# MINING PLAN FOR JHIRIA WEST OCP

## 1.1 BACKGROUND OF THE PROJECT REPORT

The Jhiria West Opencast Project is situated in Sohagpur coalfields and is under administrative control of Hasdeo area of SECL. SECL Board after detailed deliberations approved the Project Report for Jhiria West Opencast (1.50Mty) for Partial Outsourcing Option (Coal Departmental and OB Outsourcing) involving a capital investment of Rs. 389.97 Crores vide 279th meeting of Board of Directors of SECL held on 28.11.2018 (Wednesday) at Raipur.

- PR for Jhiria West OC 1.5 Mty was prepared to mine out total mineable coal reserves of 14.35 Mt and OB of 115.33 Mcum with an average stripping ratio of 8.04 Mcum/t. It was approved with Partial Outsourcing Option (Coal Departmental and OB Outsourcing). Extraction of coal is done by surface miner in departmental mode.

  As per this mine plan, PR for Jhiria West OC 1.5 Mty is prepared to mine out total mineable coal reserves of 13.16 Mt and OB of 107.95 Mcum with an average stripping ratio of 8.20 Mcum/t.

## 1.2 Salient Features of the Approved PR (1.50 MTY)

The Project Report for Jhiria West Opencast Project was prepared for a targeted capacity of 1.50 Mty of coal. The total mineable reserve in Jhiria West Opencast was estimated as 14.35 Mt which would give a life of 12 years at the targeted capacity of 1.50 Mty.

It was estimated that total 482.694 Ha land will be required for Jhiria West Opencast Project which includes land for quarry, external dumps, Land for infrastructures, Approach road, safety zone, Belt, CHP & siding etc, Belt, CHP & siding etc. Out of total land of 482.694 Ha, forest land was estimated as 323.737 Ha.

Coal is being mined by surface miner and transported to surface by dump trucks. At the surface, CHP has been provisioned for onward dispatch. The PR has been approved with Partial Outsourcing Option (Coal Departmental and OB Outsourcing). The salient features of the approved PR are as enumerated below: -



क्षेत्रीय महाप्रबंधक.
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

TABLE-1

| Sl. | Particulars | Unit | Partial Outsourcing (Approved) |
|---|---|---|---|
| 1 | Total Mineable Reserves | M Te. | 14.35 |
| 2 | GCV Band | | G-6 (GCV 5524) |
| 3 | Volume of OB | M.Cum | 115.33 |
| 4 | Stripping Ratio (Av.) | Cum/t | 8.04 |
| 5 | Target Output | Mt/Yr. | 1.50 |
| 6 | Peak OBR | Mcum/yr. | 11.50 |
| 7 | Project life | Year | 12 |
| 8 | Total capital investment | Rs. crores | 389.97 |
| 9 | a) Capital requirement of P&M | Rs. crores | 82.30 |
| 10 | Selling price | Rs./ t | 2395.15 |
| 11 | Estimated cost of production | | |
| | a) at 100% level | Rs./t | 1499.74 |
| | b) at 85% level | Rs./t | 1644.23 |
| 12 | Profit per tonne<br>a) at 100% level | Rs./t | 895.41 |
| | b) at 85% level | Rs./t | 750.92 |
| 13 | Break-even-point (%) | | 47.76 |
| | (Mty) | | 0.72 |
| 14 | No. of personnel | | 304 |
| 15 | OMS | Rs./t | 17.46 |
| 16 | EMS | Rs. | 3360.90 |
| 17 | Anticipated year of achieving target | Year | 4 th YEAR |
| 18 | IRR at 100% level of production | % | 55.57% |
| 19 | IRR at 85% level of production | % | 41.87% |
| 20 | Completion capital | Rs. crores | 433.69 |
| 21 | NPV @ 12% at 100% level of production | Rs crores | 520.69 |
| 22 | NPV @ 12% at 85% level of production | Rs crores | 348.29 |

## 2.0 JHIRIA WEST OC 1.5 MTY MINING PLAN

### 2.1 PROPOSED MINE WORKING

The Project of Jhiria West OC has lease area is 427.993 Ha. Based on the lease area of the project this mine plan has been prepared for an annual capacity of 1.50 Mty considering lease area of 427.993 Ha. Accordingly, the quarry area, safety zone and infrastructure area has been modified from approved project report.

## 2.2 LOCATION

The Jhiria West Opencast Project is about 12 km SW of Bijuri town, 13 km SW of Manendragrah town and 5 km SW of Rajnagar Colliery in Anuppur district of Madhya Pradesh. The area is included in the Survey of India Toposheet No. 64 I/4. The Manendragarh Pendra road passes through the Western side of the block.

## 2.3 COMMUNICATION AND ACCESSIBILITY

The Jhiria West Opencast Project, lying immediate West of old Rajnagar incline of Rajnagar lease hold Area. The Jhiria West OC Project can be approached from Rajnagar RO Siding. The distance from Rajnagar RO siding to Jhiria West OC Project is about 8.0 Km. The area can be approached by Manendragarh – Pendra road near village Phulwari-tola, located about 13 km. and 12 km. from Manendragarh and Bijuri township respectively. The district Head Quarter Anuppur is connected by an all-weather road. The Rajnagar RO siding is located in the north eastern side of the West Jhiria block. The Nearest rail head are Bijuri and Manendragarh.

## 2.4 BLOCK BOUNDARIES AND MINE BOUNDARIES

The boundary of the West Jhiria Block has been considered as follows as per the Geological Report submitted by Directorate of Geology and Mining, M.P:

1. In the **North** : An arbitrary line 200m north and parallel to the line joining the borehole no. MPWJH-09 and MPWJH-07.
2. In the **South** : An arbitrary line running east-west approximately 200m south of MPWJH-04 and .200m in the east up to confluence of Jhiria and Sautanchuanala and extending along the nala up to confluence of Kulharia nala in the east.
3. In the **East** : Kulharia Nala.
4. In the **West** : An arbitrary line 200m west of borehole no. MPWJH-09 and extended due south to join the southern boundary of the block.

The block boundary as defined above covers an area of 4.17 sq.km

The boundary of quarry are as given below: -

**North** : Incrop of LKII Seam

**South** : Fault F1F1 and 0.50m thickness line of seam LKII.

**East** : 100m safety distance from leasehold boundary.

**West** : Block boundary of West Jhiria Geological Block.

30/08

क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L

## 2.5 BRIEF GEOLOGY OF THE MINEABLE AREA

The sub-surface data from drilling in West Jhiria block reveals the presence of two prominent coal horizons i.e. seam-3 and seam-1 (LK-II). Both the seam split in top and bottom section viz. seam-3T, seam-3B and LK-IIT and LK-IIB. The topmost seam-3 (either 3T or 3B or both) is developed with workable thickness in patches in Jhiria and Amadand area located in south of present block. The seam thickness decreases towards eastern direction and developed in thin bands in Rajnagar Colliery. The area is affected by two E-W trending opposite thrown normal faults. The fault F1-F1 is situated on southern portion of the block. The fault has down throw of about 20m to 40m towards north and the throw is increasing towards east. Another fault F2-F2 is located on the northern part of the block which has down throw of about 5m-20m towards south. The throw amount is increasing towards west. Both the faults are diminishing towards E-W direction. In general coal beds exhibits gentle centripetal dip of 1° to 4° and formed sub-basinal structure. The coal shows frequent changing in their trend from WNW-ESE to E-W and NE-SW.

### 2.5.1 DETAILS OF SEQUENCE OF COAL SEAM AND THEIR PARTING

The sequence of coal seams with their thickness and parting range, grade is as shown below: -

TABLE-2

| Coal Seam & Parting | Thickness (m) | Remarks |
|---|---|---|
| Weather mantle | 3.65-27.58 | Soil, weathered mantle |
| Seam-3T | 0.35-2.14 | Thickness reduces eastward. GCV varies from G2-G16, but average grade is G7. |
| Parting | 1.56-8.35 | |
| Seam-3B | 0.86-2.95 | Thickness reduces westward. GCV varies from G3-G11, but average grade isG6. |
| Parting | 13.78-21.72 | |
| LK-II | 0.18-5.25 | GCV varies from G5-G10 but average grade is G7. |
| LK-IIT | 0.55-1.54 | Developed as thin workable |

| Coal Seam & Parting | Thickness (m) | Remarks |
|---|---|---|
| | | bands. GCV varies from G3-G9 but average grade is G6 |
| Parting | 1.00-2.11 | |
| LK-IIB | 0.40-3.25 | Consistent in development. GCV varies from G5-G8 but average grade is G7. |

### 2.5.2 NATURE OF OVERBURDEN

**NATURE**

The overburden is composed of soil, weathered mantle and mainly sandstones and shaly sandstone of varying grain size.

**INSEAM BURDEN**

The inseam burden is composed mainly of shales, sandy shales, alternative shale and sandstone, carbonaceous shale and sandstones.

**DEPTH OF EXCAVATION**

The maximum depth of excavation would be about 60m up to the floor of bottom most seam LKIIB.

### 2.5.3 MINE PARAMETERS

The Mining characteristics of the quarry have been tabulated as follows: -

TABLE-3

| Sl. No. | Particulars | Unit | Thickness |
|---|---|---|---|
| 1 | **Dominant Thickness of Seams Excluding Band** | | |
| | Seam 3T | Metre | 0.50 – 2.14 |
| | Seam 3B | Metre | 0.86 – 2.95 |
| | Seam LKIIT | | 0.55 – 1.54 |
| | Seam LKIIB | | 0.50 – 3.25 |
| | Seam LKII | Metre | 0.55 – 5.25 |
| 2 | **Dominant Thickness of OB & Parting** | | |
| | Top OB | Metre | 6.22 – 42.87 |
| | Seam L3T & Seam L3B | Metre | 1.56 – 8.35 |
| | Seam L3B & Seam LKII & LKIIT | | 13.78 – 21.72 |
| | Seam LKIIT & Seam LKIIB | Metre | 1.00 – 2.11 |
| 3 | Gradient | | 1 in 60 |

क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

| Sl. No. | Particulars | Unit | Thickness |
|---|---|---|---|
| 4 | Average Grade of coal | | G-6 with GCV 5524 Kcal/Kg |
| 5 | **Mineable Reserves** | | |
| | Seam 3T | Mt | 2.23 |
| | Seam 3B | Mt | 3.60 |
| | Seam LKIIT | Mt | 0.50 |
| | Seam LKIIB | | 1.52 |
| | Seam LKII | | 5.31 |
| | **TOTAL** | | **13.16** |
| 6 | **Volume of OB** | | |
| | Top OB | Mcum | 58.57 |
| | Seam L3T & Seam L3B | Mcum | 6.54 |
| | Seam L3B & Seam LKII | Mcum | 41.07 |
| | Seam L3B & Seam LKIIT | | 0.58 |
| | Seam LKIIT & Seam LKIIB | | 1.19 |
| | **TOTAL** | | **107.95** |
| 7 | Target output | Mty | 1.50 |
| 8 | Stripping Ratio (Av.) | Cum/t | 8.20 |
| 9 | Project life | Year | 11 |
| 10 | Main Customers | | Miscellaneous |
| 11 | Anticipated year of achieving target | Year | 4th |
| 12 | Total Land involved | Ha | 427.993 |
| **II.** | **Quarry Parameters** | | |
| 1 | Maximum width along strike | | |
| | - at surface | m | 2903 |
| | - at floor | m | 2792 |
| 2 | Minimum width along strike | | |
| | - at surface | m | 1260 |
| | - at floor | m | 1206 |
| 3 | Maximum length along dip | | |
| | - at surface | m | 1706 |
| | - at floor | m | 1648 |
| 4 | Maximum depth | m | 60.12 |
| 5 | Minimum depth | m | 10.62 |
| 6 | Maximum lift | m | 61.00 |
| 7 | Area of excavation | | |
| | - at surface | Ha | 323.77 |
| | - at floor | Ha | 296.37 |

## 2.6 MINING METHOD & RESERVES

### 2.6.1 MINEABLE RESERVES AND VOLUME OF OB

The total mineable reserves within the quarry have been estimated as 13.16 Mt with a corresponding OB volume of 107.95 Mcum.

### 2.6.2 TARGET OUTPUT PLANNED & MINE LIFE

The mine is proposed coal production of 1.50 MTY and peak OB removal is of 12.00 Mcum and with this production of 1.50 Mty the mine life works out to 11 years.

**Mine Life**

The mine life for nominal production is 11 years. The break-up is as under:

- Construction period - 1 year
- Production build-up period - 3 years
- Production period - 6 years
- Tapering period - 1 year
- Total period - 11 years

### 2.6.3 MINING STRATEGY/MINING SEQUENCE

Due to flexibility of operation, Shovel-Dumper combination will be suitable for OB removal and coal will be extracted by surface miner. In Partial Outsourcing Option, the PR has been formulated to win coal by departmental HEMM & OB by Shovel Dumper combination by Outsourcing of HEMM.

Coal from face will be transported to pit top and then it will be transported to Rajnagar siding to dispatch coal by rail.

The salient feature of the mining system is as follows: -

(i) Height & width of the benches in coal and OB will depend upon the size of the equipment. The provision of Coal Mine Regulation and related circulars shall be strictly followed for designing bench parameters in coal and OB.

(ii) Dump bench height - 30m (each bench)

(iii) Bench Slope

Coal / OB - $70^0$

Spoil - $37^0$

(iv) Total Dump Height - total dump height is 80m from quarry floor & 50m from surface.



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

Considering the average mine floor gradient of about 1 in 60, the coal benches are proposed parallel to seam floor and self-draining

**HAUL ROAD**

Haul roads have been planned at a maximum gradient of 1 in 16, the width of the haul road has been kept as 30 m. The haul road may be maintained by outsourcing agencies.

### 2.6.4 SEQUENCE OF MINING

In the 1st year the acquisition of land and other development activities will be done. Initial box cut of quarry is proposed to be developed in the 2nd year of mine operation by grading properly the access trench and making its width 30 m wide. The access trench is to be graded at less than 6% to the mine floor of about 532 m R.L. The box cut is developed in such a manner so as to facilitate the proper drainage of water towards the sump. This would also facilitate extension of coal and OB bench for full development of mine. After creation of sufficient decoaled area, internal backfilling of OB will be started in the 4th year. The coal production will continue from the 2nd year of mine life and the target coal production of 1.50 Mty will be achieved in the 4th year. The target OB removal will be achieved in the 4th year of mine operation. The life of mine will be 11 years including construction period.

### 2.6.5 DUMPING STRATEGY

In the initial years i.e. upto 3rd year, OB quantities will go to the external dumps. Internal dumping will start from the 4th year onwards. The parting OB in case of older seam may be transported through central haul road, while mining in the multi seam zone.

Initially, the soil/alluvium from top bench of OB will be stacked and stored separately. The spoil dump benches in the internally backfilled OB will be in the form of benches. With the sufficient advance of coal production bench, the backfilled OB will be leveled with dozer. Dumper/Tipper will transport soil/alluvium OB from the top OB bench and will dump the soil directly on the leveled backfilled OB.

The OB dump will be terraced at the height of 30m. The barrier distance between internal dump and coal production bench will be 100 m to have smooth functioning of

machineries. While crossing the Fault F1F1 and F2F2 the fault surface should be benched to avoid any sliding of strata to working face. The surface of OB dump will be leveled and graded. Plantation will be made on the slope of OB heap to avoid the sliding of spoil.

The slope stability study should be done. According to study report the dump design like dump bench height, berm width, total dump height & slope etc. should be modified to avoid internal dump failure. In addition to that proper precautions / observations should be taken to avoid sliding of internal OB bench. Sufficient distance should be maintained from the toe of internal OB dump to fault on quarry floor to avoid sliding of strata to working face.

Box cut & initial external OB (19.08 Mcum) are proposed to be dumped within quarry area and safety zone area to keep the land requirement bare minimum. The OB so dumped is proposed to be rehandled back to the internal dump. More land would be required if external dump kept outside quarry area and there will be additional impact on environmental point of view. So OB externally dumped within quarry area is proposed to be rehandled back to decoaled area as internal dump.

OB quantity of 19.08 Mcum will be externally dumped within quarry area for which 80.96 Ha land will be required within quarry area and safety zone area. External dump has been made near western boundary. This temporary external dump will be rehandled to internal dump subsequently. From 7$^{th}$ year to 10$^{th}$ year the external dump will be rehandled back to internal dump.

In case of external dump, spoil bench height will be kept 30 m. There will be one bench and total dump height above surface will be 30m.

The break-up of OB quantity to be accommodated in various dumps is as follows: -

| Dump | OB accommodated in Mcum |
|---|---|
| 1. Internal dump | 107.95 |
| 2. External dump outside Quarry area | 0.00 |

Top soil will be removed and stored separately. This soil will be directly spread over the leveled graded backfilled spoil for reclamation of the quarried out land.



