthes excela*	Simaroubaceae	Maharuk
51	*Alangium salivus*	Alangiceae	Akola
52	*Aloe barbedensis*	Agavaceae	Ghee kunvar
53	*Alstonia scholaris*	Apocyanaceae	Chatian

ANNEXURE-V
ECOLOGICAL DETAILS

Sr. No	Technical Name	Family	Local Name
54	*Alternanthera sessilis*	Amaranthaceae	Kanchari
55	*Ammania baccafera*	Lytharaceae	Dadmari
56	*Anoegeissus pendula*	Combretaceae	Dhav
57	*Anogeissus latifolia*	Combretaceae	Dhawa
58	*Argemone mexicana*	Papevaraceae	Bharband
59	*Asparagaus racemosus*	Liliaceae	Nag-down
60	*Atalantia monophylla*	Rutaceae	Atavi-jambhira
61	*Barleria prionoites*	Acanthaceae	Jhintikhasareya
62	*Bidens biternata*	Compositae	Chaupatia
63	*Blepharis asperima*	Acanthaceae	Chaupatia
64	*Blepharis madaraspatens*	Acanthaceae	Chaupatia
65	*Blumea lacera*	Compositae	Kkaranda
66	*Boerheavia chinensis*	Nycataginaceae	Sant
67	*Boerheavia diffusa*	Nyctaginaceae	-
68	*Borreria hispida*	Rubiaceae	Guthari
69	*Borreria stricta*	Rubiaceae	-
70	*Caesalpina pulcherima*	Caesalpinaceae	Gulutora
71	*Calotropis gigantia*	Asclepiadaceae	Ak
72	*Calotropis procera*	Asclipiadaceae	Akada
73	*Canna indicda*	Cannaceae	sabbajaya
74	*Cannabis sativa*	Cannabinaceae	Bhang, ganja
75	*Canthium diddynum*	Rubiaceae	Arsul
76	*Capparis aphylla*	Capparidaceae	Karer
77	*Capparis deciduas*	Capparidaceae	Kabra
78	*Carissa carandus*	Apocyanaceae	Karaunda
79	*Casearia graveolens*	Samydiaceae	Kulkulta
80	*Cassia absus*	Caesalpinaceae	Chaksu
81	*Cassia auriculata*	Caesalpinaceae	Tarwar
82	*Cassia obtuse*	Caesalpinaceae	Dog senna
83	*Cassia occidentalis*	Caesalpinaceae	Kasondi
84	*Cassia pumella*	Caesalpinaceae	Sarmal
85	*Cestrum diurnum*	Rubiaceae	Day queen
86	*Cestrum noctrunum*	Rubiaceae	Rat-kirani
87	*Chrysanthemum sp*	Compositae	Guldaudi
88	*Cissus quadrangularis*	Vitaceae	Hadjora
89	*Citrus liminoites*	Rutaceae	Methanembu
90	*Citrus limon*	Rutaceae	Baranimbu
91	*Cleome gynandra*	Capparidaceae	Hulhul
92	*Cleome viscose*	Capparidaceae	Panwar
93	*Clitoria ternate*	Fabaceae	Aparaji
94	*Cocculus villosa*	Cucurbiataceae	Jamtikibel
95	*Cordia dichotoma*	Rubiaceae	Lasora, chota lasora
96	*Cordia myxa*	Rubiaceae	Dahipalas
97	*Cordia rothri*	Rubiaceae	-
98	*Crataeva adsoni*	Capparidaceae	Barnabilisi
99	*Crotalaria medicagenia*	Fabaceae	Gulabi
100	*Croton bonplandinum*	Amaryllidaceae	Croton
101	*Cuscuta reflexa*	Cuscutaceae	Akasbel
102	*Daemia extensa*	Fabaceae	Uttaranjutaka
103	*Datura alba*	Solanaceae	Datura
104	*Datura fastulosa*	Solanaceae	Sadadatura
105	*Datura metal*	Solanaceae	Datura
106	*Dendrophthe falcate*	Loranthaceae	Banda
107	*Desmodium triflorum*	Asclepiadaceae	Kudaliya
108	*Echinops echinatus*	Compositae	Gokru
109	*Eclipta alba*	Compositae	Bhangra, babri
110	*Eclipta prostrate*	Compositae	-
111	*Emilia lajerium*	Compositae	Hirankhuri
112	*Erythrina indica*	Papillionaceae	Madar
113	*Euphorbia geniculata*	Euphorbiaceae	Tredahra sehund
114	*Euphorbia hirta*	Euphorbiaceae	Dudhi
115	*Euphorbia hyperocifolia*	Euphorbiaceae	Hashkaradana

ANNEXURE-V
ECOLOGICAL DETAILS

Sr. No	Technical Name	Family	Local Name
116	*Euphorbia nerifolia*	Euphorbiaceae	-
117	*Euphorbia neruri*	Euphorbiaceae	Potatanokesad
118	*Euphorbia nivula*	Euphorbiaceae	Katathohar
119	*Euphorbia piluliflora*	Euphorbiaceae	-
120	*Euphorbia thymiflora*	Euphorbiaceae	Choti-dhudhi
121	*Euphorbia tricauli*	Euphorbiaceae	Kompal sehund
122	*Evolvulus alsinoides*	Convolvulaceae	Shyamakantha
123	*Evolvulus numalaris*	Convolvulaceae	-
124	*Feronia elephantum*	Rutaceae	Bilin
125	*Ficus benghalensis*	Moraceae	Bar
126	*Ficus carica*	Moraceae	Anjir
127	*Ficus glomerata*	Moraceae	Gular
128	*Ficus hispida*	Moraceae	Daduri
129	*Ficus racemosus*	Moraceae	Gular
130	*Ficus relisiosa*	Moraceae	Pipal
131	*Flacourtia indica*	Flacourtiaceae	Paniala
132	*Flacourtia latifolia*	Flacourtiaceae	Bilangra`
133	*Flacourtia Montana*	Flacourtiaceae	Pitpapra
134	*Fumaria indica*	Papillionaceae	-
135	*Gardenia lucida*	Rubiaceae	Dikamali
136	*Garuga pinnata*	Burseraceae	Kharpat
137	*Gmelina arborea*	Rubiaceae	Gambhar
138	*Gomphrena globosa*	Amaranthaceae	Globe amaranth
139	*Grewia hirta*	Tiliaceae	Kakarrundah
140	*Grewia salivifolia*	Tiliaceae	-
141	*Grewia subinaqualis*	Tiliaceae	Biul
142	*Haplanthus tentaculatus*	Acanthaceae	Kastula
143	*Haplanthus verticillatus*	Acanthaceae	-
144	*Helictris isora*	Rubiaceae	Marophali
145	*Heliotropium indicum*	Rubiaceae	Hattajuri
146	*Hibiscus gibbosa*	Malvaceae	Jasut
147	*Hibiscus micronthus*	Malvaceae	Chineserose
148	*Hibiscus ovalifolia*	Malvaceae	-
149	*Hibiscus rosa-cianensis*	Malvaceae	Jasut
150	*Hibsicus caesus*	Malvaceae	-
151	*Holostemma annularia*	Aslepiadaceae	Chhirvel
152	*Hygrophylla auriculata*	Acanthaceae	-
153	*Hyptis suavalens*	Labiatae	Vilayati tulasi
154	*Ichnocarpus frutens*	Poaceae	Kalidudhi
155	*Ipomea aquatica*	Convolvulaceae	Karmi
156	*Ipomea carnea*	Convolvulaceae	Railway creeper
157	*Ipomea coccinea*	Convolvulaceae	Bilaikand
158	*Ipomea tuba*	Convolvulaceae	Nakhari
159	*Ixora parviflora*	Rubiaceae	Kotagandhal
160	*Ixora singapuriens*	Rubiaceae	Ixora
161	*Jacarandra jacquimontii*	Bignoniaceae	Jacarandra
162	*Jasmimum arborens*	Oleaceae	Chameli
163	*Jatropha gossypifolia*	Euphorbiaceae	Bheerenda
164	*Justia simplex*	Acanthaceae	Udisanabhalu
165	*Justia diffusa*	Acanthaceae	-
166	*Justicia diffusa*	Acanthaceae	-
167	*Lannea asplenifolia*	Anacardiaceae	Jhingaram
168	*Lantana camara*	Verbinacaee	Lantana
169	*Lathyrus sativus*	Papillionaceae	Khesari
170	*Lawsonia inermis*	Lythraceae	Mehandi
171	*Lepidogathis cristata*	Acanthaceae	Bhaiterada
172	*Leptodenia pyrotechnica*	Asclepiadaceae	Dori
173	*Leptodenia reticulate*	Asclepiadaceae	Khimp
174	*Leucas aspera*	Labiatae	Chota halkulasa
175	*Leucas longifolia*	Labiatae	-
176	*Leucas stelligera*	Labiatae	
177	*Lophophora tridinatus*	Scrophulariaceae	-

ANNEXURE-V
ECOLOGICAL DETAILS

Sr. No	Technical Name	Family	Local Name
178	*Loranthus sp*	Loranthaceae	Loranthus
179	*Malvastrum coramandalicum*	Malvaceae	Nagkeshar
180	*Medicago aureus*	Papillionaceae	Wilayati gawath
181	*Medicago indica*	Papillionaceae	-
182	*Melia azadirachta*	Meliaceae	Bakain
183	*Michaelia champaca*	Annonaceae	Champaca
184	*Mimosa hamata*	Mimosaceae	Natchnapath
185	*Mollugo cerviana*	Aizoaceae	Ghimasak
186	*Mollugo hirta*	Aizoaceae	-
187	*Moringa oleifera*	Moringaceae	Munaga
188	*Morus alba*	Moraceae	Turti
189	*Mucuna prurita*	Papillionaceae	Kiwach
190	*Murraya exotica*	Rutaceae	Kamini,marchulo
191	*Murraya koenigii*	Rutaceae	Mitha neem
192	*Musa paradisica*	Musaceae	Kela
193	*Nerium indicum*	Apocyanaceae	Kaner
194	*Nicotiana plumbaginifolia*	Solanaceae	Tambaku
195	*Ocimum americanum*	Labiatae	Kala tulasi
196	*Ocimum basillum*	Labiatae	Babui tulasi
197	*Ocimum canum*	Labiatae	Ramtulasi
198	*Ocimum sanctum*	Labiatae	Tulsi
199	*Oldenlandia umbellate*	Convolvulaceae	Damanpapar
200	*Oldenlandia corymbosa*	Rubiaceae	Chirval
201	*Opuntia dillinii*	Opuntiaceae	Nagphana
202	*Panicum turgidum*	Poaceae	Munt, muruta grass
203	*Panicum maximus*	Poaceae	Guidnea grass
204	*Parkinsonia aculata*	Mimosaceae	Vilayati kikar
205	*Parthenium hysterophorus*	Compositae	Congress grass
206	*Paspalum strobilanthus*	Passifloraceae	Kodo,kodra
207	*Passiflora foetida*	Passifloraceae	passion flower
208	*Pavonia zeylanica*	Malvaceae	Sugandha-pala
209	*Peltophorum ferrusinum*	Caesalpinaceae	Copper pod
210	*Peristrophe bicalculata*	Acanthaceae	Atrilal
211	*Phoenix aculis*	Palmae	Khajur
212	*Phyllanthes nirurii*	Euphorbiaceae	Jaramla
213	*Phyllanthes emblica*	Euphorbiaceae	Amla
214	*Phyllanthes urinaria*	Euphorbiaceae	Lal bhui anaalah
215	*Physalis minima*	Solanaceae	Tulati pati
216	*Pithocolobium dulce*	Mimosaceae	Jangle jilebe
217	*Polyalthia longifolia*	Annonaceae	Asokam
218	*Polygala chinensis*	Polygalaceae	Meradu
219	*Pongamia pinnata*	Fabaceae	Karanj
220	*Prosopis cineraria*	Mimosaceae	Khejra
221	*Prosopis juliflora*	Mimosaceae	Kabuli kikar
222	*Psidium guava*	Myrtaceae	Amrud
223	*Rosa macrophyla*	Rosaceae	Ban-gulab
224	*Saccharum munja*	Poaceae	Pandi, paunda
225	*Sapindus emerginatus*	Sapindaceae	Rita
226	*Sida cordifolia*	Malvaceae	Kungyi
227	*Sida rhombifolia*	Malvaceae	Bhiunli
228	*Sida vernanicaefolia*	Malvaceae	Bananiyar
229	*Sesamum indicum*	Pedaliaceae	Til
230	*Solanum nigrum*	Solanaceae	Kakamachi
231	*Solanum suratensis*	Solanaceae	Kateli, katai,
232	*Solanum xanthocarpum*	Solanaceae	Ringani
233	*Sterculia villosa*	Tiliaceae	Udal, udar
234	*Sygygium cumini*	Myrtaceae	Jamun
235	*Tephrosia purpuria*	Fabaceae	Dhamasia
236	*Tinospora cordifolia*	Rhamnaceae	Amrita
237	*Tragus biflorus*	Poaceae	Kantigrass
238	*Trapa bispinosa*	Trapaceae	Shingada
239	*Trapa natans*	Trapaceae	Shingada

ANNEXURE-V
ECOLOGICAL DETAILS

Sr. No	Technical Name	Family	Local Name
240	*Tribulus terrestris*	Zygophyllaceae	Gokhru
241	*Tridax procumbens*	Compositae	Mexican daisy
242	*Tripogon jacquimontii*	Poaceae	--
243	*Triumferta pilosa*	Tiliaceae	Kura
244	*Vernonia cinera*	Compositae	Daudotpala
245	*Vicoa indica*	Compositae	Sona Sali
246	*Vitex Negundo*	Verbinaceae	Shambalu
247	*Wrightia tomentosa*	Apocyanaceae	Dudhi
248	*Xanthium strumarium*	Compositae	Banokra
249	*Yucca gloriosa*	Agavaceae	Agave
250	*Zizyphus jujube*	Rhamnaceae	Ban ber
251	*Zizyphus mauritiana*	Rhamanaceae	Ber
252	*Zizyphus nummalaris*	Rhamnaceae	Jhahrber
253	*Zizyphus oenoplica*	Rhamnaceae	Makai
254	*Zornia gobbosa*	Compositae	Roonkari
V. Grasslands			
255	*Cenchurus ciliaris*	Poaceae	Anjan, dhaman
256	*Apluda mutica*	Poaceae	Ponai
257	*Chloris dolichosta*	Poaceae	Bamna
258	*Cyanodactylon sp*	Poaceae	Bermuda grass
259	*Dichanthium annulatum*	Poaceae	Jaunerea
260	*Inperata cylendrica*	Poaceae	Dharba, dabh
261	*Themeda quadrivalvis*	Poaceae	Kapur ghas
262	*Aristida adscensionsis*	Poaceae	Grass
263	*Cymbopogon jwarancusa*	Cyperaceae	Lamajjakka
264	*Cyperus aristatus*	Cyperaceae	Guinea rush
265	*Cyperus difformis*	Cyperaceae	Mutha, motha
266	*Cyperus rotundus*	Cyperaceae	Mutha, motha
267	*Cyperus triceps*	Cyperaceae	Nirbisi
268	*Eragrostis diahena*	Poaceae	Grass
269	*Eragrostis tenella*	Poaceae	Bharbhuri
270	*Ichnocarpus frutenscens*	Poaceae	Kalidudhi
VI.	**Endemic Species**	**No endemic species recorded/reported as per Botanical survey of India records**	
VII.	**Endangered Species**	**No endangered species reported/recorded as per Botanical survey of India records**	

TABLE-2
LIST OF PLANT SPECIES RECORDED IN MINE LEASE AREA

Sr. No	Technical Name	Family	Local Name
I. Agricultural Crops			
1	*Hordium vulgare*	Poaceae	Jav
2	*Sorghum vulgare*	Poaceae	Jowar
3	*Zea mays*	Poaceae	Makka
II. Commercial Crops (including vegetables)			
III. Plantations			
4	*Acacia nilotica*	Mimosaceae	Babul
5	*Albizia lebbeck*	Mimosaceae	Siris
6	*Albizia odorattissima*	Mimosaceae	Kala siris
7	*Albizia procera*	Mimosaceae	Safed siris
8	*Azadirachta indica*	Meliaceae	Neem
9	*Bauhinia variegate*	Caesalpinaceae	Kachnar
10	*Eucalyptus sp*	Myrtaceae	Neelagiri
IV. Natural Vegetation/Forest Type			
11	*Acacia leucophloe*	Mimosaceae	Safed kikar
12	*Acacia Senegal*	Mimosaceae	Kumata
13	*Achyranthes aspera*	Amaranthaceae	Latjira
14	*Aegle marmelos*	Rutaceae	Bel
15	*Aerva lanata*	Compositae	Dholimundi
16	*Agave wightii*	Agavaceae	Banskeora

ANNEXURE-V
ECOLOGICAL DETAILS

Sr. No	Technical Name	Family	Local Name
17	*Ageratum conyzoides*	Compositae	Ghanera osadi
18	*Ailanthes excela*	Simaroubaceae	Maharuk
19	*Aloe barbedensis*	Agavaceae	Ghee kunvar
20	*Anoegeissus pendula*	Combretaceae	Dhav
21	*Anogeissus latifolia*	Combretaceae	Dhawa
22	*Argemone mexicana*	Papevaraceae	Bharband
23	*Asparagaus racemosus*	Liliaceae	Nag-down
24	*Atalantia monophylla*	Rutaceae	Atavi-jambhira
25	*Barleria prionoites*	Acanthaceae	Jhintikhasareya
26	*Blepharis madaraspatens*	Acanthaceae	Chaupatia
27	*Blumea lacera*	Compositae	Kkaranda
28	*Boerheavia chinensis*	Nycataginaceae	Sant
29	*Boerheavia diffusa*	Nyctaginaceae	-
30	*Borreria hispida*	Rubiaceae	Guthari
31	*Borreria stricta*	Rubiaceae	-
32	*Caesalpina pulcherima*	Caesalpinaceae	Gulutora
33	*Calotropis gigantia*	Asclepiadaceae	Ak
34	*Calotropis procera*	Asclipiadaceae	Akada
35	*Canna indicda*	Cannaceae	sabbajaya
36	*Cannabis sativa*	Cannabinaceae	Bhang, ganja
37	*Canthium diddynum*	Rubiaceae	Arsul
38	*Capparis aphylla*	Capparidaceae	Karer
39	*Capparis deciduas*	Capparidaceae	Kabra
40	*Carissa carandus*	Apocyanaceae	Karaunda
41	*Cassia auriculata*	Caesalpinaceae	Tarwar
42	*Cassia obtuse*	Caesalpinaceae	Dog senna
43	*Cassia occidentalis*	Caesalpinaceae	Kasondi
44	*Cassia pumella*	Caesalpinaceae	Sarmal
45	*Cassia tora*	Caesalpinaceae	Chakunda
46	*Cayratia terifolia*	Vitaceae	Amal-bel
47	*Citrus liminoites*	Rutaceae	Methanembu
48	*Citrus limon*	Rutaceae	Baranimbu
49	*Cleome gynandra*	Capparidaceae	Hulhul
50	*Cleome viscose*	Capparidaceae	Panwar
51	*Clitoria ternate*	Fabaceae	Aparaji
52	*Commelina benghalensis*	Commelinaceae	Kanchara
53	*Cratàeva adsoni*	Capparidaceae	Barnabilisi
54	*Crotalaria burhia*	Fabaceae	Ghagari
55	*Crotalaria medicagenia*	Fabaceae	Gulabi
56	*Croton bonplandinum*	Amaryllidaceae	Croton
57	*Cryptostegia grandiflora*	Orchidaceae	Vilayati vakhandi
58	*Cuscuta reflexa*	Cuscutaceae	Akasbel
59	*Daemia extensa*	Fabaceae	Uttaranjutaka
60	*Dalbergia paniculata*	Fabaceae	Shisham
61	*Datura alba*	Solanaceae	Datura
62	*Datura fastulosa*	Solanaceae	Sadadatura
63	*Datura metal*	Solanaceae	Datura
64	*Euphorbia piluliflora*	Euphorbiaceae	-
65	*Euphorbia thymiflora*	Euphorbiaceae	Choti-dhudhi
66	*Euphorbia tricauli*	Euphorbiaceae	Kompal sehund
67	*Evolvulus numalaris*	Convolvulaceae	-
68	*Feronia elephantum*	Rutaceae	Bilin
69	*Ficus carica*	Moraceae	Anjir
70	*Ficus glomerata*	Moraceae	Gular
71	*Ficus hispida*	Moraceae	Daduri
72	*Flacourtia Montana*	Flacourtiaceae	Pitpapra
73	*Fumaria indica*	Papillionaceae	-
74	*Haplanthus tentaculatus*	Acanthaceae	Kastula
75	*Haplanthus verticillatus*	Acanthaceae	-
76	*Helictris isora*	Rubiaceae	Marophali
77	*Ipomea tuba*	Convolvulaceae	Nakhari
78	*Ixora parviflora*	Rubiaceae	Kotagandhal

ANNEXURE-V
ECOLOGICAL DETAILS

Sr. No	Technical Name	Family	Local Name
79	*Ixora singapuriens*	Rubiaceae	Ixora
80	*Jatropha gossypifolia*	Euphorbiaceae	Bheerenda
81	*Justia simplex*	Acanthaceae	Udisanabhalu
82	*Justia diffusa*	Acanthaceae	-
83	*Justicia diffusa*	Acanthaceae	-
84	*Lantana camara*	Verbinacaee	Lantana
85	*Leucas aspera*	Labiatae	Chota halkulasa
86	*Leucas longifolia*	Labiatae	-
87	*Ocimum americanum*	Labiatae	Kala tulasi
88	*Ocimum basillum*	Labiatae	Babui tulasi
89	*Ocimum canum*	Labiatae	Ramtulasi
90	*Ocimum sanctum*	Labiatae	Tulsi
91	*Opuntia dillinii*	Opuntiaceae	Nagphana
92	*Opuntia elator*	Cacataceae	Nagphana
93	*Panicum turgidum*	Poaceae	Munt, muruta grass
94	*Parkinsonia aculata*	Mimosaceae	Vilayati kikar
95	*Parthenium hysterophorus*	Compositae	Congress grass
96	*Phoenix aculis*	Palmae	Khajur
97	*Phyllanthes nirurii*	Euphorbiaceae	Jaramla
98	*Phyllanthes emblica*	Euphorbiaceae	Amla
99	*Phyllanthes urinaria*	Euphorbiaceae	Lal bhui anaalah
100	*Physalis minima*	Solanaceae	Tulati pati
101	*Pithocolobium dulce*	Mimosaceae	Jangle jilebe
102	*Prosopis cineraria*	Mimosaceae	Khejra
103	*Prosopis juliflora*	Mimosaceae	Kabuli kikar
104	*Sida cordifolia*	Malvaceae	Kungyi
105	*Sida rhombifolia*	Malvaceae	Bhiunli
106	*Sida vernanicaefolia*	Malvaceae	Bananiyar
107	*Tephrosia purpuria*	Fabaceae	Dhamasia
108	*Tinospora cordifolia*	Rhamnaceae	Amrita
109	*Tridax procumbens*	Compositae	Mexican daisy
110	*Wrightia tomentosa*	Apocyanaceae	Dudhi
111	*Xanthium strumarium*	Compositae	Banokra
112	*Yucca gloriosa*	Agavaceae	Agave
113	*Zizyphus jujube*	Rhamnaceae	Ban ber
114	*Zornia gobbosa*	Compositae	Roonkari
V. Grasslands			
115	*Cenchurus ciliaris*	Poaceae	Anjan, dhaman
116	*Apluda mutica*	Poaceae	Ponai
117	*Chloris dolichosta*	Poaceae	Bamna
118	*Aristida adscensionsis*	Poaceae	Grass
119	*Cyperus elsinoides*	Cyperaceae	-
120	*Cyperus triceps*	Cyperaceae	Nirbisi
121	*Eragrostis tenella*	Poaceae	Bharbhuri
VII.	**Endangered Species**	**No endangered species reported/recorded as per Botanical survey of India records**	

TABLE-3
LIST OF ANINALS RECORDED IN MINE LEASE AREA

Technical Name	English Name	Distribution	Conservation status as per Wild Life protection Act (1972)
Aves			
Acridotheres tristicus	Common myna	Observed	Sch-IV
Alcedo athis	Common kingfisher	Observed	Sch-IV
Anas acuta	Common Teal	Rare	Sch-IV
Ardeola grayii	Pond Heron	Common	Sch-IV
Caprimulgus asiaticus	Common Indian jar	Observed	Sch-IV
Centropus sinensis	Crow Pheasant	Observed	Sch-IV

ANNEXURE-V
ECOLOGICAL DETAILS

Technical Name	English Name	Distribution	Conservation status as per Wild Life protection Act (1972)
Cinnyris lotensis	Loten's sunbird	Observed	Sch-IV
Columbus livibus	Rock Pigeon	Observed	Sch-IV
Coracias benghalensis	Indian Roller	Observed	Sch-IV
Corvus splendens	House Crow	Observed	Sch-IV
Egretta garzetta	Little Egret	Common	Sch-IV
Haliastur Indus	Brahmny kite	Observed	Sch-IV
Hierococys varius	Common Hawk Cuckoo	Observed	Sch-IV
Lalage sykesi	Black Headed cocoo	Observed	Sch-IV
Megalaima merulinus	Indian Cuckoo	Observed	Sch-IV
Meops phillipinus phillipinus	Blue tailed bee eater	Rare	Sch-IV
Merops leschenaultia	Chestnut headed Bee Eater	Observed	Sch-IV
Microfus affinis	House swift	Observed	Sch-IV
Nectarinia asiatica	Purple sunbird	Observed	Sch-IV
Passer domisticus	House Sparrow	Observed	Sch-IV
Ploceus philippines	Weaver bird	Observed	Sch-IV
Pycnonotus jokokus	White browed Bulbul	Observed	Sch- IV
Temenuchus pagodarum	Brahmny Myna	Observed	Sch- IV
Turdoides striatus	White headed Babler	Observed	Sch- IV
Nectarinia asiatica	Purple sunbird	Observed	Sch- IV
Reptiles			
Calotes versicolor	Common garden lizard	Rare	Sch-IV
Chamaleon zeylanicus (Laurenti)	Indian chamaeleon	Common, villages	Sch-IV
Bangarus spp.	Krait	Rare, plantations	Sch-IV
Naja naja	Indian cobra	Rare	Sch-IV
Vipera spp.	Russels viper	Rare	Sch-IV
Butterflies			
Triodes minos	Southern Birwing	Common	Sch-IV
Pachliopta hector	Crimson rose	Common	Sch-IV
Papilo demoleus	Lime butterfly	Common	Sch-IV
Graphium agamemnos	Tailed jay	Common	Sch-IV
Papilo polymnstor	Blue mormon	Common	Sch-IV
Junonia atlites	Grey pansey	Common	Sch-IV
Juninia almana	Peacock pansey	Occasional	Sch-IV
Neptis hylas	Common sailor	Common	Sch-IV
Parantica aglea	Glassy tiger	Common	Sch-IV
Mammals			
Lepus nigricollis	Hare	common	Sch-III
Hyaena hyaena	Hyaena	Rare	Sch-III
Canis auries	Jackal	Occassional	Sch-III
Funambulus spp.	Squirrel	Common	Sch-IV
Sus sucrofa	Wild pig	Occassional	Sch-III
Herpestes edwardii	Common mongoose	Occassional	Part-II of Ch-II
Bandicota indica	Bandicoot	Common	Sch-IV
Bandicota bengalensis	Bandicoot	Common	Sch-IV
Vulpus benghalensis	Wildfox	Occassional	Sch-III
Bosephalus tragocamelus	Blue bull or Nilgai	Rare	Sch-III

ANNEXURE-V
ECOLOGICAL DETAILS

COPY OF DISTRICT FOREST OFFICER LETTER

कार्यालय उप वन संरक्षक, राजसमंद

क्रमांकः पत्रा ( ) सर्वे/उवसं/2008–09/ 8667 दिनांकः– 11-12-08

प्रेषिति :–

महाप्रबन्धक,
हिन्दुस्तान जिंक लिमिटेड,
राजपुरा– दरीबा माईन्स,
राजसमंद (राज0)

विषय :– खनन पट्टा सं. एम.एल. 2/89 (राजपुरा दरीबा लेड– जिंक माइन) के 10 किमी परिधि के क्षेत्र में अनारक्षित वन क्षेत्र का प्रमाण पत्र/ देने के संबंध में।

प्रसंग :– आपका पत्रांक मप्र (राद) 84 (3) / दिनांक 04.11.08 के कममें।

महोदय,

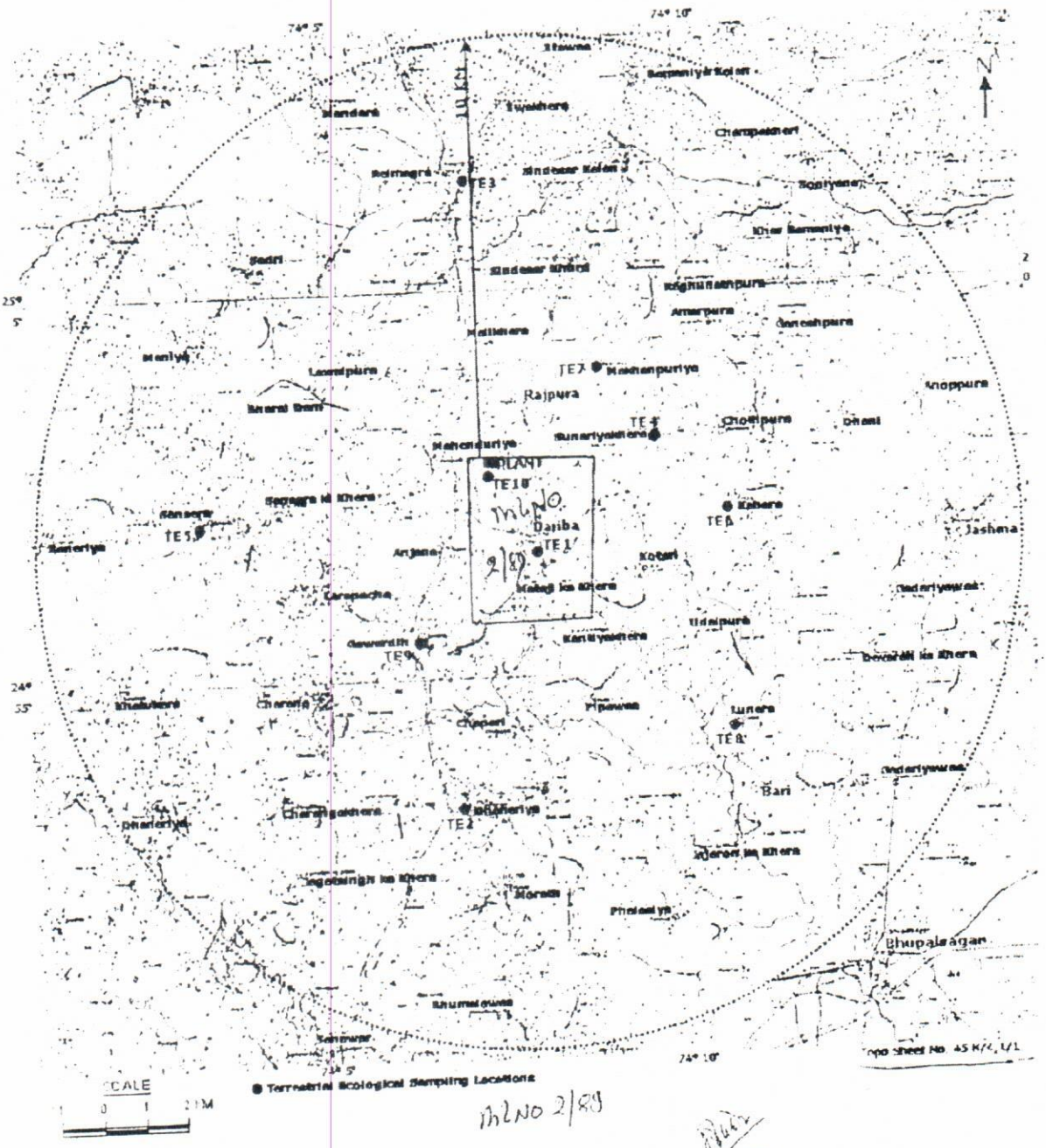
उपर्युक्त विषयान्तर्गत प्रासगिक पत्र के संलग्नक जी.टी.शीट नं. 45 K/4, L/1 पर मार्क खनन क्षेत्र (ML No 2/89 राजपुरा दरीबा लेंड– जिंक माइन) तह0 रेलमगरा, जिला राजसमंद के 10 किमी की परिधि में इस वन मण्डल अधीन घोषित वन क्षेत्र नहीं है।

भ व दी य

संलग्नक :– उपरोक्तानुसार जी.टी.शीट नक्शा

उप वन संरक्षक
राजसमंद

ANNEXURE-V
ECOLOGICAL DETAILS



m/NO 2/80

उप [illegible] अधिकारी
राजसमन्द

ANNEXURE-V

ECOLOGICAL DETAILS

कार्यालय उप वन संरक्षक राजसमन्द (राज.)

क्रमांक एफ (1) उ.व.स./फैना/फ्लोरा/उवस/09/ 2110 दिनांक 24-3-09

यूनिट हेड
हिन्दुस्तान जिंक लि०
राजपुरा दरीबा माईन्स
जिला - राजसमन्द (राज.)

विषय:- m.l.No 2/89 राजपुरा दरीबा माईन्स के 10km की परिधी में प्रमुखतया पाये जाने वाले फैना एवं फ्लोरा के सम्बन्ध में.

सन्दर्भ:- आपका पत्रांक RDM/Env/2009/ दिनांक 11/3/09 के क्रम में.

महोदय,

उपरोक्त विषयान्तर्गत सन्दर्भित पत्र से चाही गयी सूचना प्रधान मुख्य वन संरक्षक, वन्य जीव एवं वन बन्दोबस्त राज. जयपुर के पत्र क्रमांक 2961-73 दिनांक 17/12/98 के संलग्नक प्राप्त कार्य-आयोजना पुस्तिका में वर्णित फैना/फ्लोरा की प्रमाणित सूची पत्र के संलग्नक भिजवाई जा रही है.

संलग्न- उपरोक्तानुसार

भवदीय

उप वन संरक्षक
राजसमन्द

1.	2.	3.
तुषार अभिलेख	814	496
आरक्षित क्षेत्रों की पंजिका	815	496
अधिकारों एवं सुविधाओं की पंजिका	816	496
वन उपज की पंजिका	817	496

अध्याय-21

भावी आय व्यय का अनुमान एवं कार्य आयोजना पर व्यय

सामान्य विवरण	818-821	497-499
विगत प्राप्तियां	822	499
विगत राजस्व एवं व्यय के आंकड़े	823	499
भावी अनुमानित राजस्व	824	500
भावी अनुमानित व्यय	825	501
कार्य आयोजना पर व्यय	826	501

अध्याय-22

निर्देशों एवं सुझावों का सारांश	-	502-507

ANNEXURE-V
ECOLOGICAL DETAILS

(एक)

जिले में सामान्यत: पाये जाने वाले पेड़ पौधों की सूची

नाम	अन्तर्राष्ट्रीय लेटिन नाम हिन्दी में	अन्तर्राष्ट्रीय लेटिन नाम अंग्रेजी में	कुल
	2.	3.	4.
	पिलींगटोनिया होरटेनसिस	Pilingtonia hortensis Linn.	Bignoniceae.
	बुखानानिया लांजन	Buchanania Lanzan Spreng	Anacardiaceae.
	मोरिन्डाटिंक्टोरिया	Morinda tinctoria Roxb.	Rubiaceae.
	मेन्जिफेरा इन्डिका	Mangifera indica Linn.	Anacardiace.
	एलान्जियम सालवीफोलियम	Alangium salvifolium Linn.	Cornaceae
...न, बरडाक	कैसिया फिस्टुला	Cassia fistula Linn.	Caesalpindaceae.
	हार्डविकिया बाइनाटा	Hardwickia binata Cor.	Leguminosae.
	एम्बलिका आफिसिनेलिस	Emblica officinalis Gaerth.	Euphorbiaceae
	एलेन्थस एक्सेल्सा	Allanthus excelsa Roxb.	Simarubaceae
	सेपिन्डस इमारजिनेटस	Sapindus emarginatus Valh.	Sapindaceae.
...ड	रीसिनस कोमुनिस	Ricinus communis Linn.	Euphorbiaceae.
...सापाला, अशोक	पोलीएलथिया लांगीफोलिया	Polyalthia longifolia Hook.F.	Anonaceae.
...क चन्दन	पुत्रन्जीवा राक्सीबरगाई	Putranjiva roxiburghii wall	
अरनी	क्लेरोडेन्ड्रोन वित्कोसम	Clerodendron viscosum Roxb.	Verbinaceae
अप्टा	बहुनिया मालाबेरिका	Bauhinia malabarica Roxb.	Rubiaceae
एन्डरोक	एनोगाईसस लेटेरिफा	Anogeissus sericea Stapf.	Combretaceae
इमली	टेमरिन्डस इन्डिका	Tamarindus indica Linn.	Leguminosae

T. C.

1-	2-	3-	4-
इन्दोक	स्टागाईसिस एक्यूमिनेटा	Anogeissus acuminata	Combretaceae.
कचनार	बोहिनिया वेरिगेटा	Bauhinia variegata Idnn.	Leguminosae
कदम	एन्थोसेफेलस इन्डिकस	Anthocephalus indicus	Rubiaceae
कदम	मित्रागाइना पूर्वीफ्लोरा	Mitragyna Parvifolia(Roxb.)	Rubiaceae
कहडा	टीमीनेलिया अर्जुना	Terminalia arjuna Wall.	Combretaceae
कड़वाता	होलारिना एन्टीडाइसेन्ट्रिका	Holorrhina antidysenterica Wall	Apocynaceae
करंज	पोनगैमिया पिन्नाटा	Pongamia Pinnata (Linn.)Plesse	Lequmineceae.
कत्थी, धौक	स्टोगाईसिस पेन्डुला	Anogeissus Pendula Edgew.	Combretaceae.
काकोन	फ्लेकोरशिया इन्डिका	Flacourtia Indica(Burm.f.) Mirr.	Bixaceae.
कैथ	फेरोनिया लिमोनिया	Feronia limonia Swingle(Linn.)	Lythraceae
कलसाडरिया	लेगर स्ट्रोमिया पारवीफ्लोरा	Lagerstroemia Parviflora Roxb.	Lythraceae
कलझाड़िया	ब्राइडेलिया रेटुसा	Bridelia retusa Spreng.	Euphorbiaceae
कपासिया, पुला	कीडिया केलीसिना	Kydia calicyna Roxb.	Malvaceae.
कड़ाया	स्टेरकुलिया यूरेन्स	Sterculia urens Roxb.	Sterculiaceae
करी, जीम्बया	मिलिउसा टोमेन्टोसा	Miliusa tomentosa Roxb.	Anonaceae.
कठुम्बर	फाइकस हिसपिडा	Ficus hispida Linn.	Moraceae
केर	केपेरिस डेसिडुआ	Capparis decidua Forsk.	Capparidaceae
ककेड़ा	मइटेनस इमारजिनेटा	Maytenus erergi-nata Willd.	Celastraceae
कामिनी, कुन्ती	मुराया पेनिकुलेटा	Murraya paniculata Linn.	Rutaceae

1-	2-	3-	4-
	कैसिया स्यामिया	Cassia siamea Linn.	Leguminoesae
	अकेसिया सेनेगल	Acacia senegal	Mimoseae
	श्लाइचेरा ओलिओसा	Schleichera oleosa (Lour) Oken	Sapindaceae
	एकेशिया फेरुजिनाई	Acacia ferruginea	
	अलबीजिया ओडोरेटिसिमा	Albiggia odoretissima Linn.	
	अकेसिया कटेचु	Acacia catechu Willd.	Leguminosae.
	फोइनिक्स सिलवेस्ट्रिस	Phoenix sylvestris Roxb.	Palmae
	अकेसिया ल्यूकोफ्लीया	Acacia leucophloea Wild.	Mimoseae
	प्रोसोपिस सीनेरेरिया	Prosopis cineraria	-"-
	राइटिया टोमेन्टोसा	Wrightia tomentosa Roemisen.	Apocynaceae
	राइटिया टिंक्टोरिया	Wrightia tinctoria R.Br.	-"-
सागवान	ऐरियोलिना हुकेरिना	Eriolaena hookeriana W & A	
	फाइकस ग्लोमेरेटा	Ficus glomerata Roxb.	Moraceae
गुलमोहर	डेलोनिक्स रीजिया	Delonix regia W & A.	Leguminosae
गोंदा खैर	डाइक्रोस्टेकिस सिनेरिया	Dichrostachys cineria W & A.	- " -
गुन्दा, लसोड़ा	कार्डिया डाइकोटोमा	Cordia dichotoma Forest	Boraginaceae.
गंधपलास	एरीथ्रिना इन्डिका	Erythrina indica Roxb.	Leguminosae
गुगल	कोमीफोरा मुकुल	Commiphora mukul	Burseraceae.