30/08

क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L

## 2.7 LEAD FOR OB AND COAL

For OB removal yearwise lead has been estimated and based on that average lead for OB removal is estimated to 1.60 Km. The average lead for Coal is estimated to 1.50 Km.

## 2.8 CALENDAR PROGRAMME OF EXCAVATION

Considering the average width of quarry and annual advance of quarry floor, the calendar programme has been prepared and given in the following table: -

TABLE-4

| YEAR | TOTAL COAL | TOTAL OB | SR | OB REHANDLED |
|---|---|---|---|---|
| 1 | Construction Period | | | |
| 2 | 0.50 | 4.00 | 8.00 | |
| 3 | 1.00 | 8.00 | 8.00 | |
| 4 | 1.50 | 12.00 | 8.00 | |
| 5 | 1.50 | 12.00 | 8.00 | |
| 6 | 1.50 | 12.00 | 8.00 | |
| 7 | 1.50 | 12.00 | 8.00 | 4.00 |
| 8 | 1.50 | 12.00 | 8.00 | 4.00 |
| 9 | 1.50 | 12.00 | 8.00 | 5.00 |
| 10 | 1.50 | 12.00 | 8.00 | 6.08 |
| 11 | 1.16 | 11.95 | 10.30 | |
| **TOTAL** | **13.16** | **107.95** | **8.20** | **19.08** |

## 2.9 PROJECTED COAL QUALITY

The average GCV of the seams considered for mining together comes to 5524Kcal/Kg. So, the average grade of coal 'G-6'.

The seamwise GCV and average GCV of mine area of Jhiria West OC are as given below.

TABLE-5

| SL NO | SEAM NAME | GCV (Kcal/kg) | AVERAGE GRADE |
|---|---|---|---|
| 1 | Seam 3T | 5464 | G7 |
| 2 | Seam 3B | 5778 | G6 |
| 3 | Seam LKII | 5313 | G7 |
| 4 | Seam LKIIT | 5635 | G6 |
| 5 | Seam LKIIB | 5583 | G6 |
| | **Average** | **5524** | **G6** |

## 2.10 PUMPING & DRAINAGE

Three numbers of main pumps each of 225lps, 70m head have been provided to meet the requirements. Provisions have been made considering the peak demand which is occasional, so no standby pumps have been provided. Further the pumps may be repaired and kept ready for use in rainy season. Main pumps will be installed on pontoons.

One diesel engine operated pump of 80lps capacity, 60m head has been provided for operation in the initial period and then as standby for use in case of emergency. Similarly, electrically operated pump of same capacity has also been provided.

All the main pumps will be provided with pressure gauges on delivery side and suction side for measuring the head developed so that corrective action will be taken for operating the pump at the duty point. The main pumps have been provided considering life of the mine. ent. During heavy rainfall, overburden may be washed away from edges of slopes and internal dumps, pumps capable of slurry handling will be required.

## 2.11 CRUSHING, INPIT COAL TRANSPORT AND COAL HANDLING PLANT

- Coal will be mined by surface miner as such no crushing arrangement is required.
- Coal mined by surface miner will be transported by trucks/dumpers to pit top.
- Coal from pit top will be transported to Rajnagar siding about 6.0 KM by road.
- A wharf wall or mechanical loading arrangement suitable for loading of one rack (59 box N) will be constructed at the siding.
- Coal from siding to various customer will be transported by rail through Rajnagar Railway siding.

## 2.12 WORKSHOP AND STORES

An E&M workshop, Excavation workshop and store have been proposed, in which repair and maintenance will be done for departmental & partial hiring option and An E&M workshop and store have been proposed, in which repair and maintenance will be done for outsourcing option.



30/08

क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

## 2.13 POWER SUPPLY, ILLUMINATION AND COMMUNICATION

### Source of Power

Jhiria West Opencast Project is located in the close proximity of existing Rajnagar RO UG mine of SECL in Hasdeo Area. The source of power supply for this Project shall be from Rajnagar Substation of CSPDCL located at around 6.5 km from the Project site. This project shall receive power at 33kV by means of DCDS overhead line (AAAC, WOLF equivalent) on steel towers drawn from Rajnagar RO Substation.

The power demand for outsourcing option, the maximum power demand comes to around 866 kVA for which 2x1000 kVA, 33/3.4 kV substation shall be adequate. For partial outsourcing option shall be around 882 kVA for which 2x1000 kVA, 33/3.4 kV substation shall be adequate. For departmental option shall be around 3296 kVA for which 2x5000 kVA, 33/3.4 kV substation shall be adequate.

### Energy Consumption

The energy consumption has been calculated considering active power, annual number of working hours of equipment/ installation wise.

For Outsourcing Option, the specific energy consumption will be approximately 5.02 kWh / tonne. For Partial Outsourcing Option, the specific energy consumption will be approximately 5.72 kWh / tonne. For Deptt. Option, the specific energy consumption will be approximately 13.23 kWh / tonne.

## 2.14 LAND REQUIREMENT

The break-up of land involved in the project is as follows: -

**TABLE-6**

| S.N. | Component | Forest (in Ha) | Non- Forest (in Ha) | | Total (in Ha) |
|---|---|---|---|---|---|
| | | | TL | GL | |
| 1 | Quarry Area | 285.651 | 25.217 | 12.902 | 323.770 |
| 2 | Mining Safety Zone | 65.366 | 24.812 | 1.997 | 92.175 |
| 3 | Infrastructure | 0.00 | 3.338 | 1.44 | 4.778 |
| 4 | Road | 3.241 | 4.029 | 0 | 7.270 |
| | **Total** | **354.258** | **57.396** | **16.339** | **427.993** |

## 2.15 STATUS OF LAND ACQUISITION

The area is free from any industrial activity, and is also devoid of any monument of historical or archaeological importance. Jhiria West OC project is being planned on a virgin block. Total land 427.993 Ha has been notified under section 4(i) on dated 12/082016, 7(i) on dated 06/01/2018, 9(i) on dated 09/03/2019,11(i) on dated 15.05.2019. compensation for 73.735 Ha. land acquisition is under process of approval at SECL Head Quarter.

### FOREST LAND

Proposal for 354.258 Ha. Forest Land is under processed for stage- I clearance at MOEF.

### 2.16 R & R Details

The part of five villages i.e Bhalmuri, Fulkona, Dumarkachhar, Bangawan, Padritola are located within the mine area. The Project Affected Family of these villages are about 220 Nos.

## 2.17 MINE CLOSURE PLANNING

### 2.17.1 INTRODUCTION

Mine Closure in real sense is reclamation/ rehabilitation of mined-out area along with other disturbed area to achieve sustainable development through land and other natural resources improvement. This chapter is prepared as per the "Guidelines for preparation of Mining plan for the coal and lignite blocks" issued by MoC, GoI on 16.12.2019 and 29.05.2020. The mine closure plan (progressive and final) shall be approved along with the approval of Mining plans/ Feasibility report/ Project Report as applicable.

Although, the mining activities may last a few decades, but they are liable to leave a long-lasting impact on the landscape, ecology and on local inhabitants. Hence the mine closure details of the mining plan should be oriented towards the restoration of the land back to its original condition as far as practicable. The mine closure plan contains two components viz., Progressive or concurrent mine closure and Final mine closure activities. Progressive mine closure would include various land use activities to be done continuously and sequentially during the entire period of mining operations. Final mine closure activities would start towards the end of



30/08

क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

mine life and may continue even after the resources are exhausted or/and mining is discontinued till the mining area is restored to an acceptable level.

Progressive mine closure plan shall be prepared for every 5 years from the beginning of mining operations and it shall be monitored by central government party agency. The cost estimates of Various project specific activities viz., mined-out land details and their technical, biological reclamation/restoration plan, water quality management, infrastructure to be retained and demolished, disposal of mining machinery etc will be updated and approved 5 years prior to the actual closure time of the mine.

### 2.17.2 Land degradation and restoration schedule

The tentative details of cumulative Land degradation and technical reclamation is tabulated in Table 7. The tentative details of biological reclamation are tabulated in Table 8.

**Table 7: Details of Land degradation and technical reclamation**

| Stage | Cumulative Land degraded area in Ha | | | | Cumulative Technically reclaimed area in Ha | | | |
|---|---|---|---|---|---|---|---|---|
| | Excavated | Dump (Extn + Top Soil) | Infrastructure /others | Total | Back filling | Dump (Extn + Top Soil) | Others | Total |
| Base yr (22-23) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Y-1 | 0.000 | 0.000 | 4.778 | 4.778 | 0.000 | 0.000 | 0.000 | 0.000 |
| Y-3 | 57.140 | 56.510 | 4.778 | 118.428 | 0.000 | 0.000 | 0.000 | 0.000 |
| Y-5 | 142.980 | 80.960 | 4.778 | 228.718 | 59.530 | 0.000 | 0.000 | 59.530 |
| Y-10 | 268.880 | 0.000 | 4.778 | 273.658 | 224.660 | 0.000 | 0.000 | 224.660 |
| Y-11/Final | 323.770 | 0.000 | 4.778 | 328.548 | 259.706 | 0.000 | 0.000 | 259.706 |
| Post closure1 | 323.770 | 0.000 | 4.778 | 328.548 | 259.706 | 0.000 | 0.000 | 259.706 |
| Post closure2 | 323.770 | 0.000 | 4.778 | 328.548 | 259.706 | 0.000 | 0.000 | 259.706 |
| Post closure3 | 323.770 | 0.000 | 4.778 | 328.548 | 259.706 | 0.000 | 0.000 | 259.706 |
| Post closure4 | 323.770 | 0.000 | 4.778 | 328.548 | 259.706 | 0.000 | 0.000 | 259.706 |
| Post closure5 | 323.770 | 0.000 | 4.778 | 328.548 | 259.706 | 0.000 | 0.000 | 259.706 |

### 2.17.3 Biological Reclamation

In opencast mining, the original vegetation is completely stripped off and the soil profile sequences may be disturbed. It is therefore necessary that utmost care be taken in handling the top soil so that the same can be reused for re-vegetation of the area during reclamation. The purpose of biological reclamation is to bring back the vegetation and biodiversity that exist in pre-mining condition. After technical reclamation of OB dumps and redistribution of top soil over it, the dumps will be biologically reclaimed by plantation as shown in Figure 17.3, Figure 17.4 and Figure 17.5.

**Table 8: Details of biological reclamation**

| Stage | Biologically reclaimed area (Cumulative in Ha.) | | | | | Forest land (Return) | Undisturbed/ to be left for public/com use | Total |
|---|---|---|---|---|---|---|---|---|
| | Agriculture | Plantation | Water body | Public/Company use | Total | | | |
| Base yr (20-21) | | | | | | | | |
| Y-1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Y-3 | 0.000 | 30.000 | 0.000 | 0.000 | 30.000 | 0.000 | 0.000 | 30.000 |
| Y-5 | 0.000 | 86.400 | 0.000 | 0.000 | 86.400 | 0.000 | 0.000 | 86.400 |
| Y-10 | 0.000 | 241.040 | 0.000 | 0.000 | 241.040 | 0.000 | 0.000 | 241.040 |
| Y-11 | 0.000 | 283.353 | 64.064 | 0.000 | 347.417 | 0.000 | 0.000 | 347.417 |
| Post Closure1 | 0.000 | 325.864 | 64.064 | 2.750 | 392.678 | 0.000 | 0.000 | 392.678 |
| Post Closure2 | 0.000 | 361.179 | 64.064 | 2.750 | 427.993 | 0.000 | 0.000 | 427.993 |
| Post Closure3 | 0.000 | 361.179 | 64.064 | 2.750 | 427.993 | 0.000 | 0.000 | 427.993 |
| Post Closure4 | 0.000 | 361.179 | 64.064 | 2.750 | 427.993 | 0.000 | 0.000 | 427.993 |
| Post Closure5 | 0.000 | 361.179 | 64.064 | 2.750 | 427.993 | 0.000 | 0.000 | 427.993 |

* Biologically reclaimed area can be used alternatively for Agriculture, Solar power or other utility subject to the prevailing conditions & Laws. The same will be finalized in the Final MCP.

As per Letter F. No. 22-34/2018-IA.III, Dated: 16th January 2020 of Ministry of Environment, Forest and Climate Change, Government of India, the mining lease holders shall, after ceasing mining operations, undertake re-grassing the mining area and any other area which may have been disturbed due to their mining activities and restore the land to a condition which is fit for growth of fodder for flora & fauna etc.

A nursery is a prerequisite for supply of seedlings of suitable species of right size to the extent required. Rajya Van Vikas Nigam may be contacted for supply. As far as possible local plant species may be preferred.

**Species for plantation**: -

- **Fruit bearing trees**
  - Jamun, Mango, Imli, Sitaphal, Bel, Ganga Imli, etc.
- **Medicinal trees**
  - Neem, Karanj, Harra, Behara, Aonla, Arjun, Mahua, Kusum
- **Timber value trees**
  - Teak, Shivan / Ghamar, Sissoo, Sisham, Safed Sirus, Bamboo, Peltaforum, Babool,
- **Ornamental trees**
  - Gulmohur, Kachnar, Amaltas, Saptaparni, Grevelia, Peepal, Palm tree

### 2.17.4 Post closure Water quality management

Different activities of coal mining substantially affect hydrological and topographical characteristics of the mining areas which in turn affect the surface runoff, soil moisture, and evapotranspiration and groundwater behavior. Hence; suitable measures to be taken to minimize impacts on water resources (surface and groundwater) in an acceptable manner throughout the life of mine and post-closure.

Post closure of mine the water quality will be monitored in stations as prescribed by the state pollution control board. In case of any higher value observed due to direct or indirect impact caused by reclaimed mine area, necessary action would be taken by management.

The water bodies generated in the mine leasehold area like mine void filled with water shall be protected properly in terms of quality and quantity. In this regard, water quality monitoring of major ion chemistry, biological parameters and the PTEs shall be monitored yearly once and if found any quality deterioration, proper treatment shall be adopted prior to supplying water to the local populace for various uses alongside ensuring no contaminant leaching into the neighbouring aquifer units. Furthermore, it is imperative to undertake the periodic maintenance of mine void filled with water in terms of the development of green patch and proper fencing along the periphery of the



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

mine void. This, in turn, will arrest the settling of dust particles into the mine void, decrease the evaporation losses from the water body, increase the infiltration of water, and enhance natural beauty of the structure. Also, it is recommended to take up the desilting of mine void, if found can result in a drastic reduction in its capacity.

Water table level and ground water quality should be monitored at regular interval, suitable measures may be taken to avoid ground water pollution.

### 2.17.5 Post closure Air quality management

Regular Environmental monitoring of Air for 05 parameters (PM100, PM10, PM2.5, SOx and NOx) will be carried out in monitoring stations fixed as per Environmental Clearance for minimum three years after final closure of mine at a frequency of twice in a month. Apart from this Heavy metals in air in above stations will be monitored at a frequency of twice in a year for minimum three years. Based on the reports obtained required corrective measures will be implemented. The general corrective measures will be as follows,

1. Suitable green belt will be developed to curtail dust pollution.
2. Biological reclamation will be done immediately after technical reclamation of OB dumps.

### 2.17.6 Waste management

The waste in OC mine is mainly removed over burden (OB). The details of waste management are clearly explained in Table 9.

**Table 9: The details of waste management (Figures in Mm³)**

| Stage | OB Removal (Cumulative) (Mm³) | | | External Dump (Cumulative) (Mm³) | | Internal Backfilling (Cumulative) (Mm³) | |
|---|---|---|---|---|---|---|---|
| | Top Soil | OB | Total | Top Soil | OB | Top Soil | OB |
| Y-1 | 0.00 | - | - | 0.000 | - | 0.000 | - |
| Y-3 | 0.17 | 11.83 | 12.00 | 0.000 | 11.83 | 0.000 | - |
| Y-5 | 0.43 | 35.57 | 36.00 | 0.000 | 19.08 | 0.12 | 16.49 |
| Y-10 | 0.81 | 95.19 | 96.00 | 0.000 | 0.000 | 0.80 | 95.19 |
| Y-11 | 0.97 | 106.98 | 107.95 | 0.000 | 0.000 | 0.97 | 106.98 |
| MC 1 | 0.97 | 106.98 | 107.95 | 0.000 | 0.000 | 0.97 | 106.98 |
| MC 2 | 0.97 | 106.98 | 107.95 | 0.000 | 0.000 | 0.97 | 106.98 |
| MC 3 | 0.97 | 106.98 | 107.95 | 0.000 | 0.000 | 0.97 | 106.98 |
| MC 4 | 0.97 | 106.98 | 107.95 | 0.000 | 0.000 | 0.97 | 106.98 |
| MC 5 | 0.97 | 106.98 | 107.95 | 0.000 | 0.000 | 0.97 | 106.98 |

### 2.17.7 Topsoil management

Proper handling and management of topsoil is necessary for future vegetation growth in the mine reclaimed area.

The objectives of Top Soil Management are,

* Maintain a topsoil balance that achieves rehabilitation objectives during the life of mine.
* Ensure effective topsoil removal techniques are employed to maximise volumes of suitable topsoil removed and minimise wastage.
* Maintain topsoil viability during stripping, spreading, and stockpiling, through best practices, effective stockpile design and treatment.

In accordance with the objectives the following strategies will be adopted in providing sufficient stable soil material for rehabilitation.

***Stripping:***

Prior to the commencement of stripping, area will be cleared of vegetation. Soil stripping will be undertaken by dozers and hydraulic backhoe excavators to maximise the preservation of the quality of the soil. The HEMM operators and supervisors should be trained and made aware for the same. This will ensure that the entire topsoil is salvaged and the quality of topsoil is not reduced through contamination with unsuitable excavated material.

***Stock piling:***

Wherever possible, the stripped topsoil will be spread directly onto areas being reclaimed. Wherever this is not possible, the topsoil will be stored in stockpiles. Stock piles will be dumped at places where they would not be disturbed by future mining. Sediment fences or other barriers can be used wherever necessary to retain sediment. Stockpiles will be located on the dip side of the proposed mine boundary. The proposed site will be marked in the land use plan and will be updated accordingly. The overall topography for the graded surface should be designed to minimize the uncontrolled flow of runoff. Dispersed sheet flow should be broken up by terraces or benches along the slope that also follow topographic contours. On a fine scale the ground surface can be roughened by the tracks of a bulldozer perpendicular to the slope. Construction of stockpiles with a "rough" surface condition will reduce erosion hazard, improve drainage and promote re-vegetation.



30/08

क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

***Stockpile preservation:***

Stockpiling topsoil may result in disruption and loss of beneficial soil microorganisms and nutritional values, hence needs the following amendments during preservation: -

1. Re-vegetation of the stockpile will be done as scheduled below to protect the soil from erosion, discourage weeds and maintain active populations of beneficial soil microbes.

* Temporary Seeding: within 30 days after the formation of the stockpile.

* Permanent Vegetation: If stockpiles will not be used within 12 months, they will be stabilized with permanent vegetation to control erosion and weeds like green panic, Japanese millet (spring sowing), Oats (winter sowing), Dry land Lucerne, Seaton park sub-clover. Topsoil can be mixed with organic material or manufactured soil amendments to improve the growing capability.

2. To the extent practicable, above ground vegetation, including tree litter should be mixed or otherwise incorporated into the topsoil.

3. Application of Fertilizers: Stockpiled topsoil needs significant fertilizer application for the establishment and maintenance of vegetation.

4. Soil amendments: Soil amendments should be applied before seeding or planting. Common soil amendments used are bio-solids, compost, manure, and lime and coal combustion by-products.

Prior to the placement, the top of stockpile material should be mixed with the remainder of stockpile to ensure that living organisms are distributed throughout the topsoil material at the time of final placement. In case, the material has been stockpiled for over nine-month period, use of microorganisms inoculates may be necessary to re-establish microorganisms in the topsoil material.

***Site Preparation:***

Before spreading topsoil, establish erosion and sedimentation control structures such as diversions, berms, dikes, waterways and sediment basins. Adjust grades and elevations for receipt of topsoil. Roughening - Immediately prior to spreading the topsoil, loosen the subgrade to a proper depth to ensure bonding of the topsoil and subsoil. Soil horizons will be replaced in the same order that they were removed. Top soil will be uniformly distributed to pre-

mining thickness. If sufficient top soil is available, it is suggested that a minimum compacted depth of a half metre on 3:1 slope and one metre on flatter slope. Topsoil will not be spread while it is frozen or muddy. The topsoil will be compacted to ensure good contact with the underlying soil, but excessive compaction will be avoided, as it increases runoff and inhibits seed germination. Light compaction with roller will be done where turf is to be established.

On slopes and areas that will not be mowed, the surface will be left rough after spreading topsoil.

***Monitoring:***

Specific team / manpower is to be deployed for this most important step of topsoil management. The team will monitor the area and quantum of top soil management with the authorities of mine on quarterly basis and regularly monitor the given points of significant importance:

* Monitoring Erosion Control: This step is necessary during stock piling as well as reclamation stage of topsoil management. Take corrective measure in areas showing evidence of erosion, sedimentation or slope failure. This is a serious problem, because erosion causes fertile farmland to lose nutrients and water retention ability. Because the first thing to go is precious topsoil, the soil removed by erosion contains about three times more nutrients and 1.5 to five times more organic matter than that which remains behind.
* Soil fertility maintenance: Organic or inorganic fertilizer should be applied periodically if vegetation growth is poor.
* Regular monitoring of top soil management should be done until vegetation is demonstrated to be successfully established.

The action plan for topsoil management is given in Table 10.

**Table 10: The action plan for topsoil management**

| Year | Top soil removed, Mcum | Top soil removed cumulative, Mcum | Top soil spread, Mcum | | | Top Soil Stacked Cumulative, Mcum |
|---|---|---|---|---|---|---|
| | | | External dump | Internal dump | Total | |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.09 | 0.09 | 0.00 | 0.00 | 0.00 | 0.09 |
| 3 | 0.09 | 0.17 | 0.00 | 0.00 | 0.00 | 0.17 |
| 4 | 0.13 | 0.30 | 0.00 | 0.00 | 0.00 | 0.30 |
| 5 | 0.13 | 0.43 | 0.00 | 0.12 | 0.12 | 0.31 |



क्षेत्रीय महाप्रबंधक
Area General Manager
वासदेव , एस.ई.सी.एल.
VasdeoArea, S.E.C.L.

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 0.08 | 0.50 | 0.00 | 0.13 | 0.13 | 0.25 |
| 7 | 0.08 | 0.58 | 0.00 | 0.13 | 0.13 | 0.15 |
| 8 | 0.08 | 0.66 | 0.00 | 0.13 | 0.13 | 0.13 |
| 9 | 0.08 | 0.73 | 0.00 | 0.13 | 0.13 | 0.09 |
| 10 | 0.08 | 0.81 | 0.00 | 0.13 | 0.13 | 0.04 |
| 11 | 0.16 | 0.97 | 0.00 | 0.17 | 0.17 | 0.03 |
| MC 1 | 0.16 | 0.97 | 0.00 | 0.03 | 0.03 | 0.00 |
| MC 2 | 0.16 | 0.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| MC 3 | 0.16 | 0.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| MC 4 | 0.16 | 0.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| MC 5 | 0.16 | 0.97 | 0.00 | 0.00 | 0.00 | 0.00 |

### 2.17.8 Restoration of Land used for Infrastructure

Infrastructure to be retained will be determined in the Final Mine Closure Plan. In case of retaining of infrastructure for use by other projects or other Misc. use, all appropriate measures for strengthening & stabilizing of the same may be done, which may be firmed in final MCP.

### 2.17.9 Disposal of mining machinery

The different mining machinery proposed for this project and their disposal plan is tabulated in Table 11.

**Table 11: Disposal plan for mining machinery**

| S No. | Particulars | Proposed Disposal Practice |
|---|---|---|
| a | Disposal or reuse of existing HEMM, workshop and railway siding for OC. | The disposal mode & dismantling plan of Mine Infrastructure & equipment will be detailed in final mine closure plan after considering all possible alternatives |
| b | Disposal or reuse of transmission and sub-station. | The disposal mode & dismantling plan of Mine Infrastructure & equipment will be detailed in final mine closure plan after considering all possible alternatives |

### 2.17.10 Safety and security

**Table 12: Proposed safety and security practices**

| Sl. No. | Particulars | Proposed safety Practice |
|---|---|---|
| A | Surface grading and Fencing around abandoned quarry. | At the end of Mining Operation, there will be a void/water body. Suitable surface fencing/guarding may be provided around void/water body to avoid falling of faunal species in it. |
| B | Providing one-time lighting arrangement. | Provision for Lighting is Provided in the PR. |

| | | |
|---|---|---|
| C | Slope stability arrangement for high wall and back filled dumps. | Proper benching / Terracing of slopes will be done. Proper Signage to be used at appropriate places. |

### 2.17.11Abandonment cost and financial assurances

The different activities considered for mine closure are mentioned in Figure 17.1 and Figure 17.2 along with their schedule for implementation.

| S. No | Activities in Reclamation Phase, each phase@5year | 1st | | | | | 2nd | | | | | MC | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 Years of Life | | | | | | | | | | | | | | | |
| 1 | Backfilling and Grading of Dump | | | | | | | | | | | | | | | |
| 2 | Provision of water coursing channels | | | | | | | | | | | | | | | |
| 3 | Provision of sedimentation pond | | | | | | | | | | | | | | | |
| 4 | Provision of garland drains | | | | | | | | | | | | | | | |
| 5 | Provision of check dams at high velocity points | | | | | | | | | | | | | | | |
| 6 | Top soil preservation | | | | | | | | | | | | | | | |
| 7 | Top soil application | | | | | | | | | | | | | | | |
| 8 | Site preparation and plantation | | | | | | | | | | | | | | | |
| 9 | Plantation in Internal Dump | | | | | | | | | | | | | | | |
| 10 | Environmental Monitoring | | | | | | | | | | | | | | | |

**Figure 17.1: Schedule for implementation of mine closure activities**

| Sl. No | Activities | Half Yearly | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Preparation of Survey & Disposal Report | | | | | | | | | | |
| 2 | Slope Stability study for high walls and internal dumps | | | | | | | | | | |
| 3 | Disposal of P&M including HEMM, CHP, W/S, Siding | | | | | | | | | | |
| 4 | Backfilling of mined out Area (OC) | | | | | | | | | | |
| 5 | Dismantling of Industrial structure | | | | | | | | | | |
| 6 | Grading & dozing of high walls for OC | | | | | | | | | | |
| 7 | Fencing of quarry | | | | | | | | | | |
| 8 | Clearing of Coal Stock and Infrastructural Area. | | | | | | | | | | |
| 9 | Disposal / Dismantling of Residential colony | | | | | | | | | | |
| 10 | Plantation & landscaping on backfilled area. | | | | | | | | | | |
| 11 | Plantation over cleaned land of Infrastructure. | | | | | | | | | | |
| 12 | Environmental Monitoring | | | | | | | | | | |

**Figure 17.2: Implementation schedule specific to final mine closure activities**



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

### 2.17.2 Cost of Activities to be taken up for closure of the mine

The cost to be incurred in different activities involved in the mine closure activities are given in Table 13.

**Table 13: Proposed cost of different progressive mine closure activities**

| COST OF ACTIVITIES TO BE TAKEN UP FOR PROGRESSIVE CLOSURE OF MINE | | | |
|---|---|---|---|
| Head | PARAMETERS | Unit | Amount "Rs. Cr" |
| Progressive closure | Water quality management | LS | 1.19 |
| | Air quality management | LS | 2.14 |
| | *Waste Management | LS | 0.95 |
| | Barbed wire fencing | LS | 0.26 |
| | Barbed wire fencing around the Pit | LS | 0.26 |
| | Filling of Void - Rehandling of Crown Dump | LS | 2.40 |
| | Top Soil management | LS | 2.97 |
| | Technical I Reclamation of Mined out of land and OB Dump | LS | 20.37 |
| | Biological Reclamation of Mined out of land and OB Dump, Plantation over virgin area including green belt | LS | 2.67 |
| | Manpower Cost and supervision | LS | 2.39 |
| | Toe Wall around the dump | LS | 0.39 |
| | Garland drain | LS | 0.48 |
| | Garland Drain around the dump | LS | 0.32 |
| | Any other Activity | LS | 0.40 |
| Dismantaling of Infrastructure & Disposal/ rehabilitation of Mining machinery | Dismantling of workshop | LS | 1.71 |
| | Rehabilitation of the dismantled Facilities | LS | |
| | Dismantling of pumps and Pipes/ other facilities | LS | |
| | Dismantling of stowing bunker, provisioning of pumps for bore well pumping arrangement | LS | |
| | Dismantling of UG equipment | LS | |
| | Rearranging water pipeline to dump top park/ Agricultural land | LS | |
| | Dismantling of Power lines | LS | |
| Safety and security | Barbed wire fencing | LS | 0.26 |
| | Barbed wire fencing around the Pit | LS | 0.096 |
| | Barbed wire fencing with masonry pillars | LS | 0.032 |
| | Concrete wall with Masonry pillars around the pit | LS | |
| | Securing air shaft and installation of bore well pump | LS | |
| | Securing of Incline | LS | |
| | Concrete wall fencing around the water body | LS | 1.03 |
| | Boundary wall around the water body | | |
| | Stabilisation! viz benching, pitching etc) of side walls of the water body | | |

Mining Plan for Jhiria West OCP (1.5 Mty)

| COST OF ACTIVITIES TO BE TAKEN UP FOR PROGRESSIVE CLOSURE OF MINE | | | |
|---|---|---|---|
| Head | PARAMETERS | Unit | Amount "Rs. Cr" |
| | Toe Wall around the dump | LS | 0.39 |
| | Garland drain | LS | 0.44 |
| | Garland Drain around the dump | | |
| | MISC SAFETY WORKS | LS | 0.26 |
| Technical and Biological Reclamation of Mined out of land and OB Dump | Drainage Channel from main Ob dump | LS | 0.54 |
| | Filling of Void | LS | 6.07 |
| | Top Soil management | LS | 0.94 |
| | OB Rehandling for backfilling | LS | 6.07 |
| | Terracing, blanketing with soil and vegetation of External OB Dump | LS | 0.70 |
| | Peripheral road, gates, view point, cemented steps on bank | LS | 0.48 |
| | Expenditure on development of Agricultural land | LS | 0.11 |
| | Landscaping and Plantation | LS | 0.87 |
| Post Closure management and supervision | Power Cost | LS | 0.094 |
| | Post Mining Water quality management | LS | 0.19 |
| | Post Mining Air quality management | LS | 0.38 |
| | Subsidence monitoring for 5 years | LS | 0 |
| | Waste Management | LS | 0.19 |
| | Manpower Cost and supervision | LS | 0.094 |
| Others | Entrepreneurship development (vocational/skill development training for sustainable income of affected people | LS | 0.50 |
| | Golden Handshake / Retrenchment benefits to 100 employees of OC | LS | 1.08 |
| | Golden Handshake / Retrenchment benefits to 200 employees of UG | LS | |
| | Onetime financial grant to societies / institutions /organisations which is dependent upon the project; | LS | |
| | Provide jobs in other mines of the company | LS | |
| | Continuation of other services like running of schools etc. | LS | |
| | | | |
| Total | COST FOR THE ENTIRE LIFE (Prog & Final) | | 59.69 |
| Total | TOTAL ANNUAL COST | | 2.49 |
| Total | PROGRESSIVE COST FOR THE ENTIRE LIFE | | 39.61 |
| Total | ANNUAL PROGRESSIVE COST | | 1.65 |



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क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

### 2.17.3 Financial assurance

The amount to be deposited in Escrow account as a security against the mine activities to be carried out for the closure of the mine is based on the project area. As per the guidelines of the MoC, vide letter no: 34011/28/2019 -CPAM Dt: 16th December,2019 the mine closure cost estimation is as in Table 14 and the amount to be deposited in Escrow account is as in Table 115.