उप वन संरक्षक
राजसमन्द

1.	2.	3.	4.
गुर्जन	लेनिया कोरोमेनिडेलिका	Lannea coromandelica Merr.	Anacardiaceae
गुन्दी	कोर्डिया डाईकोटोमा	Cordia dichotoma Willd.	Boraginaceae.
गिरनार, जेंजना	कोक्लोस्पर्मम गोसीपियम	Cochlospermum gossypium Linn.	Bixaceae
घटबोर	जिजिफस जाइलोपायरा	Zizyphus xylopyra Willd.	Rhamnaceae.
छोला, दाक, पलास, खांखरा	ब्यूटिया मोनोस्पर्मा	Butea monosperma Lamk Taub.	Leguminosae.
धूरेत	होलोपटीलिया इन्टग्रीफोलिया	Holoptelica integrifolia Planch.	Ulmaceae.
चन्दन	सेन्टलम एलबम	Santlum album Linn.	Santalaceae.
चापेती, खंभा	बेहूनिया परपूरिया	Bauhinia purpuria Linn.	Leguminosae
चिकोन	डायोस्पाईरस मोन्टाना	Diospyros montana Roxb.	Ebenaceae
चिल्ला मुर्राल्यो	ओगिरीया इलिप्टिका	Casearia elliptica Willd.	Flacourtiaceae
चिरचा	अलबीजिया ओडोरेटिसिमा	Albissia odoratissima Linn.F.	Leguminosae
चमकारर	गारडीनिया टरगिडा	Gardenia turgida Roxb.	Rubiaceae.
जामुन	ताझमीनियम क्यूमिनी	Syzygium cumini Linn. Skeels	Myrtaceae
जालपीलू	सेल्वेडोरा ओलिओयडिस	Salvadora oleoides	Salvadoraceae.
जाल्डर	सेल्वेडोरा परसिका	Salvadora Persica	-"-
जामुन	यूजीनिया ओपरकुलेटा	Eugenia operculata Roxb	Myrtaceae.
जती	इलियोडेन्ड्रोन गलोकम	Elaeodendron glaucum	Celastraceae.

1.	2.	3.	4.
	पिथीकोलोबियम डलसी	Pithecolobium dulce Willd.	Leguminosae
	जेकेरन्डा माझोसीफोलिया	Jacaranda mimosaefolia Benth.	Bignoniaceae
	बोहनिया रेसीमोसा	Bauhinia racemosa Lamk.	Leguminosae.
	टैमरिक्स डायोका	Tamarix dioca Roxb.	Tamaricaceae
	एहरीशिया लेविस	Ehretia laevis Roxb.	Boraginaceae.
	डायोस्पायरस मेलेनोजाक्सीलोन	Diospyros melanoxylon Roxb.	Ebenaceae.
	ओजीनिया जीनेन्सिस	Eugenia cojenensis	Papillionaceae.
	टूना सिलियटा	Toona ciliata Roem.	Meliaceae
	राईटिया टिक्टोरिया	Wrightia tinctoria R.Br.	Apocynaceae
	ग्रिविया टिलीफोलिया	Grewia tiliaefolia Vahl.	Tiliaceae
	डेलबर्जिया पेनिकुलेटा	Dalbergia paniculata	Papilionaceae
	स्लोगाइसस लेटिफोलिया	Anogeissus latifolia Wall.	Combretaceae
	स्पाडिरेक्टा इन्डिका	Azadirachta indica Ajuss.	Combretaceae
	ओपेन्शिया डिलेनाइ	Opuntia dillenii	Cactaceae
	साइट्रस मेडिका	Citrus medica	Rutaceae
	स्टीरीओस्पर्मम सोवेवोलेन्स	Starenospermum suaveolens D.C.	Bignoniaceae
	फाइकस लेकोर	Ficus Boch Ham	Moraceae
	फाइकस स्पफाई	Ficus rumphii	Moraceae
	फाइकस रिलीजिओसे		

T.C.

उपवन संरक्षक
राजसमन्द
T.C.

1.	2.	3.	4.
बबूल	अकेशिया निलोटिका	Acacia nilotica (L) Willd.	Leguminoceae
बहेड़ा	टरमीनेलिया बेलेरिका	Terminalia bellerica (Gaertn) Roxb.	Combretaceae
बरगद, बड़	फाइक्स बेंगालेंसिस	Ficus bengalensis Linn.	Moraceae
बीजा	टेरोकारपस मारसुपियम	Pterocarpus marsupium (Roxb.)	Leguminoceae
बरना	क्रेटिवा रेलिजिओसा	Crateva religiosa Forst.	Capparidaceae
बेल, बीली	ईगल मारमेलोस	Aegle marmelos (Linn.) Correa	Rutaceae
बिलेन्दू	डायोस्पीयरस कार्डिफोलिया	Diospyros cardifolia Roxb.	Ebenaceae
बुरवान	पार्किनसोनिया एकुलियेटा	Parkinsonia aculeata	Caesalpinnaceae
महुआ	मधुका इंडिका	Madhuca indica Gmel.	Sapotaceae.
मीन्डला	डोलिकेन्ड्रोन फेलकेटा	Dolichandrone falcata Seem.	Bignoniaceae
मोरवा	ज़ेपेरा स्वीटेनॉयडिस	Schrebera swietenoides Roxb.	Oleaceae.
रेन[खिनी]	माइमुसोपस हेक्सेन्ड्रा	Mimusops hexandra (Roxb.)	Sapotaceae
रोझ	सोयामिडा फेब्रिफ्यूगा	Soymida febrifuga Juss.	Meliaceae.
रोहनी, रोली	मेलोटस फिलीपीनेसिस	Mallotus philippinensis Muell.	Euphorbiaceae
रोहेड़ा	टेकोमेला अन्डुलेटा	Tecomella undulata	Bignoniaceae
सादड़	टरमीनेलिया टोमेन्टोसा	Terminalia tomentosa W. & A.	Combretaceae
सागवान	टेक्टोना ग्रेन्डिस	Tectona grandis Linn.	Verbenaceae

T.C

उप वन संरक्षक
राजसमन्द

2.	3.	4.
बोसवेलिया सिर्रेटा	Boswellia serrata Roxb.	Burseraceae
डेलोनिक्स इलेटा	Delonix elata	Leguminosae
बोम्बेक्स सीबा	Bombax ceiba D.C.	Malvaceae
मोरिंगा कंकेनेसिस	Moringa concanensis	Moringaceae
मोरस अल्बा	Morus alba Linn.	Moraceae
अल्बीजिया प्रोसेरा	Albizzia procera Benth.	Leguminosae.
अल्बीजिया लेबेक	Albizzia lebbek	- " -
स्नोना स्क्वेमोसा	Anona squamosa Linn.	Anonaceae
डलबर्जिया सिस्सु	Dalbergia sissoo	Leguminosae
प्रोसोपिस ज्यूलीफ्लोरा	Prosopis juliflora	- " -
यूकेलिप्टस	Eucalyptus	Myrtaceae
अडाइना कार्डिफोलिया	Adina cordifolia	Rubiaceae
बेलेनाइटिस इजिप्टिका	Balanites aegyptica Delile.	Simarubiaceae
तिन्दुक	Diospyros tomentosa	Ebenaceae

1.	2.	3.	4.
		छ- छोटे वृक्ष एवं झाड़ी	
अनिया	क्लेरोडेन्ड्रोन विस्कोसम	Clerodendron visconsum	Verbenaceae
अडुता	एडाटोडा वेसिका	Adhatoda Vasica	Acanthaceae
अरकुआ	गाइनेन्ड्रोपसिस गाइनेन्ड्रा	Gynandropsis cyandra	Capridaceae
असगन्धा	विथेनिया सोमेनीफेरा	Withania somanifera Linn.	Rubiaceae
आधाशीशी	जैन्थियम स्ट्रूमेरियम	Xanthium strumarium Linn.	Compositae
आंकड़ा	केलोट्रोपिस प्रोसेरा	Calotropis procera R.Br.	Asclepiadaceae
आंकड़ा(सफेद)	केलोट्रोपिस गाइगेन्टिया	Calotropis gigantea	- " -
आंधी झाड़ा	एकीरेन्थस एस्पेरा	Achyranthes aspera Linn.	Amarantaceae
आंवला	कैसिया ओरीकुलेटा	Cassia auriculata	Caesalpiniaceae
इन्द्राइन	सिट्रुलस कोलोसाईन्थस	Citrullus colocynthis Linn.	Cucurbitaceae
इक्मा	इक्सोरा पारविफ्लोरा	Ixora parviflora Roxb.	Rubiaceae
जंटकेती	लेपिडेगेथिस ट्राईनरविस	Lepidagathis trinervis	Acanthaceae
जंयती	एजीरेटम कोनिजोयेडिस	Ageratum convzoides Linn.	Compositeae
सर-पटेरा	टाइफा	Typha	Typhaceae
काली खाली	ग्रिविया फ्लेवेसेन्स	Grewia flavescens Juss.	Tiliaceae
केलत्पारिया	सेक्यूरिनेगा ल्यूकोफाइरस	Securinega leucopyrus	Euphorbiaceae
कत्पारिया (जाल)	केपेरिस एपाइनोसा	Capparis spinosa Linn.	Capparidaceae
कंटेर	केपेरिस सेपेरिया	Capparis separia	-"-

2.	3.	4.
केपेरिस डेसिडुआ	Capparis decidua	Capparidaceae
कैरिसा स्पाइनेरम	Carissa spinarum	Apocynaceae
पेरीस्ट्रोफी बाइकेलकुलेटा	Peristrophe bicalaculata Nees.	Acanthaceae
नेलम्बो न्यूसीफेरा	Nelumbo nucifera	Gaertn.
नीरियम इन्डीकम	Nerium indicum	Mill
एकन्थोस्पर्मम् हीस्पीडम	Acanthospermum hispidum	Compositae
कैसिया आक्सीडेन्टेलिस	Cassia occidentallis Linn.	Leguminosae
मुसा पेराडिसका	Musa paradisca Linn.	Musaceae
पेन्डेनस ओडोरेटिसीमा	Pandnus odoratissima Linn.	Pandanaceae.
क्रोटोलेरिया बुरिया	Crololaria burbia Tucham	Leguminosae
अरजीनिया इण्डिका	Urginia indica Kunth	Liliaceae
कोरकोरस ट्राईलोकुलेरिस	Corchorus trilocularis Linn.	Tiliaceae
पेरीप्लोका अफाइला	Periploca aphylla	Asclepiadaceae
लेप्टाडीनिया पायरोटेकनिका	Leptadenia Pyrotechnica	- " -
डोडोनिया विस्कोसा	Dodonia viscosa Linn.	Sapindaceae
साईडा ओवेटा	Sida ovata Forst F.	Malvaceae
सेरीकोस्टोमा पोलीफ्लोरम	Sericostoma Pauciflorum	Stocks

T.C.

1.	2.	3.	4.
गोखरू	ट्रिब्युलस टेरेस्ट्रीस	Tribulus terrestris Linn.	Zygophyllaceae
गुडशारिया	ग्रिविया हिरसुटा	Grewia hirsuta	Tiliaceae
गंगोर	ग्रिविया टेनेक्स	Grewia tenax Fiori.	- " -
गुलचीन	प्लुमेरिया एक्टीफोलिया	Plumeria acutifolia	Foir
गुरशारिया	ग्रीविया हीरसुप्टा	Grewia hirsuta	Vabl.
गुगल	कोमीफोरा मुकुल	Commifora mukull (Arn)	Burseraceae
ग्वारपाठा	एलोय बारबेडेन्सिस	Aloe barbadensis	Hill
घिंडियों का धीनिया	मोलुगो सरवियना	Molluge cerviana	Aizoaceae
चित्राल	प्लमबेगो सेलानिका	Plumbago zeylanica Linn.	Plumbaginaceae
चाय कामड़ी	पेवोनिया इण्डिका	Pavonia indica Linn.	Malvaceae
चापरेन	ग्रीविया फ्लेवेसेन्स	Grewia flavescens	
चिरचिटा	फुपेलिया टोमेन्टोसा	Pupalia tomentosa Moq	Amrantaceae
जवासा	एल्हगी कमेलोरम	Alhagi camelorum	Papilionaceae
जंगली प्याजलाई	एमरेन्थस स्पाइनोसस	Amaranthus Spinosus Linn.	Amaryllidaceae
जंगली तिल	सेसमम इन्डीकम	Sesamum indicum Linn.	Scrophulariaceae
जार बेरी	जीजीफस फ्रुटीकोसा	Zizyphus fruticosa	Rhamnaceae
झाज	टेमेरिक्स डायओका	Tamarix dioica	Tamaricaceae
झर पत्ती	साईडा प्रजाति	Sida Spp.	Malvaceae

उप वन संरक्षक
राजसमन्द

3.	4.
लेन्टाना केमारा	Lantana camara Verbenaceae
टेफरोसिया परप्यूरिया	Tephrosia Purpurea
जिजीफस न्यूमुलेरिया	Zizyphus nummularia Rhamnaceae
इन्डीगोफेरा ओबलोंगीफोलिया	Indigofera oblongifolia Forsk Papilionaceae
माइमोसा रुबीकौलिस	Mimosa rubicaulis Linn. Mimoseae
निक्टेन्थस आरबोरेरिसटस	Nyctanthes arbertristis Linn.
रस माइसूरेनसिस	Rhus mysurensis Anacardiaceae
ग्रिविया विलोसा	Grewia villosa Tiliaceae
पेपावर सोम्नीफेरम	Papaver somniferum Papavaraceae
पेन्डलेन्डिया एक्वरटा	Pendlandia exerta Rubiaceae
ओसीमम सैंक्टम	Ocimum sanctum Labiatae
यूफोरबिया निवुलिया	Euphorbia nivulis Mimoseae
फेगोनिया क्रीटिका	Faconia cretica Zygophyllaceae
होलारिना एन्टीडाइसेन्टेरिका	Holorrhina antidysenterica Willd. Combretaceae
यूफोरबिया हर्टा	Euphorbia hirta Euphorbiaceae
यूफोरबिया ग्रेन्यूलेटा	Euphorbia granulata Forsk Eupherbiaceae
यूफोरबिया हाईपरसीफोलिया	Euphorbia hypercifolia Linn. - " -

Euphorbia nivulina

Euphorbia neriifolia

1.	2.	3.	4.
दूधी	यूफोरबिया प्रोस्टेटा	Euphorbia prostata Grah.	Euphorbiaceae
धतूरा	धतूरा मेटल	Datura metal Linn.	Solanaceae
धोलीचिरायता	डाइरोफाईलोन इण्डिका	Dyroplayton indica Gibbs.	Plumbaginaceae
धावडी झाडी	वुडफोर्डिया फ्लोरीबन्डा	Woodfordia Floribunda Salish syn. fruticosa	Lythraceae
धोली मूसली	कुरकुलिगो ओरची-ओइडस	Curculigo orchioides	Amaryllidaceae
नील	इन्डिगोफेरा टिंक्टोरिया	Indigofera tinctoria Linn.	Leguminosae
नेगड	वाइटेक्स निगन्डो	Vitex negundo Linn.	Verbenaceae
नागफनी थोर	ओपनशिया डेलीनाई	Opuntia dillenii Haw	Euphobiaceae
पंवारिया	केसिया टोरा	Cassia tora Linn.	Caesalpiniaceae
पीली कैती	बारलेरिया प्रायोपटस	Barleria prionitis	Acanthaceae
पीथारिया	एबुटीलोन रेमोसम	Abutilon ramosum	Malvaceae
बेंडल	जिम्नोस्पोरिया स्पाइनोसा	Gymnosporia spinosa (Forsk) Fl.	Celastraceae
बंडापास	थेस्पेसिया लेम्पास	Thespesia lampas Dalz. & Gibs.	Malvaceae
बोली	अकेशिया जेक्मोनशाई	Acacia jacquemontii	Mimosaceae
बापची	ओसीमम अमेरिकेनम	Ocimum americanum	Labiatae
बासूती	टेफ्रोसिया हुकरियाना	Tephrosia hookeriana	Papilionaceae

3.	4.
इन्डिगोफेरा कार्डिफोलिया	Indigofera cordifolia Heyne — Leguminosae
इन्डीगोफेरा लिनीफोलिया	Indigofera linifolia Retz. — - " -
इन्डीगोफेरा स्पाइकेपिस्टा	Indigofera spicabaptista — - " -
अरुआ स्यूडोटोमेन्टोसा	Aerua pseudotomentosa — Amarnthaceae
मार्टीनिया एनस	Martynia annua Linn. — Pedaliaceae
बारलेरिया प्रायोनाईटिस	Barleria prionitis Linn. — Acantiaceae
बारलेरिया क्रिस्टेटा	Barleria cristata Linn. — - " -
गोसिपियम वाईटीमम	Gossypium wightiamum — Malv & Gibs
ग्रीविया विलोसा	Grewia villosa Willd. — Tiliaceae
डेन्ड्रोकेलेमस स्ट्रीक्टस	Dendrocalamus strictus Nees. — Gra
कोमेलाईना बेंगालेन्सिस	Commelina benghalensis Linn. — Commelinaceae
क्रोटोलेरिया प्रजाति	Crotolaria — Leguminosae
एकेशिया जेक्मोनताई	Acacia jacquemontii — - " -
जेसमाईन सेमबेक	Jasminum Sambac Ait
आईपोमिया फीस्टुलोसा	Ipomoea fistulosa Mart — Convolvulaceae
केनाबिस सेटाईवा	Cannabis sativa Linn.

T.C.

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राजसमन्द

1.	2.	3.	4.
भृंगराज	एकलिप्टा इरेक्टा	Eclipta erecta Linn.	
मकोइ	जिजीफस रोनोप्लीया	Zizyphus connulia	Rhamnaceae
मकोय	सोलेनम नाइग्रम	Solanum nigrum	Solanaceae
मरोड़फली	हेलीक्टेरेस आइसोरा	Helicteres isora Linn.	Sterculiaceae
मेंहदी	लावसोनिया इनरमिस	Lawsonia inermis Linn.	Lythraceae
मोरली	साईलिस्थम युरोपियम	Lycium europaeum	Solanaceae
राम बांस	अगेव सिसलाना	Agave sisalana Pera	
राम बांस	अगेव अमेरीकाना	Agave americana Linn.	Amarylladaceae
रतनजोत	जेटरोफा करकस	Jatropha curcus	
रबर बेल	क्रीप्टोस्टीजिया ग्रान्डीफ्लोरा	Cryptostegia grandiflora	
वन अरहड़	फ्लेमिनिया सेमिअलाटा	Flemingia semialata Roxb.	Leguminosae
वन तुलसी	पोगोस्टीमोन बेंगलेनसिस	Pogostemon benghalensis (Burm.f)O.Ktze	Labiatae
शालपर्णी	डेसमोडियम जेंजीटीकम	Desmodium gangeticum	Leguminoseae
सत्यानती	आरजीमोन मेक्सीकाना	Argemone maxicana Linn.	Papavaraceae
तफेद, त्यानी हरितगार	निक्टे-थेस आर्बोट्रस्टस	Nyctanthes arbo-tristis Linn.	Oleaceae

उप वन संरक्षक
राजसमन्द

AV-21

3.	4.
सिनेगा	Securinega leucopyrus (Willd) Euphorbiaceae
ल्यूकोपाईरस	
डीमेरा मूरीकेटा	Dicera muricata Linn. Compositae
सीसस लोटोईडस	Cissus lotoides Linn Ficoidae
बोरेरीया स्ट्रीक्टा	Borraria stricta Linn.
क्रोटोलेरिया बरिया	Crotolaria burbia Benth Leguminosae
डेलोनिक्स अलाटा	Delonix alata Leguminosae
ट्रापा बाईस्पोईनोसा	Trapa bispinose Roxb. Onagraceae
अनोना स्क्वीमोसा	Anona squemose Linn. Annonaceae
आरटीमिसिया स्कोपेरिया	Artemesia scoparia Wolds. Compositae
आक्जेलिस कोरनीकुलेटा	Oxalis corniculata Linn. Oxaliolaceae

ग-अरोही क्षुप एवं लतायें

कुसकुटा रेफ्लेक्सा	Cuscuta reflexa Roxb.	Convrlulaceae
अकेशिया पिन्नाटा	Acacia pinnata Willd.	Leguminoseae
मुकुना प्रूरिटा	Mucuna prurita	- " -
केपरिटिया कारनोसा	Cayratia carnosa Gagnep.	Ampelidaceae
सीजलपीनीया सीपेरिया	Caesalpinia sepiaria	Leguminoseae

AV-19

1.	2.	3.	4.
कंकोड़ा	मोमोरडिका डायोका	Momordica dioica	Cucurbiteeae
गुडबेल	विसकम ओरियन्टेल	Viscum orientale Willd.	Loranthaceae
गेडालिंगी	क्रिप्टोलेपिस बुक्यानी	Cryptolepis buchananni Roem. & Sch.	Asclepiadaceae
जंगली तुरई	लुफा एक्यूटेन्गुला	Luffa acutangula	Cucurbiteeae
दूधी बेल {काली बेल}	इक्नोकारपस फ्रुटैसेन्स	Ichnocarpus frutescens (Linn) W.Br.	Apocynaceae
दूधनी	मिलिशिया अरीकुलेटा	Millettia auriculata Baker	Papilionaceae
दूधी	क्रीप्टोस्टीजिया ग्रान्डीफ्लोरा	Cryptostegia grandiflora Br.	Apocynaceae
दूधी बेल	वेलेरिस सोलोनेसिया	Vallaris solanacea	Apocynaceae
नाहरकांटा	एस्पेरागस डुमोसस	Asparagus dumosus Baker.	Liliaceae
नीमगीलोय	टीनोस्पोरा कारडीफोलिया	Tinospora cordifolia Miers.	Menispermaceae
पहाड़बेल	सीसाम्पेलोस परीरा	Cissampelos pareira	Menispermaceae
पलास बेल	ब्यूटिया पारवीफ्लोरा	Butea parviflora Roxb.	Leguminosae
बांदा	लोरेन्थस लोन्गीफ्लोरस	Loranthus Longiflorus	Loranthaceae
मालकांगनी	सिलेस्ट्रस पेनीकुलेटा	Celastrus paniculata Willd.	Celastraceae
रत्ती पिरमु	एब्रस प्रिकेटोरियस	Abrus precatorius Linn.	Paplionaceae
रीका बेल	एरिस्टोलोचिया ब्रेक्टिएटा	Aristolochia bracteata	Aristolochiaceae
	आईपोमिया पेन्टाफिल्ला	Ipomea pentaphylla	Conuoluaeeae
	कोनवोलुलस प्रजाति	Convolulus sps.	Conuolulaeeae

2.	3.	4.
घ- घास		
सेंक्रस सिलिएरिस	Cenchrus ciliaris Linn.	Poaceae
डाइकेन्थियम एनुलेटम	Dichanthium annulatum Staff	- " -
सेक्रम एपोनटेनियम	Saccharum apontaneum Linn.	- " -
वेटिवेरिया जिजेनीयोडिस	Vetiveria zizanioides Linn. Nash.	- " -
क्राइसोपोगोन ग्राइलस	Chrysopogon Gryllus (Linn.) Trin.	- " -
कोइक्स जाइजेन्शिया	Coix gigantea Koen ext. Roxb.	- " -
पेनिकम एन्टीडोटेल	Panicum antidotale Retz.	- " -
इम्पेरेटा सिलिन्ड्रिका	Imperta cylindrica Linn.	- " -
साइनोडोन डेक्टाइलोन	Cynodon dactylon Pers.	- " -
सेक्रम मून्जा	Saccharum munja (Roxb.)	- " -
एपलुडा म्युटिका	Apluda mutica Linn.	- " -
सोरगम हेलीपेन्स	Sorghum halepense Linn.	- " -
क्लोरिस डोलिकोस्टेकिस	Chloris dolichostachya Linn.	- " -
सेंक्रस बारबेटस	Cenchrus barbetus Schum.	- " -
हेटरोपोगान कटोरटस	Heteropogon contortus Linn.	- " - T.C.
इक्नोक्लोआ कोलोनम	Echinochloa colonum Linn.	- " -
सेहिमा नरवोसम	Sehima nervosum Staff.	- " -
थीमेडा क्वाड्रीवेलविस	Themeda quadrivalvis	- " -

1.	2.	3.	4.
रोसा	सिम्बोपोगान मारटिनाइ	Cybopogon martinii	Poacene
लापला	एरिस्टिडा डिप्रेसा	Aristida depressa Retz.	- " -

T.C.

उप वन संरक्षक
राजसमन्द

1.	2.	3.	4.

ड- - मुख्य-मुख्य औषधीय पौधा

विथेनिया सोम्नीफेरा	Withania somnifera	Solanaceae
हेमीडेसमस इन्डीकस	Hemidesmus indicus	Asclipidaceae
एन्ड्रोग्राफीस पेनीकुलेटा	Andrographis paniculata	Acanthaceae
कुरकुलिगो आरकीओइडस	Curculigo orchioides	Amaryllidaceae
प्लेमबेगो जाईलेनिका	Plumbago Zeylanica	Plumlagineceae
पाईस्टोमा तीनाईल	Pachystoma senile	Ordidaceae

च- - बांस

डेन्ड्रोकेलेमस स्ट्रिक्टस	Dendrocalamus strictus	Poacese
बेम्बुसा अरन्डीनेसिया	Bambusa arundinacea	- " -

छ- - परजीवी

क्सकुटा रिफ्लेक्सा	Cuscuta reflexa Roxb.	Convolvulaceae
लोरेनथस लोंगिफ्लोरस	Loranthus longi-florus Dvsc.	Loranthaceae

कार्य आयोजना क्षेत्र में आमतौर पाये जाने वाले पक्षियों की सूची

हिन्दी नाम	आम अंग्रेजी नाम	लेटिन नाम
1.	2.	3.
पनडुब्बी	Little Grebe	Podicaps ruficollis
पनकौवा	Little cormorant	Phalacrocorax niger
पनडुब्बी	Indian Darter	Ankinga rufa
धूसन	Grey heron	Ardea cinerea
धंधा बगला	Pond heron, Paddy bird	Ardeola grayii
सुरखिया बगला	Cattle Egret	Buculcus ibis
किलछिया	Little Egret	Egretta garzetta
कोकरी	Painted stork	Ibis leucocephalus
मानिक जोर	Whitenecked stork	Ciconia episcopus
चमचा	Spoonbill	Platales leucorodia
घुन्डा	White ibis	Threskiornis melanocephala
सीलही	Lesser whistling Teal	Dendrocygna javenica
चक्वा चक्वी	Rubby sheldrake	Tadorna ferruginea
सींख पर	Pintail	Anas acuta
छोटी मुरगाबी	Cotton Teal	A. Creoca
गर्म पाई	Spotbill	A. Poecilorhyncha
नकटा	Nukta	Sarkidiornis melanotes
बासी	Blackwinged kite	Elanus caeruleus
	Crested Honey Buzzard	Pernis ptilorhynchus
चील	Pariah kite	Milvus migrans
शिकरा	Shikara	Accipiter badius

2.	3.
White-eyed Buzzard	Butastur teesa
King vulture	Torgos calvus
White backed vulture	Gyps bengalensis
Tawny Eagle	Aquila rapax
White Scavanger Vulture	Neophron perenopterus
Kestrel	Falco tinnunculus
Black partridge	Francolinus francolinus
Rain Quail	Coturnix coromandelica
Jungle Bush Quail	Perdicula asiatica
India peafoul	Pav cristatus
Sarus crane	Grus antigone
White breasted water hen	Amaurornis phoenicurus
Moorhen	Gallinula chloropus
Purple Moorhen	Porphyria porphyris
Common Coot	Fulica atra
Pheasant-tailed Jacana	Hydrophasianus chirurgus
Red-wattled lapwing	Vanellus indicus
Yellow-wattled lapwing	V. malabaricus
Red shank	Tringa totanus
Wood sand piper	Tringa glareola
Common sundpiper	T.hypoleucos
Little stint	Calidris munuta

T.C.

उप [illegible]

राजसमन्द

1.	2.	3.
कातिया	Large Cuckoo Shrike	C.novaehollandiae
	Wood Shrike	Tephrodornis pondicerianus
रामगंगरा	Grey tit	Parus major
	Yellow checked tit	P.xanthogenys
पानी का पिलाकिया	Yellowheaded wagtail	Motacilla citreola
पिलाकिया	Grey wagtail	Motacilla caspica
धोबन	White wagtail	M. Alba
संवन	Large Pied wagtail	M.Maderaspatensis
शक्कर खोरा	Pruple sunbird	Nectarinia asistica
बहना	White Eye	Zosterops palpebrosa
गोरेया	House Sparrow	Passer domesticus
बया	Weaver Bird Red Avadavat	Ploceus philippinus
सर मुनिया	White throated Munia	Lonchura malabarica
पहार पिपिया	Crested Bunting	Melophus lathami

T.C.

उप वन संरक्षक
राजसमन्द

वन्यजीव संरक्षण हेतु में सामान्यतः पाये जाने वाले प्राणियों / स्तनि वर्गीय की सूची

स्थानीय नाम	अंग्रेजी नाम	लेटिन नाम
1.	2.	3.
बन्दर	Rhesus macaque Mondey	Macaca mulatta
लंगूर	Common Langur, Hanuman monkey	Presbytis entellus
बघेरा, तेंदुआ	Baghera	Panthera pardus
जंगली बिल्ली	Jungle cat	Felis chaus
नेवला	Common Mongoose	Herpestes edwardsi
सियार	Jackal	Canis aureus
लोमड़ी	Indian Fox	Vulpes bengalensis
भरख	Striped Hyaena	Hyaena hyaena
बिज्जू	Common Palm Civet	Paradoxarus hermaphoditus
उद बिलाव	Smooth Indian Otter	Lutra perspicillata
नील गाय	Blue bull	Boselaphus tragocamelus
चीतल	Spotted Dear	Axis axis
सांभर	Sambhar	Cervus unicolor
जंगली सूअर	Indian Wild Bear	Sus Seroja cristatus
गिलहरी	Five striped palm Squirrel	Funambulus pennanti
चूहा	Common House Rat Indian Field Mouse	Rattus rattus Mus booduga
सेही	Indian Hare	Lepus nigricollis
खरगोश	Indian Hare	Lepus nigricollis
छछुन्दर	Grey Musk Shrew	Suncus murinus

Annexure-VI

Landuse Pattern

ANNEXURE-VI
LANDUSE PATTERN

Sl.No.	Name of P.S. & District	Name of Village	Forest Land	Total Irrigated Land	Un-Irrigated Land	Cultivable Waste Land	Area not Available for Cultivation	Total Land
0-3 Km.	Railmagra							
1	(Rajasamand)	Makhanpuriya	0.00	47.00	59.00	20.00	14.00	140.00
2		Mahenduriya	0.00	45.00	318.00	165.00	148.00	676.00
3		Rajpura	0.00	23.00	304.00	166.00	77.00	570.00
4		Sunariya Khera	0.00	26.00	86.00	39.00	77.00	228.00
5		Kabra	0.00	52.00	291.00	143.00	133.00	619.00
6		Kotrii	0.00	146.00	867.00	262.00	51.00	1326.00
7		Udalpura	0.00	25.00	158.00	100.00	21.00	304.00
8		Peepawas	0.00	18.00	272.00	226.00	33.00	549.00
9		Katiya Khera	0.00	4.00	60.00	3.00	6.00	73.00
10		Mataji Ka Khera	0.00	35.00	62.00	12.00	16.00	125.00
11		Anjana	0.00	36.00	160.00	274.00	139.00	609.00
12		Gawaradi	0.00	141.00	377.00	295.00	128.00	941.00
13		Chhapri	0.00	15.00	154.00	177.00	141.00	487.00
14		Chawandiya	0.00	2.00	140.00	194.00	166.00	502.00
15	Kapasan	Manohar Kheri	0.00	29.20	60.92	77.93	24.81	192.86
16	(Chittaurgarh)	Chauthpura	0.00	28.24	299.06	256.45	65.83	649.58
17		Goojariya Khera	0.00	27.78	111.77	140.41	106.02	385.98
		Sub Total	**0.00**	**700.22**	**3779.75**	**2550.79**	**1346.66**	**8377.42**
3-7 Km.	Railmagra							
1	(Rajasamand)	Lathiya Kheri	0.00	155.00	5.00	28.00	83.00	271.00
2		Pachhmata	0.00	129.00	313.00	203.00	84.00	729.00
3		Khar Bamaniya	0.00	104.00	268.00	445.00	90.00	907.00
4		Ganeshpura	0.00	11.00	51.00	10.00	4.00	76.00
5		Sanwaliya Khera	0.00	17.00	38.00	10.00	10.52	75.52
6		Bakhatpura	0.00	17.00	34.00	75.00	18.00	144.00
7		Shivpura	0.00	33.00	92.00	109.00	39.00	273.00
8		Sindesarkhurd	0.00	47.00	216.00	363.00	178.00	804.00
9		Mali Khera	0.00	22.00	38.00	67.00	15.00	142.00
10		Sarwariya Kheri	0.00	41.00	83.00	130.00	12.00	266.00
11		Shoupura	0.00	9.00	69.00	32.00	19.58	129.58
12		Laxmipura	0.00	27.00	84.00	31.00	31.00	173.00
13		Bharai	0.00	54.00	216.00	158.00	294.82	722.82
14		Chhdanga Kheri	0.00	10.00	136.00	52.00	81.29	279.29
15		Jagatsingh Ji Ka Khera	0.00	0.00	48.00	34.00	32.01	114.01
16		Dhaneriya	0.00	26.00	554.00	314.00	226.00	1120.00
17		Chhdanga Ka Khera	0.00	5.00	111.00	110.00	48.03	274.03
18		Charana	0.00	37.00	553.00	501.01	335.00	1426.01
19		Ladpacha	0.00	63.00	284.00	401.00	189.00	937.00
20	Kapasan	Dhani	0.00	33.31	179.39	102.14	20.46	335.30
21	(Chittaurgarh)	Anoppura	0.00	70.01	278.55	207.94	44.01	600.51
22		Jashma	0.00	224.72	1130.38	1095.20	320.62	2770.92
23		Gadriyawas	0.00	16.93	92.30	67.87	22.87	199.97
24		Loonera	0.00	36.48	195.74	582.06	48.48	862.76
25		Deoron Ka Khera	16.39	63.19	119.19	91.67	147.56	438.00
26		Rooppura @ Dhanna Khera	0.00	19.36	35.76	159.26	49.82	264.20
27		Kana Khera	0.00	64.55	82.87	404.54	178.00	729.96
28		Usrol		76.55	171.96	510.69	51.33	810.53
29		Bari		48.51	111.21	205.77	35.72	401.21
30		Jajron Ka Khera		39.22	49.93	98.39	14.71	202.25
31		Phalasiya		55.54	237.53	681.59	74.36	1049.02
		Sub Total	**16.39**	**1555.37**	**5877.81**	**7280.13**	**2798.19**	**17527.89**
7-10 Km.	Railmagra							
1	(Rajasamand)	Bamaniya Kalan	0.00	434.00	100.00	195.00	301.00	1030.00
2		Jeetawas	0.00	389.00	269.00	46.67	173.33	878.00
3		Jeewa Khera	0.00	28.00	72.00	27.00	16.12	143.12
4		Morra	0.00	53.00	131.00	8.00	42.00	234.00
5		Madara	0.00	91.00	260.00	136.00	180.00	667.00
6		Gamerpura	0.00	16.00	86.00	62.00	30.99	194.99
7		Karoliya	0.00	25.00	135.00	278.00	97.00	535.00
8		Meniya	0.00	13.00	537.00	199.00	173.33	922.33
9		Sadri	0.00	57.00	129.00	746.00	253.08	1185.08
10		Chanpa Kheri	0.00	69.00	103.00	47.00	17.00	236.00
11		Panotiya	0.00	117.00	52.16	69.08	89.16	327.40
12		Karma Kheri	0.00	24.00	8.08	14.24	31.08	77.40
13		Jagpura	0.00	76.32	22.68	53.84	63.26	216.10
14		Gilund	0.00	684.52	728.48	682.84	531.16	2627.00
15		Lakhmipura	0.00	22.00	46.00	87.00	11.00	166.00
16		Damodarpura	0.00	35.00	121.00	180.00	35.00	371.00
17		Chhtri Khera	0.00	36.00	81.00	109.00	19.00	245.00
18		Soniyana	0.00	89.00	163.00	120.00	25.00	397.00
19		Sansera	0.00	58.00	500.00	181.00	652.37	1391.37
20		Khatookra	0.00	38.00	446.00	547.00	250.02	1281.02
21	Kapasan	Sejgariya	0.00	28.42	217.26	36.93	19.20	301.81
22	(Chittaurgarh)	Surajpura	0.00	10.64	71.46	29.29	3.56	114.95
23		Dhamana	0.00	181.88	919.61	605.04	455.16	2161.69
24		Sanwaliya Khera	0.00	56.82	40.92	28.19	71.25	197.18

ANNEXURE-VI
LANDUSE PATTERN

Sl.No.	Name of P.S. & District	Name of Village	Forest Land	Total Irrigated Land	Un-Irrigated Land	Cultivable Waste Land	Area not Available for Cultivation	Total Land
25		Gulabpura	0.00	44.44	73.72	73.10	24.00	215.26
26		Oron Ka Khera	0.00	12.61	32.58	66.98	40.00	152.17
27		Mali Khera	0.00	40.54	56.72	210.59	129.85	437.70
28		Mewada	0.00	34.23	201.47	385.13	32.00	652.83
29		Mewada Colony	0.00	1.38	85.21	55.29	8.14	150.02
30		Rayapuriya Khurd		9.44	146.75	170.26	17.91	344.36
31		Shambhoo Pura		9.60	42.34	16.05	8.01	76.00
32		Sadipura		8.99	91.71	69.38	34.71	204.79
33		Kankarwa		294.00	466.78	490.13	306.30	1557.21
34		Matuniya		48.80	61.05	77.03	81.25	268.13
35		Bhoopal Sagar		142.14	228.09	260.59	136.22	767.04
36	Mavli	Dhaneriya	0.00	120.00	473.00	306.00	72.00	971.00
37	(Udaipur)	Khartana	0.00	88.00	419.00	215.00	96.00	818.00
38		Man Khand	0.00	72.00	143.00	52.00	73.00	340.00
39		Bhumlawas	0.00	94.00	26.00	0.00	132.00	252.00
40		Girdharipura	0.00	36.00	53.00	42.00	40.00	171.00
		Sub Total	**0.00**	**3688.77**	**7840.07**	**6977.65**	**4771.46**	**23277.95**
0-10 Km.		**Grand Total**	**16.39**	**5944.36**	**17497.63**	**16808.57**	**8916.31**	**49183.26**

Annexure-VII

Demographic Details

ANNEXURE-VII
DEMOGRAPHIC DETAILS

Sl.No.	Name of P.S. & District	Name of Village	Total House Holds	Total Population	Total Male	Total Female	Population Below 6 Agegroup	Male Below 6 Agegroup	Female Below 6 Agegroup	SC Population	ST Population	Total Literates	Male Literates	Female Literates	Total Workers	Main Workers	Marginal Workers	Non Workers
0-3 Km.	Railmagra																	
1	(Rajasamand)	Makhanpuriya	63	306	152	154	61	32	29	77	47	137	79	58	218	90	128	88
2		Mahenduriya	562	2818	1444	1374	412	217	195	688	347	1665	1024	641	1170	893	277	1648
3		Rajpura	188	980	486	494	144	90	54	47	96	405	276	129	408	279	129	572
4		Sunariya Khera	150	779	381	398	113	57	56	78	64	422	264	158	371	178	193	408
5		Kabra	268	1147	563	584	157	78	79	176	130	531	356	175	355	348	7	792
6		Kotrii	557	2939	1473	1466	444	236	208	535	400	1454	943	511	1422	1244	178	1517
7		Udalpura	89	409	188	221	88	38	50	31	30	139	98	41	244	148	96	165
8		Peepawas	101	516	266	250	98	50	48	141	145	185	148	37	263	85	178	253
9		Katiya Khera	36	172	85	87	24	12	12	7	62	72	48	24	94	35	59	78
10		Mataji Ka Khera	79	408	201	207	74	37	37	14	114	190	138	52	232	89	143	176
11		Anjana	346	1608	806	802	243	118	125	260	248	872	552	320	546	529	17	1062
12		Gawaradi	409	2034	993	1041	268	131	137	161	180	1080	702	378	1058	752	306	976
13		Chhapri	172	827	396	431	134	69	65	84	221	317	215	102	459	251	208	368
14		Chawandiya	178	760	370	390	134	83	51	49	105	242	175	67	440	96	344	320
15		Dariba (CT)	704	2833	1508	1325	235	127	108	429	178	2382	1343	1039	775	759	16	2058
16	Kapasan	Manohar Kheri	57	297	149	148	43	22	21	5	97	160	105	55	185	57	128	112
17	(Chittaurgarh)	Chauthpura	93	495	254	241	66	37	29	151	32	284	176	108	275	146	129	220
18		Goojariya Khera	75	420	208	212	59	37	22	77	1	187	109	78	222	120	102	198
		Sub Total	**4127**	**19748**	**9923**	**9825**	**2797**	**1471**	**1326**	**3010**	**2497**	**10724**	**6751**	**3973**	**8737**	**6099**	**2638**	**11011**
3-7 Km.	Railmagra																	
1	(Rajasamand)	Lathiya Kheri	116	613	307	306	92	56	36	33	142	268	177	91	323	195	128	290
2		Pachhmata	434	2177	1068	1109	328	175	153	309	148	1093	697	396	961	931	30	1216
3		Khar Bamaniya	216	974	467	507	146	88	58	182	161	256	193	63	620	587	33	354
4		Ganeshpura	83	360	175	185	64	25	39	158	1	100	85	15	218	93	125	142
5		Sanwaliya Khera	31	176	82	94	32	10	22	0	0	69	48	21	102	77	25	74
6		Bakhatpura	49	227	114	113	39	20	19	52	42	53	43	10	149	70	79	78
7		Shivpura	71	339	178	161	75	39	36	91	245	158	100	58	222	107	115	117
8		Sindesarkhurd	172	769	376	393	127	57	70	191	0	308	229	79	469	232	237	300
9		Mali Khera	86	472	225	247	78	36	42	5	155	173	129	44	272	89	183	200
10		Sarwariya Kheri	68	341	179	162	57	31	26	25	48	125	102	23	108	93	15	233
11		Shoupura	35	155	67	88	19	4	15	0	80	73	48	25	86	74	12	69
12		Laxmipura	69	327	171	156	62	36	26	49	74	184	108	76	174	155	19	153
13		Bharai	194	946	456	490	184	87	97	235	100	610	316	294	487	353	134	459
14		Chhdanga Kheri	147	729	378	351	134	74	60	137	234	316	216	100	391	16	375	338
15		Jagatsingh Ji Ka Khera	63	323	159	164	62	35	27	0	85	151	97	54	94	73	21	229
16		Dhaneriya	599	2986	1480	1506	502	253	249	1125	216	1424	962	462	939	648	291	2047
17		Chhdanga Ka Khera	117	587	286	301	92	45	47	44	234	249	168	81	334	264	70	253
18		Charana	314	1429	726	703	175	105	70	195	192	598	395	203	588	510	78	841
19		Ladpacha	285	1309	641	668	177	92	85	153	204	628	406	222	689	556	133	620
20	Kapasan	Dhani	105	538	290	248	101	49	52	50	104	275	189	86	313	128	185	225
21	(Chittaurgarh)	Anoppura	228	1015	519	496	135	73	62	365	150	293	249	44	672	399	273	343
22		Jashma	863	4248	2139	2109	570	285	285	864	47	2037	1379	658	2231	1642	589	2017
23		Gadriyawas	83	389	198	191	54	31	23	66	33	213	117	96	210	113	97	179
24		Loonera	230	1138	564	574	193	96	97	78	262	320	232	88	557	533	24	581
25		Deoron Ka Khera	125	653	334	319	117	61	56	66	107	197	170	27	410	252	158	243
26		Rooppura @ Dhanna Khera	59	227	108	119	38	19	19	29	123	59	41	18	114	106	8	113
27		Kana Khera	157	748	387	361	96	52	44	132	110	266	195	71	463	37	426	285
28		Usrol	215	1072	515	557	145	68	77	212	294	265	205	60	604	316	288	468
29		Bari	129	560	282	278	82	42	40	138	61	272	164	108	330	314	16	230
30		Jajron Ka Khera	96	401	216	185	45	24	21	14	186	304	176	128	296	296	0	105
31		Phalasiya	192	810	406	404	96	53	43	120	126	422	242	180	235	216	19	575
		Sub Total	**5631**	**27038**	**13493**	**13545**	**4117**	**2121**	**1996**	**5118**	**3964**	**11759**	**7878**	**3881**	**13661**	**9475**	**4186**	**13377**
7-10 Km.	Railmagra																	
1	(Rajasamand)	Bamniya Kalan	522	2823	1363	1460	393	196	197	159	4	1181	780	401	1154	997	157	1669
2		Jeetawas	386	1900	948	952	236	120	116	447	88	755	535	220	1031	909	122	869
3		Jeewa Khera	138	656	308	348	101	52	49	47	120	277	194	83	344	172	172	312