**Table 14: The mine closure cost estimation**

| | | |
|---|---|---|
| WPI as on | April 2019 | 121.100 |
| WPI as on base date (provisional) | February 2022 | 145.300 |
| Escalation rate of closure cost | | 5% |
| Base rate of closure cost "Rs. Lakhs/Ha" | | 9.000 |
| Present rate of closure cost "Rs. Lakhs/Ha" | | 10.799 |
| Total project area in Ha | | 427.993 |
| Amount to be deposited into Escrow Account "Rs. In Lakhs | | 4621.688 |
| Total life of the mine in years | | 11 |
| Annual Closure Cost "Rs. In Lakhs" | | 420.154 |
| Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Lakhs" | | **5969.031** |

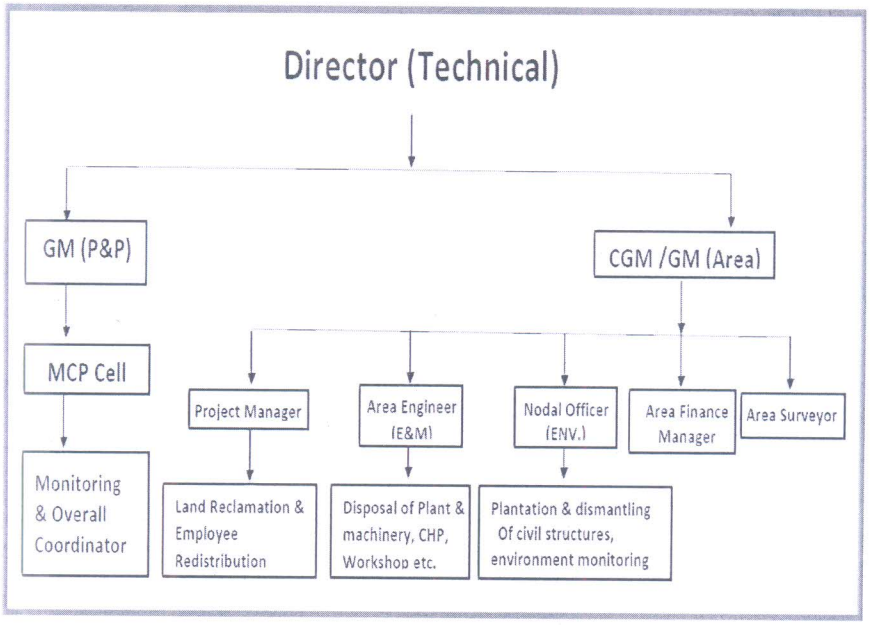
**Table 15: Amount to be deposited in Escrow account**

| Year | Year No | Fund Schedule in Rs Lakh | Fund to be Reimbursed (Maximum) in Rs lakh |
|---|---|---|---|
| 2022-23 | 1 | 420.153 | |
| 2023-24 | 2 | 441.161 | |
| 2024-25 | 3 | 463.219 | |
| 2025-26 | 4 | 486.380 | |
| 2026-27 | 5 | 510.699 | |
| **Progressive** | **Phase-1** | **2321.613** | 50% of balance amount at the end of Phase I |
| 2027-28 | 6 | 536.234 | |
| 2028-29 | 7 | 563.046 | |
| 2029-30 | 8 | 591.198 | |
| 2030-31 | 9 | 620.758 | |
| 2031-32 | 10 | 651.796 | |
| **Progressive** | **Phase-2** | **2963.032** | 50% of balance amount at the end of Phase II |
| 2032-33 | 11 | 684.386 | |
| **MC1** | 12 | | |
| **MC2** | 13 | | |
| **MC3** | 14 | | |

| Year | Year No | Fund Schedule in Rs Lakh | Fund to be Reimbursed (Maximum) in Rs lakh |
|---|---|---|---|
| MC4 | 15 | | |
| MC5 | 16 | | |
| Final Phase | | 684.386 | 100% of balance amount at the end of final Phase |
| Grand TOTAL | | 5969.031 | |

### 2.17.4 Implementation Protocol

For implementing the mine closure activities, the following organisational structure has been proposed:

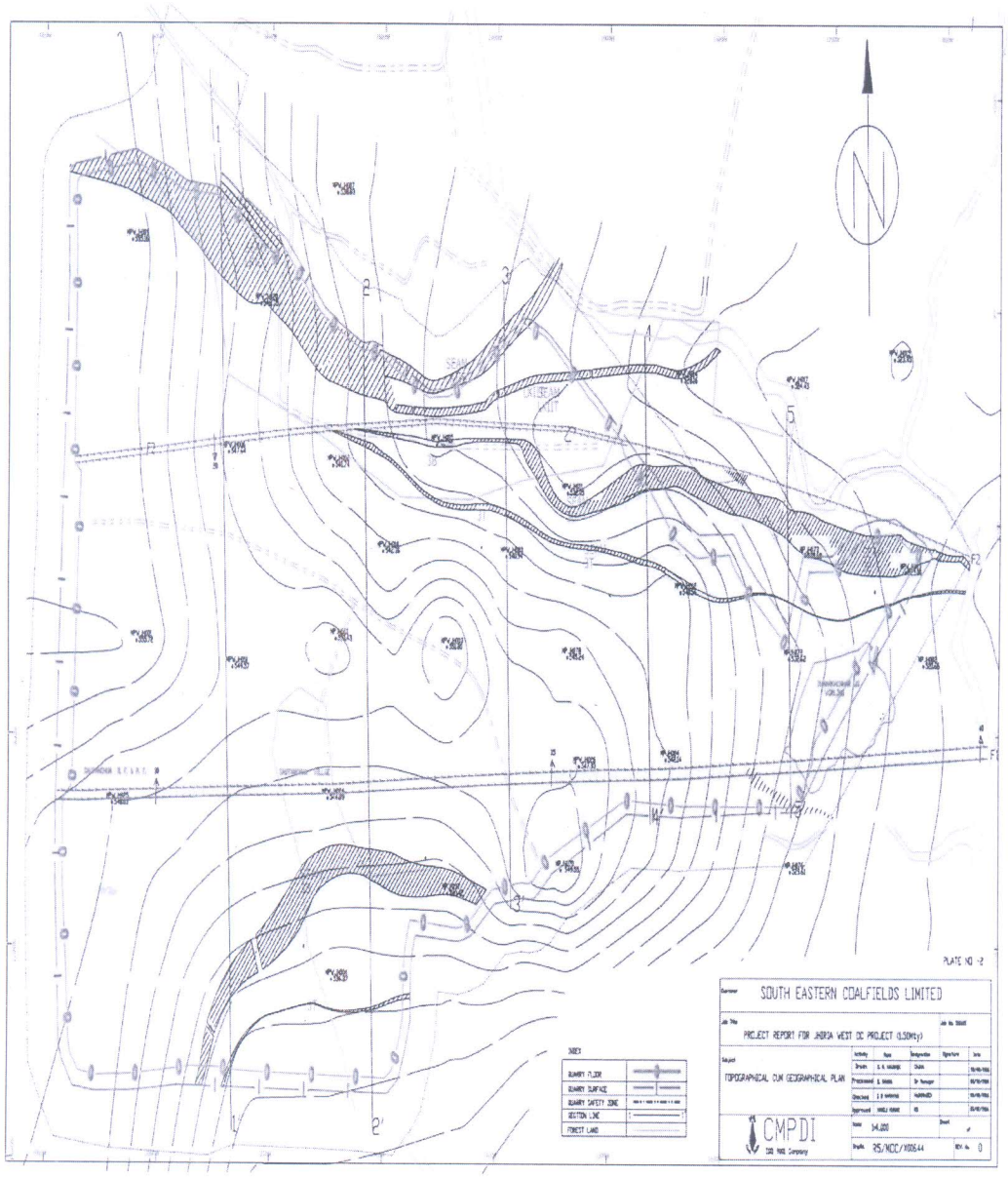



Environmental monitoring for three years after closure of mine will be carried out to evaluate the environmental quality of the area. If needed, proper mitigation measures will be taken up after evaluating the environmental quality. The funds for this have been provided in the cost estimate. Before closure of the mine, Area GM will make arrangement to prepare survey and disposal report and the same will be submitted to DGMS for acceptance.

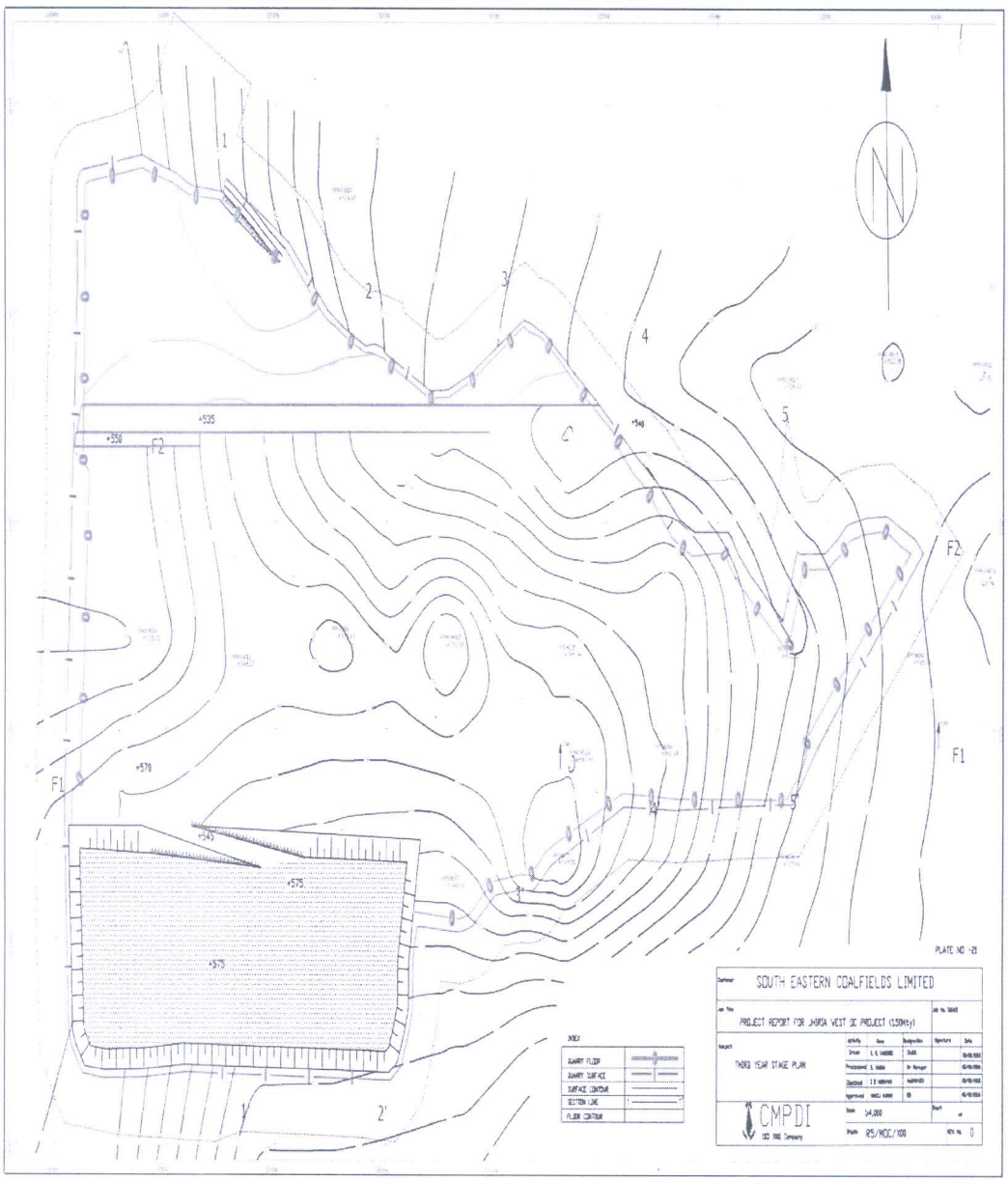


क्षेत्राय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

## STAGE PLANS:



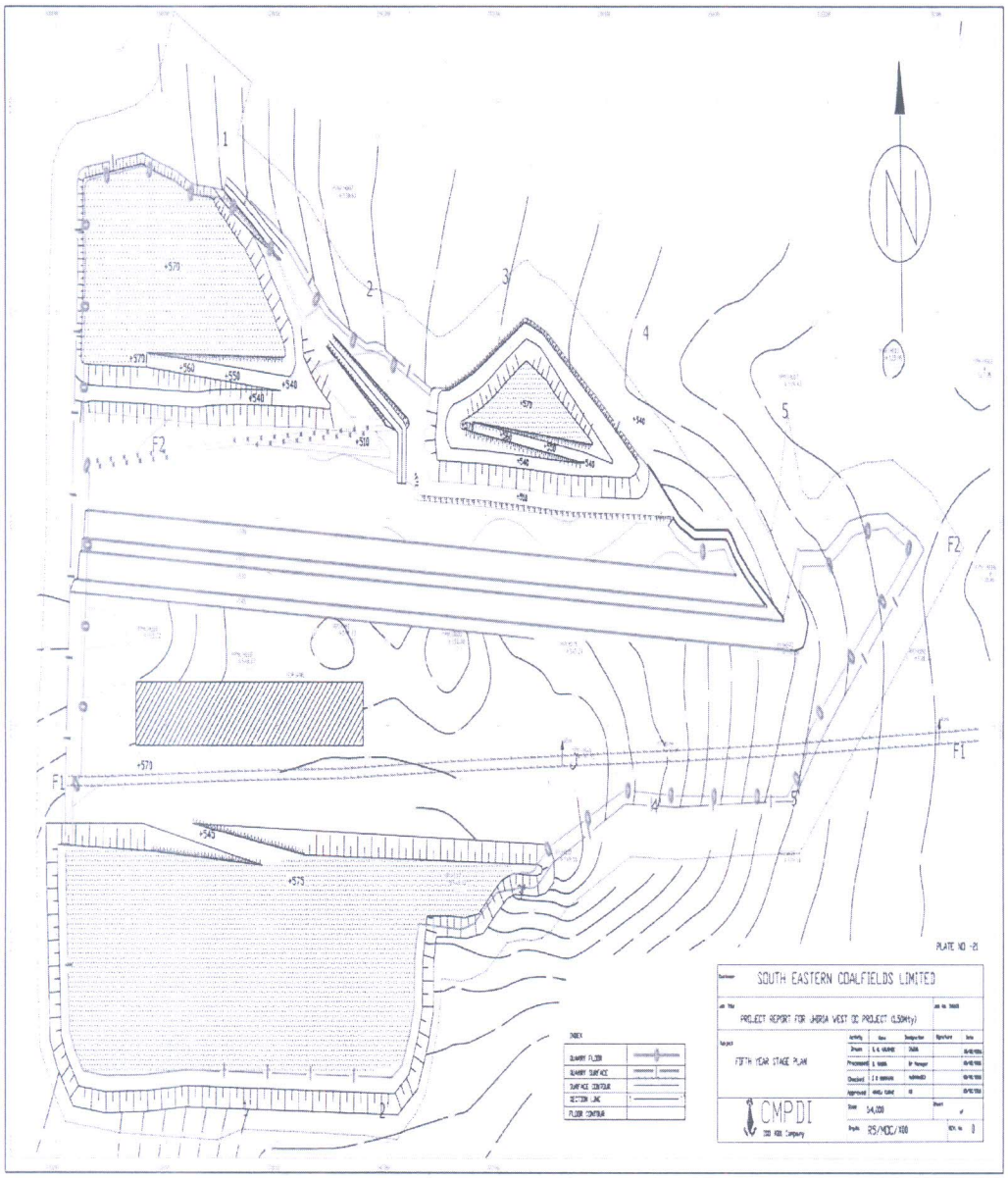

Topographical Plan



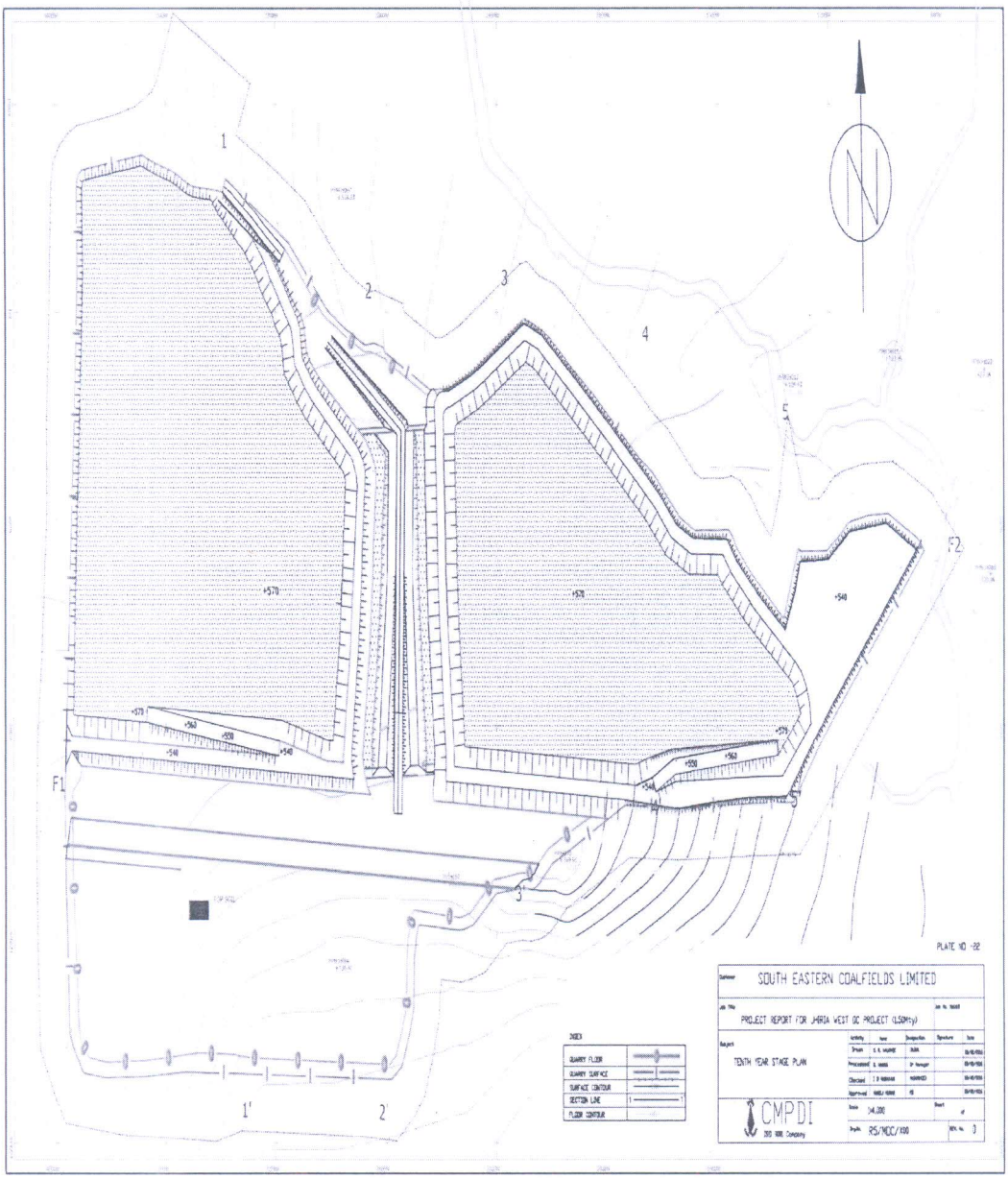

3rd Year Stage Plan



30/08
क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.



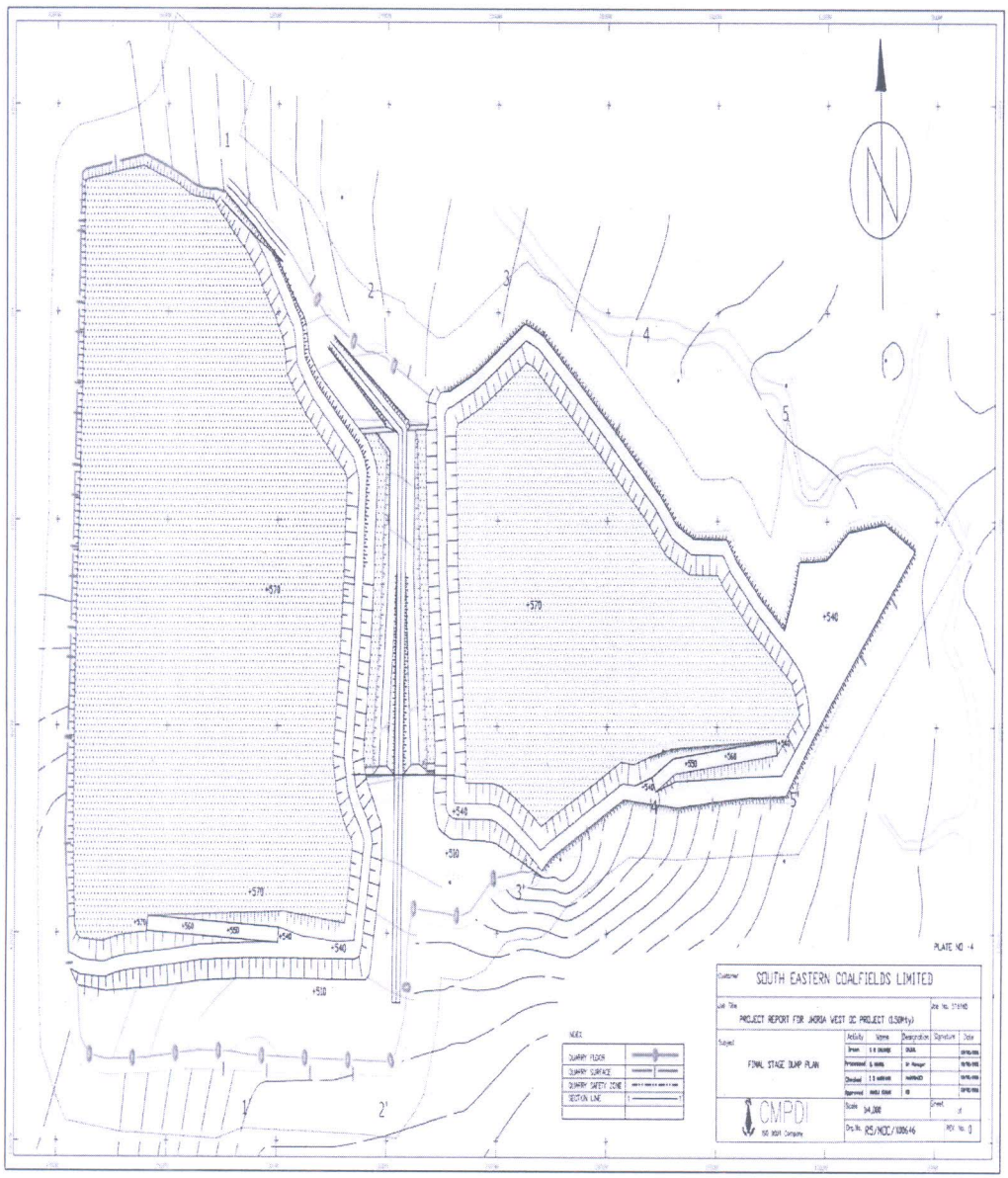

5rd Year Stage Plan




10th Year Stage Plan



30/08
क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.




Final Year Dump Plan

## 2.18 MANPOWER & PRODUCTIVITY

The manpower requirement for proposed project has been calculated on the basis of 3 shift operation for 330 days in a year. The breakup of the manpower requirement of this project has been summarized as follows:

**Table 16: Manpower Requirement**

| Sl. No | Particular | Partial Outsourcing Option. (Nos) |
|---|---|---|
| 1 | Workers | 170 |
| 2 | Monthly paid staff | 108 |
| 3 | Officers | 26 |
| | Total | 304 |

## 2.19 PROJECT IMPLEMENTATION SCHEDULE

It is well known fact that for timely implementation of a project, it is essential that all the activities related with project construction are properly planned, closely monitored and effectively supervised.

All implementing departments should have their own implementation manuals which are followed for monitoring and construction of the project, so that, man, materials and money are made available to the project in time as spelt in the project report, with a view to prevent cost and time over-run. Responsibility, power for each executive to be included in the implementation manual to prevent overlapping of operational areas. Sufficient administrative and financial power to be defined for key executive to take timely and effective decisions for the implementation of the project. Time estimates are broad and indicative only, necessary modifications to suit local site conditions are to be incorporated subsequently.

The life of the proposed mine will be 11 years including construction period. The maximum quarry depth will be around 60.12 m. The Production Program proposed is as given below: -

**Table 17**

| YEAR | TOTAL COAL | TOTAL OB |
|---|---|---|
| 1 | | |
| 2 | 0.50 | 4.00 |
| 3 | 1.00 | 8.00 |
| 4 | 1.50 | 12.00 |



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

| | | |
|---|---|---|
| 5 | 1.50 | 12.00 |
| 6 | 1.50 | 12.00 |
| 7 | 1.50 | 12.00 |
| 8 | 1.50 | 12.00 |
| 9 | 1.50 | 12.00 |
| 10 | 1.50 | 12.00 |
| 11 | 1.16 | 11.95 |
| **TOTAL** | **13.16** | **107.95** |

**2.19.1** Technically, zero date has been adopted as the date of approval and/or date of environmental clearance or the date of the land acquisition whichever is later.

## 2.20 CRITICAL ACTIVITY

### CONSTRAINTS ON MINE DEVELOPMENT

(i) A nalla named as "Kulharia nalla" is flowing along the periphery of the eastern boundary of the Project. Sufficient care should be taken to avoid inrush of water from Kulharia Nalla into the mine.

(ii) Rehabilitation & resettlement of five villages is involved in the project. Acquisition of land along with R&R of PAP is a critical activity and should be done for opening of the project. No of PAP is 220.

## 2.21 ENVIRONMENT MANAGEMENT

### 2.21.1 Introduction

Environmental management is necessary for planning different developmental activities, in order to optimal utilization of the earth's resources. It also helps in preserving the quality of environment for healthy growth of society.

This chapter deals with the existing environmental quality along with impact of different activities during operation of the project over environment and management strategies to mitigate adverse impacts resulted by these activities.

### 2.21.2 Existing Environment Quality

The baseline data generation was carried out during October to December 2020 which is a no monsoon period. This data has been used to give a basic idea of existing environmental quality in the proposed project area.

### 2.21.3 Ambient Air quality in buffer zone

The summarized air quality monitoring data for PM10, PM2.5, SO2, & NOx at different locations (Ref Figure 21.1) has been shown in Table 18.

**Table 18: Ambient Air quality**

| Sample Location | Concentration of 24 Hrs average | | | | | | MoEF/CPCB Coal Mines Standards |
|---|---|---|---|---|---|---|---|
| | Mini. | Max. | 98th Percentile | AM | GM | SD | |
| | $PM_{10}$ Concentration (µg/m³) | | | | | | |
| Sautanchua Village | 54.30 | 83.00 | 83.00 | 74.78 | 74.35 | 7.68 | 250 |
| Manjholi Village* | 57.40 | 96.50 | 96.50 | 85.32 | 84.58 | 10.60 | 250 |
| Harri Village | 47.60 | 72.60 | 72.60 | 64.78 | 64.40 | 6.79 | 100 |
| Dumarkachar Village | 38.10 | 66.80 | 66.80 | 59.34 | 58.70 | 8.11 | 100 |
| Amadand Village | 44.30 | 87.00 | 87.00 | 73.94 | 73.09 | 10.59 | 100 |
| Gulutola Village | 37.40 | 72.90 | 72.90 | 64.38 | 63.35 | 10.55 | 100 |
| Bhad Village | 48.30 | 79.90 | 79.90 | 68.25 | 67.67 | 8.57 | 100 |
| Chukan Village | 42.10 | 82.90 | 82.90 | 72.25 | 71.37 | 10.37 | 100 |
| Phejatola Village | 37.80 | 74.20 | 74.20 | 63.13 | 62.40 | 8.94 | 100 |
| | $PM_{2.5}$ Concentration (µg/m³) | | | | | | |
| Sautanchua Village | 29.30 | 45.50 | 45.50 | 40.60 | 40.39 | 4.00 | ---- |
| Manjholi Village* | 30.50 | 50.10 | 50.10 | 44.27 | 43.98 | 4.84 | ---- |
| Harri Village | 19.40 | 42.70 | 42.70 | 36.90 | 36.38 | 5.57 | 60 |
| Dumarkachar Village | 20.70 | 36.50 | 36.50 | 32.42 | 32.05 | 4.51 | 60 |
| Amadand Village | 26.10 | 51.20 | 51.20 | 43.45 | 42.94 | 6.24 | 60 |
| Gulutola Village | 18.80 | 37.00 | 37.00 | 32.62 | 32.09 | 5.38 | 60 |
| Bhad Village | 25.70 | 42.70 | 42.70 | 36.63 | 36.32 | 4.65 | 60 |
| Chukan Village | 22.20 | 43.80 | 43.80 | 38.06 | 37.59 | 5.47 | 60 |
| Phejatola Village | 20.00 | 39.90 | 39.90 | 33.90 | 33.50 | 4.85 | 60 |
| | $SO_2$ Concentration (µg/m³) | | | | | | |
| Sautanchua Village | 12.10 | 36.70 | 36.70 | 29.06 | 28.20 | 6.18 | 120 |
| Manjholi Village* | 16.60 | 33.60 | 33.60 | 28.73 | 28.43 | 3.80 | 120 |
| Harri Village | 6.40 | 16.10 | 16.10 | 11.87 | 11.58 | 2.54 | 80 |
| Dumarkachar Village | 5.70 | 14.40 | 14.40 | 10.60 | 10.44 | 2.79 | 80 |
| Amadand Village | 17.40 | 31.30 | 31.30 | 25.64 | 25.42 | 3.28 | 80 |
| Gulutola Village | 8.50 | 23.10 | 23.10 | 16.88 | 16.42 | 3.77 | 80 |
| Bhad Village | 10.60 | 19.60 | 19.60 | 15.62 | 15.36 | 2.81 | 80 |
| Chukan Village | 5.10 | 19.30 | 19.30 | 14.16 | 13.66 | 3.42 | 80 |
| Phejatola Village | 6.80 | 14.30 | 14.30 | 10.88 | 10.65 | 3.73 | 80 |
| | NOx Concentration (µg/m³) | | | | | | |
| Sautanchua Village | 8.40 | 28.90 | 28.90 | 22.41 | 21.65 | 4.99 | 120 |
| Manjholi Village* | 11.90 | 23.80 | 23.80 | 18.43 | 18.23 | 2.63 | 120 |
| Harri Village | 6.30 | 13.40 | 13.40 | 9.43 | 9.22 | 3.28 | 80 |
| Dumarkachar Village | 5.20 | 12.90 | 12.90 | 8.47 | 8.25 | 3.08 | 80 |
| Amadand Village | 11.50 | 23.40 | 23.40 | 16.07 | 15.81 | 3.09 | 80 |
| Gulutola Village | 6.50 | 19.20 | 19.20 | 12.92 | 12.52 | 4.06 | 80 |



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

| Sample Location | Concentration of 24 Hrs average | | | | | | MoEF/CPCB Coal Mines Standards |
|---|---|---|---|---|---|---|---|
| | Mini. | Max. | 98th Percentile | AM | GM | SD | |
| Bhad Village | 6.10 | 16.10 | 16.10 | 11.91 | 11.53 | 2.89 | 80 |
| Chukan Village | 5.70 | 15.70 | 15.70 | 11.53 | 11.20 | 3.52 | 80 |
| Phejatola Village | 5.30 | 11.80 | 11.80 | 8.12 | 7.88 | 3.03 | 80 |


**Figure 21.1: Locations of Air quality monitoring stations**

### 2.21.4 Water Quality

#### a) Water quality status of surface and ground water

The water quality data at different locations is shown in Table 19

**Table 19 Surface and Ground Water Quality**

| Criteria Pollutants | Unit | Max | Min | Acceptable Limit | Permissible Limit |
|---|---|---|---|---|---|
| | Ground Water as Per IS 10500:2012 | | | | |
| pH | - | 7.42 | 6.92 | 6.5 to 8.5 | No Relaxation |
| Total Dissolved Solids | mg/l | 626 | 255.6 | 500 | 2000 |
| Total hardness as $CaCO_3$ | mg/l | 424 | 122 | 200 | 600 |
| Chlorides | mg/l | 115 | 55 | 250 | 1000 |
| Fluoride | mg/l | 0.77 | 0.06 | 1 | 1.5 |
| Calcium as Ca | mg/l | 120.2 | 28.1 | 75 | 200 |
| Iron | mg/l | 4.6 | 0.09 | 0.3 | No Relaxation |
| Total suspended solids | mg/l | < 5 | < 5 | --- | --- |
| Nitrate | mg/l | 15.5 | 8.8 | 45 | No Relaxation |
| | Surface Water as Per IS 2296:1982 | | | | Class-C |
| pH | - | 7.19 | 6.58 | | 6.5 to 8.5 |
| DO | mg/l | 6.9 | 5.6 | | 4 |
| BOD | mg/l | 9 | 2 | | 3 |

| | | | | | |
|---|---|---|---|---|---|
| COD | mg/l | 30.0 | < 5 | | --- |
| Total Dissolved Solids | mg/l | 456 | 154 | | 1500 |
| Feacal Coliform | MPN/ | 23 | absent | | --- |
| Total Coliform | 100ml | 54 | 24 | | 500 |
| Nitrate | mg/l | 13 | 6.6 | | 50 |

**b) Effluent Water Quality**

The effluent water quality data at different locations (Ref Figure 21.2) is shown in Table 20