ANNEXURE-VII
DEMOGRAPHIC DETAILS

Sl.No.	Name of P.S. & District	Name of Village	Total House Holds	Total Population	Total Male	Total Female	Population Below 6 Agegroup	Male Below 6 Agegroup	Female Below 6 Agegroup	SC Population	ST Population	Total Literates	Male Literates	Female Literates	Total Workers	Main Workers	Marginal Workers	Non Workers
4		Morra	177	891	429	462	143	76	67	4	41	336	227	109	268	25	243	623
5		Madara	353	1840	894	946	306	148	158	224	166	824	530	294	785	466	319	1055
6		Gamerpura	83	479	238	241	99	55	44	111	13	226	151	75	236	58	178	243
7		Karoliya	126	613	310	303	81	37	44	16	121	313	199	114	317	243	74	296
8		Meniya	241	1101	520	581	208	92	116	76	14	421	271	150	631	386	245	470
9		Sadri	356	1788	916	872	300	141	159	248	329	731	523	208	546	229	317	1242
10		Chanpa Kheri	114	560	273	287	94	45	49	86	10	181	147	34	242	148	94	318
11		Panotiya	293	1353	660	693	249	128	121	269	38	492	349	143	672	355	317	681
12		Karma Kheri	5	24	11	13	8	4	4	0	0	2	1	1	11	10	1	13
13		Jagpura	167	1193	603	590	274	147	127	13	0	397	310	87	519	402	117	674
14		Gilund	1175	6276	3111	3165	891	477	414	1628	53	3125	2026	1099	2392	1902	490	3884
15		Lakhmipura	41	258	132	126	51	31	20	34	29	73	55	18	134	93	41	124
16		Damodarpura	97	535	266	269	57	29	28	93	60	206	147	59	318	249	69	217
17		Chhtri Khera	80	457	217	240	65	27	38	38	116	187	134	53	313	45	268	144
18		Soniyana	167	794	381	413	133	63	70	82	67	282	188	94	481	351	130	313
19		Sansera	398	1894	940	954	293	164	129	226	275	1028	640	388	822	503	319	1072
20		Khatookra	324	1434	702	732	216	116	100	166	297	647	430	217	591	417	174	843
21	Kapasan	Sejgariya	119	551	282	269	71	41	30	64	96	238	182	56	388	149	239	163
22	(Chittaurgarh)	Surajpura	117	513	265	248	110	48	62	39	130	174	137	37	324	166	158	189
23		Dhamana	606	2864	1419	1445	418	217	201	648	173	1095	761	334	1409	739	670	1455
24		Sanwaliya Khera	58	302	148	154	44	24	20	34	30	121	85	36	193	136	57	109
25		Gulabpura	66	285	133	152	33	19	14	14	18	111	77	34	189	131	58	96
26		Oron Ka Khera	66	292	144	148	51	28	23	0	0	52	43	9	184	89	95	108
27		Mali Khera	237	1158	596	562	215	127	88	99	70	241	199	42	726	444	282	432
28		Mewada	157	714	350	364	89	45	44	75	86	184	154	30	500	345	155	214
29		Mewada Colony	157	587	309	278	93	53	40	524	0	77	66	11	154	4	150	433
30		Rayapuriya Khurd	91	381	176	205	66	29	37	36	85	121	91	30	157	131	26	224
31		Shambhoo Pura	27	130	64	66	19	6	13	11	24	88	52	36	102	102	0	28
32		Sadipura	79	335	161	174	64	33	31	109	36	94	69	25	233	159	74	102
33		Kankarwa	934	4909	2485	2424	774	406	368	854	432	2306	1532	774	2460	1307	1153	2449
34		Matuniya	129	640	341	299	129	77	52	113	174	163	137	26	361	298	63	279
35		Bhoopal Sagar	1005	4995	2574	2421	687	354	333	693	396	2865	1813	1052	2022	1601	421	2973
36	Mavli	Dhaneriya	329	1719	873	846	240	127	113	256	488	640	460	180	1165	761	404	554
37	(Udaipur)	Khartana	513	2530	1247	1283	456	197	259	474	209	952	689	263	1226	991	235	1304
38		Man Khand	223	1114	577	537	181	102	79	26	359	484	316	168	435	435	0	679
39		Bhumlawas	146	745	378	367	149	79	70	0	506	226	152	74	337	300	37	408
40		Girdharipura	121	577	291	286	112	62	50	37	5	182	134	48	320	162	158	257
41		Fatehnagar (M)	3728	19648	10026	9622	2887	1472	1415	2858	2246	11594	7067	4527	6441	5457	984	13207
		Sub Total	**14151**	**71858**	**36061**	**35797**	**11086**	**5694**	**5392**	**10931**	**7404**	**33692**	**22053**	**11639**	**31133**	**21867**	**9266**	**40725**
0-10 Km.		**Grand Total**	**23909**	**118644**	**59477**	**59167**	**18000**	**9286**	**8714**	**19059**	**13865**	**56175**	**36682**	**19493**	**53531**	**37441**	**16090**	**65113**

ANNEXURE-VII
INFRASTRUCTURE DETAILS

Table 1 : Demographic Profiles of the Villages in the Core Zone and Buffer Zone

Sl.No.	Name of the Village	Distance from the core zone	Name of the Tehsil	Number of Population				Literacy rate		
				No.of House Holds	SC	ST	Others	Total	Male	Female
0-3 Km.										
1	Makhanpuriya	0-3 Km.	Railmagra	63	77	47	182	306	79	58
2	Mahenduriya	0-3 Km.	Railmagra	562	688	347	1783	2818	1024	641
3	Rajpura	0-3 Km.	Railmagra	188	47	96	837	980	276	129
4	Sunariya Khera	0-3 Km.	Railmagra	150	78	64	637	779	264	158
5	Kabra	0-3 Km.	Railmagra	268	176	130	841	1147	356	175
6	Kotrii	0-3 Km.	Railmagra	557	535	400	2004	2939	943	511
7	Udalpura	0-3 Km.	Railmagra	89	31	30	348	409	98	41
8	Peepawas	0-3 Km.	Railmagra	101	141	145	230	516	148	37
9	Katiya Khera	0-3 Km.	Railmagra	36	7	62	103	172	48	24
10	Mataji Ka Khera	0-3 Km.	Railmagra	79	14	114	280	408	138	52
11	Anjana	0-3 Km.	Railmagra	346	260	248	1100	1608	552	320
12	Gawaradi	0-3 Km.	Railmagra	409	161	180	1693	2034	702	378
13	Chhapri	0-3 Km.	Railmagra	172	84	221	522	827	215	102
14	Chawandiya	0-3 Km.	Railmagra	178	49	105	606	760	175	67
15	Dariba (CT)	0-3 Km.	Railmagra	704	429	178	2226	2833	1343	1039
16	Manohar Kheri	0-3 Km.	Kapasan	57	5	97	195	297	105	55
17	Chauthpura	0-3 Km.	Kapasan	93	151	32	312	495	176	108
18	Goojariya Khera	0-3 Km.	Kapasan	75	77	1	342	420	109	78
	Sub Total			**4127**	**3010**	**2497**	**14241**	**19748**	**6751**	**3973**
3-7 Km.										
1	Lathiya Kheri	3-7 Km.	Railmagra	116	33	142	438	613	177	91
2	Pachhmata	3-7 Km.	Railmagra	434	309	148	1720	2177	697	396
3	Khar Bamaniya	3-7 Km.	Railmagra	216	182	161	631	974	193	63
4	Ganeshpura	3-7 Km.	Railmagra	83	158	1	201	360	85	15
5	Sanwaliya Khera	3-7 Km.	Railmagra	31	0	0	176	176	48	21
6	Bakhatpura	3-7 Km.	Railmagra	49	52	42	133	227	43	10
7	Shivpura	3-7 Km.	Railmagra	71	91	245	3	339	100	58
8	Sindesarkhurd	3-7 Km.	Railmagra	172	191	0	578	769	229	79
9	Mali Khera	3-7 Km.	Railmagra	86	5	155	312	472	129	44
10	Sarwariya Kheri	3-7 Km.	Railmagra	68	25	48	268	341	102	23
11	Shoupura	3-7 Km.	Railmagra	35	0	80	75	155	48	25
12	Laxmipura	3-7 Km.	Railmagra	69	49	74	204	327	108	76
13	Bharai	3-7 Km.	Railmagra	194	235	100	611	946	316	294
14	Chhdanga Kheri	3-7 Km.	Railmagra	147	137	234	358	729	216	100
15	Jagatsingh Ji Ka Khera	3-7 Km.	Railmagra	63	0	85	238	323	97	54
16	Dhaneriya	3-7 Km.	Railmagra	599	1125	216	1645	2986	962	462
17	Chhdanga Ka Khera	3-7 Km.	Railmagra	117	44	234	309	587	168	81
18	Charana	3-7 Km.	Railmagra	314	195	192	1042	1429	395	203

ANNEXURE-VII
INFRASTRUCTURE DETAILS

Sl.No.	Name of the Village	Distance from the core zone	Name of the Tehsil	No.of House Holds	SC	ST	Others	Total	Male	Female
19	Ladpacha	3-7 Km.	Railmagra	285	153	204	952	1309	406	222
20	Dhani	3-7 Km.	Kapasan	105	50	104	384	538	189	86
21	Anoppura	3-7 Km.	Kapasan	228	365	150	500	1015	249	44
22	Jashma	3-7 Km.	Kapasan	863	864	47	3337	4248	1379	658
23	Gadriyawas	3-7 Km.	Kapasan	83	66	33	290	389	117	96
24	Loonera	3-7 Km.	Kapasan	230	78	262	798	1138	232	88
25	Deoron Ka Khera	3-7 Km.	Kapasan	125	66	107	480	653	170	27
26	Rooppura @ Dhanna Khera	3-7 Km.	Kapasan	59	29	123	75	227	41	18
27	Kana Khera	3-7 Km.	Kapasan	157	132	110	506	748	195	71
28	Usrol	3-7 Km.	Kapasan	215	212	294	566	1072	205	60
29	Bari	3-7 Km.	Kapasan	129	138	61	361	560	164	108
30	Jajron Ka Khera	3-7 Km.	Kapasan	96	14	186	201	401	176	128
31	Phalasiya	3-7 Km.	Kapasan	192	120	126	564	810	242	180
	Sub Total			**5631**	**5118**	**3964**	**17956**	**27038**	**7878**	**3881**
7-10 Km.										
1	Bamniya Kalan	7-10 Km.	Railmagra	522	159	4	2660	2823	780	401
2	Jeetawas	7-10 Km.	Railmagra	386	447	88	1365	1900	535	220
3	Jeewa Khera	7-10 Km.	Railmagra	138	47	120	489	656	194	83
4	Morra	7-10 Km.	Railmagra	177	4	41	846	891	227	109
5	Madara	7-10 Km.	Railmagra	353	224	166	1450	1840	530	294
6	Gamerpura	7-10 Km.	Railmagra	83	111	13	355	479	151	75
7	Karoliya	7-10 Km.	Railmagra	126	16	121	476	613	199	114
8	Meniya	7-10 Km.	Railmagra	241	76	14	1011	1101	271	150
9	Sadri	7-10 Km.	Railmagra	356	248	329	1211	1788	523	208
10	Chanpa Kheri	7-10 Km.	Railmagra	114	86	10	464	560	147	34
11	Panotiya	7-10 Km.	Railmagra	293	269	38	1046	1353	349	143
12	Karma Kheri	7-10 Km.	Railmagra	5	0	0	24	24	1	1
13	Jagpura	7-10 Km.	Railmagra	167	13	0	1180	1193	310	87
14	Gilund	7-10 Km.	Railmagra	1175	1628	53	4595	6276	2026	1099
15	Lakhmipura	7-10 Km.	Railmagra	41	34	29	195	258	55	18
16	Damodarpura	7-10 Km.	Railmagra	97	93	60	382	535	147	59
17	Chhtri Khera	7-10 Km.	Railmagra	80	38	116	303	457	134	53
18	Soniyana	7-10 Km.	Railmagra	167	82	67	645	794	188	94
19	Sansera	7-10 Km.	Railmagra	398	226	275	1393	1894	640	388
20	Khatookra	7-10 Km.	Railmagra	324	166	297	971	1434	430	217
21	Sejgariya	7-10 Km.	Kapasan	119	64	96	391	551	182	56
22	Surajpura	7-10 Km.	Kapasan	117	39	130	344	513	137	37
23	Dhamana	7-10 Km.	Kapasan	606	648	173	2043	2864	761	334
24	Sanwaliya Khera	7-10 Km.	Kapasan	58	34	30	238	302	85	36
25	Gulabpura	7-10 Km.	Kapasan	66	14	18	253	285	77	34
26	Oron Ka Khera	7-10 Km.	Kapasan	66	0	0	292	292	43	9

ANNEXURE-VII
INFRASTRUCTURE DETAILS

Sl.No.	Name of the Village	Distance from the core zone	Name of the Tehsil	No.of House Holds	SC	ST	Others	Total	Male	Female
27	Mali Khera	7-10 Km.	Kapasan	237	99	70	989	1158	199	42
28	Mewada	7-10 Km.	Kapasan	157	75	86	553	714	154	30
29	Mewada Colony	7-10 Km.	Kapasan	157	524	0	63	587	66	11
30	Rayapuriya Khurd	7-10 Km.	Kapasan	91	36	85	260	381	91	30
31	Shambhoo Pura	7-10 Km.	Kapasan	27	11	24	95	130	52	36
32	Sadipura	7-10 Km.	Kapasan	79	109	36	190	335	69	25
33	Kankarwa	7-10 Km.	Kapasan	934	854	432	3623	4909	1532	774
34	Matuniya	7-10 Km.	Kapasan	129	113	174	353	640	137	26
35	Bhoopal Sagar	7-10 Km.	Kapasan	1005	693	396	3906	4995	1813	1052
36	Dhaneriya	7-10 Km.	Mavli	329	256	488	975	1719	460	180
37	Khartana	7-10 Km.	Mavli	513	474	209	1847	2530	689	263
38	Man Khand	7-10 Km.	Mavli	223	26	359	729	1114	316	168
39	Bhumlawas	7-10 Km.	Mavli	146	0	506	239	745	152	74
40	Girdharipura	7-10 Km.	Mavli	121	37	5	535	577	134	48
41	Fatehnagar (M)	7-10 Km.	Mavli	3728	2858	2246	14544	19648	7067	4527
	Sub Total			**14151**	**10931**	**7404**	**53523**	**71858**	**22053**	**11639**
0-10 Km.	**Grand Total**			**23909**	**19059**	**13865**	**85720**	**118644**	**36682**	**19493**

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Table 2 : Occupation of Population and Work Forces of the Buffer Zone							
	Worker's Classification						
Sl.No.	Name of the Village	Main Workers (Male)	Main Workers (Female)	Marginal Workers (Male)	Marginal Workers (Females)	Non Workers (Male)	Non Workers (Female)
0-3 Km.							
1	Makhanpuriya	81	9	20	108	51	37
2	Mahenduriya	641	252	90	187	713	935
3	Rajpura	220	59	23	106	243	329
4	Sunariya Khera	152	26	57	136	172	236
5	Kabra	265	83	2	5	296	496
6	Kotrii	775	469	56	122	642	875
7	Udalpura	107	41	4	92	77	88
8	Peepawas	58	27	83	95	125	128
9	Katiya Khera	33	2	22	37	30	48
10	Mataji Ka Khera	78	11	37	106	86	90
11	Anjana	415	114	11	6	380	682
12	Gawaradi	441	311	62	244	490	486
13	Chhapri	171	80	61	147	164	204
14	Chawandiya	84	12	114	230	172	148
15	Dariba (CT)	699	60	14	2	795	1263
16	Manohar Kheri	40	17	55	73	54	58
17	Chauthpura	138	8	1	128	115	105
18	Goojariya Khera	103	17	26	76	79	119
	Sub Total	**4501**	**1598**	**738**	**1900**	**4684**	**6327**
3-7 Km.							
1	Lathiya Kheri	120	75	53	75	134	156
2	Pachhmata	599	332	4	26	465	751
3	Khar Bamaniya	271	316	11	22	185	169
4	Ganeshpura	81	12	23	102	71	71
5	Sanwaliya Khera	46	31	0	25	36	38
6	Bakhatpura	64	6	7	72	43	35
7	Shivpura	105	2	10	105	63	54
8	Sindesarkhurd	188	44	43	194	145	155
9	Mali Khera	81	8	53	130	91	109
10	Sarwariya Kheri	91	2	1	14	87	146
11	Shoupura	38	36	6	6	23	46
12	Laxmipura	84	71	6	13	81	72
13	Bharai	237	116	39	95	180	279
14	Chhdanga Kheri	16	0	192	183	170	168
15	Jagatsingh Ji Ka Khe	62	11	16	5	81	148
16	Dhaneriya	613	35	114	177	753	1294
17	Chhdanga Ka Khera	151	113	7	63	128	125
18	Charana	359	151	24	54	343	498
19	Ladpacha	359	197	28	105	254	366
20	Dhani	95	33	70	115	125	100
21	Anoppura	320	79	19	254	180	163
22	Jashma	1081	561	102	487	956	1061
23	Gadriyawas	103	10	16	81	79	100
24	Loonera	334	199	6	18	224	357
25	Deoron Ka Khera	194	58	8	150	132	111
26	Rooppura @ Dhanna	66	40	2	6	40	73
27	Kana Khera	32	5	220	206	135	150
28	Usrol	303	13	9	279	203	265
29	Bari	180	134	6	10	96	134
30	Jajron Ka Khera	156	140	0	0	60	45
31	Phalasiya	213	3	14	5	179	396
	Sub Total	**6642**	**2833**	**1109**	**3077**	**5742**	**7635**
7-10 Km.							
1	Bamniya Kalan	742	255	29	128	592	1077
2	Jeetawas	496	413	32	90	420	449
3	Jeewa Khera	116	56	68	104	124	188
4	Morra	25	0	201	42	203	420
5	Madara	345	121	92	227	457	598
6	Gamerpura	55	3	69	109	114	129
7	Karoliya	150	93	23	51	137	159
8	Meniya	256	130	61	184	203	267

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Sl.No.	Name of the Village	Main Workers (Male)	Main Workers (Female)	Marginal Workers (Male)	Marginal Workers (Females)	Non Workers (Male)	Non Workers (Female)
9	Sadri	225	4	269	48	422	820
10	Chanpa Kheri	119	29	27	67	127	191
11	Panotiya	295	60	43	274	322	359
12	Karma Kheri	5	5	0	1	6	7
13	Jagpura	228	174	39	78	336	338
14	Gilund	1307	595	254	236	1550	2334
15	Lakhmipura	47	46	21	20	64	60
16	Damodarpura	134	115	22	47	110	107
17	Chhtri Khera	44	1	114	154	59	85
18	Soniyana	217	134	19	111	145	168
19	Sansera	426	77	92	227	422	650
20	Khatookra	379	38	62	112	261	582
21	Sejgariya	110	39	81	158	91	72
22	Surajpura	150	16	26	132	89	100
23	Dhamana	704	35	109	561	606	849
24	Sanwaliya Khera	89	47	0	57	59	50
25	Gulabpura	84	47	0	58	49	47
26	Oron Ka Khera	72	17	11	84	61	47
27	Mali Khera	288	156	61	221	247	185
28	Mewada	217	128	13	142	120	94
29	Mewada Colony	2	2	96	54	211	222
30	Rayapuriya Khurd	92	39	11	15	73	151
31	Shambhoo Pura	54	48	0	0	10	18
32	Sadipura	90	69	14	60	57	45
33	Kankarwa	1103	204	301	852	1081	1368
34	Matuniya	177	121	6	57	158	121
35	Bhoopal Sagar	1209	392	151	270	1214	1759
36	Dhaneriya	446	315	136	268	291	263
37	Khartana	640	351	50	185	557	747
38	Man Khand	295	140	0	0	282	397
39	Bhumlawas	192	108	6	31	180	228
40	Girdharipura	149	13	17	141	125	132
41	Fatehnagar (M)	4681	776	478	506	4867	8340
	Sub Total	**16455**	**5412**	**3104**	**6162**	**16502**	**24223**
0-10 Km.	**Grand Total**	**27598**	**9843**	**4951**	**11139**	**26928**	**38185**

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Table : 4 Educational Facilities and CBOs within the Study Area

Sl.No.	Name of the Village	Primary School	Middle School	Senior Secondary School	College	Trining School	Adult Literacy Center	Other Educational Facilities
0-3 Km.								
1	Makhanpuriya	1	0	0	0	0	0	0
2	Mahenduriya	2	2	0	0	0	0	0
3	Rajpura	1	0	0	0	0	0	0
4	Sunariya Khera	1	1	0	0	0	0	0
5	Kabra	1	1	0	0	0	1	0
6	Kotrii	2	1	0	0	0	0	0
7	Udalpura	1	0	0	0	0	0	0
8	Peepawas	1	0	0	0	0	0	0
9	Katiya Khera	1	0	0	0	0	0	0
10	Mataji Ka Khera	1	0	0	0	0	1	0
11	Anjana	2	1	0	0	0	0	0
12	Gawaradi	1	0	0	0	0	0	0
13	Chhapri	1	0	0	0	0	0	0
14	Chawandiya	1	0	0	0	0	0	0
15	Manohar Kheri	1	0	0	0	0	0	0
16	Chauthpura	1	0	0	0	0	0	0
17	Goojariya Khera	1	0	0	0	0	0	0
	Sub Total	**20**	**6**	**0**	**0**	**0**	**2**	**0**
3-7 Km.								
1	Lathiya Kheri	1	0	0	0	0	0	0
2	Pachhmata	2	1	0	0	0	0	0
3	Khar Bamaniya	1	1	0	0	0	0	0
4	Ganeshpura	1	0	0	0	0	1	0
5	Sanwaliya Khera	1	0	0	0	0	0	0
6	Bakhatpura	1	0	0	0	0	0	0
7	Shivpura	1	1	0	0	0	0	0
8	Sindesarkhurd	1	0	0	0	0	0	0
9	Mali Khera	1	0	0	0	0	0	0
10	Sarwariya Kheri	1	0	0	0	0	0	0
11	Shoupura	1	0	0	0	0	0	0
12	Laxmipura	2	0	0	0	0	0	0
13	Bharai	1	0	0	0	0	0	0
14	Chhdanga Kheri	1	0	0	0	0	0	0
15	Jagatsingh Ji Ka Khera	5	1	0	0	0	0	0
16	Dhaneriya	1	0	1	0	0	0	0
17	Chhdanga Ka Khera	1	1	0	0	0	0	0
18	Charana	1	1	0	0	0	0	0
19	Ladpacha	1	0	0	0	0	0	0
20	Dhani	1	1	1	0	0	0	0
21	Anoppura	2	1	0	0	0	0	0
22	Jashma	1	0	0	0	0	0	0
23	Gadriyawas	1	1	0	0	0	0	0
24	Loonera	1	0	0	0	0	0	0
25	Deoron Ka Khera	1	0	0	0	0	0	0
26	Roopppura @ Dhanna Khera	1	0	0	0	0	0	0
27	Kana Khera	1	1	0	0	0	0	0
28	Usrol	1	0	0	0	0	0	0
29	Bari	1	0	0	0	0	0	0
30	Jajron Ka Khera	1	1	0	0	0	1	0
31	Phalasiya	1	0	0	0	0	0	0
	Sub Total	**38**	**11**	**2**	**0**	**0**	**1**	**0**
7-10 Km.								
1	Bamaniya Kalan	2	1	0	0	0	0	0
2	Jeetawas	1	1	0	0	0	1	0
3	Jeewa Khera	1	1	0	0	0	0	0
4	Morra	1	1	0	0	0	0	0
5	Madara	1	0	0	0	0	0	0
6	Gamerpura	1	1	0	0	0	0	0
7	Karoliya	1	0	0	0	0	0	0
8	Meniya	1	1	0	0	0	0	0
9	Sadri	1	0	0	0	0	0	0
10	Chanpa Kheri	1	1	0	0	0	0	0
11	Panotiya	0	0	0	0	0	0	0
12	Karma Kheri	1	1	0	0	0	0	0
13	Jagpura	3	1	1	0	0	0	0
14	Gilund	0	0	0	0	0	0	0
15	Lakhmipura	1	0	0	0	0	0	0
16	Damodarpura	1	0	0	0	0	0	0
17	Chhtri Khera	1	1	0	0	0	0	0
	Soniyana							

AV

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Sl.No.	Name of the Village	Primary School	Middle School	Senior Secondary School	College	Trining School	Adult Literacy Center	Other Educational Facilities
19	Sansera	1	1	0	0	0	0	0
20	Khatookra	1	1	0	0	0	0	0
21	Sejgariya	1	0	0	0	0	0	0
22	Surajpura	1	0	0	0	0	0	0
23	Dhamana	4	2	0	0	0	0	0
24	Sanwaliya Khera	1	0	0	0	0	0	0
25	Gulabpura	1	0	0	0	0	0	0
26	Oron Ka Khera	1	0	0	0	0	0	0
27	Mali Khera	1	1	0	0	0	0	0
28	Mewada	1	0	0	0	0	0	0
29	Mewada Colony	1	0	0	0	0	0	0
30	Rayapuriya Khurd	1	0	0	0	0	0	0
31	Shambhoo Pura	0	0	0	0	0	0	0
32	Sadipura	1	0	0	0	0	0	0
33	Kankarwa	1	1	0	0	0	0	0
34	Matuniya	1	0	0	0	0	0	0
35	Bhoopal Sagar	2	2	1	0	0	0	1
36	Dhaneriya	1	1	0	0	0	0	1
37	Khartana	1	1	0	0	0	0	0
38	Man Khand	1	0	0	0	0	0	0
39	Bhumlawas	1	0	0	0	0	0	0
40	Girdharipura	0	0	0	0	0	0	0
	Sub Total	**43**	**21**	**2**	**0**	**0**	**1**	**2**
0-10 Km.	**Grand Total**	**101.00**	**38.00**	**4.00**	**0.00**	**0.00**	**4.00**	**2.00**

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Table : 5 Medical Facilities Within the Study Area

Sl.No.	Name of the Village	MEDI FAC	MCW CNTR	M HOME	CWC	H CNTR	PH CNTR	PHS CNTR	FWC CNTR	TB CLN	N HOME	RMP	SMP	CHW	OTH CNTR
0-3 Km.															
1	Makhanpuriya	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Mahenduriya	1	0	0	0	1	1	1	0	0	0	0	0	1	0
3	Rajpura	1	0	0	0	0	0	1	0	0	0	0	0	0	0
4	Sunariya Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Kabra	1	0	0	0	0	0	1	0	0	0	0	0	0	0
6	Kotrii	1	0	0	0	0	1	1	0	0	0	0	0	0	0
7	Udalpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Peepawas	2	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Katiya Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Mataji Ka Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Anjana	2	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Gawaradi	1	0	0	0	0	0	1	0	0	0	0	0	1	0
13	Chhapri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Chawandiya	2	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Manohar Kheri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Chauthpura	1	0	0	0	0	0	1	0	0	0	0	0	0	0
17	Goojariya Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub Total	**28**	**0**	**0**	**0**	**1**	**2**	**6**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
3-7 Km.															
1	Lathiya Kheri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Pachhmata	1	0	0	0	0	0	1	0	0	0	0	0	0	0
3	Khar Bamaniya	1	0	0	0	0	0	1	0	0	0	0	0	0	0
4	Ganeshpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Sanwaliya Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Bakhatpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Shivpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Sindesarkhurd	2	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Mali Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Sarwariya Kheri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Shoupura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Laxmipura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Bharai	2	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Chhdanga Kheri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Jagatsingh Ji Ka Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Dhaneriya	1	0	0	0	0	0	1	0	0	0	0	0	1	0
17	Chhdanga Ka Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Charana	1	0	0	0	0	0	1	0	0	0	0	0	1	0
19	Ladpacha	2	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Dhani	2	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Anoppura	1	0	0	0	0	1	0	0	0	0	0	0	0	0

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Sl.No.	Name of the Village	MEDI FAC	MCW CNTR	M HOME	CWC	H CNTR	PH CNTR	PHS CNTR	FWC CNTR	TB CLN	N HOME	RMP	SMP	CHW	OTH CNTR
22	Jashma	1	0	0	0	0	1	0	0	0	0	0	0	0	0
23	Gadriyawas	2	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Loonera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
25	Deoron Ka Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Roopura @ Dhanna k	2	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Kana Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Usrol	1	0	0	0	0	1	0	0	0	0	0	0	0	0
29	Bari	2	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Jajron Ka Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
31	Phalasiya	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub Total	**55**	**0**	**0**	**0**	**0**	**3**	**4**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
7-10 Km.															
1	Bamaniya Kalan	1	0	0	0	0	0	1	0	0	0	0	0	1	0
2	Jeetawas	1	0	0	0	0	0	1	0	0	0	0	0	0	0
3	Jeewa Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Morra	2	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Madara	1	0	0	0	0	0	1	0	0	0	0	0	0	0
6	Gamerpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Karoliya	1	0	0	0	0	0	1	0	0	0	0	0	0	0
8	Meniya	2	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Sadri	1	0	0	0	0	0	1	0	0	0	0	0	1	0
10	Chanpa Kheri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Panotiya	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Karma Kheri	2	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Jagpura	1	0	0	0	1	0	0	0	0	0	0	0	0	0
14	Gilund	1	0	0	0	0	1	1	0	0	0	0	0	0	0
15	Lakhmipura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Damodarpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Chhtri Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Soniyana	1	0	0	0	0	0	1	0	0	0	0	0	0	0
19	Sansera	1	0	0	0	0	0	1	0	0	0	0	0	0	0
20	Khatookra	1	0	0	0	0	0	1	0	0	0	0	0	0	0
21	Sejgariya	2	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Surajpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
23	Dhamana	1	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Sanwaliya Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
25	Gulabpura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Oron Ka Khera	2	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Mali Khera	1	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Mewada	2	0	0	0	0	0	1	0	0	0	0	0	0	0
29	Mewada Colony	2	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Rayapuriya Khurd	2	0	0	0	0	0	0	0	0	0	0	0	0	0

ANNEXURE-VII
INFRASTRUCTURE FACILITIES

Sl.No.	Name of the Village	MEDI FAC	MCW CNTR	M HOME	CWC	H CNTR	PH CNTR	PHS CNTR	FWC CNTR	TB CLN	N HOME	RMP	SMP	CHW	OTH CNTR
31	Shambhoo Pura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
32	Sadipura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
33	Kankarwa	1	0	0	0	0	1	0	0	0	0	0	0	0	0
34	Matuniya	2	0	0	0	0	0	0	0	0	0	0	0	0	0
35	Bhoopal Sagar	1	0	0	0	0	1	0	0	0	0	0	0	0	0
36	Dhaneriya	1	0	0	0	0	0	1	0	0	0	0	0	1	0
37	Khartana	1	0	0	0	0	0	0	0	0	0	0	0	0	0
38	Man Khand	2	0	0	0	0	0	0	0	0	0	0	0	0	0
39	Bhumlawas	1	0	0	0	0	0	1	0	0	0	0	0	0	0
40	Girdharipura	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub Total	**62**	**0**	**0**	**0**	**1**	**3**	**12**	**0**	**0**	**0**	**0**	**0**	**3**	**0**
0-10 Km.	**Grand Total**	**145.00**	**0.00**	**0.00**	**0.00**	**2.00**	**8.00**	**22.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**0.00**

Note :

MEDI FAC edical Facilities
MCW CNTR y & Child Care Center
M HOME aternity Home
CWC d Welfare Center
H CNTR Health Center
PH CNTR ary Health Center
PHS CNTR y Health Sub Center

FWC CNTR : Family Welfare Center
TB CLN : TB Clinic
N HOME : Nursing Home
RMP egistered Medical Pratitioners
SMP ıbsidized Medical Practitioners
CHW Community Health Workers
OTH CNTR : Other Centers

Annexure-VIII

Fly Ash MOU

ANNEXURE-VIII
FLYASH MoU

AC/MTRLS/08-09/

16th December, 2008

Shri Rakesh Mishra
Project Head
Hindustan Zinc Limited
CPP DARIBA

Sub: Lifting of Fly Ash from your 3 x 80 MW Dariba Smelter CPP

Dear Sir,

We are in need of huge quantity of Fly Ash for our cement manufacturing process. We shall therefore be in a position to lift 800 MTs of Fly Ash everyday from your 3 x 80 MW CPP at Dariba Smelter, subject to Fly Ash meeting our specified parameters viz LOI, Blaine etc.

Thanking you,

Yours faithfully
For ADITYA CEMENT
(Unit: Grasim Industries Limited)

(Yash Paul Singal)
General Manager (Materials)

ADITYA CEMENT
apuram - 312 622, Dist - Chittorgarh (Raj.) India. Tel. : (01472) 221001 - 221010, Fax : (01472) 221020, E-mail : adityacement@adityabirla.com
Registered Office : Grasim Industries Limited, Birlagram, Nagda - 456 331(M.P.)

SUBSIDENCE AND BLAST VIBRATION CONTROL

FOR

RAJPURA DARIBA MINES

ENVIRONMENT CLEARANCE

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

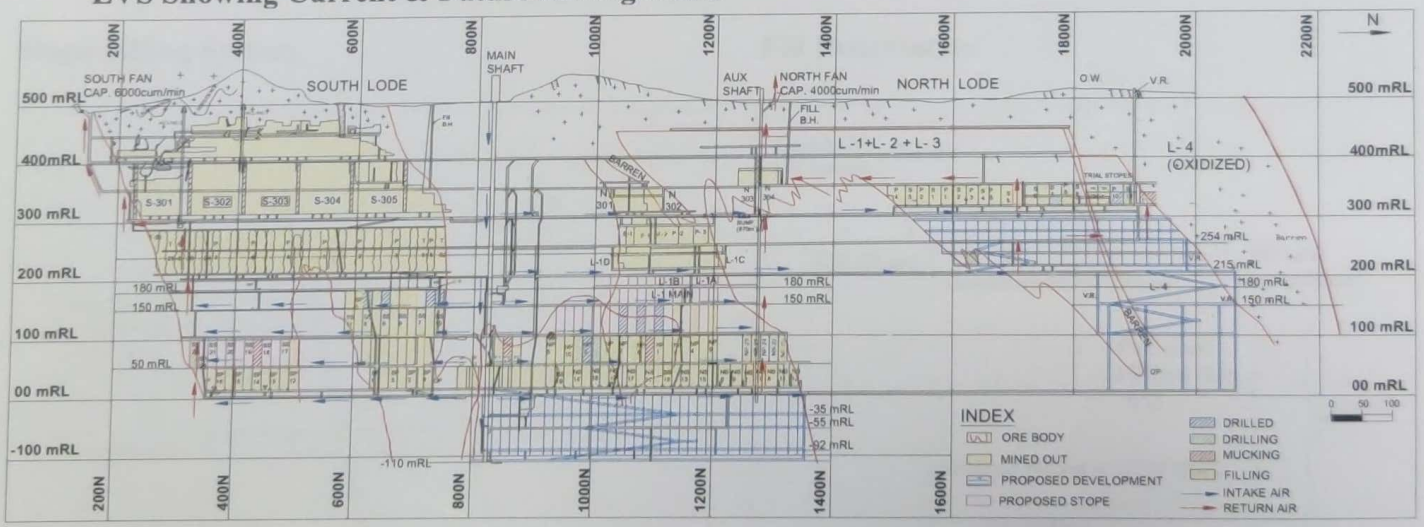
Salient Features – Mining

Mode of Entry	-	Shafts
Mining Method	-	Vertical Retreat Mining(VRM) & Blast Hole Stoping (BHS) ith back filling.
Capacity Enhancement-		0.631 mtpa to 0.90 mtpa
Beneficiation	-	0.90 to 1.2 mtpa

Present Power Requirement	-	9 MVA
Additional Power Requirement	-	3 MVA
Present Water Requirement	-	4600 KLD
Additional Water Requirement	-	1200 KLD
Additional Employment resource)	-	150 (Contractual
Total Investment	-	75 Crore
Proposed Life of Mine	-	20 years

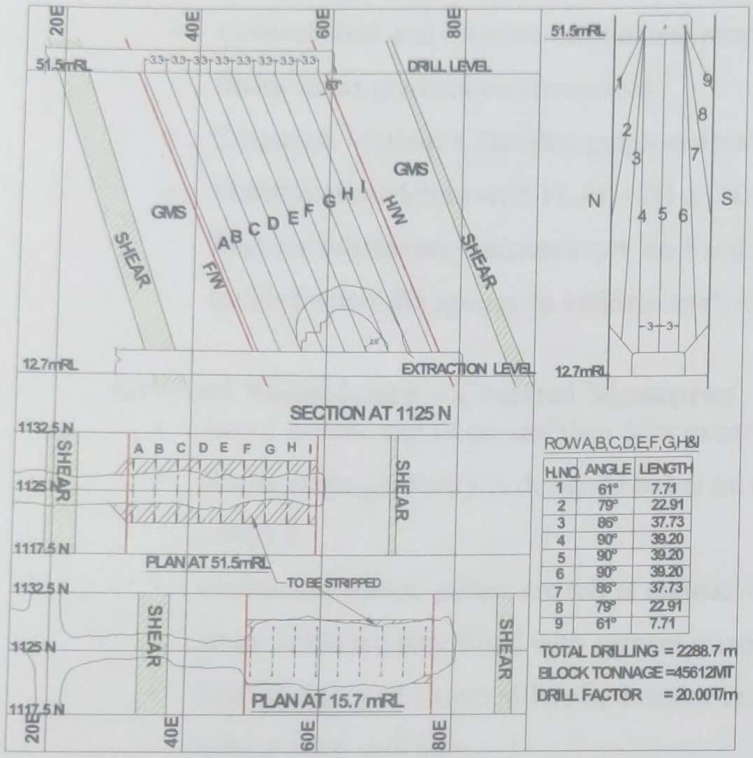
No additional approval for drawl of water will be required for proposed enhancement.