**Table 20: Effluent water quality**

| S. No. | Parameter | Unit | Value | GSR No. 422 E |
|---|---|---|---|---|
| 1. | pH at 25 °C | -- | 6.61 | 5.5 to 9.0 |
| 2. | Temperature°C | °C | 26.4 | NE 5°C receiving temp |
| 3. | Colour | CU | 12.0 | 15 |
| 4. | Odour | ... | Agreeable | - |
| 5. | Turbidity | NTU | 16.0 | - |
| 6. | Chloride | mg/L | 42.0 | - |
| 7. | Fluoride | mg/L | 0.57 | 2.0 |
| 8. | Sulphate | mg/L | 172.0 | - |
| 9. | COD | mg/L | 30.0 | 250 |
| 10. | BOD | mg/L | 9.3 | 30 |
| 11. | Nitrate Nitrogen | mg/L | 10.2 | 10 |
| 12. | Aluminium | mg/L | 0.35 | - |
| 13. | Cadmium (As Cd) | mg/L | <0.01 | 2.0 |
| 14. | Copper (As Cu) | mg/L | <0.1 | 3.0 |
| 15. | Arsenic (as As) | mg/L | <0.02 | 0.2 |
| 16. | Lead (As Pb) | mg/L | <0.02 | 0.1 |
| 17. | Mercury (As Hg) | mg/L | <0.001 | 0.01 |
| 18. | Nickel (Ni) | mg/L | <0.05 | 3.0 |
| 19. | Zinc (As Zn) | mg/L | <0.1) | 5.0 |
| 20. | Iron | mg/L | 0.50 | 3.0 |
| 21. | Total Chromium | mg/L | <0.1) | 2.0 |
| 22. | Manganese (As Mn) | mg/L | <0.1) | 2.0 |
| 23. | Phenolic Compounds | mg/L | <0.1) | 1.0 |
| 24. | Orthophosphate | mg/L | <0.5) | 5.0 |
| 25. | TSS | mg/L | 31.2 | 100 |
| 26. | Vanadium (As V) | mg/L | <0.1) | 0.2 |
| 27. | Cyanide | mg/L | <0.1) | 0.2 |
| 28. | Hexavalent Chromium as $Cr^{+6}$ | mg/L | <0.05) | 0.1 |
| 29. | Total Kjheldal Nitrogen as TKN | mg/L | 40.3 | 100 |
| 30. | Ammonical Nitrogen as $NH_3$ | mg/L | 6.2 | 50 |
| 31. | Oil & Grease | mg/L | <2) | 10 |
| 32. | Calcium as Ca | mg/L | 60.9 | - |
| 33. | Total Hardness as $CaCo_3$ | mg/L | 256.0 | - |
| 34. | Residual Chlorine | mg/L | <0.1) | - |
| 35. | Selenium (As Se) | mg/L | <0.02) | 0.05 |
| 36. | Boron (As B) | mg/L | <0.1) | - |
| 37. | Sulphide | mg/L | 1.6 | 2.0 |



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

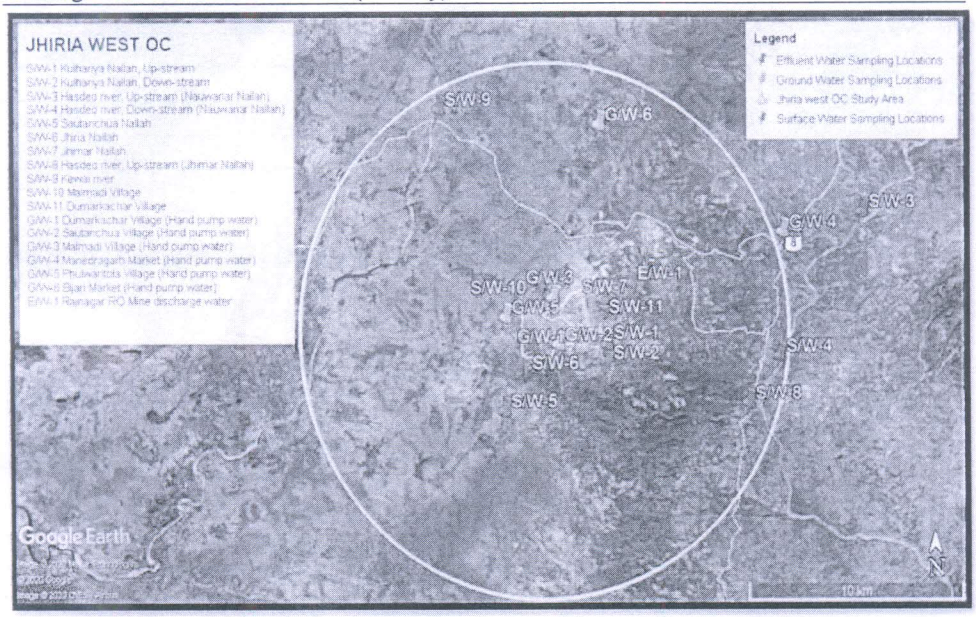



**Figure 21.2: Locations of water quality monitoring stations**

### 2.21.5 Noise levels

The noise quality data at different locations (Ref Figure 21.1) is shown in Table 21

**Table 21: Noise quality**

| S N. | Name of Location CPCB Standards of 2000 | Category | Noise Level in dB(A) | | | |
|---|---|---|---|---|---|---|
| | | | Day | | Night | |
| | | | Min. | Max. | Min. | Max. |
| | **Industrial area** | **A** | **75** | | **70** | |
| | **Commercial area** | **B** | **65** | | **55** | |
| | **Residential area** | **C** | **55** | | **45** | |
| | **Silence zone** | **D** | **50** | | **40** | |
| 1 | Sautanchua Village | A | 50.9 | 53.8 | 40.5 | 43.9 |
| 2 | Manjholi Village* | A | 50.9 | 54.3 | 38.9 | 40.5 |
| 3 | Harri Village | C | 52.7 | 53.2 | 40.7 | 42.1 |
| 4 | Dumarkachar Village | C | 50.7 | 54.2 | 42.9 | 44.9 |
| 5 | Amadand Village | C | 53.3 | 54.2 | 40.4 | 44.2 |
| 6 | Gulutola Village | C | 49.7 | 52.9 | 38.9 | 41.5 |
| 7 | Bhad Village | C | 48.9 | 54.7 | 38.7 | 42.7 |
| 8 | Chukan Village | C | 51.7 | 53.0 | 40.7 | 44.2 |
| 9 | Phejatola Village | C | 49.8 | 53.1 | 40.8 | 44.2 |

### 2.21.6 Flora and Fauna

The ecology and bio-diversity study mainly consists of identification of different flora and fauna present in the study area and determining their diversity. The

bio-diversity index of core zone and buffer zone were separately determined with the help of quadrate sampling of 10m x 10 m by using Simpson's index method. Malga RF, Kora RF, Hadibari RF, part of Nandalal Patera RF forms a part of the study area. The survey was conducted from 04.10.2021 to 06.10.2021. The summary of floral diversity is tabulated in Table 22. The average biodiversity in core zone is 0.32 and buffer zone is 0.39. The detailed list of flora and fauna identified in core zone and buffer zone of the project is in Table 23. During survey, it is observed that endangered, endemic and migratory species are not present in the study area. Also, migratory corridors, flight paths and spawning grounds are not present in the study area.

**Table 22: The summary of Bio diversity**

| Quadrant (Q) | Species (Scientific name) in Core Zone | Number of trees (n) | %Simpsons biodiversity Index |
|---|---|---|---|
| Q1 | *Butea monosperma* (Lam.) Taub. | 3 | 0.37 |
| | *Diospyros melanoxylon* Roxb. | 25 | |
| | *Mangifera indica* L. | 1 | |
| | *Shorea robusta* Roth | 1 | |
| Q2 | *Gardenia gummifera* L.f. | 1 | 0.5 |
| | *Shorea robusta* Roth | 2 | |
| | *Terminalia chebula* Retz. | 1 | |
| Q3 | *Madhuca longifolia* var. *latifolia* (Roxb.) A.Chev. | 1 | 0.25 |
| | *Shorea robusta* Roth | 3 | |
| Q4 | *Shorea robusta* Roth | 5 | 0 |
| Q5 | *Diospyros melanoxylon* Roxb. | 2 | 0.5 |
| | *Shorea robusta* Roth | 2 | |
| **Quadrant (Q)** | ***Species (Scientific name) in Buffer Zone*** | **Number of trees (n)** | **%Simpsons biodiversity Index** |
| | | | |
| Q1 | *Butea monosperma (Lam.) Taub.* | 5 | 0.5 |
| | *Ziziphus jujuba Mill.* | 7 | |
| | *Leucaena leucocephala (Lam.) de Wit* | 2 | |
| Q2 | *Sterculia urens Roxb.* | 1 | 0.5 |
| | *Butea monosperma (Lam.) Taub.* | 2 | |
| | *Lagerstroemia parviflora Roxb.* | 5 | |
| | *Chloroxylon swietenia (Roxb.) DC.* | 2 | |
| Q3 | *Shorea robusta Roth* | 1 | 0.07 |
| | *Diospyros melanoxylon Roxb.* | 30 | |
| | *Gardenia gummifera L.f.* | 1 | |
| Q4 | *Madhuca longifolia var. latifolia (Roxb.) A.Chev.* | 4 | 0 |
| Q5 | *Shorea robusta Roth* | 1 | 0.5 |
| | *Mangifera indica L* | 1 | |
| Q6 | *Shorea robusta Roth* | 4 | 0 |
| Q7 | *Shorea robusta Roth* | 5 | 0.17 |
| | *Diospyros melanoxylon Roxb.* | 1 | |
| Q8 | *Careya arborea Roxb.* | 1 | 0.34 |
| | *Diospyros melanoxylon Roxb.* | 1 | |
| | *Shorea robusta Roth* | 4 | |
| Q9 | *Semecarpus anacardium L* | 1 | 0.67 |
| | *Diospyros melanoxylon Roxb.* | 1 | |
| | *Shorea robusta Roth* | 1 | |
| Q10 | *Shorea robusta Roth* | 1 | 0.67 |



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

| | | | |
|---|---|---|---|
| | *Lagerstroemia parviflora Roxb.* | 1 | |
| | *Diospyros melanoxylon Roxb.* | 1 | |
| Q11 | *Shorea robusta Roth* | 3 | 0.25 |
| | *Boswellia serrata Roxb.* | 1 | |
| Q12 | *Shorea robusta Roth* | 3 | 0.25 |
| | *Terminalia chebula Retz.* | 1 | |
| Q13 | *Shorea robusta Roth* | 2 | 0.8 |
| | *Semecarpus anacardium L* | 1 | |
| | *Diospyros melanoxylon Roxb.* | 1 | |
| | *Butea monosperma (Lam.) Taub.* | 1 | |
| Q14 | *Madhuca longifolia var. latifolia (Roxb.) A.Chev.* | 2 | 0.6 |
| | *Shorea robusta Roth* | 2 | |
| | *Anogeissus latifolia (Roxb. ex DC.) Wall. ex Guill. & Perr.* | 1 | |
| Q15 | *Diospyros melanoxylon Roxb.* | 1 | 0.6 |
| | *Lagerstroemia parviflora Roxb.* | 2 | |
| | *Hymenodictyon orixense (Roxb.) Mabb.* | 1 | |
| | *Butea monosperma (Lam.) Taub.* | 1 | |

**Table 23: Detailed list of flora and fauna identified**

| Common name | Local name | Botanical name | Name of class/Family |
|---|---|---|---|
| | **List of Vegetables in the Core Zone** | | |
| Bitter Gourd | Karela | *Momordica charantia* L. | *Cucurbitaceae* |
| Bottle guard | Laukee | *Lagenaria siceraria* (Molina) Standl | *Cucurbitaceae* |
| Brinjal | Baingan | *Solanum melongena* L. | *Solanaceae* |
| Chilly | Lalmirchi | *Capsicum annum* L. | *Solanaceae* |
| Coriander, | Dhanya | *Coriandrum sativum*L. | *Apiaceae* |
| Lemon | Nimbu | *Citrus limon* (L.) Burm f | *Rutaceae* |
| Pumpkin | Kaddoo | *Cucurbita maxima* Duch ex Lam. | *Cucurbitaceae* |
| Ridged guard | Turee | *Luffa acutangula* (L.) Roxb. | *Cucurbitaceae* |
| Tomato | Tamatar | *Lycopersicum esculentum* L. | *Solanaceae* |
| | **List of Vegetables in the Buffer Zone** | | |
| Amaranthus | Cauleyi | *Amaranthus hybridus* L. | *Amaranthaceae* |
| Bitter Gourd | Karela | *Momordica charantia* L. | *Cucurbitaceae* |
| Bottle guard | Laukee | *Lagenaria siceraria* (Molina) Standl | *Cucurbitaceae* |
| Brinjal | Baingan | *Solanum melongena* L. | *Solanaceae* |
| Chilly | Lalmirchi | *Capsicum annum* L. | *Solanaceae* |
| Coriander | Dhanya | *Coriandrum sativum* L. | *Apiaceae* |
| Lady finger | Bhindi | *Abelmoschus esculentus* (L.) Moench | *Malvaceae* |
| Lemon | Nimbu | *Citrus limon* (L.) Burm f | *Rutaceae* |
| Pointed guard | Parwal | *Trichosanthes dioica* Roxb. | *Cucurbitaceae* |
| Potato | Aloo | *Solanum tuberosum* L. | *Solanaceae* |
| Pumpkin | Kaddoo | *Cucurbita maxima* Duch ex Lam. | *Cucurbitaceae* |
| Purple yam | Ratalu | *Dioscorea alata* L. | *Dioscoreaceae* |
| Ridged guard | Turee | *Luffa acutangula* (L.) Roxb. | *Cucurbitaceae* |
| Sweet potato | Shakarakand | *Ipomoea batatas* (L.) Lam. | *Convolvulaceae* |
| Tomato | Tamatar | *Lycopersicum esculentum* L. | *Solanaceae* |
| | **List of Commercial Crops in Core Zone** | | |
| Paddy | Chawal | *Oryza sativa* L. | *Poaceae* |
| Maize | Makki | *Zea mays* L. | *Poaceae* |
| | **List of Commercial Crops in Buffer Zone** | | |
| Bengal gram | Toor | *Cajanus cajan* L. | *Leguminosae* |
| Niger seed | Ramtil | *Guizotia abyssinica* CASS. | *Asteraceae* |
| Paddy | Chawal | *Oryza sativa* L. | *Poaceae* |
| Pearl millet | Bhajra | *Pennisetum glaucum* (L.) R. Brown | *Poaceae* |
| Mat bean | Mot | *Phaseolus aconitifolius* Jacq. | *Leguminosae* |

| | | | |
|---|---|---|---|
| Green gram | Moong | *Phaseolus mungo* L. | *Leguminosae* |
| Pea | Matar | *Pisum sativum* L. | *Leguminosae* |
| Maize | Makki | *Zea mays* L. | *Poaceae* |

**Status of Natural Vegetation/Shrub/Climber species in Study Area**

| Species Name | Abundance | | Average | | Minimum | | IUCN Status |
|---|---|---|---|---|---|---|---|
| | Core | Buffer | Core | Buffer | Core | Buffer | |
| *Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill. & Perr. | | 1 | | 1.00 | | 1 | - |
| *Boswellia serrata* Roxb. | | 1 | | 1.00 | | 1 | - |
| *Butea monosperma* (Lam.) Taub. | 3 | 9 | 3 | 2.25 | 3 | 1 | LC |
| *Careya arborea* Roxb. | | 1 | | 1.00 | | 1 | - |
| *Chloroxylon swietenia* (Roxb.) DC. | | 2 | | 2.00 | | 2 | VU |
| *Diospyros melanoxylon* Roxb. | 27 | 36 | 13.5 | 5.14 | 2 | 1 | - |
| *Gardenia gummifera* L.f. | 1 | 1 | 1 | 1.00 | 1 | 1 | LC |
| *Hymenodictyon orixense* (*Roxb.*) *Mabb.* | | 1 | | 1.00 | | 1 | - |
| *Lagerstroemia parviflora* Roxb. | | 8 | | 2.67 | | 1 | - |
| *Leucaena leucocephala* (Lam.) de Wit | | 2 | | 2.00 | | 2 | - |
| *Madhuca longifolia* var. *latifolia* (Roxb.) A.Chev. | 1 | 6 | 1 | 3.00 | 1 | 2 | - |
| *Mangifera indica* L | 1 | 1 | 1 | 1.00 | 1 | 1 | DD |
| *Semecarpus anacardium* L | | 2 | | 1.00 | | 1 | - |
| *Shorea robusta* Roth | 13 | 27 | 2.6 | 2.45 | 1 | 1 | LC |
| *Sterculia urens* Roxb. | | 1 | | 1.00 | | 1 | - |
| *Terminalia chebula* Retz. | 1 | 1 | 1 | 1.00 | 1 | 1 | LC |
| *Ziziphus jujuba* Mill. | | 7 | | 7.00 | | 7 | LC |

**List of Plants in Core Zone**

| Scientific name | Common name | Habitant | Family average | Abundance | Avg. | Min. | IUCN |
|---|---|---|---|---|---|---|---|
| **Shrubs/Climbers** | | | | | | | |
| *Gloriosa superba* L. | | Wild | 2 | 2 | 2 | 2 | - |
| *Lantana camera* L. | Wild sage | Invasive | 5 | 5 | 5 | 5 | - |
| *Rivea ornata* (Roxb.) Choisy. | | Wild | 28.5 | 2 | 2 | 2 | - |
| *Senna occidentalis* (L.) Link. | | Wild | 12 | 4 | 4 | 4 | - |
| **Herbs/Grasses** | | | | | | | |
| *Aristida setacea* Retz. | Broom grass | Wild | 17.71 | 13 | 13 | 13 | - |
| *Bothriochloa pertusa (L.) A. Camus* | | Wild | 17.71 | 14 | 14 | 14 | - |
| *Cyperus squarrosus L.* | | Wild | 7.00 | 7 | 7 | 7 | - |
| *Elephantopus scaber* L. | Bull's tongue | Wild | 22.50 | 40 | 20 | 20 | - |
| *Emilia sonchifolia* (L.) DC. | | Wild | 22.50 | 5 | 2.5 | 1 | - |
| *Eragrostis unioloides (Retz.) Nees ex Steud.* | | Wild | 17.71 | 27 | 13.5 | 7 | - |
| *Eragrostis viscosa* (Retz.) Trin. | | Wild | 17.71 | 12 | 6 | 4 | - |
| *Evolvulus nummularius* (L.) L. | | Wild | 28.50 | 55 | 18.3 | 7 | - |
| *Grona triflora* (L.) H.Ohashi & K.Ohashi | | Wild | 12.00 | 25 | 25 | 25 | - |
| *Hedyotis pinifolia* Wall. ex G.Don | | Wild | 12.67 | 7 | 3.5 | 2 | - |
| *Lindernia antipoda.* (L.) Alston. | | Wild | 34.00 | 34 | 17 | 9 | - |
| *Mitracarpus hirtus* (L.) DC. | | Wild | 12.67 | 25 | 25 | 25 | - |
| *Oldenlandia herbacea.* (L.) Roxb. | | Wild | 12.67 | 6 | 6 | 6 | - |
| *Oplismenus compositus* (L.) P.Beauv. | | Wild | 17.71 | 56 | 28 | 22 | - |
| *Paspalidium flavidum* (Retz.) A.Camus | | Wild | 17.71 | 0 | 0 | 0 | - |
| *Phyllanthus virgatus* G. Forst. | | Wild | 6.00 | 6 | 6 | 6 | - |
| *Senna tora*(L.) Roxb. | panwar | Invasive | 12.00 | 7 | 7 | 7 | - |
| *Sporobolus diandrus* (Retz.) | Smut grass | Wild | 17.71 | 2 | 2 | 2 | - |



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.

| Scientific name | Common name | Habitant | Family average | Abundance | Avg. | Min. | IUCN |
|---|---|---|---|---|---|---|---|
| P.Beauv. | | | | | | | |

**List of Plants in Buffer Zone**

| Scientific name | Common name | Habitant | Family Avg | Abundance | Avg. | Min | IUCN |
|---|---|---|---|---|---|---|---|
| **Shrub / Climber** | | | | | | | |
| *Annona squamosa* L. | Custard apple | Wild | 11.0 | 11 | 5.5 | 4 | LC |
| *Dioscorea alata* L. | | Cultivated | 4.0 | 4 | 4 | 4 | - |
| *Hemidesmus indicus* (L.) R. Br. | | Wild climber | 7.0 | 7 | 3.5 | 2 | - |
| *Lantana camera* L. | Wild sage | Invasive | 131.0 | 131 | 11.9 | 3 | - |
| *Senna occidentalis* (L.) Link. | | Wild | 12.3 | 8 | 4 | 2 | LC |
| *Sida mysorensis* Wight & Arn. | | Wild | 31.4 | 4 | 4 | 4 | - |
| *Stephania japonica* (Thunb.) Miers | | Wild | 1.0 | 1 | 1 | 1 | - |
| *Xanthium strumarium* L. | | Weed | 48.8 | 38 | 7.6 | 2 | - |
| **Herbs** | | | | | | | |
| *Acanthospermum hispidum* D.C. | | Weed | 48.8 | 22 | 11 | 10 | - |
| *Achyranthes aspera* L. | | Weed | 27.0 | 7 | 7 | 7 | - |
| *Ageratum conyzoides* L. | | Weed | 48.8 | 74 | 24.67 | 8 | - |
| *Alternanthera ficoidea* (L.) P. Beauv. | | Invasive | 27.0 | 47 | 15.67 | 12 | - |
| *Anisomeles heyneana* Benth. | | Wild | 89.7 | 10 | 10 | 10 | - |
| *Aristida setacea* Retz. | Broom grass | Wild | 44.5 | 73 | 9.13 | 2 | - |
| *Biophytum sensitivum* DC. | | Wild | 2.0 | 2 | 2 | 2 | - |
| *Bothriochloa pertusa (L.) A. Camus* | | Wild | 44.5 | 4 | 4 | 4 | - |
| *Cleome viscosa* L. | | Weed | 4.0 | 4 | 4 | 4 | - |
| *Dicliptera paniculata* (Forssk.) I.Darbysh. | | Wild | 5.0 | 5 | 5 | 5 | - |
| *Digitaria bicornis* (Lam.) Roem. & Schult. | | Wild | 44.5 | 14 | 7 | 7 | - |
| *Elephantopus scaber* L. | Bull's tongue | Wild | 48.8 | 61 | 10.17 | 2 | - |
| *Eleusine indica* (L.) Gaertn. | | Invaded | 44.5 | 40 | 40 | 40 | LC |
| *Eragrostiella bifaria* (Vahl) Bor | | Wild | 44.5 | 30 | 15 | 5 | - |
| *Eragrostis unioloides (Retz.) Nees ex Steud.* | | Wild | 44.5 | 62 | 12.4 | 6 | LC |
| *Eragrostis viscosa* (Retz.) Trin. | sticky love grass | Wild | 44.5 | 4 | 4 | 4 | - |
| *Euphorbia hirta* L. | | Wild | 20.0 | 20 | 20 | 20 | - |
| *Grona triflora* (L.) H.Ohashi & K.Ohashi | | Invaded | 12.3 | 4 | 4 | 4 | - |
| *Hedyotis pinifolia* Wall. ex G.Don | | Wild | 75.5 | 12 | 12 | 12 | - |
| *Lindernia antipoda.* (L.) Alston. | | Wild | 28.0 | 28 | 28 | 28 | LC |
| *Mesosphaerum suaveolens* (L.) Kuntze | | Weed | 89.7 | 253 | 36.14 | 4 | - |
| *Mitracarpus hirtus (L.) DC.* | | Wild | 75.5 | 139 | 23.17 | 10 | - |
| *Murdannia nudiflora* (L.) Brenan. | | Wild | 8.0 | 8 | 4 | 4 | - |
| *Oplismenus compositus* (L.) P.Beauv. | | Wild | 44.5 | 127 | 63.5 | 27 | - |
| *Phyllanthus virgatus* G. Forst. | | Wild | 12.0 | 12 | 6 | 2 | - |
| *Plectranthus mollis (Aiton) Spreng.* | | Wild | 89.7 | 6 | 6 | 6 | - |
| *Senna tora*(L.) Roxb. | Panwar | Invasive | 12.3 | 25 | 8.33 | 7 | - |
| *Sida acuta* L. | Wire | Wild | 31.4 | 114 | 28.50 | 4 | - |

| Scientific name | Common name | Habitant | Family Avg | Abundance | Avg. | Min | IUCN |
|---|---|---|---|---|---|---|---|
| | weed | | | | | | |
| *Sida rhombifolia* L. | | Wild | 31.4 | 15 | 15 | 15 | - |
| *Sporobolus diandrus* (Retz.) P.Beauv. | Smut grass | Wild | 44.5 | 109 | 18.17 | 4 | - |
| *Triumfetta pentandra* A.Rich. | | Wild | 31.4 | 18 | 6 | 4 | - |
| *Urena lobata* L. | Caesar's weed | Wild | 31.4 | 6 | 3 | 2 | LC |
| *Urochloa ramosa* (L.) T.Q.Nguyen | | Wild | 44.5 | 0 | 0 | 0 | LC |
| **Grasses** | | | | | | | |
| *Cynodon dactylon* (L.) Pers. | | Wild | 44.5 | 115 | 38.33 | 10 | - |
| Cyperus compressus L. | | Wild | 44.5 | 4 | 4 | 4 | LC |
| *Scleria lithosperma* (L.) Sw. | | Wild | 44.5 | 4 | 4 | 4 | LC |
| *Setaria pumila* (Poir.) Roem. & Schult. | | Wild | 44.5 | 25 | 18.5 | 12 | - |

**List of Aquatic flora in the Study Area**

| Common name | Local name | Botanical name | Class/Family | IUCN Status |
|---|---|---|---|---|
| Blue Lotus | Neelkamal | *Nymphaea nouchali* Burm f | *Nymphaeaceae* | LC |
| Dense flower Knotweed | Bihagni | *Persicaria glabra* (Willd.) M.Gómez | | LC |
| Lesser Bulrush | Patera | *Typha angustifolia* L. | *Typhaceae* | LC |
| Pangorai | Nagar motha | *Cyperus corymbosus* Rottb. | *Cyperaceae* | LC |
| Pickerel Weed | Panpatta | *Monochoria vaginalis* (Burm.f.) C.Presl | *Pontedraceae* | LC |
| Sacred lotus | Kamal | *Nelumbo nucifera* Gaertn. | *Nelumbonaceae* | - |
| Turkey Tangle Frogfruit | bukkan | *Phyla nodiflora* (L.) Grene | *Verbenaceae* | LC |
| Water Morning Glory | Nali | *Ipomoea aquatica* Forssk. | *Convolvulaceae* | LC |
| Water Shamrock | Caupatiya | *Marsilea quadrifolia* L. | *Marsiliaceae* | LC |
| Water Snowflake | Kumudini | *Nymphoides indica* (L.) Kuntze. | *Menyanhaceae* | LC |
| Wild Taro | Arvi, Kachalu | *Colocasia esculenta* (L.) Schott | *Araceae* | LC |

**List of Terrestrial Fauna in the Core Zone**

| Sl. No. | Name | | | WPA, 1972 Status | ICUN Status |
|---|---|---|---|---|---|
| | Common | Local | Scientific | | |
| **Mammal** | | | | | |
| 1 | Spotted Deer | Chital | *Axis axis* | III | LC |
| 2 | Bandicoot Rat | Chuha | *Bandicota bengalensis* | IV/V | LC |
| 3 | Jackal | Geedhad | *Canis aureus* | II | LC |
| 4 | Sambar | Hiran | *Cervus unicolor* | III | VU |
| 5 | 3 Strip Palm squirrel | Gilahari | *Funambulus pennanti* | IV | LC |
| 6 | Common Mongoose | Nevlaa | *Herpestes edwardsi* | II | LC |
| 7 | Hyaena | Lakadbagga | *Hyaena hyaena* | III | NT |
| 8 | Indian Field Mouse | Chuha | *Mus booduga* | V | LC |
| 9 | Rhesus Macaque | Bandar | *Presbytis entellus* | - | - |
| 10 | Common House Rat | Chuha | *Rattus rattus* | IV/V | LC |
| 11 | Indian Fox | Lomri | *Vulpes bengalensis* | II | LC |
| **Birds** | | | | | |
| 1 | Common Myna | Myna | *Acridotheres tristis* | IV | LC |
| 2 | Small blue kingfisher | Ramchiraya | *Alcedoatthis* | IV | LC |
| 3 | House Swift | | *Apus affinis* | | LC |
| 4 | Indian pond heron | Andhabagula | *Ardeola grayii* | IV | LC |
| 5 | Cattle egret | Bagula | *Bubulcus ibis* | IV | LC |
| 6 | Crow pheasant | Couckoo | *Centropus sinensis* | IV | LC |
| 7 | Indian roller | | *Coracias benghalensis* | | LC |



क्षेत्रीय महाप्रबंधक
Area General Manager
एस.ई.सी.एल.
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| Sl. No. | Name | | | WPA, 1972 Status | ICUN Status |
|---|---|---|---|---|---|
| | Common | Local | Scientific | | |
| 8 | House Crow | Kauva | *Corvus splendens* | V | LC |
| 9 | Little egret | KilchiaBagla | *Egretta garzetta* | IV | LC |
| 10 | Koel | Koyal | *Eudynamys scolopacea* | IV | LC |
| 11 | Rose ringed parakeet | Tota | *Psittacula krameria* | IV | LC |
| | | | **Reptile** | | |
| 1 | Smooth water snake | Sanmp | *Enhydris enhydris* | - | LC |
| 2 | House lizard | Chipkali | *Hemidactylus sp.* | - | LC |
| 3 | Cobra | Cobra | *NajaNaja* | II | - |
| 4 | Rat snake | Sanmp | *Ptyas mucosus* | II | - |
| 5 | Olive keel back snake | | *Natrix piscator* | | |
| | | | **Amphibian** | | |
| 1 | Common toad | Medhak | *Bufo melanostictus* | - | LC |
| 2 | Common frog | Medhak | *Euphlyctis hexadactyla* | - | - |
| 3 | Indian bull frog | Medhak | *Rana tigrine* | - | - |
| | | | **Insects** | | |
| 1 | Dragon flies | Vyaadh-Patang | *Anisoptera* | - | - |
| 2 | Grasshopper | Tidda | *Bacillus rossi* | - | - |
| | | | **Butterflies** | | |
| 1 | Common Emigrant | Titli | *Catopsiliapomona (Fabricius)* | - | - |
| 2 | Blue Tiger | Titli | *Tirumala limniaceleopardus (Butler)* | - | - |
| 3 | Striped tiger | | *Danaus genutia* | | |

**List of Terrestrial Fauna in the Buffer Zone**

| Sl. No. | Name | | | WPA, 1972 Status | ICUN Status |
|---|---|---|---|---|---|
| | Common | Local | Scientific | | |
| | | | **Mammal** | | |
| 1 | Spotted Deer | Chital | *Axis axis* | III | LC |
| 2 | Bandicoot Rat | Chuha | *Bandicota bengalensis* | IV/V | LC |
| 3 | Jackal | Geedhad | *Canis aureus* | II | LC |
| 4 | Sambar | Hiran | *Cervus unicolor* | III | VU |
| 5 | Jungle Cat | Jangli Billi | *Felis chaus* | II | LC |
| 6 | 3 Strip Palm squirrel | Gilahari | *Funambulus pennanti* | IV | LC |
| 7 | Common Mongoose | Nevlaa | *Herpestes edwardsi* | II | LC |
| 8 | Hyaena | Lakadbagga | *Hyaena hyaena* | III | NT |
| 9 | Indian Hare | Khargosh | *Lepus nigricollis* | IV | LC |
| 10 | Indian Field Mouse | Chuha | *Mus booduga* | IV/V | LC |
| 11 | Rhesus Macaque | Bandar | *Presbytis entellus* | - | - |
| 12 | Common House Rat | Chuha | *Rattus rattus* | IV/V | LC |
| 13 | Wild Pig | | *Sus scrofa* | | |
| 14 | Indian Fox | Lomri | *Vulpes bengalensis* | II | LC |
| | | | **Birds** | | |
| 1 | Common Myna | Myna | *Acridotheres tristis* | IV | LC |
| 2 | Small blue kingfisher | Ramchiraya | *Alcedo atthis* | IV | LC |
| 3 | House Swift | Babeela | *Apus affinis* | - | LC |
| 4 | Indian pond heron | Andhabagula | *Ardeola grayii* | IV | LC |
| 5 | Cattle egret | Bagula | *Bubulcus ibis* | IV | LC |
| 6 | Indian roller | | *Coracias benghalensis* | - | LC |
| 7 | House Crow | Kauva | *Corvus splendens* | V | LC |
| 8 | Crow pheasant | Couckoo | *Centropus sinensis* | IV | LC |
| 9 | Little egret | KilchiaBagla | *Egretta garzetta* | IV | LC |
| 10 | Koel | Koyal | *Eudynamys scolopacea* | IV | LC |
| 11 | Painted partirideg | Kala teetar | *Francolinus pictus* | IV | LC |
| 12 | Bastar Hill Myna | Kali Myna | *Gracula religiosa* | IV | LC |

| Sl. No. | Name | | | WPA, 1972 Status | ICUN Status |
|---|---|---|---|---|---|
| | Common | Local | Scientific | | |
| 13 | Black-rumped flameback | | *Dinopium benghalensis* | | LC |
| 14 | Baya weaver | | *Ploceus philippinus* | | |
| 15 | Asian Green Bee-eater | | *Merops orientalis* | | |
| 16 | House sparrow | Gauriyya | *Passer domesticus* | - | LC |
| 17 | Woodpecker | Sutar | *Picidae* | IV | - |
| 18 | Rose ringed parakeet | Tota | *Psittacula krameria* | IV | LC |
| 19 | Red-vented bulbul | Bulbul | *Pycnonotus cafer* | IV | LC |
| 20 | Spotted Dove | Kabutar | *Streptopelia chinensis* | IV | - |
| 21 | Asian pied starling | Maina | *Sturnus contra* | IV | - |
| 22 | Common Babbler | Gaigai | *Turdoides caudatus* | IV | LC |
| 23 | Common Hoopoe | | *Upupa epops* | - | LC |
| 24 | Red-wattled lapwing | Titeeri | *Vanellus indicus* | - | LC |
| | | | **Reptile** | | |
| 1 | Krait | Sanmp | *Bungarus caeruleus* | - | - |
| 2 | Smooth water snake | Sanmp | *Enhydris enhydris* | - | LC |
| 3 | Garden Lizard | | *Calotes versicolor* | - | - |
| 4 | House lizard | Chipkali | *Hemidactylus sp.* | - | LC |
| 5 | Cobra | Cobra | *NajaNaja* | II | - |
| 6 | Common water snake | Sanmp | *Natrix piscator* | - | - |
| 7 | Rat snake | Sanmp | *Ptyas mucosus* | II | - |
| 8 | Russel's viper | Sanmp | *Vipera russeli* | II | - |
| | | | **Amphibian** | | |
| 1 | Common toad | Medhak | *Bufo melanostictus* | - | LC |
| 2 | Common frog | Medhak | *Euphlyctis hexadactyla* | - | - |
| 3 | Green pond frog | Medhak | *Rana hexadactyla* | - | - |
| 4 | Common green frog | Medhak | *Ramnella variegate* | - | - |
| 5 | - | Medhak | *Rana cyanophlyctis* | - | LC |
| 6 | Indian bull frog | Medhak | *Rana tigrine* | - | - |
| | | | **Insects** | | |
| 1 | Dragon flies | Vyaadh-Patang | *Anisoptera* | - | - |
| 2 | Grasshopper | Tidda | *Bacillus rossi* | - | - |
| | | | **Butterflies** | | |
| 1 | Common hedge blue | Titli | *Acytolepis puspa* | - | - |
| 2 | Ciliate blue | Titli | *Anthene emolus* | - | - |
| 3 | Forget-me-not | Titli | *Catochrysops strabo fem* | - | - |
| 4 | Mottled emigrant | Titli | *Catopsilia pyranthe* | - | - |
| 5 | Common emigrant | Titli | *Catopsilia pomona (Fabricius)* | - | - |
| 6 | Cycad blue | Titli | *Chilades pandava* | - | - |
| 7 | Common grass yellow | Titli | *Eurema hecabe* | - | - |
| 8 | The common cerulean | Titli | *Jamides celeno* | - | - |
| 9 | Blue tiger | Titli | *Tirumala limniaceleopardus (Butler)* | - | - |