LVS Showing Current & Future Mining Block



ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Vertical Crater Retreat Mining Method:

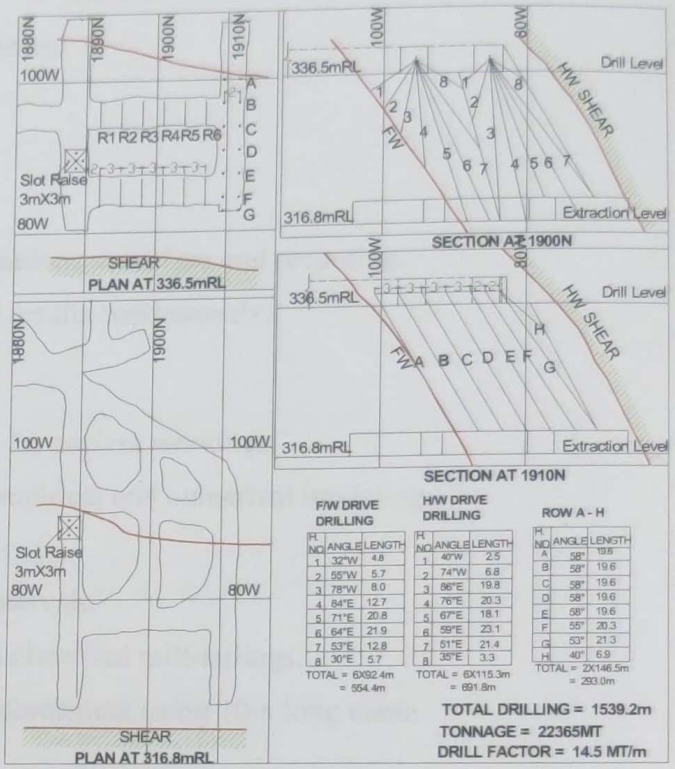


ROW A,B,C,D,E,F,G,H&I

H.NO.	ANGLE	LENGTH
1	61°	7.71
2	79°	22.91
3	86°	37.73
4	90°	39.20
5	90°	39.20
6	90°	39.20
7	86°	37.73
8	79°	22.91
9	61°	7.71

TOTAL DRILLING = 2288.7 m
BLOCK TONNAGE =45612MT
DRILL FACTOR = 20.00T/m

Blast Hole Stoping Method:



F/W DRIVE DRILLING

H. NO.	ANGLE	LENGTH
1	32°W	4.8
2	55°W	5.7
3	78°W	8.0
4	84°E	12.7
5	71°E	20.8
6	64°E	21.9
7	53°E	12.8
8	30°E	5.7

TOTAL = 6X92.4m = 554.4m

H/W DRIVE DRILLING

H. NO.	ANGLE	LENGTH
1	40°W	2.5
2	74°W	6.8
3	86°E	19.8
4	76°E	20.3
5	67°E	18.1
6	59°E	23.1
7	51°E	21.4
8	35°E	3.3

TOTAL = 6X115.3m = 691.8m

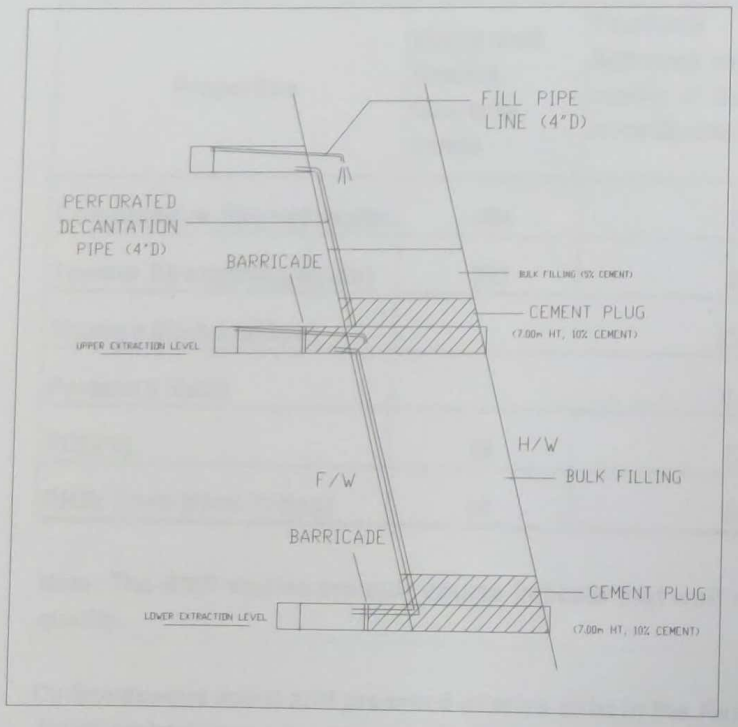
ROW A - H

H. NO.	ANGLE	LENGTH
A	58°	19.6
B	58°	19.6
C	58°	19.6
D	58°	19.6
E	58°	19.6
F	55°	20.3
G	53°	21.3
H	40°	6.9

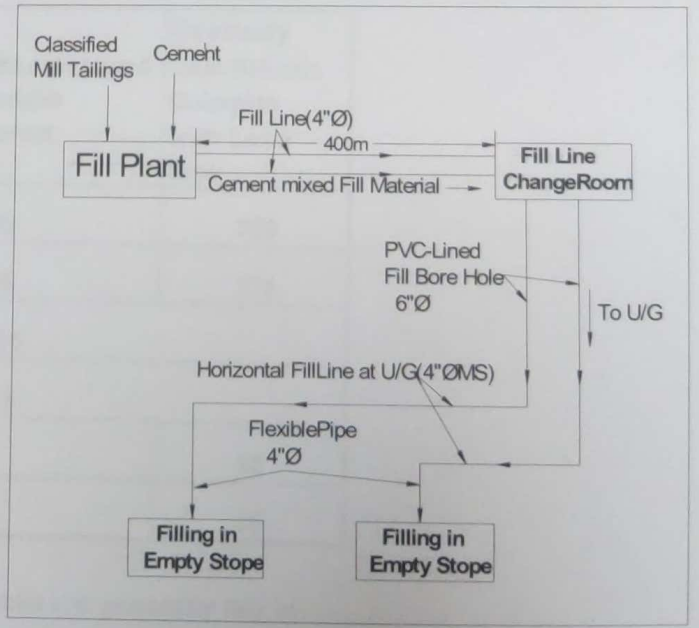
TOTAL = 2X146.5m = 293.0m

TOTAL DRILLING = 1539.2m
TONNAGE = 22365MT
DRILL FACTOR = 14.5 MT/m

Stope Filling System



Fill Reticulation



ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Ground Subsidence – Current Practices

- Geotechnical and Physico-mechanical properties.
- Insitu stress gradient determination .
- Empirical Mathew's Stability graph method.
- Numerical modeling with FLAC- 2D & 3D.
- Regular subsidence measurement on fixed stations at surface and recording.
- Involve scientific agency to validate analysis results continuously.
-

Ground Subsidence – Control Measures

- Intact surface cap of greater than 50m except for ancient workings.
- Stable stope geometry is designed based on empirical and numerical modeling analysis.
- Horizontal crown pillars are left at regular intervals.
- Stope voids are post filled with cement mixed classified mill-tailings.
- Strengthening of crown pillars by interior reinforcement using 10m long cable bolting from drill sills.
- Subsidence measurements are regularly done at surface stations above stoping area and record maintained.

Physico- Mechanical Properties of rock

Properties	Hang wall Chert & Quartzite bands	Footwall Schistose rocks composed mainly of Quartzite mica/Biotite schist	Orebody Calc Silicate Dolomite with Lead Zinc
Compressive Strength(kg/sq.	650	780	700
Tensile Strength(kg/sq.cm)	202	296	276
Young's Modulus(Gpa)	22-35 .		
Poisson's Ratio	0.23		
RQD(%)	65	75	85
RMR(Rock Mass Rating)	50	60	55

Note: The RMR studies are duly course indicate that wall rocks are generally fair in quality.

Carbonaceous schist and presence of mica chist in the Hang Wall added with shallow dip of orebodies render hanging Wall comparitively weeker than orebodies . Hence systematic vertical rib pillars at 50m interval along strike.

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

In situ stresses At 250mRL(240m from Surface)
(Hydro - Fracture test by NGRI Hyd.)

Max. Horizontal stress, SH	12.79MPa
Min. Horizontal stress, SH	9.50MPa
Vertical stress Sv	6.0MPa
Direction of Stress SH	N30E

Mathew's Stability Analysis for ensuring stable stope geometry:

- stability number N = Q' x A x B x C

- The modified rock mass ratings:-
  RQD (Rock Quality Designation) = 50 to 65

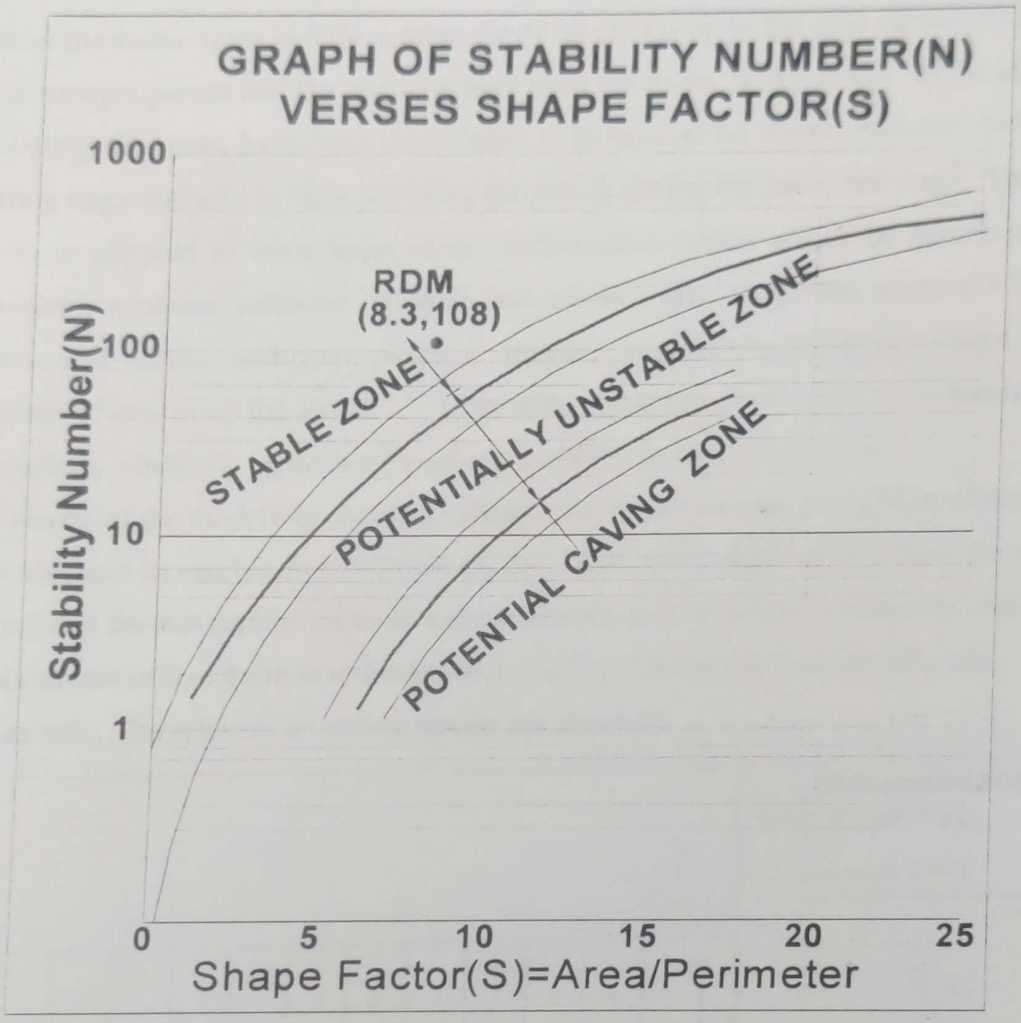
Ratings

- Jn (one set + random) = 3
- Jr (rough ,undulating) = 3
- Ja (tightly healed) = 0.75
- Jw (medium inflow) = 0.66
- SRF (Stress Reduction Factor) = 1

- Q' = (60*3*0.66) / (3*0.75*1)
  =52.8
- Sv = 10.0MPa at 0 mRL
- The intact rock strength of hanging wall (Sc) = 70Mpa
- Sc/Sv = 7
- Hence rock strength factor A is 0.65 from graph .
- The rock defect factor B is = 0.7 (major joint set are across hangwall)
-
- Hanging wall dips at 60 degrees
- C = 8 - 7* cosine 60 = 4.5

- Hence,
- N = 52.8 *0.65 * 0.7 * 4.5 = 108(corrected)
- Shape factor = area/perimeter
  (Stope height= 100m, 20m strike length, width of stope = 20m)
  S ,shape factor = (100*20) / 2 * (100 +20)
  Shape factor = 8.33

- The coordinate (8.33 , 108.0) falls very much in the stable zone in the Mathews stability graph.



(After Mathews et at 1981)

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Numerical Modelling for Ground Stability Analysis:

Numerical modelling analysis has been carried out to predict the stability of the ground around the excavations and the continuity of its effects up to the near surface rocks. The basic rock properties and the insitu stresses used are given in the report. In the numerical modelling the rocks have been considered to behave as an elastic material during load bearing stage and also to have plasticity properties during the post peak stage. The model has been allowed to store large strain/ deformation which are to be governed by its volumetric modulus, cohesive strength and tensile limits. Hence the model is allowed to display both elastic conditions, yielding situation or plasticity failure conditions. The resultant effects of all the above large stain conditions is allowed to be transferred to the surface, enabling identification of any possible surface disturbance.

The results of the modelling analysis indicate that the immediate Hang Wall of the stopes are stable and its displacements do not exceed 7mm upto a depth of 3m. Also the surface ground and the sub surface rocks do not experience any subsidence. However, negligible displacement of 0 to 5mm is indicated in modelling results and is practically not measurable. The relevant modeling results are attached.

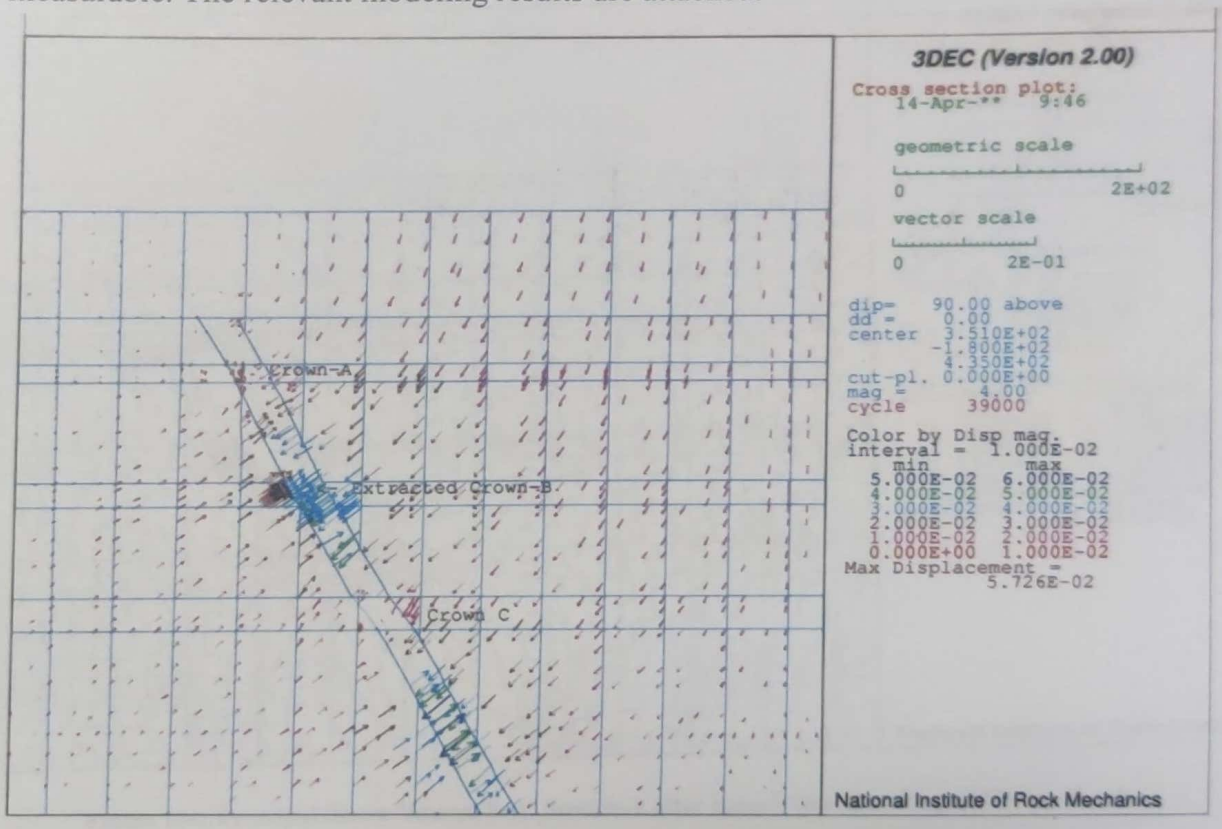


Figure 136: Displacement Vectors in V Section-1 after completion of mining of Crown-B only

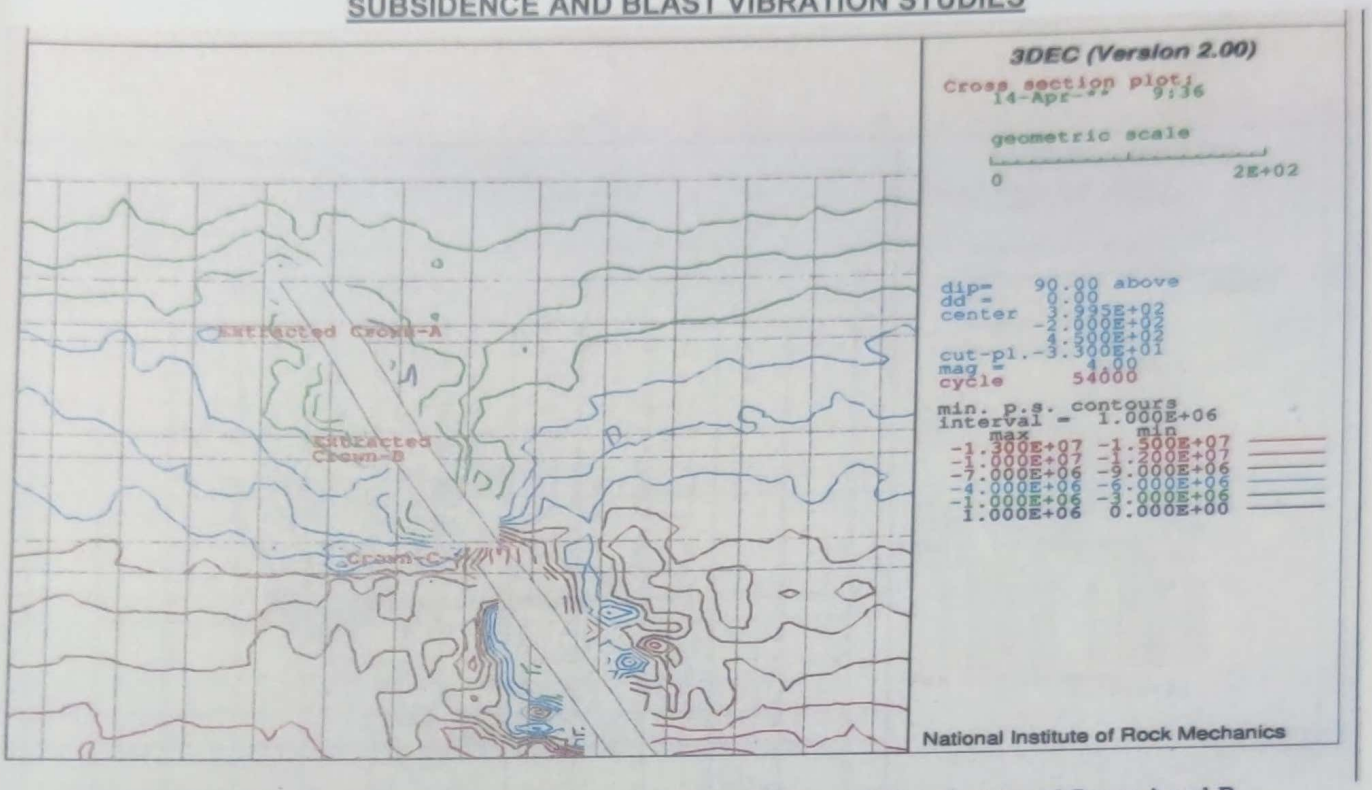


Figure 129: Minimum Principal Stress distribution in V Section-1 after completion of mining of Crown-A and B

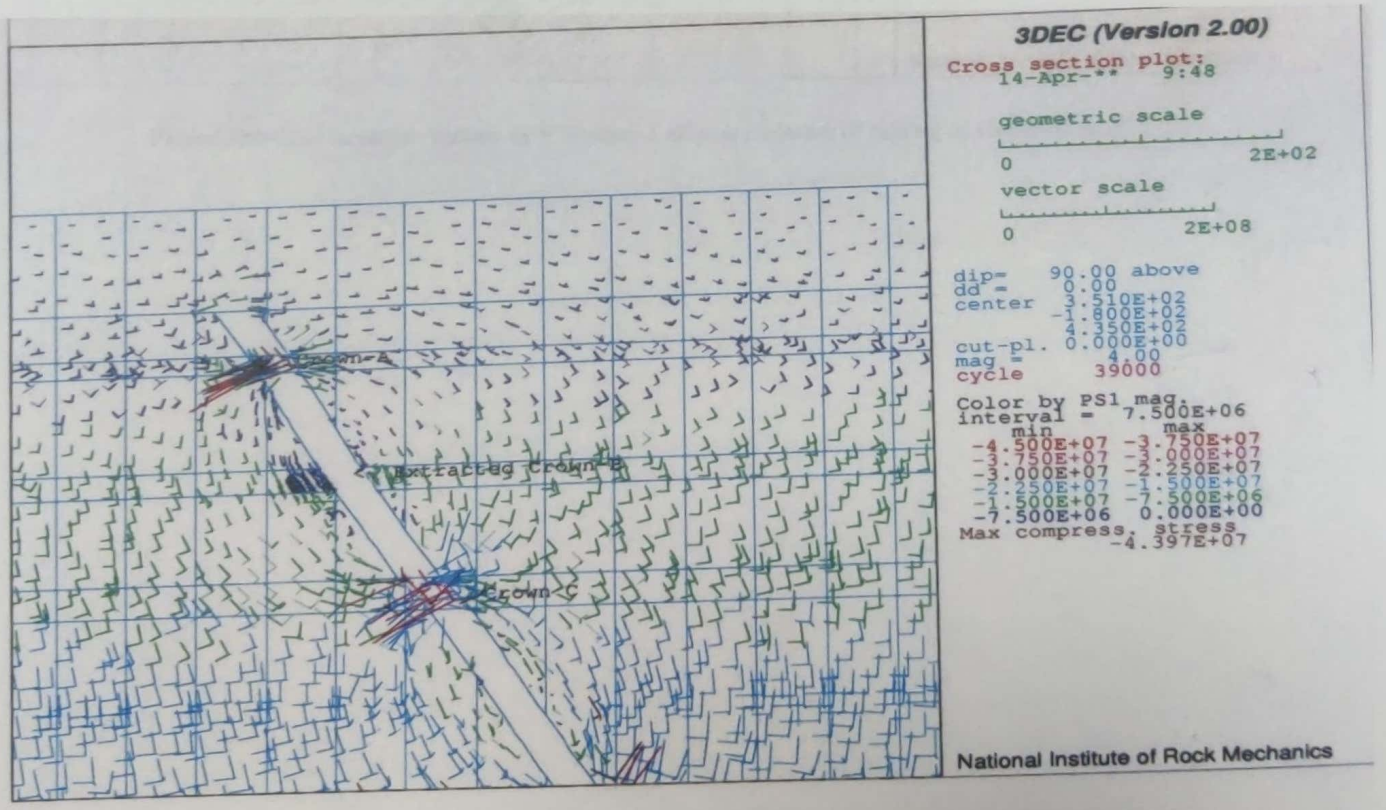


Figure 131: Principal Stress Vectors in V Section-1 after completion of mining of Crown-B only

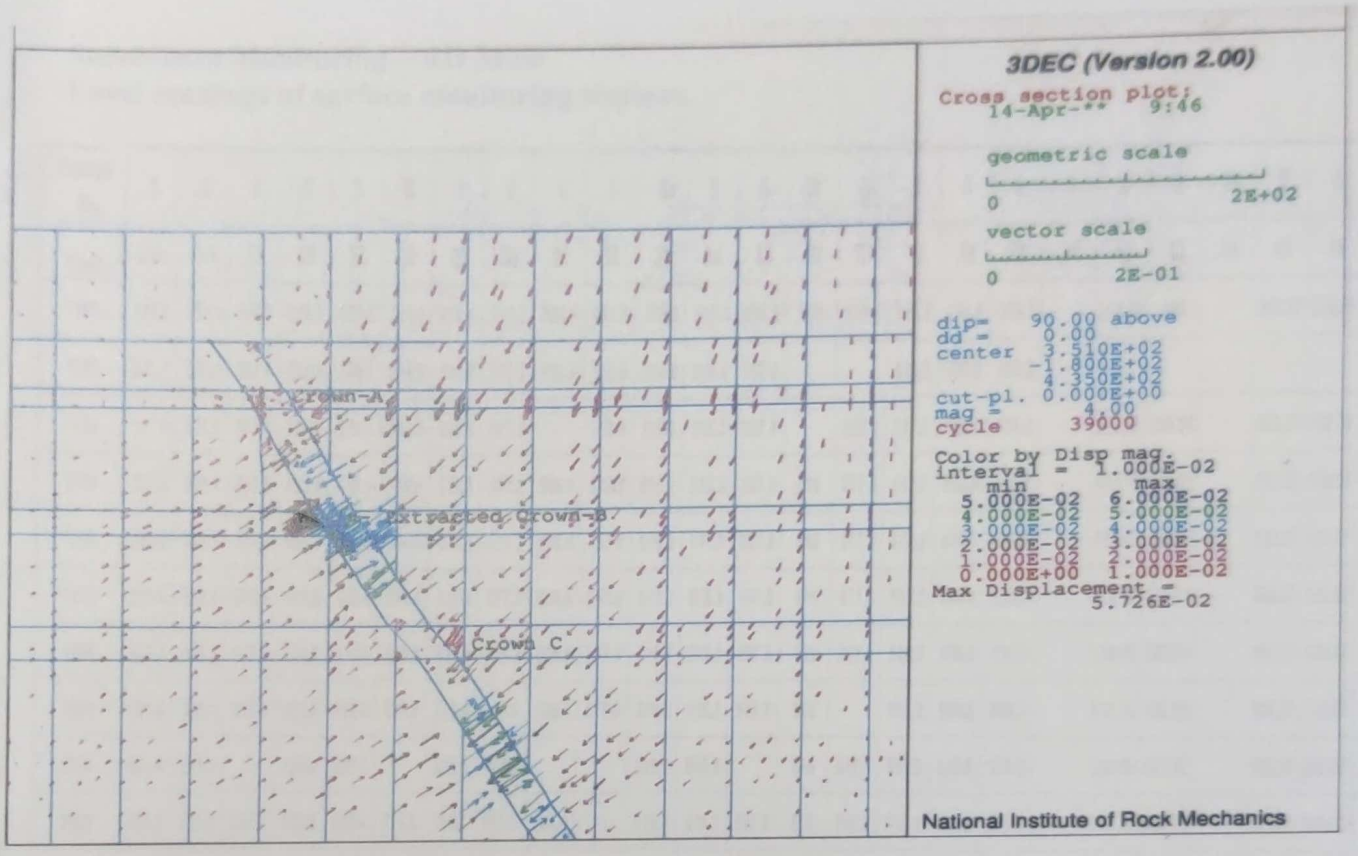


Figure 136: Displacement Vectors in V Section-1 after completion of mining of Crown-B only

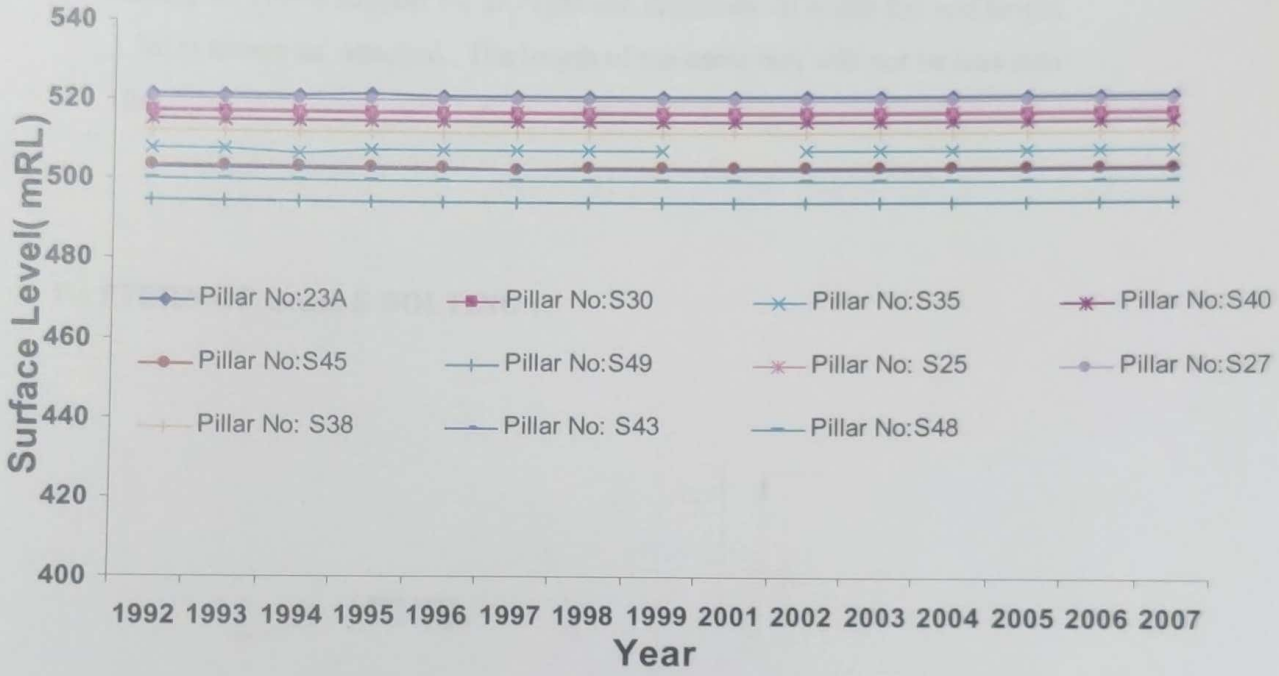
ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Subsidence Monitoring – RD Mine
Level readings of surface monitoring stations.

Station No	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Year	23A	24A	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
1992	521.6	521.1	517.6	520.7	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.9	515.3		510.76	503		503.37	500.07		500.17	494.6
1993	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.2	507.8			512.2	506.8	515.3									
1994	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2		517.9	519.2	515.3	507.8		517.8	512.2	506.8	515.3		510.76	503.01		503.37	500.07		500.18	
1995	527.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.76	503.02		503.37	500.07		500.18	
1996	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.77	503		503.37	500.07		500.18	494.6
1997	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.77	502.91		503.37	500.07		500.18	
1998	521.6	521.1	517.6	520.8	520.5	514.6	518.5	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.78	502.91		503.37	500.07		500.23	494.7
1999	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.1	508.4	517.9	519.2	515.3	507.8	516		512.2	506.8	515.3		510.76	502.91		503.37	500.07		500.17	494.6
2001	521.6	521.1		520.8	520.4		518.4	517.2			519.2	515.3		516	517.8	512.2	506.8	515.3		510.79	502.91		503.39	500.07		500.24	494.7
2002	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.2	508.4		519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.79	502.91		503.38	500.07		500.24	494.7
2003	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.2		517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3	513.47	510.8	502.91		503.36	500		500.22	494.7
2004	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.76	502.91		503.4	500		500.05	
2005	521.6	521.1	517.6	520.8	520.4		518.4	517.2		517.9	519.2	515.3	507.7	516	517.8	512.2	506.8	515.3		510.71	502.95		503.3	499.91		500.1	
2006	521.6	521.1		520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.7	516	517.8	512.2	506.8	515.3		510.71	502.91		503.3	499.9		500.09	494.6
2007	521.6				520.4	514.5	518.3			517.9	519.2		507.7		517.8		506.8	515.3		510.71	502.91		503.3	499.9		500.09	494.6
(Upto Dec 2008)	521.6				520.4	514.5	518.3			517.9	519.2		507.7		517.8		506.8	515.3		510.71	502.91		503.3	499.9		500.09	494.6

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

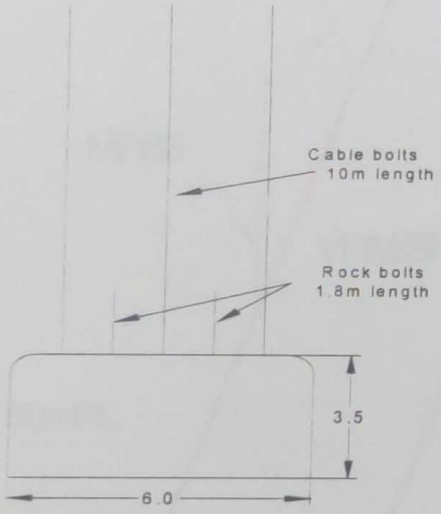
Subsidence Monitoring – RD Mine(Graphical)



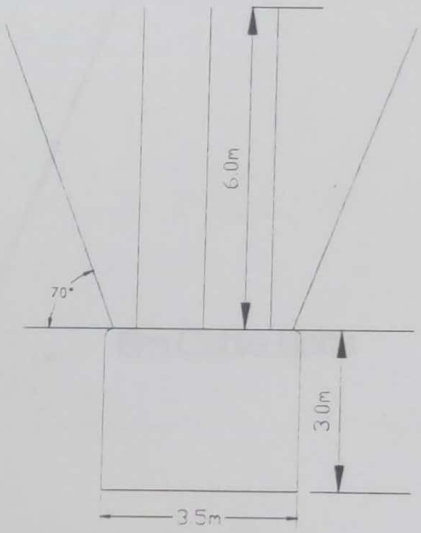
CABLE BOLTING FOR INTERIOR REINFORCEMENT OF ROCK MASS:

- The ore drives and cross cuts in in drill sills will be reinforced with cable bolting up to 10m in the crown to further stabilise the cap rock . Pattern of cable bolting for crown support for drivages and crosscuts of width 6m and height 3.5m is shown as attached . The length of the cable bolt will not be less than 10m.

PATTERN OF CABLE BOLTING :



Drill Sill

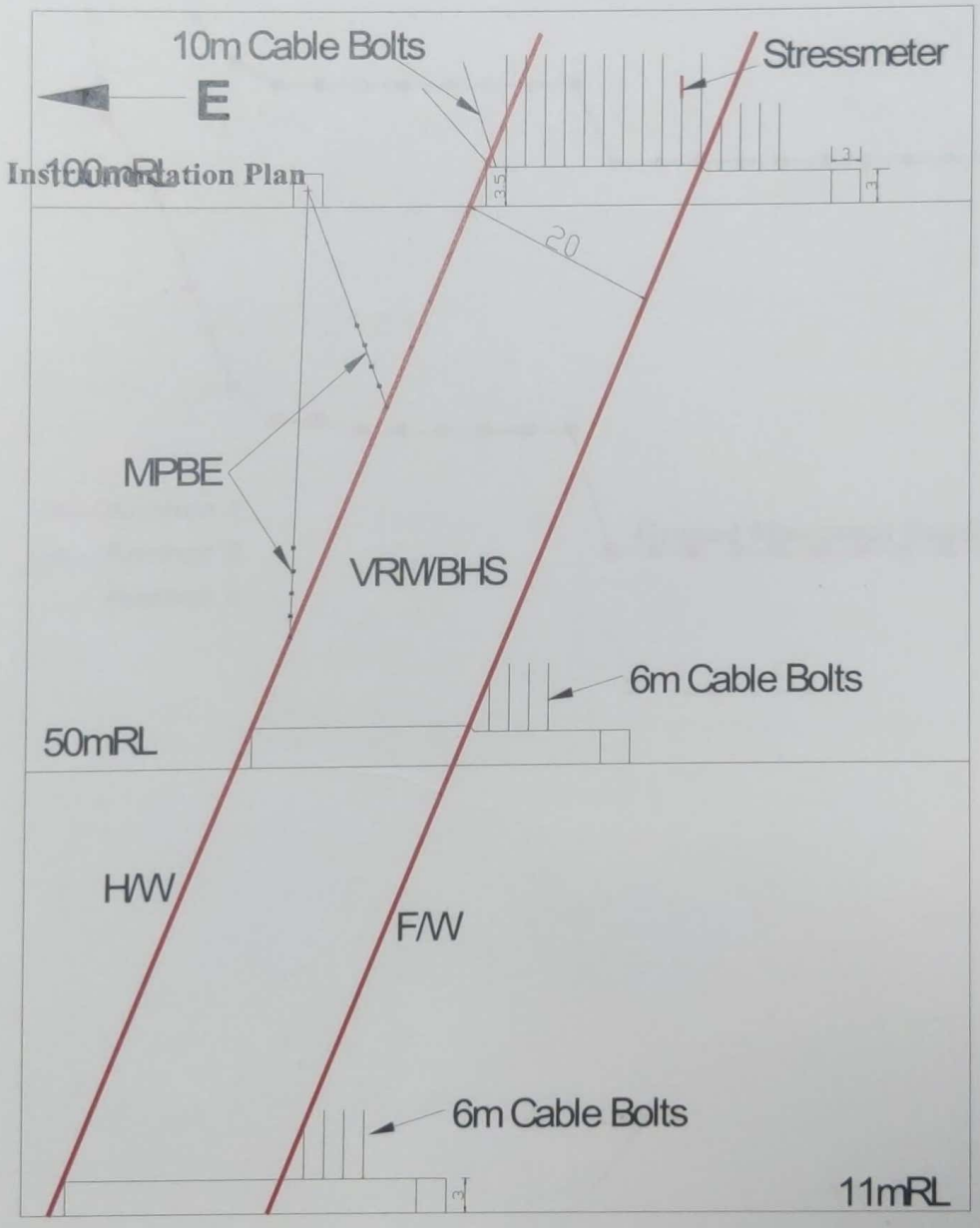


Extraction Brow

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

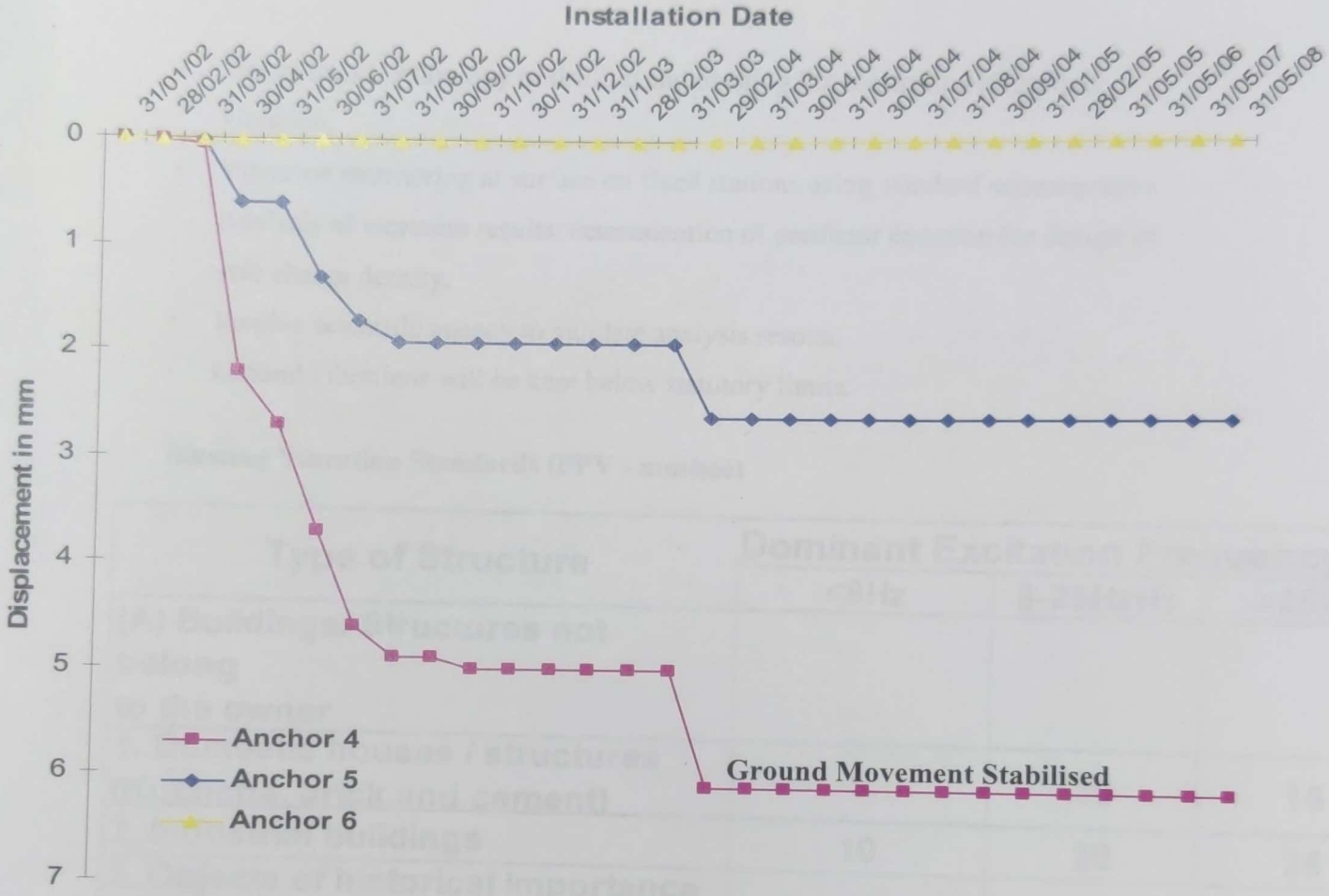
Instrumentation and Monitoring

- Ground movement is monitored with multi point bore hole extensometers .
- Stress concentrations are monitored with uniaxial bore hole stress meters specially in crown pillars.
- An instrumentation plan to monitor the movement of hanging wall and stress development in crown pillar is shown as attached.



ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

HANGWALL DISPLACEMENT



Blast Vibration Prediction and Control

- Use of latest technology of drilling and blasting for controlling of ground vibration.
- Vibration monitoring at surface on fixed stations using standard seismographs
- Analysis of vibration results, determination of predictor equation for design of safe charge density.
- Involve scientific agency to validate analysis results.
- Ground vibrations will be kept below statutory limits.

Blasting Vibration Standards (PPV - mm/sec)

Type of Structure	Dominant Excitation Frequency, H		
	<8Hz	8-25HzHz	>25Hz
(A) Buildings/ Structures not belong to the owner			
1. Domestic houses / structures (Kuchcha, brick and cement)	5	10	15
2. Industrial buildings	10	20	25
3. Objects of historical importance and sensitive structures	2	5	10
(B) Buildings belonging to owner with			
1. Domestic houses / structures	10	15	25
2. Industrial buildings	15	25	50

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Peak Particle Velocity - Predictor Equation

$$V = k \times (R/Qmax1/2)-b$$

V= Peak Particle velocity (mm/s)
K,b are site constants to be determined by regression analysis
R= Distance of the measuring transducer from the blasting face (m)
Qmax= maximum explosives weight per delay (kg)

Blast Vibration Analysis - Current Observations

Date	Location of blast	Total Explosive Kg	Maximum charge per delay, Kg	Monitoring distance, M	P.P.V. mm/sec	Measuring station
13/5/05	NS-16(50MRL) CROWN BLAST			456	2.24,2.68	RMC
10/7/05	SP-13(50MRL) CROWN BLAST			651	5.89	MATAJI TEMPLE
20/8/05	NS-16(100MRL) CROWN BLAST			407	6.26,10.59	RMC
1/10/05	441N(50MRL) CROWN BLAST			630	3.28	MATAJI TEMPLE
15/11/05	SP-12(50MRL)	2750	425	673	1.49	MATAJI TEMPLE
23/12/05	NB-9(50MRL)	252	50	451	2.117,1.953	RMC
23/12/05	T-19(50MRL) CROWN BLAST	3840	400	517	1.446,1.208	RMC
11/1/06	SP-15(50MRL)	712	32	69	36.68,20.43	SP-13(50MRL)
13/1/06	SP-15(50MRL)	550	37	67	62.33	SP-13(50MRL)
16/1/06	SP-15(50MRL)	500	37	66	10.14	SP-13(50MRL)
17/1/06	NB-11(50MRL)	700	125	574	2.38	SP-13(50MRL)
21/1/06	SP-15(50MRL)	600	36	64	23.26,5.67	SP-13(50MRL)
25/1/06	SP-15(50MRL)	700	37	62	28.18,3.88	SP-13(50MRL)
3/2/06	SP-15(50MRL)	750	31.25	61	7	SP-13(50MRL)
23/2/06	SP-15(50MRL)	612.5	31.25	60	6.56,7.9	SP-13(50MRL)
4/3/06	SP-15(50MRL) CROWN BLAST	3043.75	188	609	1.98,2.35	MATAJI TEMPLE
7/3/06	NB-11(50MRL)	325	81.25	469	1.31,1.34	RMC
4/5/06	SS-5(150 MRL) CROWN BLAST	3275	425	713	2.87,1.43	MATAJI TEMPLE
5/6/06	NS-11(50MRL)	3886.25	378.2	462	3.43,3.88	RMC
5/6/06	NS-11(50MRL) CROWN BLAST	3886.25	378.2	480	6.12	MAIN SHAFT
23/8/06	SP-16(50MRL) CROWN BLAST	5500	250	589	2.68,1.19	MATAJI TEMPLE
7/11/06	SP-16	625	65.75	425	12.82,4.62	MAIN SHAFT, 50MRL INSET
7/11/06	SP-22(50MRL) FIRST BLAST	187	31.25	65,95	52.62,14.76	MAIN SHAFT, 50MRL INSET
21/11/06	SS-18	662.5	150	365	3.88	0 MRL INFRONT OF MAIN SHAFT
21/11/06	NS-12	268.25	37.5	219	5.22	0 MRL INFRONT OF MAIN SHAFT
21/11/06	SP-22(50MRL)	512	62	12	19.98	0 MRL INFRONT OF MAIN SHAFT
27/11/06	SP-22(50MRL)	600	65	602	4.62,5.52	RMC
27/11/06	NS-12(100MRL) CROWN BLAST	2693.75	387.5	433	4.62	RMC
2/12/06	456N(50MRL) CROWN BLAST	3468.75	325	670	2.58	MATAJI TEMPLE
10/12/06	SP-22(50MRL) CROWN BLAST	900	100	450	2.83	MAIN SHAFT
27/3/07	SP-23	750	90	450	1.4	MAIN SHAFT
27/3/07	SP-11	900	85		1.27	MAIN SHAFT
5/4/07	SS-19	4120	480		2.16	MATAJI TEMPLE
12/4/07	41N	3500	475		1.65	MATAJI TEMPLE

Contd...

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Date	Location of blast	Total Explosive Kg	Maximum charge per delay, Kg	Monitoring distance, M	P.P.V. mm/sec	Measuring station
2/6/07	SP23	650	71	450	0.83	MAIN SHAFT
21/6/07	SS-21	3800	275	580	5.06	MATAJI TEMPLE
23/7/07	P-1	706.75	162	100	>31.75	U/G MAIN SHAFT INSET 100 MRL
26/7/07	NS-19			130	21.6	U/G MAIN SHAFT INSET 100 MRL
26/7/07	P-1	531.25	75	100	33.6	U/G MAIN SHAFT INSET 100 MRL
26/7/07	NP-8	656	93.75		3.08	U/G MAIN SHAFT INSET 100 MRL
1/8/07	NP-9(CROWN BLAST)	3900	387.51		6.06	RMC
6/8/07	P-1(CROWN BLAST)		240	100	61.3	U/G MAIN SHAFT INSET 100 MRL
30/11/07	NP8(150mRL) CROWN BLAST	3875	331.25	350	1)15.4 2) 16.00	1)DG SET 2) S/F BACKSIDE IN SUB STATION PILLAR
8/12/07	NS21 100mRL	2375	200	400	1)14.2 2) 5.86	1)AUXILARY SHAFT 2) S/F
8/12/07	NP4(100mRL)	1950	160	410	1)12.4 2) 6.72	1)AUXILARY SHAFT 2) S/F
28/12/07	NS-17 1066N 50mRL(CROWN BLAST)	3900	387.51	420	1)3.33 2) 3.37	1)DG SET FOUNDATION 2) S/F
8/1/08	711N 150mRL	368.55	50	185	1)4.41 2)4.91	1)U/G 150mRL INSET 2) M/S ECODET 11HOLES
9/1/08	711N 150mRL	593	62.5	185	1)7.97 2)5.99	1)U/G 150mRL INSET 2) M/S ECODET 16HOLES
11/1/08	711N 150mRL	437.5	100	180	1)20.6 2)21.0	1)U/G 150mRL INSET 2) M/S ECODET 5HOLES
12/1/08	711N 150mRL	525	75	180	1)8.87 2)7.56	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)15HOLES
16/1/08	711N 150mRL	650	150	175	1)11.1 2)10.4	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)7HOLES
17/1/08	711N 150mRL	500	62.5	175	1)5.63 2)6.68	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)16HOLES
18/1/08	711N 150mRL	781.25	75	175	1)8.87 2)10.4	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)17HOLES
21/1/08	711N 150mRL	756.25	100	170	1)9.76 2)12.0	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)10HOLES
22/1/08	711N 150mRL	286.25	75	170	1)9.96 2)10.9	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)7HOLES
24/1/08	711N 150mRL	600	75	165	1)8.35 2)8.13	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)16HOLES
26/1/08	711N 150mRL	687.5	75	165	1)10.8 2)11.3	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)16HOLES
6/2/2008	711N 150mRL	487.5	62.5	160	1)7.56 2)9.39	1)U/G 150mRL INSET 2) M/S ECO DET 15HOLES
8/4/2008	711N 150mRL	650	56.25	160	1)5.86 2)6.36	1)U/G 150mRL INSET 2) M/S ECO DET
11/5/2008	711N 150mRL	662.5	50	155	7.72	U/G 150mRL INSET ECO DET
12/6/2008	711N 150mRL	537	50	150	1)8.72 2)9.63	U/G 150mRL INSET ECO DET
13/7/2008	1066N 100mRL	3900	387.5	370	1)9.83 2)9.36	1) S/F 2)DG SET BACKSIDE NEAR AIR CLEANER ECODET
10/9/2008	NP4 1170N CROWN BLAST	4500	350	350	8.09	RMC

Annexure-IX
Subsidence and Blast Vibration Studies

SUBSIDENCE AND BLAST VIBRATION CONTROL

FOR

RAJPURA DARIBA MINES

ENVIRONMENT CLEARANCE

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Salient Features – Mining

Mode of Entry - Shafts

Mining Method - Vertical Retreat Mining(VRM)
& Blast Hole Stoping (BHS) ith back filling.

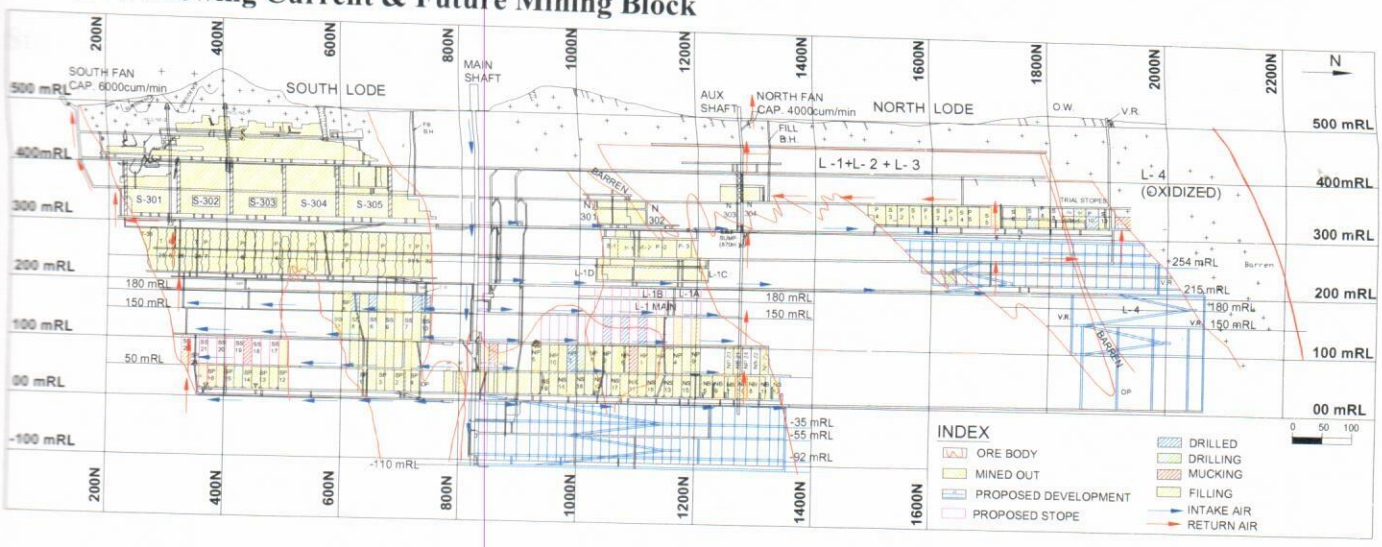
Capacity Enhancement- 0.631 mtpa to 0.90 mtpa

Beneficiation - 0.90 to 1.2 mtpa

Present Power Requirement	-	9 MVA
Additional Power Requirement	-	3 MVA
Present Water Requirement	-	4600 KLD
Additional Water Requirement	-	1200 KLD
Additional Employment resource)	-	150 (Contractual
Total Investment	-	75 Crore
Proposed Life of Mine	-	20 years

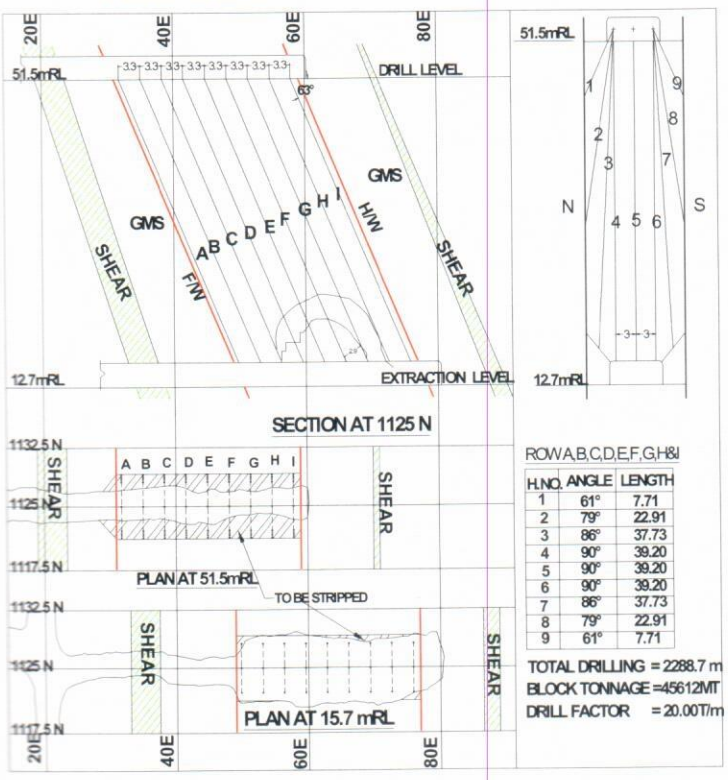
No additional approval for drawl of water will be required for proposed enhancement.

LVS Showing Current & Future Mining Block



ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Vertical Crater Retreat Mining Method:

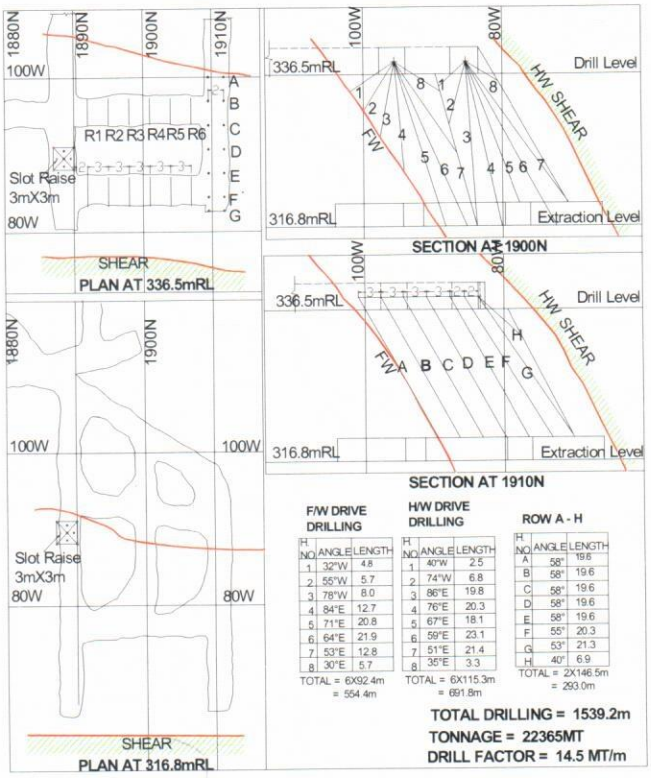


ROW A,B,C,D,E,F,G,H&I

H.NO.	ANGLE	LENGTH
1	61°	7.71
2	79°	22.91
3	86°	37.73
4	90°	39.20
5	90°	39.20
6	90°	39.20
7	86°	37.73
8	79°	22.91
9	61°	7.71

TOTAL DRILLING = 2288.7 m
BLOCK TONNAGE =45612MT
DRILL FACTOR = 20.00T/m

Blast Hole Stoping Method:



F/W DRIVE DRILLING

H.NO.	ANGLE	LENGTH
1	32°W	4.8
2	55°W	5.7
3	78°W	8.0
4	84°E	12.7
5	71°E	20.8
6	64°E	21.9
7	53°E	12.8
8	30°E	5.7

TOTAL = 6X92.4m = 554.4m

H/W DRIVE DRILLING

H.NO.	ANGLE	LENGTH
1	40°W	2.5
2	74°W	6.8
3	86°E	19.8
4	76°E	20.3
5	67°E	18.1
6	59°E	23.1
7	51°E	21.4
8	35°E	3.3

TOTAL = 6X115.3m = 691.8m

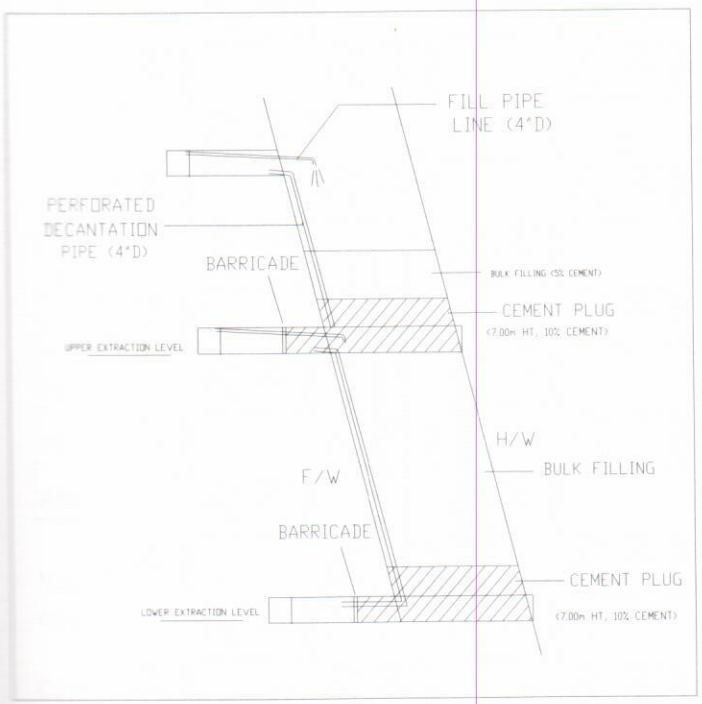
ROW A - H

H.NO.	ANGLE	LENGTH
A	58°	19.6
B	58°	19.6
C	58°	19.6
D	58°	19.6
E	58°	19.6
F	55°	20.3
G	53°	21.3
H	40°	6.9

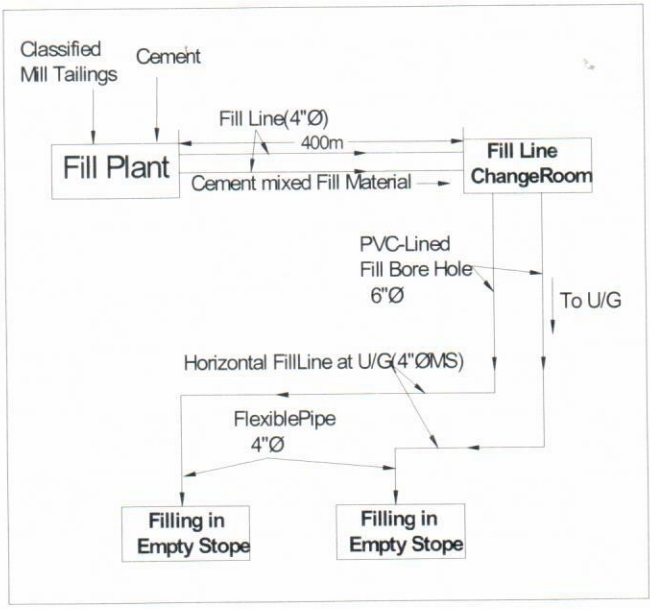
TOTAL = 2X146.5m = 293.0m

TOTAL DRILLING = 1539.2m
TONNAGE = 22365MT
DRILL FACTOR = 14.5 MT/m

Stope Filling System



Fill Reticulation



ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Ground Subsidence – Current Practices

- Geotechnical and Physico-mechanical properties.
- Insitu stress gradient determination .
- Empirical Mathew's Stability graph method.
- Numerical modeling with FLAC- 2D & 3D.
- Regular subsidence measurement on fixed stations at surface and recording.
- Involve scientific agency to validate analysis results continuously.
-

Ground Subsidence – Control Measures

- Intact surface cap of greater than 50m except for ancient workings.
- Stable stope geometry is designed based on empirical and numerical modeling analysis.
- Horizontal crown pillars are left at regular intervals.
- Stope voids are post filled with cement mixed classified mill-tailings.
- Strengthening of crown pillars by interior reinforcement using 10m long cable bolting from drill sills.
- Subsidence measurements are regularly done at surface stations above stoping area and record maintained.

Physico- Mechanical Properties of rock

Properties	Hang wall Chert & Quartzite bands	Footwall Schistose rocks composed mainly of Quartzite mica/Biotite schist	Orebody Calc Silicate Dolomite with Lead Zinc
Compressive Strength(kg/sq.	650	780	700
Tensile Strength(kg/sq.cm)	202	296	276
Young's Modulus(Gpa)	22-35.		
Poisson's Ratio	0.23		
RQD(%)	65	75	85
RMR(Rock Mass Rating)	50	60	55

Note: The RMR studies are duly course indicate that wall rocks are generally fair in quality.

Carbonaceous schist and presence of mica chist in the Hang Wall added with shallow dip of orebodies render hanging Wall comparitively weeker than orebodies . Hence systematic vertical rib pillars at 50m interval along strike.

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

In situ stresses At 250mRL(240m from Surface)
(Hydro - Fracture test by NGRI Hyd.)

Max. Horizontal stress, SH	12.79MPa
Min. Horizontal stress, SH	9.50MPa
Vertical stress Sv	6.0MPa
Direction of Stress SH	N30E

Mathew's Stability Analysis for ensuring stable stope geometry:

- stability number N = Q' x A x B x C

- The modified rock mass ratings:-
  RQD (Rock Quality Designation) = 50 to 65

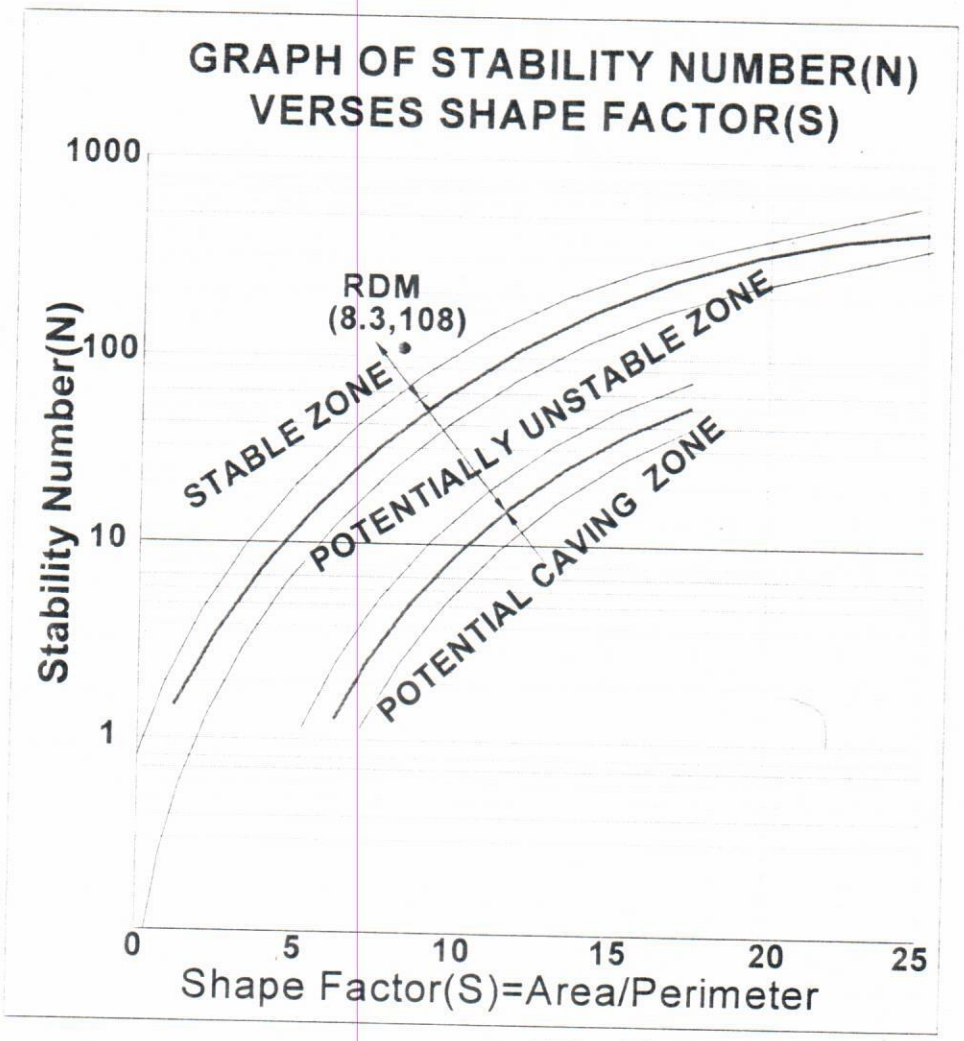
Ratings

- Jn (one set + random) = 3
- Jr (rough ,undulating) = 3
- Ja (tightly healed) = 0.75
- Jw (medium inflow) = 0.66
- SRF (Stress Reduction Factor) = 1

- Q' = (60*3*0.66) / (3*0.75*1)
  =52.8
- Sv = 10.0MPa at 0 mRL
- The intact rock strength of hanging wall (Sc) = 70Mpa
- Sc/Sv = 7
- Hence rock strength factor A is 0.65 from graph .
- The rock defect factor B is = 0.7 (major joint set are across hangwall)
-
- Hanging wall dips at 60 degrees
- C = 8 - 7* cosine 60 = 4.5

- Hence,
- N = 52.8 *0.65 * 0.7 * 4.5 = 108(corrected)
- Shape factor = area/perimeter
  (Stope height= 100m, 20m strike length, width of stope = 20m)
  S .shape factor = (100*20) / 2 * (100 +20)
  Shape factor = 8.33

- The coordinate (8.33 , 108.0) falls very much in the stable zone in the Mathews stability graph.



(After Mathews et at 1981)

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Numerical Modelling for Ground Stability Analysis:

Numerical modelling analysis has been carried out to predict the stability of the ground around the excavations and the continuity of its effects up to the near surface rocks. The basic rock properties and the insitu stresses used are given in the report. In the numerical modelling the rocks have been considered to behave as an elastic material during load bearing stage and also to have plasticity properties during the post peak stage. The model has been allowed to store large strain/ deformation which are to be governed by its volumetric modulus, cohesive strength and tensile limits. Hence the model is allowed to display both elastic conditions, yielding situation or plasticity failure conditions. The resultant effects of all the above large stain conditions is allowed to be transferred to the surface, enabling identification of any possible surface disturbance.

The results of the modelling analysis indicate that the immediate Hang Wall of the stopes are stable and its displacements do not exceed 7mm upto a depth of 3m. Also the surface ground and the sub surface rocks do not experience any subsidence. However, negligible displacement of 0 to 5mm is indicated in modelling results and is practically not measurable. The relevant modeling results are attached.

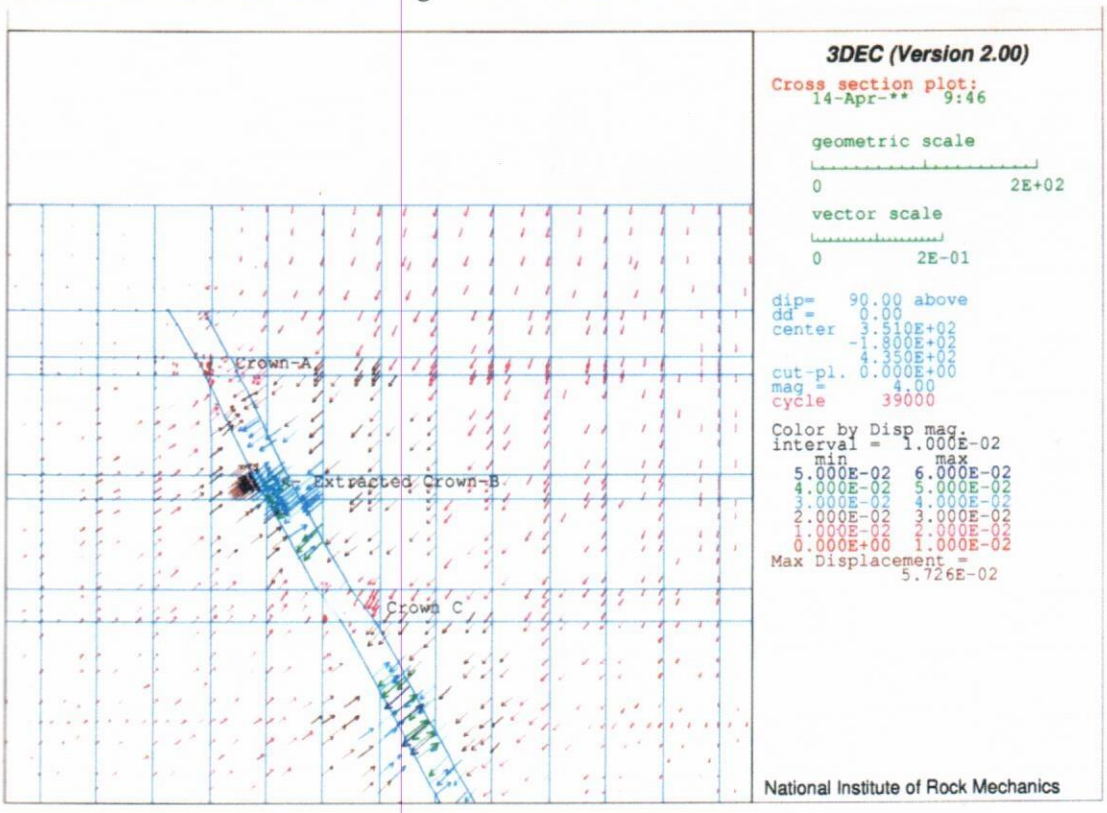


Figure 136: Displacement Vectors in V Section-1 after completion of mining of Crown-B only

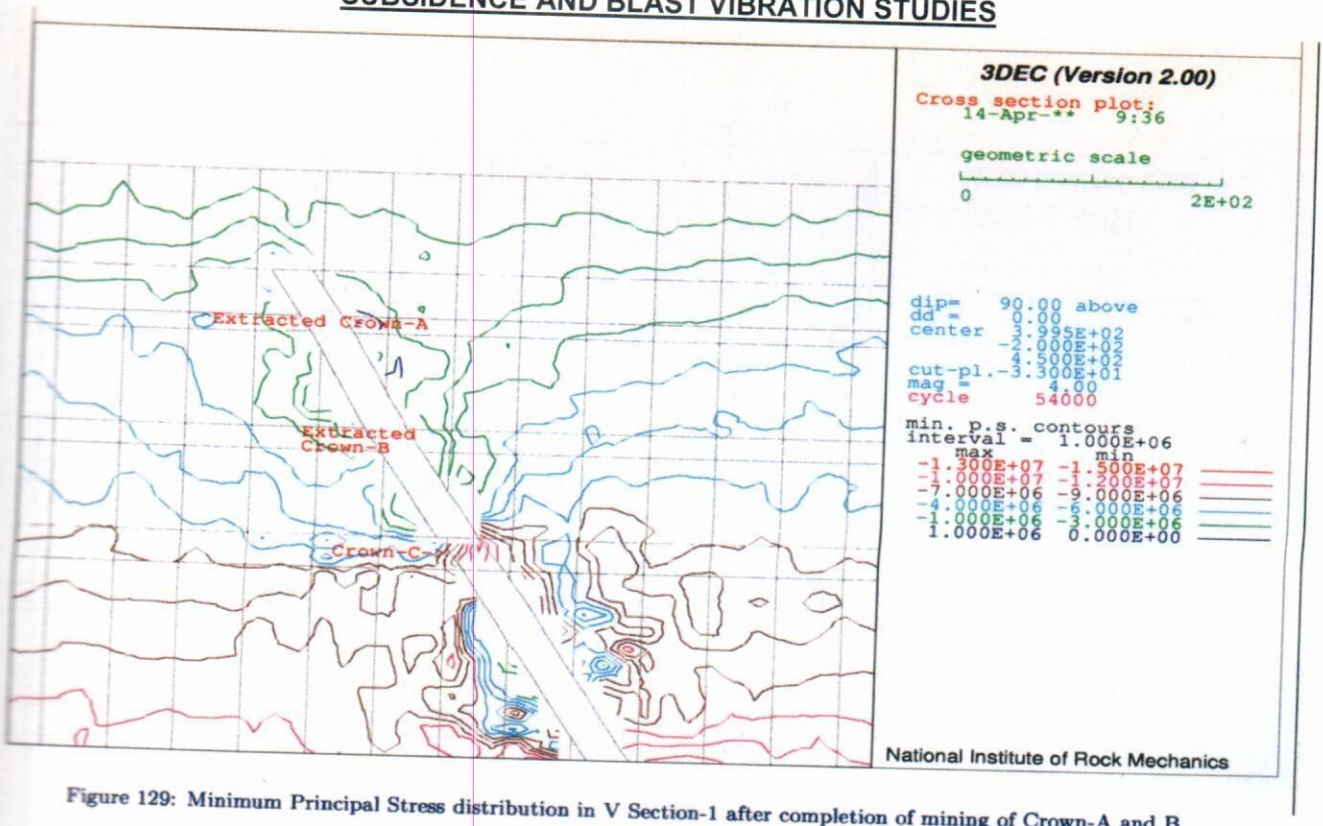


Figure 129: Minimum Principal Stress distribution in V Section-1 after completion of mining of Crown-A and B

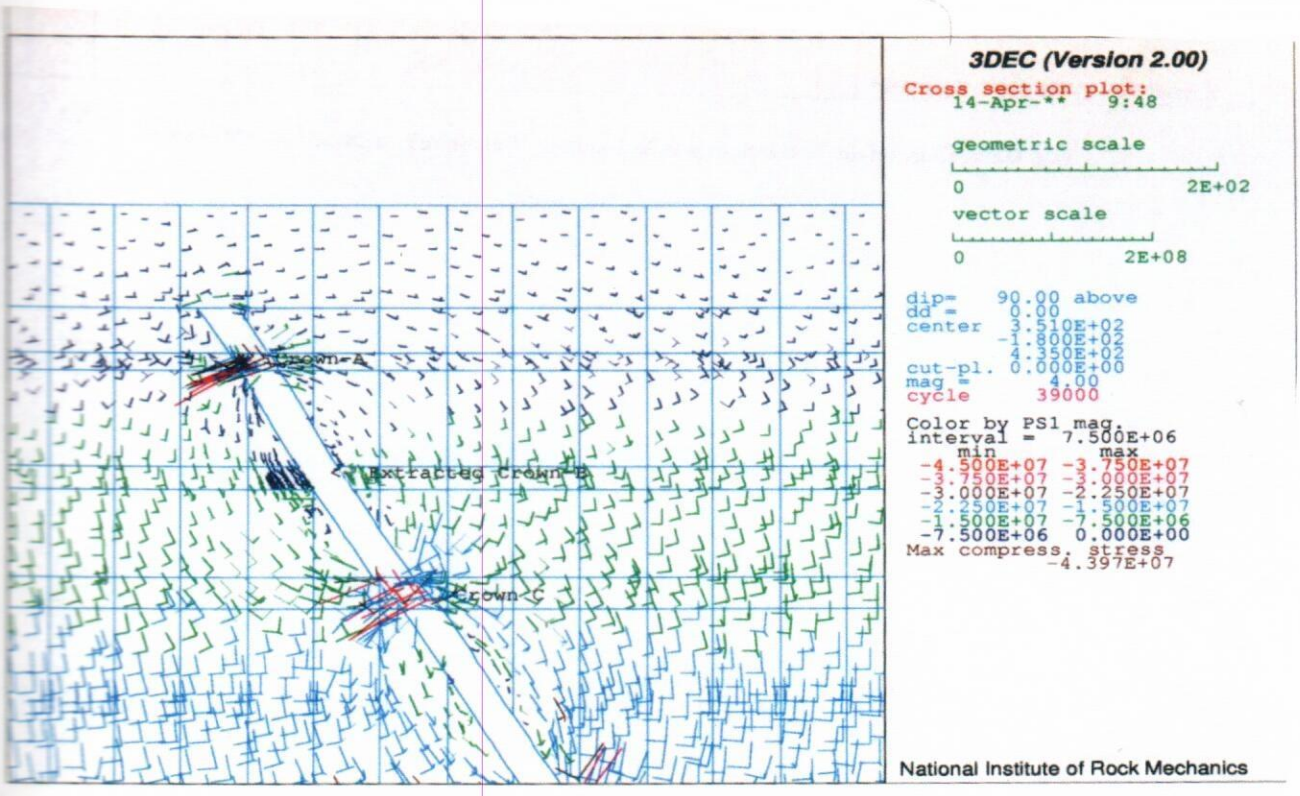


Figure 131: Principal Stress Vectors in V Section-1 after completion of mining of Crown-B only

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

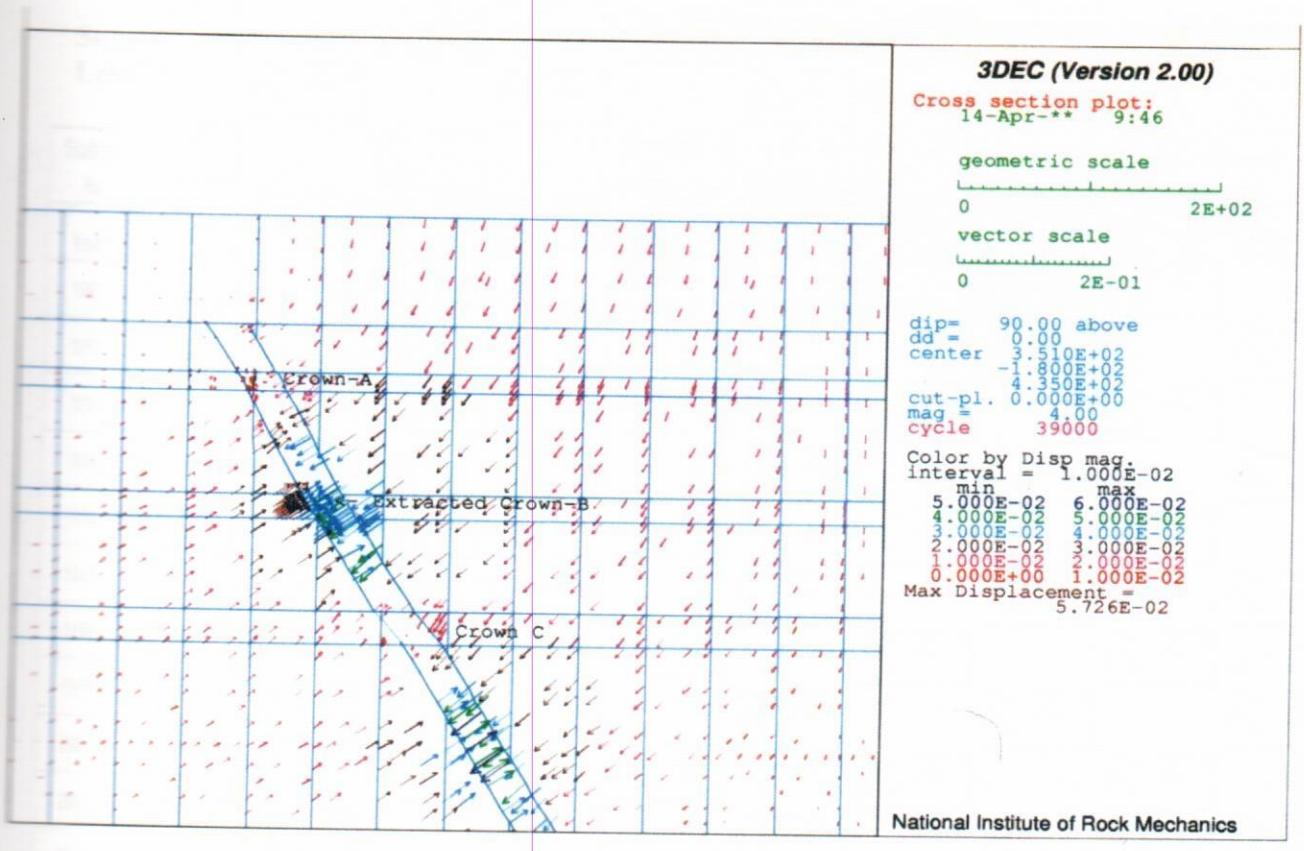


Figure 136: Displacement Vectors in V Section-1 after completion of mining of Crown-B only

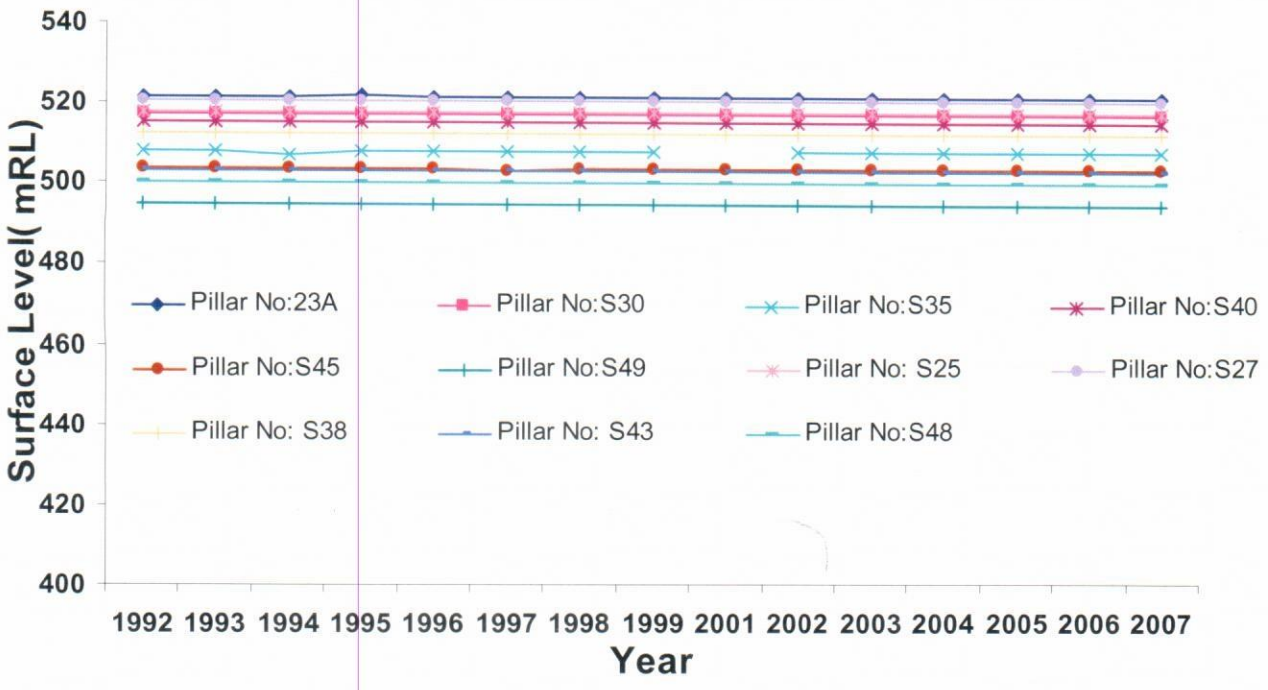
ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Subsidence Monitoring – RD Mine
Level readings of surface monitoring stations.

Station No	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Year	23A	24A	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	
1992	521.6	521.1	517.6	520.7	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.9	515.3		510.76	503		503.37	500.07		500.17	494.6	
1993	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.2	507.8			512.2	506.8	515.3										
1994	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2		517.9	519.2	515.3	507.8		517.8	512.2	506.8	515.3		510.76	503.01		503.37	500.07		500.18		
1995	527.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.76	503.02		503.37	500.07		500.18		
1996	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.77	503		503.37	500.07		500.18	494.6	
1997	521.6	521.1	517.6	520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.77	502.91		503.37	500.07		500.18		
1998	521.6	521.1	517.6	520.8	520.5	514.6	518.5	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.78	502.91		503.37	500.07		500.23	494.7	
1999	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.1	508.4	517.9	519.2	515.3	507.8	516		512.2	506.8	515.3		510.76	502.91		503.37	500.07		500.17	494.6	
2001	521.6	521.1		520.8	520.4		518.4	517.2			519.2	515.3		516	517.8	512.2	506.8	515.3		510.79	502.91		503.39	500.07		500.24	494.7	
2002	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.2	508.4		519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.79	502.91		503.38	500.07		500.24	494.7	
2003	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.2		517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3	513.47	510.8	502.91		503.36	500		500.22	494.7	
2004	521.6	521.1	517.6	520.8	520.4	514.6	518.4	517.2	508.4	517.9	519.2	515.3	507.8	516	517.8	512.2	506.8	515.3		510.76	502.91		503.4	500		500.05		
2005	521.6	521.1	517.6	520.8	520.4		518.4	517.2		517.9	519.2	515.3	507.7	516	517.8	512.2	506.8	515.3		510.71	502.95		503.3	499.91		500.1		
2006	521.6	521.1		520.8	520.4	514.5	518.4	517.2	508.4	517.9	519.2	515.3	507.7	516	517.8	512.2	506.8	515.3		510.71	502.91		503.3	499.9		500.09	494.6	
2007	521.6				520.4	514.5	518.3			517.9	519.2		507.7		517.8		506.8	515.3		510.71	502.91		503.3	499.9		500.09	494.6	
(Upto Dec 2008)	521.6				520.4	514.5	518.3			517.9	519.2		507.7		517.8		506.8	515.3		510.71	502.91		503.3	499.9		500.09	494.6	

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Subsidence Monitoring – RD Mine(Graphical)

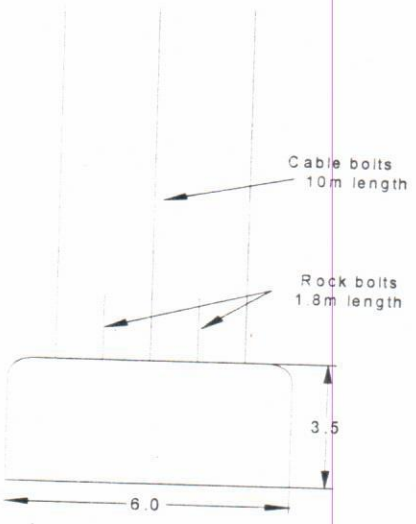


ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

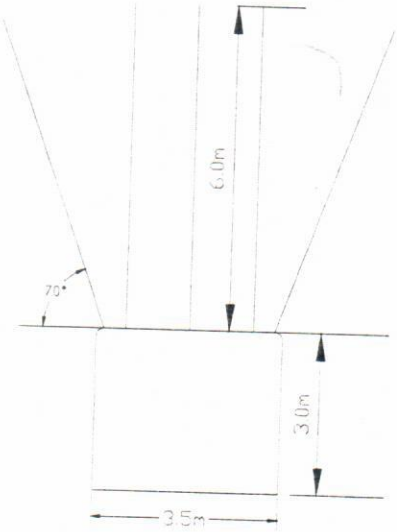
CABLE BOLTING FOR INTERIOR REINFORCEMENT OF ROCK MASS:

- The ore drives and cross cuts in in drill sills will be reinforced with cable bolting up to 10m in the crown to further stabilise the cap rock . *Pattern of cable bolting for crown support for drivages and* crosscuts of width 6m and height 3.5m is shown as attached . The length of the cable bolt will not be less than 10m.

PATTERN OF CABLE BOLTING :



Drill Sill

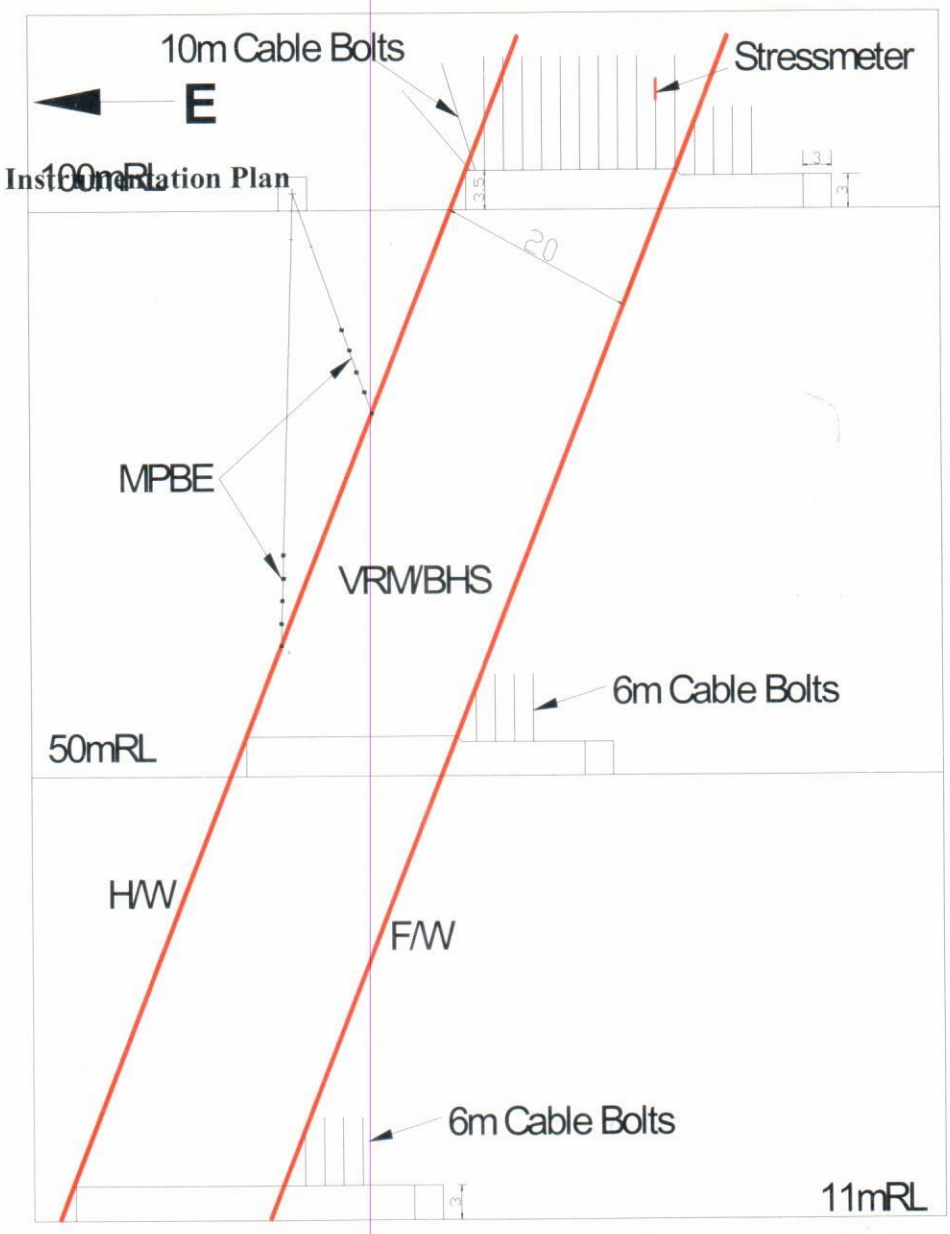


Extraction Brow

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

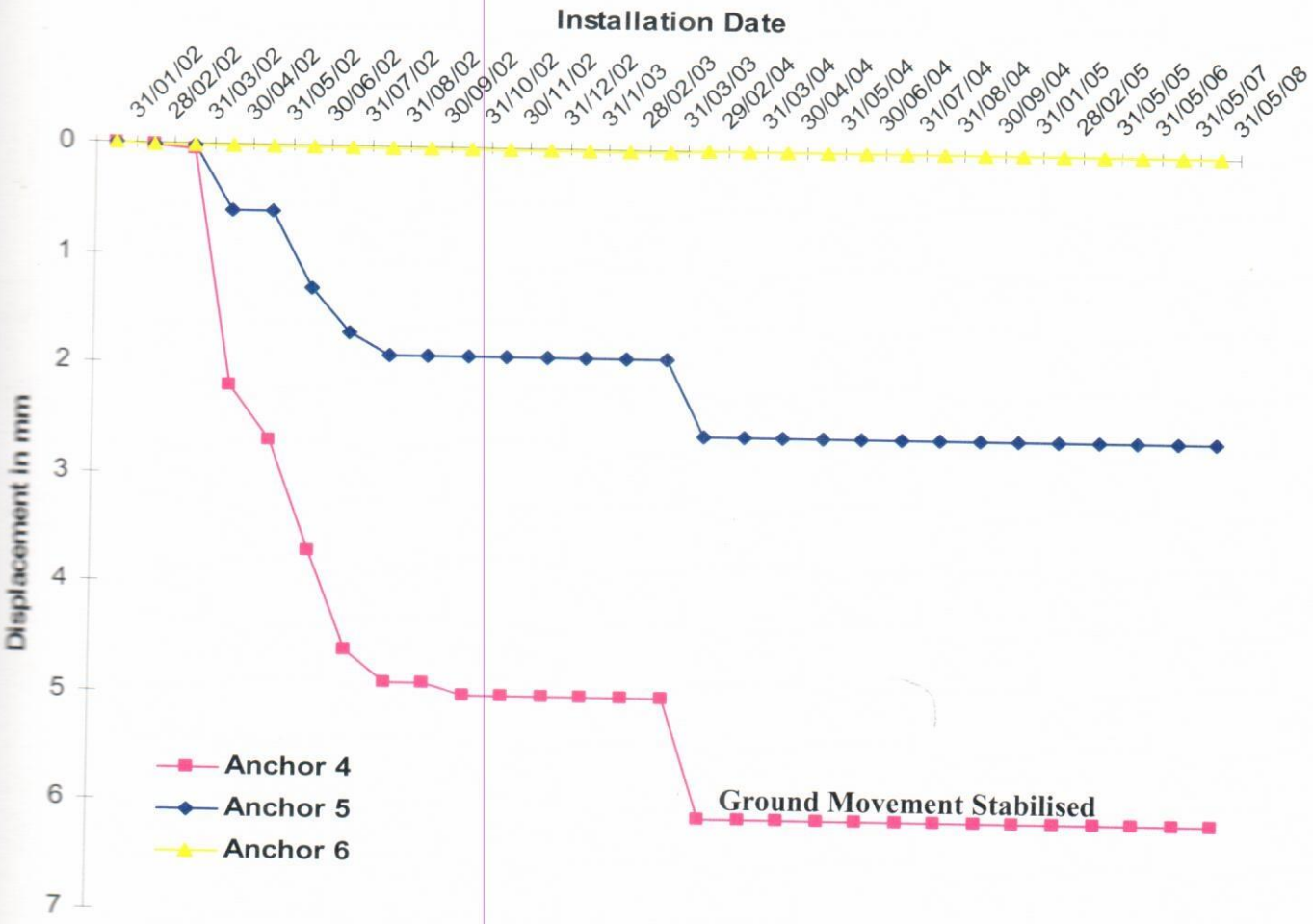
Instrumentation and Monitoring

- Ground movement is monitored with multi point bore hole extensometers .
- Stress concentrations are monitored with uniaxial bore hole stress meters specially in crown pillars.
- An instrumentation plan to monitor the movement of hanging wall and stress development in crown pillar is shown as attached.



ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

HANGWALL DISPLACEMENT



Blast Vibration Prediction and Control

- Use of latest technology of drilling and blasting for controlling of ground vibration.
- Vibration monitoring at surface on fixed stations using standard seismographs
- Analysis of vibration results, determination of predictor equation for design of safe charge density.
- Involve scientific agency to validate analysis results.
- Ground vibrations will be kept below statutory limits.

Blasting Vibration Standards (PPV - mm/sec)

Type of Structure	Dominant Excitation Frequency, H		
	<8Hz	8-25HzHz	>25Hz
(A) Buildings/ Structures not belong to the owner			
1. Domestic houses / structures (Kuchcha, brick and cement)	5	10	15
2. Industrial buildings	10	20	25
3. Objects of historical importance and sensitive structures	2	5	10
(B) Buildings belonging to owner with			
1. Domestic houses / structures	10	15	25
2. Industrial buildings	15	25	50

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Peak Particle Velocity - Predictor Equation

V= k X (R/Qmax1/2)-b

V= Peak Particle velocity (mm/s)
K.b are site constants to be determined by regression analysis
R= Distance of the measuring transducer from the blasting face (m)
Qmax= maximum explosives weight per delay (kg)

Blast Vibration Analysis - Current Observations

Date	Location of blast	Total Explosive Kg	Maximum charge per delay, Kg	Monitoring distance, M	P.P.V. mm/sec	Measuring station
13/5/05	NS-16(50MRL) CROWN BLAST			456	2.24,2.68	RMC
10/7/05	SP-13(50MRL) CROWN BLAST			651	5.89	MATAJI TEMPLE
20/8/05	NS-16(100MRL) CROWN BLAST			407	6.26,10.59	RMC
1/10/05	441N(50MRL) CROWN BLAST			630	3.28	MATAJI TEMPLE
15/11/05	SP-12(50MRL)	2750	425	673	1.49	MATAJI TEMPLE
23/12/05	NB-9(50MRL)	252	50	451	2.117,1.953	RMC
23/12/05	T-19(50MRL) CROWN BLAST	3840	400	517	1.446,1.208	RMC
11/1/06	SP-15(50MRL)	712	32	69	36.68,20.43	SP-13(50MRL)
13/1/06	SP-15(50MRL)	550	37	67	62.33	SP-13(50MRL)
16/1/06	SP-15(50MRL)	500	37	66	10.14	SP-13(50MRL)
17/1/06	NB-11(50MRL)	700	125	574	2.38	SP-13(50MRL)
21/1/06	SP-15(50MRL)	600	36	64	23.26,5.67	SP-13(50MRL)
25/1/06	SP-15(50MRL)	700	37	62	28.18,3.88	SP-13(50MRL)
3/2/06	SP-15(50MRL)	750	31.25	61	7	SP-13(50MRL)
23/2/06	SP-15(50MRL)	612.5	31.25	60	6.56,7.9	SP-13(50MRL)
4/3/06	SP-15(50MRL) CROWN BLAST	3043.75	188	609	1.98,2.35	MATAJI TEMPLE
7/3/06	NB-11(50MRL)	325	81.25	469	1.31,1.34	RMC
4/5/06	SS-5(150 MRL) CROWN BLAST	3275	425	713	2.87,1.43	MATAJI TEMPLE
5/6/06	NS-11(50MRL)	3886.25	378.2	462	3.43,3.88	RMC
5/6/06	NS-11(50MRL) CROWN BLAST	3886.25	378.2	480	6.12	MAIN SHAFT
23/8/06	SP-16(50MRL) CROWN BLAST	5500	250	589	2.68,1.19	MATAJI TEMPLE
7/11/06	SP-16	625	65.75	425	12.82,4.62	MAIN SHAFT, 50MRL INSET
7/11/06	SP-22(50MRL) FIRST BLAST	187	31.25	65,95	52.62,14.76	MAIN SHAFT, 50MRL INSET
21/11/06	SS-18	662.5	150	365	3.88	0 MRL INFRONT OF MAIN SHAFT
21/11/06	NS-12	268.25	37.5	219	5.22	0 MRL INFRONT OF MAIN SHAFT
21/11/06	SP-22(50MRL)	512	62	12	19.98	0 MRL INFRONT OF MAIN SHAFT
27/11/06	SP-22(50MRL)	600	65	602	4.62,5.52	RMC
27/11/06	NS-12(100MRL) CROWN BLAST	2693.75	387.5	433	4.62	RMC
2/12/06	456N(50MRL) CROWN BLAST	3468.75	325	670	2.58	MATAJI TEMPLE
10/12/06	SP-22(50MRL) CROWN BLAST	900	100	450	2.83	MAIN SHAFT
27/3/07	SP-23	750	90	450	1.4	MAIN SHAFT
27/3/07	SP-11	900	85		1.27	MAIN SHAFT
5/4/07	SS-19	4120	480		2.16	MATAJI TEMPLE
12/4/07	41N	3500	475		1.65	MATAJI TEMPLE

Contd...

ANNEXURE-IX
SUBSIDENCE AND BLAST VIBRATION STUDIES

Date	Location of blast	Total Explosive Kg	Maximum charge per delay, Kg	Monitoring distance, M	P.P.V. mm/sec	Measuring station
2/5/07	SP23	650	71	450	0.63	MAIN SHAFT
21/6/07	SS-21	3800	275	580	5.06	MATAJI TEMPLE
23/7/07	P-1	708.75	162	100	>31.75	U/G MAIN SHAFT INSET 100 MRL
26/7/07	NS-19			130	21.6	U/G MAIN SHAFT INSET 100 MRL
26/7/07	P-1	531.25	75	100	33.6	U/G MAIN SHAFT INSET 100 MRL
26/7/07	NP-9	656	93.75		3.08	U/G MAIN SHAFT INSET 100 MRL
1/8/07	NP-9(CROWN BLAST)	3900	387.51		6.06	RMC
6/8/07	P-1(CROWN BLAST)		240	100	61.3	U/G MAIN SHAFT INSET 100 MRL
30/11/07	NP8(150mRL) CROWN BLAST	3875	331.25	350	1)15.4 2) 16.00	1)DG SET 2) S/F BACKSIDE IN SUB STATION PILLAR
8/12/07	NS21 100mRL	2375	200	400	1)14.2 2) 5.85	1)AUXILARY SHAFT 2) S/F
8/12/07	NP4(100mRL)	1950	160	410	1)12.4 2) 6.72	1)AUXILARY SHAFT 2) S/F
28/12/07	NS-17 1066N 50mRL(CROWN BLAST)	3900	387.51	420	1)3.33 2) 3.37	1)DG SET FOUNDATION 2) S/F
8/1/08	711N 150mRL	368.55	50	185	1)4.41 2)4.91	1)U/G 150mRL INSET 2) M/S ECODET 11HOLES
9/1/08	711N 150mRL	593	62.5	185	1)7.97 2)5.99	1)U/G 150mRL INSET 2) M/S ECODET 16HOLES
11/1/08	711N 150mRL	437.5	100	180	1)20.6 2)21.0	1)U/G 150mRL INSET 2) M/S ECODET 5HOLES
12/1/08	711N 150mRL	525	75	180	1)8.87 2)7.56	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)15HOLES
16/1/08	711N 150mRL	650	150	175	1)11.1 2)10.4	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)7HOLES
17/1/08	711N 150mRL	500	62.5	175	1)5.63 2)6.68	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)16HOLES
18/1/08	711N 150mRL	781.25	75	175	1)8.87 2)10.4	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)17HOLES
21/1/08	711N 150mRL	756.25	100	170	1)9.76 2)12.0	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)10HOLES
22/1/08	711N 150mRL	286.25	75	170	1)9.96 2)10.9	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)7HOLES
24/1/08	711N 150mRL	600	75	165	1)8.36 2)8.13	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)16HOLES
25/1/08	711N 150mRL	687.5	75	165	1)10.8 2)11.3	1)U/G 150mRL INSET 2) M/S EXCEL DET (ORICA)16HOLES
6/2/2008	711N 150mRL	487.5	62.5	160	1)7.56 2)9.39	1)U/G 150mRL INSET 2) M/S ECO DET 15HOLES
8/4/2008	711N 150mRL	650	56.25	160	1)5.86 2)6.36	1)U/G 150mRL INSET 2) M/S ECO DET
11/5/2008	711N 150mRL	662.5	50	155	7.72	U/G 150mRL INSET ECO DET
12/6/2008	711N 150mRL	537	50	150	1)8.72 2)9.63	U/G 150mRL INSET ECO DET
13/7/2008	1066N 100mRL	3900	387.5	370	1)9.83 2)9.36	1) S/F 2)DG SET BACKSIDE NEAR AIR CLEANER ECODET
10/9/2008	NP4 1170N CROWN BLAST	4500	350	350	8.09	RMC

Annexure-X

Emission Calculations

ANNEXURE-X
EMISSION CALCULATIONS

1.0 General Calculations

- ***Area Calculations***

$$Area(m^2) = \frac{3.142 \quad x \quad (Top\ Stack\ Diameter)^2}{4}$$

- ***Temperature Correction***

Temperature correction is calculated based on standard ambient temperature of 25° C.

$$Temperature \quad Corection = \frac{273 \quad + \quad 25^0\ C}{273 \quad + \quad StackTemperature^0\ C}$$

- ***Volumetric Flow Rate***

$$Volumetric\ flow\ (\frac{Nm^3}{s}) = Area\ (m^2)\ x\ Exit\ Velocity\ (m/s)\ x\ Temperature\ Correction$$

- ***Emission Rate Calculations***

$$Emission\ Rate\ (\frac{g}{s}) = Limit\ (mg/Nm^3)\ x\ Volumetric\ flow\ (Nm^3/s)\ x\ 10^{-3}$$

- ***Minimum Stack Height Calculation***

1 *Based on Sulphur dioxide emissions*

$$Stack\ Height\ (m) = 14\ (Q)^{0.3}$$

where Q = *emission rate of Sulphur dioxide in* Kg/hr

2 *Based on Particulate Matter (PM) emissions*

$$Stack\ Height\ (m) = 74\ (Q)^{0.27}$$

where Q = *emission rate of ParticulateMatter in Tonnes* $/ hr$

When stacks are emitting both the pollutants i.e. SO_2 and PM, the stack height is calculated based on SO_2 emissions.

ANNEXURE-X
EMISSION CALCULATIONS

2.1 Emission Calculations for Proposed Zinc Smelter Plant 1 & 2

2.1.1 Sulphur dioxide (SO_2)

515 mg/Nm³ = 196.79 ppm

➢ ***Acid Plant***

The stack connected to acid plant emits only sulphur dioxide. The limit of 515 mg/Nm^3 has been considered (Design limit) to estimate the emission rate.

$$Emission\ \ rate = 515\frac{mg}{Nm^3} \times 30.3\frac{Nm^3}{S} \times 10^{-3} = 15.60\frac{g}{s}$$

The minimum Stack height required is calculated to be;

$$Stack\ Height\ (m) = 14\ (56.16)^{0.3} = 46.87\ m$$

However, Stack Height provided = 100 m

2.1.2 Particulate Matter

The particulate matter emitted through the stacks connected to Zinc melting unit, Zinc dross unit, Zinc atomizing unit, calcine unit and roaster plant. The limit of 100 mg/Nm^3 is considered for particulate emissions from all these stacks. The calculation of individual stacks are presented below;

- ***Zinc Melting Furnace Bag Filter***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 30.3\frac{Nm^3}{S} \times 10^{-3} = 3.0\frac{g}{s}$$

- ***Zinc Dross Milling Bag Filter***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 15.2\frac{Nm^3}{S} \times 10^{-3} = 1.5\frac{g}{s}$$

- ***Zinc Atomising Bag Filter***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 6.1\frac{Nm^3}{S} \times 10^{-3} = 0.6\frac{g}{s}$$

- ***Calcine Handling Unit***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 2.10\frac{Nm^3}{S} \times 10^{-3} = 0.2\frac{g}{s}$$

ANNEXURE-X
EMISSION CALCULATIONS

2.3 Emission Calculations for Proposed Lead Plant

Particulate Matter:

The limit of 100 mg/Nm^3 is considered for particulate emissions from all these stacks. The calculation of individual stacks is presented below;

- ***Shui Koushan Furnace (SKS)***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 8.5\frac{Nm^3}{S} \times 10^{-3} = 0.9\frac{g}{s}$$

- ***Precious Metal Plant***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 3.7\frac{Nm^3}{S} \times 10^{-3} = 0.4\frac{g}{s}$$

- ***Blast Furnace***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 15.3\frac{Nm^3}{S} \times 10^{-3} = 1.5\frac{g}{s}$$

2.4 Emission Calculations for Proposed Captive Power Plant 1, 2 & 3

Stack attached to Captive Power Plant emits particulate matter, Sulphur dioxide (SO_2) and Oxides of nitrogen (NOx). The emission rate calculation for each pollutant is given below;

CPP 1 & 2

- ***Emission rate of Sulphur dioxide***

  - Coal Consumption Rate : 2278 t/day = 94920 kg/hr
  - Sulphur Content : 1.5 %

  - Sulphur emission factor

$$Sulphur\ emission\ factor = \frac{SulphurContent(\%)}{100}\ x\ \frac{64}{32}$$

$$Sulphur\ emission\ factor = \frac{1.5}{100}\ x\ \frac{64}{32} = 0.03$$

  - Sulphur Emission Rate

$$Sulphur\ Emission\ Rate\ (kg/hr) = Emission\ Factor\ x\ Coal\ Consumption\ (kg/hr)$$

$$Sulphur\ Emission\ Rate\ (kg/hr) = 0.03\ x\ 94935\ (kg/hr) = 2848\ Kg/hr$$

ANNEXURE-X
EMISSION CALCULATIONS

2.3 Emission Calculations for Proposed Lead Plant

Particulate Matter:

The limit of 100 mg/Nm^3 is considered for particulate emissions from all these stacks. The calculation of individual stacks is presented below;

- ***Shui Koushan Furnace (SKS)***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 8.5\frac{Nm^3}{S} \times 10^{-3} = 0.9\frac{g}{s}$$

- ***Precious Metal Plant***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 3.7\frac{Nm^3}{S} \times 10^{-3} = 0.4\frac{g}{s}$$

- ***Blast Furnace***

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 15.3\frac{Nm^3}{S} \times 10^{-3} = 1.5\frac{g}{s}$$

2.4 Emission Calculations for Proposed Captive Power Plant 1, 2 & 3

Stack attached to Captive Power Plant emits particulate matter, Sulphur dioxide (SO_2) and Oxides of nitrogen (NOx). The emission rate calculation for each pollutant is given below;

CPP 1 & 2

- ***Emission rate of Sulphur dioxide***
  - Coal Consumption Rate : 2278 t/day = 94920 kg/hr
  - Sulphur Content : 1.5 %
  - Sulphur emission factor

$$Sulphur\ emission\ factor = \frac{SulphurContent(\%)}{100}\ x\ \frac{64}{32}$$

$$Sulphur\ emission\ factor = \frac{1.5}{100}\ x\ \frac{64}{32} = 0.03$$

  - Sulphur Emission Rate

$$Sulphur\ Emission\ Rate\ (kg/hr) = Emission\ Factor\ x\ Coal\ Consumption\ (kg/hr)$$

$$Sulphur\ Emission\ Rate\ (kg/hr) = 0.03\ x\ 94935\ (kg/hr) = 2848\ Kg/hr$$

ANNEXURE-X
EMISSION CALCULATIONS

$$Sulphur\ Emission\ Rate\ (g/s) = 2848\ x\ \frac{1000}{3600} = 791\ g/s$$

The minimum Stack height required is calculated to be;

$$Stack\ Height\ (m) = 14\ (2848)^{0.3} = 152\ m$$

However, Stack Height provided = 165 m

- ***Emission rate of Oxides of Nitrogen***

Emission rate of Oxides of Nitrogen is calculated considering the emission limit of 750 mg/Nm^3. The rate of emission of NOx is given below.

$$\text{Emission rate} = 750\frac{mg}{Nm^3} \times 226.6\frac{Nm^3}{S} \times 10^{-3} = 170.0\frac{g}{s}$$

- ***Emission rate of Particulate Matter***

Emission rate of Particulate matter is calculated considering the emission limit of 100 mg/Nm^3. The rate of emission of particulate matter is given below.

$$\text{Emission rate} = 100\frac{mg}{Nm^3} \times 226.6\frac{Nm^3}{S} \times 10^{-3} = 22.6\frac{g}{s}$$

CPP - 3

- ***Emission rate of Sulphur dioxide***
  - Coal Consumption Rate : 1139 t/day = 47467 kg/hr
  - Sulphur Content : 1.5 %
  - Sulphur emission factor

$$Sulphur\ emission\ factor = \frac{SulphurContent(\%)}{100}\ x\ \frac{64}{32}$$

$$Sulphur\ emission\ factor = \frac{1.5}{100}\ x\ \frac{64}{32} = 0.03$$

  - Sulphur Emission Rate

$$Sulphur\ Emission\ Rate\ (kg/hr) = Emission\ Factor\ x\ Coal\ Consumption\ (kg/hr)$$

$$Sulphur\ Emission\ Rate\ (kg/hr) = 0.03\ x\ 47458\ (kg/hr) = 1423.7\ Kg/hr$$

$$Sulphur\ Emission\ Rate\ (g/s) = 1424\ x\ \frac{1000}{3600} = 395\ g/s$$

ANNEXURE-X
EMISSION CALCULATIONS

The minimum Stack height required is calculated to be;

$$Stack\ Height\ (m) = 14\ (1424)^{0.3} = 123.64\ m$$

However, Stack Height provided = 165 m

- ***Emission rate of Oxides of Nitrogen***

Emission rate of Oxides of Nitrogen is calculated considering the emission limit of 750 mg/Nm^3. The rate of emission of NOx is given below.

$$Emission\ \ rate = 750\frac{mg}{Nm^3} \times 86.4\frac{Nm^3}{S} \times 10^{-3} = 64.8\frac{g}{s}$$

- ***Emission rate of Particulate Matter***

Emission rate of Particulate matter is calculated considering the emission limit of 100 mg/Nm^3. The rate of emission of particulate matter is given below.

$$\text{Emission rate} = 100\frac{\text{mg}}{\text{Nm}^3} \times 86.4\frac{\text{Nm}^3}{\text{S}} \times 10^{-3} = 8.6\ \frac{\text{g}}{\text{s}}$$

ANNEXURE-X
EMISSION CALCULATIONS

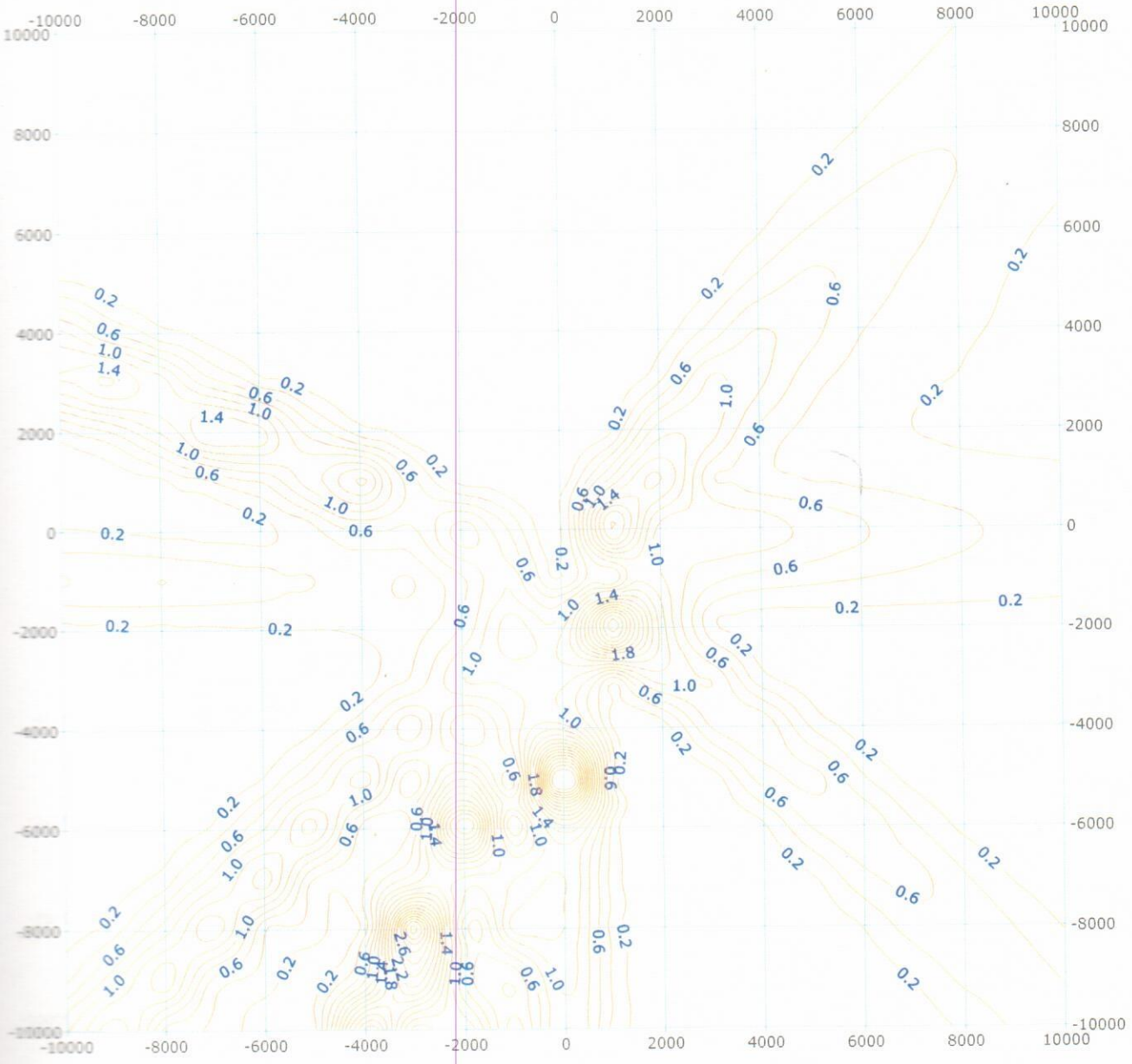


FIGURE-1
SHORT TERM 24 HOURLY INCREMENTAL GLCs OF SPM – WINTER SEASON

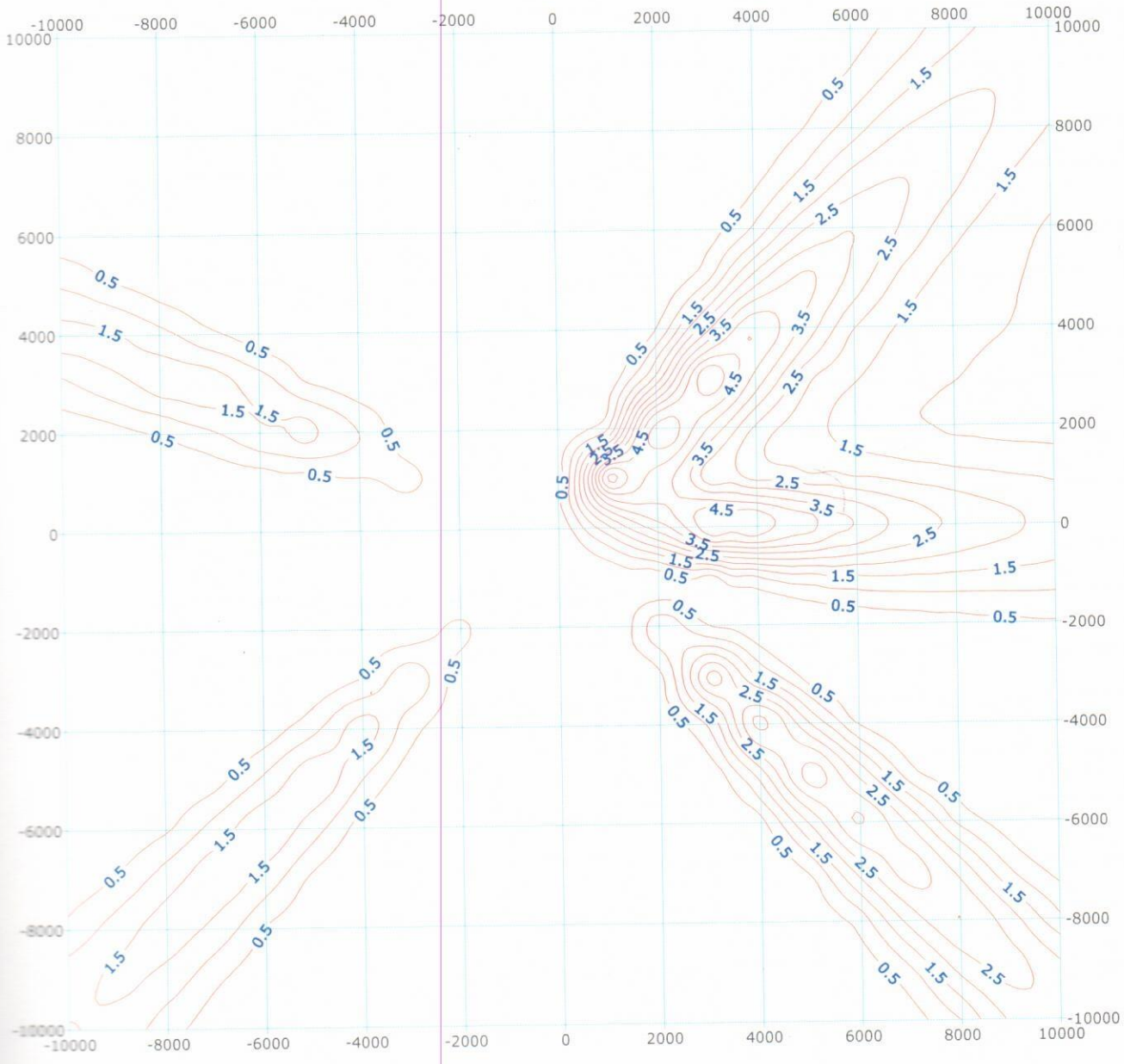


FIGURE-2
SHORT TERM 24 HOURLY INCREMENTAL GLCs OF NOx – WINTER SEASON

Inversion / Mixing Height studies at Hindustan Zinc Limited, Dariba Smelter, Dariba (Rajasthan)

ANNEXURE-X
EMISSION CALCULATIONS

Results and Discussion

The hourly averaged values of nocturnal inversion level and day time mixing height have been computed based on the observed Sodar structural details on the facsimile records. The month wise averaged hourly data for each observational day is given in the respective monthly Table. The data pertaining to nocturnal stable ABL (inversion level), day time unstable ABL and fumigation periods is highlighted in different colors. The data marked in red color pertains to day time unstable thermally convective mixing height while data marked in black refers to night time stable ABL (inversion level). The fumigation period, representing inversion breakup after sunrise, is indicated through blue color in the respective tables.

The examination of data in the tables shows variability in different hours on different days. This variability from hour to hour is associated with variations in the local micrometeorological conditions such as prevailing wind speed, wind direction, cloud cover, sunshine, humidity etc. Sudden increase in the inversion level is generally associated with the variation in the vertical component of increase in the wind speed. Vertical wind component induces mechanical mixing in the stable air mass of inversion and thereby increases the height of inversion level. Therefore, high values of inversion level in certain hours are presumed to be associated with higher wind speed or change in some other meteorological parameter causing increase in the vertical transfer of momentum during those hours.

The inversion build up is known to starts shortly after sun set. The inversion height increases in accordance with increased cooling of the ground with passage pf time. Under calm and clear sky conditions it (inversion) attains maximum height during the period of maximum cooling (0300-0500 hours) at night. Therefore, the data pertaining to 0300-0500 hours has been analyzed to know the variational trend and averaged monthly height of inversion level.

The analysis shows that the averaged inversion height is seen to vary from a minimum of hourly average of around 108m to a maximum of about 228m during the study period considering maximum cooling period (0300-0500 hours). However, the average inversion level is 213 m during December 2008, 225m during January, 191m during February and 228m during March, 2009

Similar analysis for the day time thermally convective mixing height considering maximum ground heating period (1200-1400 hours) shows, that at around noon hours during the day, hourly averaged mixing height varies from a minimum of 1377m to maximum of 1880m. The month wise data shows an averaged mixing height of 1598m during December, 2008, 1539m during January, 1876m during February and 1880 during March, 2009.

The overall analysis, taking the entire three months study period data pertaining to maximum cooling (0300-0500 hours) and heating (1200-1400 hours) shows that the averaged nocturnal level inversion is 213m while averaged day time thermally convective mixing height is 1737m.

However, on certain days the inversion height reaching more than 400m and day time mixing height reaching more than 2200m has also been observed.

It is further seen that maximum of inversion height is seen during periods of maximum ground cooling (0300-0500 hours) while maximum of day time maximum mixing height is observed around noon hours (1200-1400 hours) when the ground temperature is also maximum. These observations are in support the concept of the meteorological

considerations that maximum inversion height and mixing heights are observed during periods of maximum cooling and heating of the ground.

Concluding Remarks

Site specific Sodar study, at HZL, Dariba in Rajasthan, for a three months period (19 December, 2008 to 20 march, 2009) has been successfully completed.

Analysis of the data obtained during the entire study period shows that average of maximum inversion level considering maximum cooling period (0300-0500 hours) is 213 m during night time. The maximum of mixing height pertaining to maximum ground heating period at around noon hours (1200-1400 hours) is 1737 m. The maximum day time mixing height is seen to be more than 2 Km on several days which is fairly a good.

Besides above, low level elevated inversion layers, during the day time, have also been observed, on few days. These elevated layers curtail the mixing height significantly and need special focused detailed study to characterize their occurrence characteristics so as to incorporate the outcome in planning environment management strategies. Such studies require year long continuous sodar observations covering all the four seasons. Such studies are beyond the scope of present work and as such are not discussed here.

As elevated layers have been seen to occur, further detailed sodar study for at least a year long period is suggested to further investigate occurrence probability characteristics of elevated layers.

ANNEXURE-X
EMISSION CALCULATIONS

Hourly Averaged Mixing Height (in meters) observed at HZL, Dariba Smelter (Rajasthan) during December, 2008

Time	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec	24-Dec	25-Dec	26-Dec	27-Dec	28-Dec	29-Dec	30-Dec	31-Dec
00:00 - 01:00		200	206	-	236	176	334	206	186	160	206	237	-
01:00 - 02:00		190	239	-	338	204	217	167	240	190	200	185	-
02:00 - 03:00		230	306	-	167	175	255	151	186	171	208	220	-
03:00 - 04:00		170	230	-	231	159	216	197	196	181	207	160	-
04:00 - 05:00		180	261	-	253	158	321	209	193	209	211	316	-
05:00 - 06:00		240	276	-	208	141	220	214	174	146	171	151	-
06:00 - 07:00		150	300	-	197	206	225	225	146	148	154	245	-
07:00 - 08:00		150	350	-	217	238	240	278	140	148	200	158	-
08:00 - 09:00		130	240	-	324	220	250	206	230	152	230	146	-
09:00 - 10:00		230	-	-	429	350	1371	236	330	250	903	-	-
10:00 - 11:00		-	-	-	1498	1370	1668	250	321	1115	1413	-	-
11:00 - 12:00		-	-	-	1583	1706	1702	1668	1489	1243	1797	-	-
12:00 - 13:00		1377	-	-	1625	1644	2008	1651	1505	1540	1826	-	-
13:00 - 14:00		1502	-	-	1540	1584	1598	1569	1610	1488	1505	-	-
14:00 - 15:00		1258	-	945	1243	1464	1583	1540	1435	1663	1587	-	-
15:00 - 16:00		1396	-	1158	563	1414	1557	1073	1329	1336	1527	-	-
16:00 - 17:00		282	-	270	210	224	291	248	245	180	945	-	-
17:00 - 18:00	180	201	-	200	640	235	190	217	183	187	335	-	-
18:00 - 19:00	170	209	-	150	221	280	270	218	200	184	272	-	-
19:00 - 20:00	150	326	-	170	240	640	236	210	315	198	239	-	-
20:00 - 21:00	140	295	-	180	240	229	227	200	168	257	328	-	-
21:00 - 22:00	170	290	-	200	249	221	210	174	348	180	221	-	-
22:00 - 23:00	190	223	-	225	213	223	189	209	216	197	192	-	-
23:00 - 00:00	200	330	-	170	185	240	210	225	212	192	195	-	-

ANNEXURE-X
EMISSION CALCULATIONS

Hourly Averaged Mixing Height (in meters) observed at HZL, Dariba Smelter (Rajasthan) during January, 2009

Time	1-Jan-09	2-Jan-09	3-Jan-09	4-Jan-09	5-Jan-09	6-Jan-09	7-Jan-09	8-Jan-09	9-Jan-09	10-Jan-09	11-Jan-09	12-Jan-09	13-Jan-09	14-Jan-09	15-Jan-09
00 - 01:00	-	-	-	189	192	283	220	270	241	221	176	255	330	286	282
00 - 02:00	-	-	-	135	221	242	302	259	225	250	240	217	262	388	278
:00 - 03:00	-	-	-	220	191	237	357	234	227	238	319	225	269	318	296
:00 - 04:00	-	-	-	301	216	244	370	298	217	218	278	206	238	275	328
:00 - 05:00	-	-	-	313	171	228	350	255	187	241	394	199	222	288	207
:00 - 06:00	-	-	-	252	214	241	214	293	195	289	294	207	230	181	216
:00 - 07:00	-	-	-	155	277	248	219	322	254	228	230	306	222	210	330
:00 - 08:00	-	-	-	239	254	264	251	404	233	217	230	308	225	230	330
:00 - 09:00	-	-	-	268	250	251	280	314	310	150	230	271	235	284	280
:00 - 10:00	-	-	-	294	-	283	291	300	520	320	240	330	215	350	307
:00 - 11:00	-	-	-	1030	-	988	988	690	1158	818	563	988	903	903	818
:00 - 12:00	-	-	-	1498	1115	1243	1285	1115	1243	1073	690	1115	1540	1243	1243
:00 - 13:00	-	-	1413	1583	1583	1498	1370	1753	1498	1498	1179	1158	1668	1498	1498
:00 - 14:00	-	-	1651	1574	1850	1498	1391	1413	1540	1583	1413	1200	1158	1698	1583
:00 - 15:00	-	-	1583	1424	1413	1413	1370	690	1455	1285	818	1073	1158	1719	1243
:00 - 16:00	-	-	1211	988	1200	775	903	478	563	690	563	563	690	1200	478
:00 - 17:00	-	-	1172	1268	1413	210	210	250	210	733	240	80	140	269	233
:00 - 18:00	-	-	265	107	320	230	197	305	297	253	337	90	130	226	266
:00 - 19:00	-	-	252	296	248	253	201	352	230	280	313	80	140	189	371
:00 - 20:00	-	-	261	265	206	239	214	230	240	278	230	100	200	210	373
0:00 - 21:00	-	-	205	195	206	260	252	322	315	270	286	240	220	220	424
1:00 - 22:00	-	-	208	222	171	342	211	379	281	300	259	110	250	219	367
22:00 - 23:00	-	-	196	228	176	254	192	235	274	290	236	325	230	330	350
23:00 - 00:00	-	-	201	210	179	180	216	225	268	280	264	219	279	292	411

ANNEXURE-X
EMISSION CALCULATIONS

Hourly Averaged Mixing Height (in meters) observed at HZL, Dariba Smelter (Rajasthan) during January, 2009

Time	16-Jan-09	17-Jan-09	18-Jan-09	19-Jan-09	20-Jan-09	21-Jan-09	22-Jan-09	23-Jan-09	24-Jan-09	25-Jan-09	26-Jan-09	27-Jan-09	28-Jan-09	29-Jan-09	30-Jan-09	31-Jan-09
0 - 01:00	256	290	170	175	240	177	178	276	215	130	300	169	121	300	158	155
0 - 02:00	359	312	230	195	300	200	164	284	202	117	280	138	139	282	122	137
0 - 03:00	296	235	275	255	280	234	173	257	196	155	212	131	132	179	129	201
0 - 04:00	258	247	236	218	221	235	192	213	223	148	190	164	157	138	143	258
0 - 05:00	274	221	229	238	254	150	243	257	186	132	149	119	165	189	142	185
0 - 06:00	231	315	250	226	198	131	154	220	202	137	180	146	149	230	128	202
0 - 07:00	232	300	250	237	220	253	202	250	320	185	160	172	158	227	147	230
- 08:00	328	310	230	241	250	271	200	122	310	160	155	180	260	180	175	271
- 09:00	215	330	230	223	237	250	190	150	200	202	190	160	229	180	203	340
- 10:00	316	400	342	338	326	480	188	169	370	320	354	249	400	220	350	630
- 11:00	1158	903	1197	879	837	816	1240	837	1325	1316	1302	1095	1079	1258	1575	1418
- 12:00	1413	1115	1073	1439	1442	1259	1452	1545	1575	1407	1664	1763	1264	1664	1452	1749
- 13:00	1498	1243	1276	1689	1579	1299	1503	1689	1485	1867	1706	1814	1723	1579	1494	1918
- 14:00	1540	1583	1514	1604	1732	1337	1308	1443	1481	2003	1596	1551	1604	1282	1719	1855
- 15:00	1498	1370	1385	1439	1541	1230	1693	1274	1295	1876	1333	1271	1579	1197	1676	1452
- 16:00	690	733	751	1062	1346	1113	1367	1286	1028	1672	1294	1621	1244	1231	1197	1197
- 17:00	289	243	230	130	120	245	180	1110	210	1295	1193	248	1230	223	200	200
- 18:00	300	308	245	197	100	203	150	100	90	180	150	220	175	204	210	170
- 19:00	320	290	227	150	100	198	120	110	120	213	220	209	129	136	160	160
- 20:00	330	310	235	200	190	166	140	100	155	287	210	162	102	192	177	150
- 21:00	300	270	190	150	180	232	130	90	263	249	253	198	156	136	200	140
- 22:00	330	253	238	120	195	292	160	110	163	151	260	129	152	149	120	150
- 23:00	310	333	290	220	179	218	177	150	193	177	240	222	135	198	130	170
00:00	270	365	318	200	233	162	200	180	180	248	220	123	250	181	148	195

ANNEXURE-X
EMISSION CALCULATIONS

Hourly Averaged Mixing Height (in meters) observed at HZL, Dariba Smelter (Rajasthan) during February, 2009

15-Feb	Time	16-Feb	17-Feb	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb
209	00:00 - 01:00	231	204	299	300	179	196	251	149	143	127	149	182	160
143	01:00 - 02:00	235	323	180	320	194	329	222	128	107	162	168	158	190
148	02:00 - 03:00	247	262	228	173	220	208	223	159	134	212	174	152	212
189	03:00 - 04:00	216	229	211	175	194	223	206	145	140	207	154	160	225
185	04:00 - 05:00	205	201	213	224	224	205	136	108	202	110	161	187	205
201	05:00 - 06:00	207	202	219	215	220	162	113	130	160	136	192	167	275
229	06:00 - 07:00	220	224	300	330	172	165	120	176	200	150	259	211	240
222	07:00 - 08:00	235	320	310	310	160	168	130	152	240	160	183	202	280
387	08:00 - 09:00	350	330	310	331	160	140	240	133	300	220	242	224	310
630	09:00 - 10:00	620	548	540	570	300	240	450	189	236	270	400	480	600
1367	10:00 - 11:00	1337	1342	1197	1152	1155	1452	1197	1028	1460	1367	1325	943	1409
1418	11:00 - 12:00	1602	1579	1579	1367	1579	1706	1494	1059	1685	1579	1579	1537	1749
1638	12:00 - 13:00	2088	2045	1918	1537	2007	2024	2003	1233	1918	2088	1876	1833	2130
1537	13:00 - 14:00	2003	1918	1833	2003	1664	1961	1791	1791	1494	1986	1664	1880	1842
1448	14:00 - 15:00	1749	1706	1579	1664	1583	1668	1409	1744	1409	1681	1488	1503	1409
1281	15:00 - 16:00	1579	1664	1494	1537	1452	1537	1325	1452	1240	1240	1197	1325	1155
1132	16:00 - 17:00	1300	1312	1113	1367	1223	1197	1134	816	1121	1155	1070	1113	901
160	17:00 - 18:00	313	256	228	228	203	180	166	100	221	150	150	100	120
177	18:00 - 19:00	199	200	220	165	139	190	205	110	198	160	161	209	130
168	19:00 - 20:00	265	225	210	198	175	160	171	123	199	170	180	170	150
225	20:00 - 21:00	200	210	198	170	291	110	206	143	246	176	187	180	160
152	21:00 - 22:00	155	270	184	136	187	100	202	156	295	150	179	208	170
170	22:00 - 23:00	169	161	146	141	170	190	194	143	219	136	197	200	180
162	23:00 - 00:00	151	236	211	167	190	200	153	126	146	149	154	204	190

ANNEXURE-X
EMISSION CALCULATIONS

Hourly Averaged Mixing Height (in meters) observed at HZL, Dariba Smelter (Rajasthan) during March, 2009

	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar
0:00 - 01:00	170	150	280	150	90	95	240	190	160	250	290	140	200	160	140
1:00 - 02:00	155	310	200	170	100	130	210	170	170	220	320	160	140	170	160
2:00 - 03:00	175	290	120	330	120	160	170	180	300	280	420	190	230	170	150
3:00 - 04:00	170	350	160	310	170	170	155	180	320	450	450	230	140	150	300
4:00 - 05:00	240	320	170	240	140	160	165	185	280	350	440	220	190	155	260
5:00 - 06:00	300	300	175	230	160	150	220	240	280	320	350	300	200	160	230
6:00 - 07:00	290	310	170	280	150	160	170	240	320	310	400	310	180	170	235
7:00 - 08:00	230	280	160	290	120	130	200	260	340	280	340	300	300	190	130
8:00 - 09:00	250	160	200	330	240	135	260	350	350	350	320	280	330	300	300
9:00 - 10:00	330	350	380	520	480	290	450	400	500	550	330	340	520	450	480
0:00 - 11:00	1537	1749	1409	1409	1325	1621	1537	1494	1325	1452	1537	1409	1282	1325	1155
:00 - 12:00	1706	1876	1706	1706	1494	1791	1749	1791	1579	1706	1706	1494	1537	1494	1452
:00 - 13:00	2130	2130	2003	2003	2215	2130	2215	2173	1961	2130	1791	1452	1664	1537	1579
:00 - 14:00	2088	1791	1833	1918	1833	1749	1621	1833	2130	2257	2045	1579	1537	1791	1452
:00 - 15:00	1706	1494	1706	1494	1367	1409	1452	1494	1961	1791	1664	1367	1494	1367	1240
:00 - 16:00	1452	1240	1494	1282	1240	1325	1325	1325	1367	1537	1452	1346	1325	1282	1070
:00 - 17:00	1070	858	1155	943	901	1028	1240	1282	1240	1409	1367	1282	1240	1240	943
:00 - 18:00	170	110	240	170	180	230	190	180	180	250	260	120	140	200	70
:00 - 19:00	180	160	230	150	150	170	150	140	130	200	90	170	130	230	60
:00 - 20:00	180	150	240	140	180	150	120	130	100	160	180	110	160	160	55
:00 - 21:00	155	120	140	200	120	310	110	100	110	170	180	160	140	140	50
00 - 22:00	165	110	130	180	100	280	200	80	160	120	130	150	130	130	50
00 - 23:00	135	100	130	290	90	170	170	100	170	170	120	120	120	100	55
00 - 00:00	130	310	145	165	80	180	160	130	140	330	250	130	130	130	80

Annexure-XI

Letter from Public Works Department

ANNEXURE-XI
LETTER FROM PUBLIC WORKS DEPARTMENT

OFFICE OF THE CHIEF ENGINEER PWD RAJASTHAN JAIPUR
No.F.39(Gen.22)/EE(IV)/P&M)/09/D- 45 Dated: 13.3.09

The Chief Operating Officer and Whole Time Director,
Hindustan Zinc Limited,
Yashad Bhawan,
UDAIPUR-313004
(Fax 0294-2427752)

Sub: State Govt.'s Support for Hindustan Zinc Ltd. Strengthening and Widening of Fatehnagar- Dariba -Relmagra- Khandel Road Km.0/0 to 37/500 under PPP scheme.
Ref: You letter No. HZL/MS/GoR/08-09 dated 6.3.2009.

Dear Sir,

Please refer to the above cited letter addressed to the Principal Secretary, PWD, GoR, Jaipur and copy endorsed to this office.

An identical case – related with Grasim Cement – Kotputli, is under process with State Govt. on cost sharing model of 50% (by GoR): 50% (by Grasim Cement). On the similar lines the District Collector, Rajsamand has recommended your case under PPP scheme on cost sharing model of 50% : 50%.

You are, therefore, requested to re-consider your proposal dated 6.3.2009 and in case your management agree for cost sharing model of 50%:50% likewise, please convey the consent so that we may process the case of Widening & Strengthening of Fatehnagar- Dariba -Relmagra-Khandel Road Km.0/0 to 37/500 under PPP scheme accordingly.

CHIEF ENGINEER & ADDL. SECY.
PWD RAJASTHAN JAIPUR

No.F.39(Gen.22)/EE(IV)/P&M)/09/D- Dated:
Copy to the following for information:

1. P.S. to Pr. Secretary, PWD, Rajasthan, Jaipur.
2. P.S. to Secretary, PWD, Rajathan, Jaipur.
3. The Distt. Collector, Rajsamand.

CHIEF ENGINEER & ADDL. SECY.
PWD RAJASTHAN JAIPUR

Annexure-XII

Hazardous Operation & Activities and Occupational Health Study

ANNEXURE-XII
HAZARDOUS OPERATION AND ACTIVITTIES AND SAFETY MEASURES

S.No	Hazardous Activities	Type of Hazards	Frequency	Severity of Injury	Safety Measures
1	Drilling	Exposed to high level of Noise	HU	Hearing impairement	Safe work procedures as per SOPs and use of PPE.
		Exposed to dusty environment	HU	Dust related diseases	
2	Blasting	Struck by fly rock	HU	Serious Physical injury	Work procedure as per MMR 1961,related SOPs , close supervision and Scientific blast design.
		Exposed to dusty environment	L	Dust related diseases	
		Exposed to high level noise	*L*	*Hearing impairement*	
		Exposed to excessive vibration	L		
3	Loading	Struck by rolling big boulders	U	Serious injury, and equipment damage	Safe work procedures and under supervision
		Struck by fall of objects	U	Serious Physical injury	
4	Transportation	Accidental runaway of vehicle	HU	Serious injury, and equipment damage	work procedures as per SOPs, proper maintenance of vehicle and under supervision
		Fall of vehicle from height while reversing	HU		
		Exposed to high level noise	L	Hearing impairement	
		fire in engine to over heating	L		
5	Unloading of stone into hopper	Fall of dumper in hopper, or into lower surface	HU	Serious injury, and equipment damage	
6	Welding, gas cutting	Emission of gases & fumes	L	Asphyxiation	Safe work procedures and under supervision and SOPs, use of PPEs.
		Release of radiation & light	L	Eye injury	
		Fire	U	Burns,	
		Release of heat	L	Skin problem	
7	Storage of oil,lubricant, chemicals	Leaks and spills non-	HU	Fire & vigorous chemical raction explosion	work as per SOPs, Follow up of MSDS and under supervision ,Use of PPEs.
		compatible chemicals coming into contact			
8	Battery maintenance & handling	Acid spillage	U	Acid burns	work as per SOPs and under supervision, Use of PPEs.
9	Use/repair of hydraulic jacks & pumps	High pressure operation	L	Physical injury	Work as per SOPs, use of PPEs.
		Oil spillage	U		
		Rupture of hydraulic hoses	HU		

Note: ***HU= Highly Unlikely, U= Unlikely, L= Likely, VL=Very Likely***

Annexure-XIII
Public Hearing Details

ANNEXURE-XIII
PUBLIC HEARING DETAILS

Phone: 2491269

REGIONAL OFFICE & LABORATORY
क्षेत्रीय कार्यालय एवम् प्रयोगशाला
RAJASTHAN STATE POLLUTION CONTROL BOARD
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल
F-470, Near UCCI Building, M.I.A. UDAIPUR
एफ.470,यू0सी0सी0आई0 भवन के पास,मेवाड़ औधोगिक क्षेत्र, मादड़ी

No. RPCB/ROU/ RAJ/H-111/ 2015 Dated 16/2/09

Member Secretary
RPCB,
Jaipur

Sub:- Minutes of Public Hearing Meeting for proposed lead-zinc integrated complex- Zinc Smelter, 2x0.25 MTPA, lead semelter 1x0.125 MTPA, Captive power palnt, 3x85 MW, underground mine project (M.L. No. 2/89) expansion from 0.63 MTPA to 0.9 MTPA, Benificiation capacity from 0.9 MTPA to 1.2 MTPA and lease renewal due on 30.5.2010 at Rajpura Dariba, Tehsil Railmagra, Distt Rajsamand by Hindustan Zinc Ltd. at Mines Campus.

Ref:- District Collector, Rajsmand letter no. P.40(3)(41)Sapra/Parya/Public Hearing/05/53-59 dated 07.01.2009

Sir,

With reference to above, kindly find enclosed herewith a copy of Minutes of Public Hearing Meeting for proposed lead-zinc integrated complex- Zinc Smelter, 2x0.25 MTPA, lead semelter 1x0.125 MTPA, Captive power palnt, 3x85 MW, underground mine project (M.L. No. 2/89) expansion from 0.63 MTPA to 0.9 MTPA, Benificiation capacity from 0.9 MTPA to 1.2 MTPA and lease renewal due on 30.5.2010 at Rajpura Dariba, Tehsil Railmagra, Distt Rajsamand by Hindustan Zinc Ltd. at Mines Campus.

The draft minutes were sent to Sh. T.C. Bohra, ADM, Rajsamand for necessary amendment and for his signature. The copy of final signed minutes was received in this office recently & the same is being forwarded to HO. A copy of attendance sheet, CD, photographs and a copy of representations are also being enclosed for ready reference.

Submitted for information & further necessary action.

Yours Faithfully

Encl: As above.

sd

(V.S. Brijvasi)
Regional Officer

Copy to:- 1. T.C. Bohra, ADM, Rajsamand for informatiomn with a copy of minutes.
2. M/s Hinduatan Zinc Ltd. Rajpura Dariba Mines, for information.

16/2/09
Regional Officer

ग्राम–राजपुरा दरीबा, तहसील–रेलमगरा, जिला –राजसंमद में मैसर्स– हिन्दुस्तान जिंक लिमिटेड, लेड–जिंक इन्टीग्रेटेड कॉम्पलेक्स– जिंक स्मेल्टर, 2 x 2.5 लाख टन प्रति वर्ष, लेड स्मेल्टर 1 x 1.25 लाख टन प्रतिवर्ष, केप्टीव पावर प्लान्ट 3 x 85 मेगावाट तथा राजपुरा लेड–जिंक खान (एम.एल. 2/89) की खनन क्षमता 6.31 लाख टन प्रतिवर्ष से 9.0 लाख टन प्रतिवर्ष एवं अयस्क सज्जीकरण 9.0 लाख टन प्रतिवर्ष से 12.0 लाख टन प्रतिवर्ष के विस्तारीकरण एवं लीज (लीज वैधता 29.05.2010) नवीनीकरण के लिये पर्यावरणीय अनुमोदन अनापत्ति जारी किये जाने हेतु जन सुनवाई।

जिला कलेक्टर, राजसंमद के आदेश कमांक प040(3)(41) सा0प्र0/पर्या/जनसु0/05/53–59 दि0 7.1.09 के अनुक्रम में मैसर्स– हिन्दुस्तान जिंक लिमिटेड, लेड–जिंक इन्टीग्रेटेड कॉम्पलेक्स– जिंक स्मेल्टर, 2 x 2.5 लाख टन प्रति वर्ष, लेड स्मेल्टर 1 x 1.25 लाख टन प्रतिवर्ष, केप्टीव पावर प्लान्ट 3 x 85 मेगावाट तथा राजपुरा लेड–जिंक खान (एम. एल. 2/89) की खनन क्षमता 6.31 लाख टन प्रतिवर्ष से 9.0 लाख टन प्रतिवर्ष एवं अयस्क सज्जीकरण 9.0 लाख टन प्रतिवर्ष से 12.0 लाख टन प्रतिवर्ष के विस्तारीकरण एवं लीज नवीनीकरण के लिये पर्यावरणीय अनुमोदन अनापत्ति जारी किये जाने हेतु दिनांक 12.02.2009 को 12.15 बजे राजपुरा दरीबा लेड–जिंक माइन स्थल तहसील–रेलमगरा, जिला –राजसंमद पर जन सुनवाई आयोजित की गई। इस बैठक के दौरान जन सुनवाई हेतु निम्न सदस्य उपस्थित थेः–

क्र.सं.	नाम/ पद व पता	प्रतिनिधी, विभाग
1	श्री टी.सी. बोहरा, (आर.ए.एस.)	अतिरिक्त जिला कलेक्टर, (प्रतिनिधि–जिला कलेक्टर,) राजसंमद
2.	श्री वीरसिंह बृजवासी	क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियत्रंण मंडल, उदयपुर।

जन सुनवाई के प्रारम्भ में श्री वीर सिंह बृजवासी, क्षेत्रीय अधिकारी, राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, उदयपुर ने अवगत कराया कि यह जन सुनवाई मैसर्स– हिन्दुस्तान जिंक लिमिटेड, लेड–जिंक इन्टीग्रेटेड कॉम्पलेक्स– जिंक स्मेल्टर, 2 x 2.5 लाख टन प्रति वर्ष, लेड स्मेल्टर 1 x 1.25 लाख टन प्रतिवर्ष, केप्टीव पावर प्लान्ट 3 x 85 मेगावाट तथा राजपुरा लेड–जिंक खान (एम.एल. 2/89) की खनन क्षमता 6.31 लाख टन प्रतिवर्ष से 9.0 लाख टन प्रतिवर्ष एवं अयस्क सज्जीकरण 9.0 लाख टन प्रतिवर्ष से 12.0 लाख टन प्रतिवर्ष के विस्तारीकरण एवं लीज नवीनीकरण के लिये पर्यावरणीय स्वीकृति जारी किये जाने बाबत

क्षेत्रीय अधिकारी
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल
उदयपुर

टीकम चन्द बोहरा
अतिरिक्त जिला कलक्टर एवं

रखी गई हैं। श्री वीर सिंह बृजवासी ने जन सुनवाई के महत्व के बारे में जानकारी देते हुए कहा कि इस तरह की जन सुनवाई से जहां एक ओर प्रस्तावित परियोजना के बारे में जन चेतना की जानकारी होती हैं वहीं परियोजना से पर्यावरण को सुरक्षित रखने हेतु आम नागरिकों की सोच व सुझाव उपलब्ध हो पाते हैं। श्री बृजवासी ने सन्दर्भित लेड–जिंक इन्टीग्रेटेड कॉम्पलेक्स एवं खनन क्षमता तथा अयस्क सज्जीकरण के विस्तारिकरण के बारे में बहुत ही संक्षिप्त जानकारी भी उपस्थित जनसमूह को उपलब्ध करवाई ।

इसके पश्चात मैसर्स हिन्दुस्तान जिंक लिमिटेड, लेड–जिंक इन्टीग्रेटेड कॉम्पलेक्स–जिंक स्मेल्टर, 2 **X** 2.5 लाख टन प्रति वर्ष, लेड स्मेल्टर 1 **X** 1.25 लाख टन प्रतिवर्ष, केप्टीव पावर प्लान्ट 3 **X** 85 मेगावाट तथा राजपुरा लेड–जिंक खान (एम.एल. 2/89) की खनन क्षमता 6.31 लाख टन प्रतिवर्ष से 9.0 लाख टन प्रतिवर्ष एवं अयस्क सज्जीकरण 9.0 लाख टन प्रतिवर्ष से 12.0 लाख टन प्रतिवर्ष के विस्तारीकरण एवं लीज नवीनीकरण के लिए श्री कबीर घोष, सह.उपाध्यक्ष ने तकनिकी जानकारी उपस्थित जनसमुदाय के सामने स्लाईड शो के माध्यम से पस्तुत की! तत्पश्चात् श्री जकियूद्दीन शेख, वरिष्ठ प्रबन्धक (पर्यावरण) ने इस परियोजना से पड़ने वाले पर्यावरणीय प्रभाव के अध्ययन के बारे में विस्तार पूर्वक जानकारी दी।

उपरोक्त परियोजना का विवरण देते हुए श्री कबीर घोष ने बताया कि वर्तमान में कुल अधिग्रहित क्षैत्र 554.19 हैक्टेयर है जिसमें से 162 हेक्टर भूमि में स्मेल्टर एवं सी.पी.पी. लगाना प्रस्तावित है, जो कि राजपुरा दरीबा, तहसील–रेलमगरा, जिला–राजसंमद में स्थित हैं।

इसके बाद उपस्थित सदस्यों से श्री वीर सिंह बृजवासी, क्षेत्रीय अधिकारी, राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, उदयपुर ने प्रस्तावित परियोजना द्वारा होने वाले पर्यावरणीय प्रभाव एवं अन्य समस्याओं पर अपनी आपत्ति, राय एवं सुझाव इत्यादि प्रस्तुत करने के लिए विचार रखने हेतु आग्रह किया। उपस्थित सदस्यों एवं आमजन द्वारा प्रस्तुत आपत्तियां एवं सुझाव निम्नानुसार हैं :–

1. श्री लोभचन्द गाडरी – निवासी ग्राम राजपुरा ने कहा कि रोजगार देने के लिए वास्तविक क्षति का आंकलन होना चाहिए एवं क्षति के आधार पर रोजगार देना चाहिए।

2. श्री भेरूलाल जाट – निवासी ग्राम छापरी ने कहा कि छापरी एवं धनेरिया स्कूल कमोन्नत होने चाहिए एवं उनकी कक्षाओं का आठवी एवं सोलहवी तक बढाना चाहिए।

3. श्री बोथलाल जाट – निवासी ग्राम आंजणा ने कहा कि आस–पास की जनता ने जो सहयोग दिया है, किन्तु वे ही खुद दुखी है। पेड़ पोधे काटे जा रहे हैं । नौकरी किसी को नहीं है। जन सुनवाई का व्यापक प्रचार प्रसार नही हुआ है। लोगों में भय का

क्षेत्रीय अधिकारी
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल
उदयपुर

वातावरण है। पानी का धरातल सुख गया है। फसले दिखने को नहीं मिलती है। मेरा प्रस्ताव है कि प्रोजेक्ट के आस–पास के गांवो दरीबा, आंजणा, माताजी का खेडा इत्यादि को उचित रोजगार मिले।

4. श्री शांतिलाल मेनारिया – निवासी ग्राम गवारडी ने कहा कि इतना बडा प्रोजेक्ट लगाने के लिए वेदान्ता ग्रुप का धन्यवाद। इससे क्षेत्र का विकास होगा किन्तु पर्यावरण का नुकसान होगा। इसलिए केन्द्र और राज्य सरकार मिलकर पर्यावरण पर ध्यान दे। ट्राफिक बढ रहा है इसलिए फतहनगर से खण्डेल चौराहा तक की रोड को चौडी करें। यदि किसी घर का चिराग बुझ गया तो वेदान्ता इसकी भरपाई नहीं कर पाएगा। 10 किमी क्षेत्र एवं रेलमगरा तहसील के लोगों को निशुल्क स्वास्थ्य सुविधा उपलब्ध कराई जावे। प्राथमिकता के आधार पर रोजगार मुहेया कराया जावे।

5. श्री मिठ्ठूलाल वैष्णव – निवासी ग्रम दरीबा ने कहा कि दरीबा माइन्स प्रारम्भ करते समय दरीबा गांव को विस्थापित किया गया था। विस्थापन के समय जो सुविधाएं देने की बात कही गई थी उनमें सड़क, पानी आदि उपलब्ध करवाना था जिनकी पूर्ति नही की गई और अभी भी पानी दूर से लाना पड़ रहा है। लोग और बच्चे परेशान है। पक्की सड़के नहीं है लाइटे नहीं लगाई गई इसलिए मेरा निवेदन है कि लोगों की तकलीफों को दूर किया जावे।

6. श्री हीरालाल प्रजापत – निवासी ग्राम सुनारिया खेड़ा ने कहा कि दरीबा माइन्स में प्लान्ट के लगने से एरिये के लोगों को फायदा हुआ है किन्तु जो गांव माइन्स से लगे हुए हैं उनकी समस्याओं पर बराबर ध्यान नहीं दिया जा रहा है। हमारे गांव में टेलिंग डेम से परेशानी है इससे जमीन और पानी खराब हो गया है। मेरा प्रबन्धन से निवेदन है कि पर्यावरण पर विशेष ध्यान दिया जावे।

7. श्री राजमल जैन – निवासी ग्राम काबरा ने कहा कि उध्योग लगना क्षेत्र के लिए खुशी की बात है लेकिन आस–पास के सभी प्रभावित गांवों को सही लाभांश मिले। विशेष रूप से हमारे गांव से सम्पर्क हेतु रोड नहीं है। खेती–बाड़ी और मवेशी प्रभावित हो रहे हैं। 400 में से केवल 3 लोगों को ही रोजगार मिला है। हिन्दुस्तान जिंक से मिलने वाली रॉयल्टी से हमारी पंचायत आज दिन तक वंचित रही है। इस पर भी विशेष ध्यान दिया जावे।

8. श्री भगवत सिंह – निवासी ग्राम सुनारिया खेड़ा ने कहा कि श्रीमान् दरीबा माइन्स से एक किमी दूर सुनारिया खेड़ा गांव है वहां माइन्स के टेलिंग डेम से खेती बाड़ी व पानी खराब हो गया है गांव में 100 आदमी बेरोजगार है उनका भी समाधान किया जावे।

क्षेत्रीय अधिकारी
राजस्थान प्रदूषण नियंत्रण मण्डल
उदयपुर

9. श्री चतरसिंह राजावत – सरपंच ग्राम पंचायत राजपुरा ने कहा कि आज से पूर्व माईन्स के आज–पास का पूरा क्षेत्र कृषि से फला फुला था इतने गन्ने होते भूपालसागर शुगर फेक्ट्री मे भेजे जाते थे यहीं नहीं बेड़ा का खेडा गांव में एक मि शुगर फेक्ट्री भी थी। दरीबा माइन्स में खनन कार्य होने से कुए में पानी सुख गया है जिससे खेती प्रभावित हुई है। टेलिंग डेम से बहने वाले पानी से भूमि खराब हो गई है। वर्तमान टेलिंग डेम से सुनारिया खेडा का पानी खराब हो रहा है प्रोजेक्ट के विस्तार से इस एरिये को ज्यादा नुकसान होगा इसलिए स्थानीय लोगों को रोजगार देकर इसकी क्षतिपूर्ति की जावे।

10. श्री हरीराम गुर्जर – निवासी ग्राम कांटियां का खेड़ा ने कहा कि माइन्स से आधा किमी दूर हमारा गांव हैं वहा पहले अच्छी फसले होती थी, पीने का अच्छा पानी था सब बर्बाद हो गया है। दरीबा पंचायत के पास होने के बावजूद एक भी पैसा विकास में नहीं लगा है। गांव में श्मशान घाट एवं हेण्ड पम्प भी नहीं बनाया है। एक भी आदमी को कम्पनी ने ठेकेदारी में भी नहीं लगाया है। माननीय प्रशासन इस पर भी ध्यान दें।

11. श्री बसन्ती लाल वैष्णव – निवासी ग्राम नया दरीबा (कोटड़ी साइड) ने कहा कि आज से लगभग 1980–81 से पूर्व दरीबा विस्थापित किया गया था और हमारे पूर्वजों को हटा दिया वे बेचारे भोले भाले आदमी बैल गाड़ी में सामान डालकर चले गये। आज हमारे गाव में पीने के पानी की भयंकर समस्या है। मवेशी मुख्य रूप से प्रभावित है। दरीबा वासियों ने भूमि का दान किया था लेकिन गांव में रोजगार की समस्या है। इतनी जमीन की अवाप्ति के बाद भी गांव में जाने का रास्ता नहीं है। गांव की निरन्तर उपेक्षा की जा रही है। इसलिए हमारे गांव को विकास में प्राथमिकता दी जावें।

12. श्री कालूराम जटीया – निवासी ग्राम दरीबा ने कहा कि वर्षाकाल में स्कूल भवन में पानी गिरता है, इस पर कम्पनी व सरपंच ने आज दिन तक कोई कार्यवाही नहीं की। वारिश में गांव में जाने के लिए रास्ता क्लीयर नहीं हैं। भीलों के 2–3 मकान वर्षा के समय उनके मकानों से पानी का रिसाव होता है। गांव में एक ही हेण्डपम्प होने से पीने के पानी की समस्या है। मवेशियों के लिए पौ बनानी है एवं गांव के 10वी पास व्यक्तियों को नौकरी पढाई के हिसाब मिले।

13. श्री मोहनलाल गाडरी – पूर्व सरपंच खड़ बामनियां ने कहा कि लोड़ी सिन्देसर माइन्स में लोगों की भलाई नहीं खपाई हो रही है। मजदूरों को 100 रूपये ही देकर शोषण किया जा रहा है। मजदूरों के साथ मारपीट की जा रही है। हमारे गांव की 84 बीघा जमीन गई है लेकिन गरीब गोल चमारों को कोई रोजगार नहीं दिया गया है। मेरा

क्षेत्रीय अधिकारी
क्षेत्रीय नियंत्रण मण्डल

प्रशासन से निवेदन है कि वे इसमें हस्तक्षेप कर हमारे गांव के लोगों को प्राथमिकता से रोजगार दिलावें।

14. श्री मोहनलाल जाट – निवासी ग्राम माताजी का खेडा ने कहा कि इस जनसुनवाई में आस पास के गांवों के लोगों में व्यापक प्रचार प्रसार नहीं किया गया। दरीबा माइन्स के लगने के समय माताजी का खेडा की जमीन का मुआवजा दिया उस समय यह शर्त थी कि प्रभावित प्रत्येक परिवार के घर से एक को रोजगार दिया जाएगा। किन्तु आज भी बच्चे भटक रहे हैं प्रकृति साथ नहीं दे रही है वर्षा नहीं हो रही है। इससे गांव प्रभावित हो रहा है। चार बार पहले ब्लास्टिंग से गांव के मकानों में हो रही दरारों के बारे में लिख कर दिया लेकिन कोई सुनवाई नहीं हो रही है। वेन्टीलेशन फेन से की हवा से पूरा गांव गैस से प्रभावित हो रहा है, किसी ने ध्यान नहीं दिया है।

15. श्री विनोद जाट – वार्ड पंच ग्राम पंचायत मेहन्दुरिया ने कहा कि सम्पर्क सडक की सही व्यवस्था नहीं होने की वजह से दुर्घटना की आशंका बनी रहती है। शुद्ध पर्यावरण हेतु एरिये का सीमांकन करवाकर हरित पट्टी का विकास करवाया जावे। सामाजिक निगमित गतिविधियों की आस–पास के लोगों को पूरी जानकारी दी जावे। गांव की पंचायत से भौतिक सत्यापन करवाया जावे ताकि गांव के लोग ज्यादा से ज्यादा लाभान्वित हो सके।

16. श्री लक्ष्मण दास – उप सरपंच ग्राम मेहन्दुरिया ने कहा कि सी.एस.आर के तहत हमारी पंचायत में कोई विकास का काम नहीं हुआ है। मेरा निवेदन है कि पक्की बिल्डिंग बनवाकर एक आदर्श आंगनवाड़ी प्रारम्भ की जावे। चिकित्सा एवं पशु चिकित्सा शिविर लगाने से पूर्व व्यापक प्रचार–प्रसार किया जावें; प्रशिक्षण कार्यक्रमों का कार्यान्वयन स्थानीय स्तर पर अधिक किया जावें ताकि अधिक से अधिक लाभान्वित हो सके।

17. श्री नानालाल गाडरी – निवासी ग्राम राजपुरा ने कहा कि दरीबा में कारखाना लग रहा है, जिसका स्वागत है इससे रोजगार मिलेगा, जीवन स्तर उंचा उठेगा। पर्यावरण संबंधित जो आंकड़े प्रस्तुत किए हैं उसके अनुरूप काम नहीं हो रहा है। मेरा जिंक प्रशासन एवं राज्य प्रशासन से निवेदन है कि प्रोजेक्ट से पर्यावरण सबसे ज्यादा प्रभावित होगा अतः इसकें संरक्षण हेतु अच्छे प्रबन्ध करवाए जाए। प्रभावित गांवों में विकास के अधिक से अधिक कार्य करवाए जाए। सभी गांवों में पेयजल की सुविधा करवाई जावे।

18. श्री वरदी चन्द खारोल – पूर्व सरपंच राजपुरा ने कहा कि प्लान्ट प्रारम्भ करने से पहले आस पास की जनता को विश्वास में लेना आवश्यक है। बडे–बड़े पूंजी पति विश्वास में लेकर प्लान्ट लगा देते हैं लेकिन विस्थापन के समय नौकरी आदि पर ध्यान नहीं देते है। प्लान्ट लग रहा है इसका हम स्वागत करते हैं। मेरा सुझाव है कि

क्षेत्रीय अधिकारी
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल

आय के अनुरूप एरिये के लोगों को विश्वास में लेकर विकास पर अधिक से अधिक ध्यान दिया जावें। एरिये की जनता पिछडी हुई इसलिए प्रबन्धन को आस–पास के गांवों में मिटिंग लेकर जन सुनवाई के बारे में बताना चाहिए था। प्लान्ट से मिट्टी उडती है और निकलने वाले धुएं से सबसे ज्यादा नुकसान होगा, इसकी क्या व्यवस्था की जा रही है इसके लिए गांव वालों को विश्वास में लेना होगा अन्यथा प्लान्ट चालू नही होने दिया जाएगा। स्थानीय लोगों को अधिक से अधिक रोजगार दिया जावे। राजपुरा के पास पुरानी खदानों की फेन्सिग करवाई जावे जिससे मवेशियों की जान का खतरा नहीं रहे।

19. श्री श्याम लाल चौहान – प्रधान पं.स. रेलमगरा ने कहा कि जन सहभागिता से सबको केडर के अनुसार रोजगार मिले। प्लान्ट लगने से क्षेत्र को नुकसान होगा इसकी क्षति पूर्ति अवश्य की जानी चाहिए। जिंक प्रबन्धन शिक्षा एवं अन्य विकास कार्यों में सहभागिता को और बढ़ाए। निरन्तर गांवों के सम्पर्क में रहें। सी.एस.आर. का लाभ जन–जन तक पहुचाए। रेल योजना का लाभ क्षैत्रिय लोगों को भी मिलें। उन्होनें यह भी कहा कि बढ़ते हुए यातायात को देखेते हुए फतहनगर से खण्डेल तक की सड़क को तत्काल चौड़ा करवाया जाना चाहिए।

20. श्री शंकरलाल चौधरी – पूर्व सरपच धनेरिया गढ ने कहा कि प्लान्ट से पूरे एरिये का विकास होगा चूंकि यह एशिया का दूसरे नंम्बर का प्लान्ट है। बहुत बड़ी महत्वाकांक्षी योजना है किन्तु आस पास के गांवों से समन्वय स्थापित कर उनके असंतोष को भी दूर किया जावे। स्थानीय लोगों को रोजगार दिया जाए। ठेके में लगाए जाने वाले वाहनों में भी स्थानीय लोगों को प्राथमिकता दी जावे इससे असंतोष खत्म होगा। उन्होनें कहा कि हि.जि. एक मात्र इस एरिये का आर्थिक स्त्रोात हैं अतः क्षेत्र के लोगों की बहुत अपेक्षाए हैं। उन्होने यह भी कहा की बाहर से मजदूरी पर लगाए गए मजदूरों का परिचय पत्र बनवाया जावे इनका प्रमाणिकरण थाने से करवाया जावे जिससे किसी भी प्रकार की अपाराधिक वारदात की आशंका नहीं रहे। इन्होनें कहा कि बाघेरी एवं मान्सी वाकल परियोजनाओं का लाभ क्षेत्र वासियों को भी दिलाया जावें।

21. श्री नन्दलाल सिंघवी – जिला प्रमुख राजसमंद ने कहा कि पूर्व में अवाप्त भूमि पर रोजगार आदि नहीं दिया गया है तो इस पर प्रबन्धन को ध्यान दिया जाना चाहिए। वेदान्ता ग्रुप यहां प्रोजेक्ट लगाकर लाभ प्राप्त करेगा लेकिन एरिये के लोगों को हवा, पानी शुद्ध मिले इसकी भी जांव करवाई जानी चाहिए। टेलिग डेम से होने वाले प्रदुषण को रोकना चाहिए। पीने योग्य पानी और आमदनी के अनुरूप एरिये के विकास पर ध्यान दिया जाना चाहिए। मान्सी वाकल की तरह राजसमंद जिले के लिए भी प्रोजेक्ट बने। चिकित्सा का लाभ सम्पूर्ण क्षेत्र को मिले। यदि 20 वर्षों के लिए खनन की

क्षेत्रीय अधिकारी
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल
उदयपुर

योजना है तो उसके अनुरूप एरिये के विकास की भी योजना होनी चाहिए। पर्यावरण संरक्षण हेतु पेड़ पौधों का समुचित विकास किया जावे तथा गांव के लोगों को ही वन संरक्षण की जिम्मेदारी सौंपी जावे। प्रोजेक्ट की वजह से वाहनों में यकायक बढोतरी होगी, इसलिए हि.जि. को आगे आकर फतहनगर से खण्डेल तक की सडक को बहुत जल्दी चौडी करवाई जावे इसके अलावा रोड जाम होने पर मार्ग में कही डाइवर्सन की भी व्यवस्था की जावे। बाहर के लोगों का परिचय पत्र दिया जावे ताकि वे मूल निवासी ना हो सके।

श्री टी.सी. बोहरा, प्रतिनिधि, जिला–कलेक्टर, राजसंमद ने कहा कि स्थानीय लोगों की भावनाओं को समझकर उनका ध्यान रखा जावें। पंचायत वार आंकलन वहां के लोगों के साथ बातचीत कर उसी अनुरूप अपनी कार्य योजनाऐं बनाएं। जनता की भावनाओं के अनुसार प्राथमिकताएं तय करें। इससे लोगों में संन्तुलन की प्रवृति जागेगी। काश्तकार के लिए जमीन मां की तरह होती है, इसलिए जिंक प्रशासन काश्तकार के दर्द को समझे। पर्यावरण एक तकनीकी पहलू हैं ग्रामीणों की पीडा को समझे, उन्हें पर्यावरण संरक्षण हेतु किए जा रहे प्रयासों से अवगत कराकर विश्वास में लें। उन्होने यह भी कहा कि प्रोजेक्ट में रोजगार हेतु लगे बाहर के लोगों की पहचान की व्यवस्था सुनिश्चत हो, अनजान लोगों से अपराधिक प्रवृति बढ़ती है। तहसीलदार गांव वाइज एक सूची तैयार करवावें तथा थाने से चिन्हित करवाकर/ सत्यापित करवाकर परिचय पत्र जारी करवाएं जाएं, इससे पहचान की समस्या अवश्य हल होगी। समस्याओं के प्रति सहानुभूति न रखकर उनकी संवेदनाओं को समझे। लोगों की भावनाओं के अनुसार सामाजिक निगमित गतिविधियों के विस्तार की अपेक्षा हकीकत में जाएं।

जन सुनवाई के अन्त में श्री वीर सिंह बृजवासी, क्षेत्रीय अधिकारी, राजस्थान राज्य प्रदूषण मण्डल, उदयपुर द्वारा उपस्थित जन समूह व जन प्रतिनिधियों को जनसुनवाई में उपस्थित होने हेतु धन्यवाद दिया। जन सुनवाई के दौरान आमजन द्वारा दिए गए ज्ञापन (कुल 6) संलग्नक 2 पर संलग्न है।

जनसुनवाई बैठक में उपस्थित नागरिकों की सूची मय हस्ताक्षर संलग्नक 1 पर दी गई हैं।

(वीरसिंह बृजवासी)
क्षैत्रीय अधिकारी
राजस्थान राज्य प्रदूषण मण्डल, उदयपुर

क्षैत्रीय अधिकारी
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल
उदयपुर

13/02/09

(टी.सी. बोहरा)
अतिरिक्त जिला कलेक्टर,
(प्रतिनिधि–जिला कलेक्टर,) राजसंमद

टीकम चन्द बोहरा
अतिरिक्त जिला कलक्टर एवं
अतिरिक्त जिला मजिस्ट्रेट, राजसमन्द

Public hearing for obtaining Environment Clearance for Lead-Zinc Integrated Project- Zinc Smelter, 2 x 2.5 LTPA, Lead Smelter 1 x 1.25 LTPA, Captive Power Plant, 3 x 85 MW and Underground Mine project expansion from 6.31 LTPA to 9.00 LTPA & Beneficiation Plant capacity from 9.0 LTPA to 12.0 LTPA and renewal of mine lease due on 30.05.2010 at Tehsil Relmagra, District Rajsamand, Rajasthan.

The District Collector, Rajsamand, vide order no. Pa40(3)(41)Sa. Pra./Parya/JanSu./05/53-59 dated 07.01.2009 notified Public Hearing on 12.02.2009 for obtaining Environmental clearance for Lead-Zinc Integrated Project- Zinc Smelter, 2 x 2.5 LTPA, Lead Smelter 1 x 1.25 LTPA, Captive Power Plant, 3 x 85 MW and Underground Mine project expansion from 6.31 LTPA to 9.00 LTPA & Beneficiation Plant capacity from 9.0 LTPA to 12.0 LTPA and renewal of mine lease due on 30.05.2010 at Tehsil Relmagra, District Rajsamand, Rajasthan. The Public hearing was conducted on 12.02.2009 and following were present:

S.No.	Name / Designation & address	Representing Department
1	Shri T. C. Bohra, RAS Additional District Collector	District Collector Rajsamand
2	Shri Veer Singh Brijwasi Regional Officer	Rajasthan Pollution Control Board Udaipur

Shri Veer Singh Brijwasi, Regional Officer Rajasthan Pollution Control Board, Udaipur informed that this public hearing is being held for issuing environment clearance for Integrated Smelter Complex- Zinc Smelter, 2 x 2.5 LTPA, Lead Smelter 1 x 1.25 LTPA, Captive Power Plant, 3 x 85 MW and Underground Mine project expansion from 6.31 LTPA to 9.00 LTPA & Beneficiation Plant capacity from 9.0 LTPA to 12.0 LTPA of M/s. Hindustan Zinc Limited. He also informed about the importance of public hearing that by at one side public awareness is created for proposed project and at the same time suggestions of public are invited for protection of environment. He also mentioned in brief about the Integrated Smelter Complex and mine & mill expansion project.

Shri Kabir Ghosh, Associate Vice President of M/s. Hindustan Zinc Limited presented technical information regarding Lead-Zinc Integrated Project- Zinc Smelter, 2 x 2.5 LTPA, Lead Smelter 1 x 1.25 LTPA, Captive Power Plant, 3 x 85 MW and Underground Mine project expansion from 6.31 LTPA to 9.00 LTPA & Beneficiation Plant capacity from 9.0 LTPA to 12.0 LTPA and renewal of mine lease. After that Shri Zakkiuddin Sheikh, Senior Manager (Environment) apprised in detail about the study carried out for the environmental impact due to proposed project.

Shri Kabir Ghosh apprised that out of total 554.19 hectare land which was acquired way back for the purpose of Rajpura Dariba Mine, 162 hectare land is proposed for Smelters and CPP located at Village Rajpura Dariba, Tehsil-Relmagra, Rajsamand Dist.

Shri Veer Singh Brijwasi, Regional Officer RSPCB, Udaipur Region invited local people present in the meeting to express their suggestions, opinion, and objections on the impact of project on the environment.

The suggestions and objections given by the members and local public present are as follows:

1) Shri Lobhchand Gadri, R/O Village Rajpura said that the company should provide employment based on the real loss to the affected person.

2) Shri Bherulal Jat, R/O Village Chhapri said that Chhapri and Dhaneriya schools should be upgraded from existing 8th class level to 16th class.

3) Shri Bothlal Jat, R/O Village Anjana said that despite giving full support he is not happy as people are cutting trees. He said that the public hearing was not propagated wide spread. The people are afraid. I am of the opinion that the people of nearby villages of project like Dariba, Anjana, Mataji Ka Kheda etc. to be given priority for appropriate employment.

4) Shri Shantilal Menaria, R/O Village Gawardi express thanks to Vedanta group for bringing such a big project in the area. He said that there will a development of the area but environmental will be affected. So government gives attention for environment protection. He suggested for widening of the road between Fatehnagar and Khandel Chauraha to cope up the future increased traffic. People living around 10 km. radius area in the Relmagra Tehsil are provided free medical facilities and employment based on priority.

5) Shri Mitthulal Vaishnav, R/O Village Dariba said that at the time of commissioning of Dariba Mine was rehabilitated. At that time the facilities committed were not fully fulfilled like roads and availability of water. I request that the problems to be addressed.

6) Shri Hiralal Prajapati, R/O Village Sunariya Kheda said that people of the area are benefited but the problems of nearby villages have not been properly addressed. I request the management for protection of environment so that the impact on land and water due to tailing dam can be managed.

7) Shri Rajmal Jain R/O Village Kabra said that construction of plant is the matter of pleasure for people of the area but the benefits should go to all affected nearby villages. He also said that connecting road is not available for our village. Agriculture and cattles are affected. Only 3 people out of 400 have been employed. Our Panchayat is not getting

any share of the royalty being paid to government of Rajasthan by M/s. Hindustan Zinc Ltd. The matter may please be looked into.

8) Shri Bhagvat Singh, R/O Village Sunariya Kheda said that the agriculture and water of our village is being affected by tailing dam. About 100 persons are unemployed. He requested for the solution of this matter.

9) Shri Chatarsingh Rajawat, Sarpanch & R/O Village Rajpura said before 25 years ago there was agricultural prosperity in the vicinity of the mine. The sugar cane produced was sent to factory at Bhupalsagar and mini sugar factory in the Bedakheda village. Due to the mining activity the nearby village wells have been dried affecting the agriculture. The land is also affected by the tailing dam in the village Sunariya kheda. Due to the project this area will be affected more hence the local people to be compensated by providing employment.

10) Shri Hariram Gurjar, R/O Village Kantiya kheda said that our village is located approximately half km. away from mine. The crops and water are affected. The Dariba Panchayat has not done anything for development of the village. Cremation ground and hand pumps are not provided. No job opportunity is provided to anyone from the village. Honorable administration is requested to look into the matter.

11) Shri Basantilal Lal Vaishnav, R/O Village Naya Dariba (Kotdi Side) said that in 1980-81 Dariba was rehabilitated and our ancestors were displaced. Today in our village there is a shortage of water. Particularly the cattle stock is affected. Dariba people donated their land but they are facing the problem of employment. Despite acquirement of our land there is no road. The village is being neglected hence the priority for development to be given for our village.

12) Shri Kaluram Jatia, R/O Village Dariba said that during the rain, water trickles in our school building but neither the company nor the Sarpanch has taken any action so far. During the rain, the access to the villages is not passable. There is a tickling of water in the 2 to 3 Bhil houses during the rain. There is a drinking water problem and we have only one hand pump. The water sump be provided for cattle. The 10^{th} class pass be provided appropriate jobs.

13) Shri Mohanlal Gadri, Ex Sarpanch of Khar Bamania said that in the Sindesar Khurd Mine the people are not benefited but exploited. The labor are being paid only 100 Rs./day. Our 84 Bigha land of village has been acquired but the poor Bhil-Chamars have not been given any employment. It is my request to the administration to intervene and provide employment to our village people on priority.

14) Shri Mohanlal Jat, R/O Village Mataji Ka Kheda said that for this public hearing there is no wide propaganda in the nearby villages. At the time of commissioning of Dariba Mines compensation for Mataji Ka Kheda land was given and it was committed that one person from each affected family would be provided employment. Yet we see that the children are roaming, the nature is not helping as there is no good rainfall. Due to this the village is getting affected. In past it was complained four times in writing that cracks are developing in the houses of the village due to blasting but it has not been heard. The village is getting affected due to ventilation fan.

15) Shri Vinod Jat, Ward Panch, Gram Panchayat, Mahenduriya said that there is fear of accidents due to bad road condition of the link road. The area be demarcated for development of green belt. The people of the nearby area be fully appraised about Corporate Social Responsibilities (CSR) activities. Physical verification be done by village Panchayat so that maximum people of the village are benefited.

16) Shri Laxman Das, Deputy Sarpanch Village Mahenduriya said that in our Panchayat no development has been carried out under CSR. It is my request that a building be constructed for opening an Ideal 'Aangan Vadi'. There be adequate propaganda before organizing medical and veterinary camps. The vocational programs be conducted at local levels so that more and more people are benefited.

17) Shri Nanalal Gadri, R/O Village Rajpura said that the construction of plant is welcomed in Dariba as it will generate employment and the living standard will improve. The work is not going on as per environment data presented. Due to the project the environment would get affected hence it is my request to the Zinc and State administration for good management towards protection of environment. In the affected villages more development be done. In every village the facility of drinking water be provided.

18) Shri Vardichand Kharol, Ex. Sarpanch Village Rajpura said that before starting the plant it is essential to take into confidence the public of the nearby villages. The big businessman constructs the plant after taking people in confidence but do not care to provide employment at the time of rehabilitation. We welcomed the construction of plant. It is my opinion that according to the income (profit), the development of the area be done. The people in the area are backward hence the management should have taken meetings in the villages and apprised about public hearing. The area will be affected by dust and fumes generated from the plant, what arrangements/actions are being taken? If the people of the nearby villages are not taken into confidence the

plant will not be allowed to run. The local people be given more employment. The ancient old workings (mines) in the vicinity of Rajpura be fenced so as to avoid any mishap to the cattle.

19) Shri Shyamlal Chauhan, Pradhan Panchayat Samiti, Relmagra said that employment be provided as per cadre through public involvement. The area will get affected due to plant hence compensation be provided. The Zinc management should increase co-operation in educational and other development activities. The contact in villages be continued. The CSR benefit should go to the public. The local people be benefited by railway project. He further said that looking at the increased traffic the road from Fatehnagar to Khandel be widened immediately.

20) Shri Shankarlal Chaudhari, Ex. Sarpanch, Village Dhaneriyagadh said that from the plant there will be development of entire area because this is going to be second biggest in Asia. This is a big ambitious project but the dissatisfaction of the people of nearby villages be addressed to by establishing contract. The local people be given employment. The priority be given to local people for contracts for vehicles, this will help remove dissatisfaction. He further said that people of the area have high expectations as Hindustan Zinc Ltd. is the only economic source of the area. He said that the identity cards of the outside labors be provided with due verification from police station so that there doesn't remain any suspicion about criminal offences. The people of the area also be benefited from Bagheri and Mansiwakal projects.

21) Shri Nandlal Singhvi, Zila Pramukh, Rajasmand said that if in past employment has not been given after acquirement of land; the management should pay attention to it. The Vedanta group will gain benefit from the project but at the same time the analysis for the air and water be done so that the people of the area get pure air and water. The pollution from tailing dam be prevented. Attention be paid towards drinking water and development of the area according to the income from the project. There should be project like Mansiwakal in the Rajasmand Dist. also. The area gets benefits of medical facilities. If the mining project is for 20 years then there be projects for the development of the area accordingly. For environment protection plantation be done and the responsibility of plantation protection be given to village people. Due to the project there has been sudden increase in traffic so Hindustan Zinc Ltd. should come forward for widening of the road between Fatehnagar to Khandel as early as possible, there should be arrangements for diversion in case of traffic jam. The people from outside be provided identity card so that they do not become domicile.

Shri T. C. Bohra, representative of District Collector, Rajsamand concluded that the feelings of local people are understood and should be taken care of. Panchayat wise survey be done and after the discussion with people, the plan be framed accordingly. The priority should be fixed according to the feelings of the public; this will help inculcate the habit of balancing. For farmers the land is like mother so the Zinc administration understand the pains of the farmers. Environment is a technical aspect, understand the pains of villagers and take them in confidence by appraising them about the efforts being made towards protection of environment. The people present also expressed that the identity of the people from the outside employed for the project be assured; the strangers may increase criminal offences. The Tehsildar prepare a village wise list and get it marked/verified from police station and issue identity card so that the problem of identification gets solved. Just not have sympathy towards problems but understand the feelings. The CSR activities be expanded in reality according to the feelings of the people.

In the end of public hearing, Shri Veer Singh Brijwasi, Regional Officer RSPCB Udaipur region, thanked the local public and public representatives for their participation in the process. The memorandums (total 6 nos.) submitted by public present during public hearing are enclosed as annexure-II

The list of people present in the public hearing with their signature is attached as annexure-1.

(Veer Singh Brijwasi)
Regional Officer
Rajasthan State Pollution Control Board,
Udaipur

(T. C. Bohra)
Additional District Collector
(Representative-District Collector)
Rajsamand

पर्यावरणी क्लीयरेन्स हेतु जन सुनवाई

मेसर्स– हिन्दुस्तान जिंक लिमिटेड, राजपुरा दरीबा, तहसील रेलमगरा, जिला राजसमंद में लेड–जिंक इन्टीग्रेटेड कॉम्पलेक्सा– जिंक स्मेल्टर, 2 गुणा 0.25 मिलियन टन प्रति वर्ष, लेड स्मेल्टर 1 गुणा 0.125 मिलियन टन प्रतिवर्ष, कैप्टीव पावर प्लान्ट 3 गुणा 85 मेगावाट तथा राजपुरा लेड–जिंक खान (एम.एल. 2/89) 0.63 लाख टन प्रतिवर्ष से 0.9 लाख टन प्रतिवर्ष, अयस्क सान्द्रीकरण 0.9 लाख टन प्रतिवर्ष से 12.0 लाख टन प्रतिवर्ष के विस्तारीकरण एवं लीज नवीनीकरण ड्यू ऑन 30.05.2010 के लिये पर्यावरणीय क्लीयरेन्स चाचत् दिनांक 12.02. 2009 को प्रातः 11.00 बजे माइन्स स्थल पर ही आयोजित जन सुनवाई में उपस्थित अधिकारी एवं स्थानीय नागरिकगण:–

क्र.सं.	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
1.	Shri T.C. Bohra	ADM (RAJSAMAND)	
2.	Shri V.S. Vijayvargi	R.O., RSPCB, UDAIPUR	
3.	Kabir Ghosh	AVP (SK Project)	
4.	P.K. Jain	Unit Head (RDM)	
5.	R.Rajith	GM (Smelter RDM Complex)	
6.	R.K. Singhvi	AGM (Projects)	
7.	Z. Shukla	SM (Env)	
8.	Shivaramaiah M.S.	AGM (HSE) (Projects)	
9.	Pankaj Verma	AGM (ES) - RSC	
10.	Dr. V.P. Singh	Asset Manager (Env.)	
11.	Nirav Shah	PGET (Environment)	
12.	[illegible]	CSR [illegible]	
13.	Prakash Lal Bishnoi	CSR	
14.	P.R. Chaturvedi	AGM (HR)	
15.	Dipak Gohlya	HR	
16.	R.C. Meena	Dambe	
17.	M.L. Menaria	[illegible]	

क्रमां.	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
19	DHEERAJ Bilochi	RAMA Studio Udr	
11	VIKAS BOLIYA	RAMA Studio Udr	
20	LOKENDRA Singh	RAMA Studio Udr	
21	Yashwant Lehar	C S R.	
22	Mukesh Sadawal	CSR	
23	RoopSingh chouhan	C SR	Roop Singh
24	Madan lal Gadri	C S R	
25	Babla Kumar Gadri	C S R	
26	Nitin Lal Jat	Coachmate	
27	Pushkar Bairwa	C S R	
28	Gyarak Lal Jat	C S R	
29	Kamlesh Choudhary	CSR (Ucr)	
30	G L Punjabi	HQ	
31	BAR Kumawat	CIVIL	
32	[illegible]	[illegible]	
33	[illegible]	[illegible]	
34	[illegible]	[illegible]	
35	[illegible]	[illegible]	
36	[illegible]	[illegible]	
37	[illegible]	[illegible]	
38	[illegible]	[illegible]	
39	[illegible]	[illegible]	
40	[illegible]	[illegible]	
41	[illegible]	[illegible]	
42	[illegible]	[illegible]	
43	[illegible]	[illegible]	
44	[illegible]	[illegible]	
45	[illegible]	[illegible]	
46	[illegible]	[illegible]	
47	[illegible]	[illegible]	
48	[illegible]	[illegible]	
49	[illegible]	[illegible]	
50	[illegible]	[illegible]	
51	—		
52	[illegible]	[illegible]	
53	[illegible]	[illegible]	

क्रमां.	व्यक्ति का नाम	पता / निवास का नाम	हस्ताक्षर
54	अनील अग्रवाल	दीवा कॉलोनी	
55	रतन लाल तेली	गलाडी	
56	दलीचंद रावत	जीतावास	
57	मांगीलाल लाल गोडा	दीपा (कोटडी)	
58	[illegible]	दरीबा (कोटडी)	
59	[illegible]	कोटडी	
60	[illegible]	मेघपुरिया	
61	[illegible]	गलाडी	
62	[illegible]	कोटडी खोडा	
63	[illegible]	[illegible]	
64	[illegible]	[illegible]	
65	[illegible]	[illegible]	
66	[illegible]	[illegible]	
67	[illegible]	[illegible]	
68	[illegible]	[illegible]	
69	[illegible]	[illegible]	
70	राजू	[illegible]	
71	[illegible]	[illegible]	
72	[illegible]	[illegible]	
73	[illegible]	[illegible]	
74	[illegible]	कुरडा	
75	[illegible]	[illegible]	
76	[illegible]	[illegible]	
77	[illegible]	[illegible]	
78	S. L. Khatik	[illegible]	
79	Vasu Dev Purohit	Compressor House	
80	Gopal Lal Purohit	Elect. [illegible]	
81	[illegible]	गलाडी	
82	[illegible]	[illegible]	
83	[illegible]	[illegible]	
84	[illegible]	[illegible]	
85	[illegible]	[illegible]	
86	[illegible]	[illegible]	
87	[illegible]	[illegible]	
88	[illegible]	[illegible]	
89	[illegible]	[illegible]	

क्रम.	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
89	[illegible]	[illegible]	[illegible]
90	[illegible]	[illegible]	[illegible]
91	[illegible]	[illegible]	[illegible]
92	[illegible]	[illegible]	[illegible]
93	[illegible]	[illegible]	[illegible]
94	[illegible]	[illegible]	[illegible]
95	[illegible]	[illegible]	[illegible]
96	[illegible]	[illegible]	[illegible]
97	[illegible]	[illegible]	[illegible]
98	[illegible]	[illegible]	[illegible]
99	[illegible]	[illegible]	[illegible]
100	[illegible]	[illegible]	[illegible]
101	[illegible]	[illegible]	[illegible]
102	[illegible]	[illegible]	[illegible]
103	[illegible]	[illegible]	[illegible]
104	[illegible]	[illegible]	[illegible]
105	[illegible]	[illegible]	[illegible]
106	[illegible]	[illegible]	[illegible]
107	[illegible]	[illegible]	[illegible]
108	[illegible]	[illegible]	[illegible]
109	[illegible]	[illegible]	[illegible]
110	[illegible]	[illegible]	[illegible]
111	[illegible]	[illegible]	[illegible]
112	[illegible]	[illegible]	[illegible]
113	[illegible]	[illegible]	[illegible]
114	[illegible]	[illegible]	[illegible]
115	[illegible]	[illegible]	[illegible]
116	[illegible]	[illegible]	[illegible]
117	[illegible]	[illegible]	[illegible]
118	[illegible]	[illegible]	[illegible]
119	[illegible]	[illegible]	[illegible]
120	[illegible]	[illegible]	[illegible]
121	[illegible]	[illegible]	[illegible]
122	[illegible]	[illegible]	[illegible]
123	[illegible]	[illegible]	[illegible]

क्रमां.	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
124	जगदीश चन्द जैसाक	कालेरा /ASVN	
121	माधव लालजी गाडवी	झरीया	
126	[illegible]	[illegible]	
127	[illegible]	[illegible]	
128	Rajesh Agrawal	C 47, Bk [illegible]	
129	B L Gurjar	C-58 RDM	
130	P.K. Bhaskar	C-70 RDM	
131	[illegible]	[illegible]	
132	[illegible]	C-53 RDM	
133	[illegible]	C-1 RDM	
134	संदीप नड्डे	सी- 94	
135	[illegible]	C-08	
136	[illegible]	D-16	
137	M.K. Gupta	C-31	
138	[illegible]	A-C-C [illegible]	
139	नाँजीलाल मेनारिया	गलारडी	
140	किसनलाल जाट	आँजना	
141	लालूराम जाट	[illegible]	
142	[illegible]	[illegible]	
143	जगदीश	[illegible]	
144	[illegible]	[illegible]	
145	[illegible]	[illegible]	
146	[illegible]	[illegible]	
147	[illegible]	[illegible]	
148	[illegible]	[illegible]	
149	Ratan Lal	[illegible]	
150	[illegible]	[illegible]	
151	[illegible]	[illegible]	
152	[illegible]	[illegible]	
153	[illegible]	[illegible]	
154	[illegible] Hariram Singh	Dariba C	
155	[illegible]	U.G.W.S	
156	[illegible]	DARIBA COLONY	
157	K G Nair	Dariba	

क्रमांक	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
158	नानालाल	कांकरा (सरपंच)	नानालाल
159	PK Gupta	C TYPE PARIP	
160	Pradeep Kashyap	L.I.C Rep	
161	Sadhana Upadhyay	Bhilwara	Sadhana
162	गोरधनलाल खोजीलाल	रायपुर	गोरधनलाल
163	सोहनलाल गोयल	दुरीका	सोहनलाल
164	भगवान लाल गोयल	वार्डपंच दौरा	भगवानलाल
165	सुरेश चन्द्र जैन	दुरीका कॉलोनी	
166	[illegible]	कोटड़ी	
167	मांगुलालशर्मा	दरीबा	मांगुलालशर्मा
168	[illegible]	कोटरी	
169	[illegible]	[illegible]	
170	रोशनलाल जाखड़ी	नया दरीबा	
171	[illegible]	पुलिस कॉलोनी	
172	[illegible]	दरीबा	
173	ओमप्रकाश गोयल	दरीबा	
174	[illegible]	सरपंच गोलाड़ी	
175	[illegible]	[illegible]	
176	मोहनलाल गाडरी	पूर्व सरपंच ग्राम पंचायत जाजनोदा	
177	रतनसिंह रावत	रतनगढ़ी	
178	[illegible]	[illegible]	
179	[illegible]	दरीबा	
180	[illegible]	दरीबा	
181	[illegible]	[illegible]	
182	[illegible]	[illegible]	
183	[illegible]	[illegible]	
184	[illegible]	[illegible]	
185	[illegible]	[illegible]	
186	[illegible]	[illegible]	
187	[illegible]	[illegible]	
188	[illegible]	[illegible]	
189	[illegible]	[illegible]	
190	[illegible]	[illegible]	
191	[illegible]	[illegible]	
192	[illegible]	[illegible]	

क्रमां.	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
193	[illegible]	[illegible]	[illegible]
194	हीरालाल	[illegible]	[illegible]
195	हरिलाल	[illegible]	[illegible]
196	[illegible]	[illegible]	[illegible]
197	[illegible]	[illegible]	[illegible]
198	[illegible]	[illegible]	[illegible]
199	[illegible]	[illegible]	[illegible]
200	[illegible]	[illegible]	[illegible]
201	[illegible]	[illegible]	[illegible]
202	[illegible]	[illegible]	[illegible]
203	[illegible]	[illegible]	[illegible]
204	[illegible]	[illegible]	[illegible]
205	[illegible]	[illegible]	[illegible]
206	[illegible]	[illegible]	[illegible]
207	[illegible]	[illegible]	[illegible]
208	[illegible]	[illegible]	[illegible]
209	[illegible]	[illegible]	[illegible]
210	[illegible]	[illegible]	[illegible]
211	[illegible]	[illegible]	[illegible]
212	[illegible]	[illegible]	[illegible]
213	[illegible]	[illegible]	[illegible]
214	[illegible]	[illegible]	[illegible]
215	[illegible]	[illegible]	[illegible]
216	[illegible]	[illegible]	[illegible]
217	[illegible]	[illegible]	[illegible]
218	[illegible]	[illegible]	[illegible]
219	[illegible]	[illegible]	[illegible]
220	[illegible]	[illegible]	[illegible]
221	[illegible]	[illegible]	[illegible]
222	[illegible]	[illegible]	[illegible]
223	[illegible]	[illegible]	[illegible]
224	[illegible]	[illegible]	[illegible]
225	[illegible]	[illegible]	[illegible]
226	[illegible]	[illegible]	[illegible]
227	[illegible]	[illegible]	[illegible]
228	[illegible]	[illegible]	[illegible]

क्रमां.	व्यक्ति का नाम	पता / मुख्य का नाम	हस्ताक्षर
229	[illegible]	[illegible]	[illegible]
230	[illegible]	[illegible]	[illegible]
231	[illegible]	[illegible]	[illegible]
232	[illegible]	[illegible]	[illegible]
233	[illegible]	[illegible]	[illegible]
234	[illegible]	[illegible]	[illegible]
235	[illegible]	[illegible]	[illegible]
236	[illegible]	[illegible]	[illegible]
237	[illegible]	[illegible]	[illegible]
238	[illegible]	[illegible]	[illegible]
239	[illegible]	[illegible]	[illegible]
240	[illegible]	[illegible]	[illegible]
241	[illegible]	[illegible]	[illegible]
242	[illegible]	[illegible]	[illegible]
243	[illegible]	[illegible]	[illegible]
244	[illegible]	[illegible]	[illegible]
245	[illegible]	[illegible]	[illegible]
246	[illegible]	[illegible]	[illegible]
247	[illegible]	[illegible]	[illegible]
248	[illegible]	[illegible]	[illegible]
249	[illegible]	[illegible]	[illegible]
250	[illegible]	[illegible]	[illegible]
251	[illegible]	[illegible]	[illegible]
252	[illegible]	[illegible]	[illegible]
253	[illegible]	[illegible]	[illegible]
254	[illegible]	[illegible]	[illegible]
255	[illegible]	[illegible]	[illegible]
256	[illegible]	[illegible]	[illegible]

व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
Kiran Maheshwari	MLA, Rajsamand	
[illegible]	[illegible]	
K.S Shaktawat	Spare DKMS	
[illegible]	[illegible]	
V.SIRISHA	Engineer, HSE	
Shama Jain	JFT, HCE	
Nand Lal Singhvi	Zilla Pramukh (Raj)	
GOUTAM BHATTACHARYA	HZL/UO	
Hitesha Bhutawat	CRDS, Udaipur	
Amish Soni	CRDS, Udaipur	
Jr. ACHARYCLUPURN	VIMTA LABS Ltd	
[illegible]	[illegible]	
[illegible]	I.A.R. Tehsil Railmagra	
[illegible]	[illegible]	
[illegible]	[illegible]	P.L.C
Manoj Yadav	P.A to MCH(M)	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
ARUN SHARMA	HZL	
Rajesh Kumar	HZL	
RAKESH MISHRA	HZL	
A.K Gupta	HZL	
TARUN SHRIMALI	HZL	
MUKESH SONI	HZL	
KOUSTAV BOSE	HZL	
BIGHNESWAR SWAIN	HZL	
[illegible]	[illegible]	
Shivpal Singh Rathore	Tehsildar Railmagra	
Madhan Lal [illegible]	Reader [illegible]	

क्रमां.	नागरिक का नाम	पता / विभाग का नाम		हस्ताक्षर
287	(1) शंकर सिंह राठौड़	सुरक्षा अधिकारी		शंकर
288	(2) गोकुलाल कुमार	रावपुरा		गोकुलाल
289	(3) बद्रीलाल नायक	कॉलोनी		बद्रीलाल
290	(4) राम लाल गाडरी	उदयपुर		Ramlal
291	(5) शंकर पाल सुथार	देलमगरा		शंकर
292	(6) पुष्करलाल पुरोहित	कॉलोनी		पुष्करलाल
293	(7) श्याम लाल रावत	कॉलोनी		श्यामलाल
294	(8) मोहन लाल बलाई	जावरमाईन्स	32820.2	मोहन लाल
295	(9) मोहनलाल सालवी	बोगड़िया	35807-	मोहनलाल
296	(10) पुरुषोत्तम पुरोहित	कॉलोनी	32666	
297	20 गणेश		32540	गणेश
298	21 फुलसिंह		35857	फुलसिंह
299	22 राजेश धानवी	HZL कॉलोनी	358613	
300	23 वसंत कुमार गर्ग	HZL कॉलोनी	35567	
301	[illegible]	HZL कॉलोनी	32557	
302	B.G. Trivedi	HZL. Colony		
303	Sohanlal	PCC		
304	नरपतनाथ चौहान	H.C.C. ग्रुप दरीबा		नरपतनाथ
305	रतनलाल	दरीबा		रतनलाल
306	राजेश कुमार	दरीबा		
307	[illegible]	[illegible]		
308	[illegible]	[illegible]		
309	B.L. Sukhwal	कॉलोनी		
310	[illegible]	कुरज		
311	मोहन लाल मेनारिया	उदयपुर		
312	दिनेश कुमार सारस्वत	दरीबा माईन्स		
313	Nathu Lal [illegible]	Dariba		
314	[illegible]	रावपुरा		
315	[illegible]	[illegible]		
316	[illegible]	उदयपुर		
317	[illegible]	उदयपुर		
318	[illegible]	[illegible]		
319	[illegible]	[illegible]		
320	[illegible]	[illegible]		

क्रम.	व्यक्ति का नाम	सभा/विभाग का नाम	हस्ताक्षर
324	उदय लाल डेर	कुरज - खदान	उदय लाल
322	बन्दी लाल गाडरी	दरीबा - खदान	बन्दी लाल
323	गोपीकृष्ण चतुर्वेदी	दरीबा खदान	गोपी
324	भागी चन्द	दरीबा खदान	भागी
325	छोगालाल	दरीबा खदान	छोगालाल
326	रामेश्वर टांक	गंवारडी खदान	रामेश्वर
327	[illegible]	रेलवायर खदान	[illegible]
328	[illegible]	गंवारडी खदान	[illegible]
329	[illegible]	दरीबा - [illegible]	[illegible]
330	[illegible]	[illegible]	[illegible]
331	[illegible]	[illegible]	[illegible]
332	[illegible]	[illegible]	[illegible]
333	M. Durgaprasad	Br. Zinc Colony	[illegible]
334	T.V. Rao	G.H. CPP - DSC	T.V. Rao
331	T. Ranji	G.H. CPP. DSC	[illegible]
336	N.S. Chauhan	W.E.D. [illegible]	[illegible]
337	M.L. SHARMA	Elect (U.G.)	M.L. Sharma
338	S.C.S. PANDAR	Elect. Mtce.	S.C.S. Pandar
339	R.N. Meena	A.C.C. Mines	[illegible]
340	V.B. Dhakad	Mining	[illegible]
341	HEM Prakash	Mining	[illegible]
342	M. Gopi Goswami	Acc Mines	[illegible]
343	मोतीलाल लोहार	दरीबा	[illegible]
344	उदयराम खारोल		
345	केवा लाल	रेलवायर	[illegible]
346	गणेश लाल	[illegible]	[illegible]
347	[illegible]	[illegible]	[illegible]
348	[illegible]	[illegible]	[illegible]
349	[illegible]	[illegible]	[illegible]
350	[illegible]	[illegible]	[illegible]
351	[illegible]	[illegible]	[illegible]
352	[illegible]	[illegible]	[illegible]

	क्रम सं.	मतदाता का नाम	पता / विभाग का नाम	हस्ताक्षर
3	1	[illegible]	[illegible]	[illegible]
354	2	[illegible]	[illegible]	[illegible]
355	3	[illegible]	[illegible]	[illegible]
356	4	[illegible]	[illegible]	[illegible]
357	5	[illegible]	[illegible]	[illegible]
358	6	[illegible]	[illegible]	[illegible]
359	7	[illegible]	[illegible]	[illegible]
360	8	[illegible]	[illegible]	[illegible]
361	9	[illegible]	[illegible]	[illegible]
362		[illegible]	[illegible]	[illegible]

करां.	व्यक्ति का नाम	पता / विभाग का नाम	हस्ताक्षर
406	[illegible]	[illegible]	[illegible]
407	[illegible]	[illegible]	[illegible]
408	[illegible]	[illegible]	[illegible]
409	[illegible]	[illegible]	[illegible]
410	[illegible]	[illegible]	[illegible]
411	[illegible]	[illegible]	[illegible]
412	[illegible]	[illegible]	[illegible]
413	[illegible]	[illegible]	[illegible]
414	[illegible]	[illegible]	[illegible]
415	[illegible]	[illegible]	[illegible]
416	Kishore Kumar. D.	RD mines. (C-type)	D. Kishore
417	M. Javed Alam	RD mines (CB1-14/1)	Alam
418	Mithilesh Kumar	R.D mines (B1-15/2)	Mithilesh
419	Naveen Kumar	R.D MINES (UG-Electrical)	Naveen
420	AJIT SINGH	RDM CUG Electrical	AJIT Singh
421	[illegible]	[illegible]	[illegible]
422	[illegible]	[illegible]	[illegible]
423	K. K. Pathak	Hqjal ENV	[illegible]

Annexure-XIV

Undertaking for No Pending Court Cases

ANNEXURE-XIV
UNDERTAKING FOR NO PENDING COURT CASES

HINDUSTAN ZINC LIMITED
Rajpura Dariba
P.O. Dariba – 313 211
Rajsamand District (Rajasthan)
Phone: (02952) 265164, Fax 265164

TO WHOM IT MAY CONCERN

It is certify that there are no litigation pending against the project (Rajpura Dariba) and/or any direction/order passed by any Court of Law against the project.

Zakiuddin Sheikh
Sr. Manager (Environment)