**List of Aquatic Fauna found in the Study Area**

| Sl. No. | Name | | | ICUN Status |
|---|---|---|---|---|
| | Common | Local | Scientific | |
| 1 | Murrai | Catla | *Catla catla (Ham)* | - |
| 2 | Maggri | Spotted murrel | *Channa punctatus* | LC |
| 3 | Murgol | Murgol | *Cirrhinus mrigala* | LC |
| 4 | Boyi | Magur | *Clarias batrachus (Lin)* | LC |
| 6 | | Common carp | *Cyprinus carpio* | VU |
| 7 | Rohu | Rohu | *Labeo rohita* | LC |
| 8 | Carp | Carp | *Labeo gonious* | - |

(Source: Field survey, discussion with locals and Forest dept. officials)



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

### 2.21.7 Environment Impact

#### 2.21.7.1 Air Quality:

The extent of pollution created by mining operation mainly depends upon, the type of minerals to be exploited. As such, the extent of pollution possible from handling and transportation of coal and that due to other activities associated with the processes of open cast mining has only been taken into consideration. The impact on air quality has been considered due to the dust and smoke. The sources of dust are envisaged as,

i) Operation of blast hole drills: The operation of heavy drills engaged in making holes for blasting generates some quantity of dust.

ii) Blasting: The number of particles below 5-micron size that is injurious to health is very low in dust generated by blasting.

iii) Deployment of heavy equipment: Major sources of dust in opencast mine operation have been identified to be from haul roads, due to spillage from dumpers and tippers and abrasion by their wheels.

iv) Coal transportation: Coal from the face is proposed to be hauled up to pit head CHP located near access trench by dumpers. This will generate some quantity of dust at the site of CHP.

v) Wind: Wind plays a very important role in the formation of dust from dry dusty surface and carries it over some distances down wind. The detailed impact assessment on air quality has been shown in Table 24.

**Table 24: Detailed impact assessment on air quality**

| S.No. | Parameters | Sources | Impacts |
|---|---|---|---|
| A. | Operational | | |
| 1.00 | Meteorological Condition | Mines and combustion of coal | Dusts, Fires and smokes. |
| 2.00 | Ambient air quality | | |
| 2.01 | | Drilling and blasting | SPM, PM10, and PM 2.5 |
| 2.02 | | Coal Handling | SPM, PM10, and PM 2.5 |
| 2.03 | | OB generation | SPM, PM10, and PM 2.5 |
| 2.04 | | OB handling | SPM and exhaust fumes from dumpers |
| 2.05 | | Dump (internal and external) | SPM, PM10, and PM 2.5 till development of green coverings. |
| 2.06 | | Haul Road | SPM and PM10, PM 2.5 |
| 2.07 | | Transportation and Movement of vehicle | SPM, PM10, PM2.5, NOx and SO2 |
| B. | Post-operational | | |
| 1.00 | Meteorological condition | --- | --- |
| 2.00 | Ambient air quality | Reclamation of dump area | |
| 2.01 | | Salvaging and shifting operation of mining equipment | SPM, PM10, and PM 2.5 |

| S.No. | Parameters | Sources | Impacts |
|---|---|---|---|
| 2.02 | | Clearing of coal and other materials besides restoration of infrastructure area to the extent possible | SPM, NOx and SO2 |

### 2.21.7.2 Water Quality

The water will be consumed in various activities associated with Project and pollution thereof have been broadly identified as:

i) Water pollution from vehicle washing & workshop.

ii) Water pollution from dust suppression on haul road spraying.

iii) Water pollution after domestic use.

iv) Water pollution from mine water.

The impact assessment on water is shown in Table 25.

**Table 25: The impact assessment on water**

| Sl. No. | Parameters | Impacts Assessment |
|---|---|---|
| 1.00 | Hydro-Geological-Ground water | |
| 1.01 | Topography and Drainage | Topography and drainage by developing micro basins |
| 1.02 | Aquifer geometry | Changes in aquifer geometry, water level in the vicinity of the mine and disturb ground water flow direction. This can also create secondary fractures and higher permeability zones within the aquifer. |
| 1.03 | Water levels | After the mining activity, the aquifer restores its original water level and mined out area acts as a good reservoir. The project is an opencast mine, the impact of mining activity on unconfined aquifer will be to a maximum of 56m. (approx.) |
| 2.00 | Water Quality- Physico-Chemical and Bacteriological ones | |
| 2.01 | Ground Water Quality | Leaching of different salts from OB dump and coal stock will contaminate ground water. |
| 2.02 | Surface Water Quality | Oil & grease from workshop, TDS, TSS from ETP will degrade surface water quality. |

### 2.21.7.3 Ground Water Resource

The Ground water resource potential and likely impact would be assessed during preparation of E.M.P for this mine by considering aquifer parameters. Probable Impact of Mining on Local Water Regime will also be studied during EMP preparation.



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

### 2.21.7.4 Noise Impact

The noise impact will involve the following area considering the sound level greater than 90 dB in continued exposure.

i. The operators of stripping & coal winning equipment.
ii. Fixed plant equipment with high noise level.
iii. Exhaust system internal combustion engine.
iv. Machinery of aerodynamic origin.
v. Worn out parts of moving machinery.

The nearby villagers will also have some exposure of high noise level.

Impulsive sources of noise are movement and operation of HEMM like dumpers, trippers, shovels etc. and operation of workshop equipment like compressor, drill etc. and blasting. Suitable mitigatory measures are to be taken for the impulsive impact of noise at the equipment emitting the higher noise levels at working place so that it is kept below the level as prescribed by Directorate General of Mine Safety (DGMS).

### 2.21.7.5 Flora and Fauna

Impact assessment on flora & fauna has been shown below in Table 26

**Table 26: Impact on flora and fauna**

| S. No | Parameters | Impact Assessment |
|---|---|---|
| 1.00 | Negative | |
| 1.01 | Vegetation Cover | Except the area such as used for quarry excavation, erection & development of plants, service & allied structures, colony, roads, diversions, culverts, etc, no other area is going to affected directly or indirectly by mining activities. Hence, impact on flora and fauna will not be of appreciable level. |
| 1.02 | Forests degradation | Forests land is going to be affected by mining activity. afforested area will be generated by way of reclamation of dump areas, plantation in other available areas etc. By coal & OB transportation air pollution may affect photosynthesis and transpiration in plants by plugging their leaves pores. SO2 causes Necrosis disease in plants. Hence, major impact on flora and fauna. |
| 1.03 | Ecological change | Being an opencast project, there is minor change expected in ecological parameters on which survival of flora and fauna depends directly or indirectly, and hence, expected impact on flora and fauna are not going to an appreciable level. |
| 1.04 | Hydro- geological aspects | Owing to opencast project, water level and draw down are likely to be affected to a nominal value; ground water and |

| | | |
|---|---|---|
| | | surface water on which the flora and fauna of the area directly or indirectly depend upon are not going to be affected to an appreciable level. After mine closure, the Mine void will act a stable water source for the flora & fauna. |
| 2.00 | Positive | |
| 2.01 | Plantation work and forest & wild life conservation | Plantation work and forest & wild life conservation in a scientific way by project authorities in mine area will increase aestheticism of the area. |

### 2.21.7.6 Land Use

Impact assessment on land use has been shown in Table 27.

**Table 27: Impact on land use**

| Sl No. | Parameters | Impact Assessment | |
|---|---|---|---|
| | | Within mining area | Outside mining area |
| 1 | Topography | In the quarry area, the dump area and the mining equipment area, there will be a marked change in topography. | No appreciable damage is envisaged. |
| 2 | Damage to vegetation | Visual impact-loss of aesthetic beauty, ugly scar on land; deforestation-loss of surface soil and vegetation cover. | Visual impact-loss of aesthetic beauty, ugly scar on land; deforestation-loss of surface soil and vegetation cover. |
| 3 | Change in Landscape and Land use pattern | Total scenario of landscape and land use pattern will undergo a stark change. This involves depletion of top soil. | Landscape and land use pattern will change where erection and development of plants, service /allied services buildings are established. |
| 4 | Change in Surface Drainage | There will be a stark change in surface drainage; rather a new pattern drainage will be developed. | Surface drainage is likely to change where construction of colony, roads and drains is to be executed. |

### 2.21.8 Environment Management

### 2.21.8.1 Air Quality Management

Following air pollution control measures will be practiced within the mining area, at coal handling plant and at railway siding.

1. Surface minor may be used to assure better air quality.
2. Water spraying will be done regularly on approach roads within the mining area to minimize the dust generation.
3. Water sprinkling arrangement will be provided at the transfer point of coal.
4. Intensive plantation of adequate width all along the coal transportation road and other road will be raised to minimize transport-generated pollutants.

5. Coal transportation to railway siding will be done in covered trucks or through belt conveyor.
6. Fogging Machine/Sweeping Machine/Misting Spray Sprinkler will be used when and where found required.
7. Regular monitoring of ambient air quality of project area through Continuous Ambient Air Quality Monitoring Station (CAAQMS).
8. Regular cleaning of coal transport network to remove the spilled-up coal.
9. Green belt along transportation road and around the railway siding will be developed to curtail dust pollution (Figure 21.3).

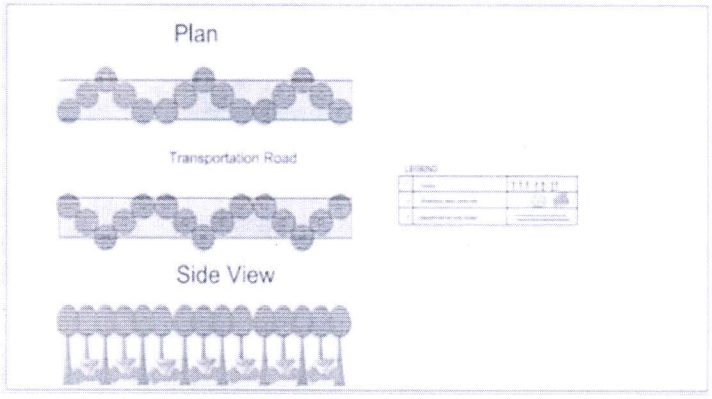


**Figure 21.3: Green belt plan**

**2.21.8.2 Water Quality**

**(a) Management of surface water drainage:**

Garland drains are made around the periphery of the mine and OB dumps. These drains are connected to the natural nalla(s) which will not be disturbed by mining operation. In the face workings, pumps are deployed which deliver water into settling tanks at the surface. Thereafter the accumulated water is discharged into these garland drains.

**(b)Mine Water Discharge:**

The mine water discharge needs treatment before discharge to the surface water drainage. The collected water at the floor of mine will be pumped to the settling tank where suspended solids will get settled. The clear water after sedimentation will be re-used for water sprinkling, plantation, mining operations, etc.

**(c) Domestic Effluent Treatment:**

Domestic effluent will be treated in Sewage Treatment Plant for the Colony and

conventional Soak-Pit system for Service Buildings.

**(d) Oil & Grease Trap:**

Oil and grease trap are being provided in the workshop to check the oil and grease generated in the workshop during maintenance of the Continuous Miner and other machinery.

**(e) Water Conservation:**

The recycled water will be used for dust suppression, vehicle washing purposes and horticulture.

**(f) Water Quality Monitoring:**

For compliance of the statutory provision of MOEF&CC and Pollution Control Board, water quality will be monitored and evaluated as per the prevailing norms. The corrective measures will be taken on the basis of monitoring results.

### 2.21.8.3 Noise Management

Suitable measures will be adopted to maintain the noise level within permissible limits at working zone. The following measures will be adopted,

1. Planting of rows of trees with thick foliage along roads and other noise generating centers to act as acoustic barriers.
2. Isolating/enclosing the noisy machines/sources by using resilient mounting/altering structures.
3. Routine maintenance schedules for machineries &equipment to eliminate noise as far as possible.
4. Balanced and properly aligned conditioning of machines to reduce vibration.
5. Provision of ear muffs/ear plugs to workers subjected to noise level above recommended limits.
6. Regular monitoring of noise level of project area.

### 2.21.8.4 Flora and Fauna Management

Massive plantation work in a scientific way by project authorities may attract birds and other fauna in future. As the area is thinly populated (consequent to the opencast mining operation) deterioration in quality of life or loss of amenity is not envisaged. Conservation plans of schedule I & II animals, if any, will be prepared and implemented.



क्षेत्र महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, S.E.C.L.

### 2.21.8.5 Land Resource Management

Present land use would be converted into external dump, internal dump, green belt, built up area, surface infrastructure, final void/water body & other surface water body etc. after the cessation of mining operation

Present Land Use: The type of lease area is shown in table 28.

**Table 28: Present land use of the project**

| S. No | Land Use | Within ML area (Ha.) | Outside ML Area (Ha.) | Total |
|---|---|---|---|---|
| 1 | Agricultural Land | 59.720 | 0.00 | 59.720 |
| 2 | Forest Land | 354.258 | 0.00 | 354.258 |
| 3 | Waste land* | 0.866 | 0.00 | 0.866 |
| 4 | Grazing land | 0.000 | 0.00 | 0.000 |
| 5 | Water body* | 1.665 | 0.00 | 1.665 |
| 6 | Other specific (Govt. land) | 14.014 | 0.00 | 14.015 |
| | **Total** | **427.993** | **0.00** | **427.993** |

*Included in Govt. land

During mining and Post mining land use is Tabulated table 29, table 30.

**Table29: During Mining land use of the project**

| S. No | During Mining Land Use | Total Land (Ha) |
|---|---|---|
| 1 | Quarry Area | 323.770 |
| 2 | Mining safety zone | 92.175 |
| 3 | Infrastructure | 4.778 |
| 4 | Road | 7.270 |
| | **Total** | **427.993** |

**Table30: Post Mining land use of the project**

| S. No | Land use | Afforested area | Final Void (Water Body) | Built-up area | Total |
|---|---|---|---|---|---|
| 1 | Excavated Area | 259.706 (Internal OB Dump) | 64.064 | 0.000 | 323.770 |
| 2 | External OB Dump | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | Safety Zone as Green belt | 92.175 | 0.000 | 0.000 | 92.175 |
| 4 | Infra and Others | 9.298 | 0.000 | 2.750 | 12.048 |
| **Total** | | **361.179** | **64.064** | **2.750** | **427.993** |

### 2.21.9 Environment Management System

Monitoring Schedule

Environmental monitoring will be carried out following the monitoring schedule for Air, Water, and Noise levels as per Standards of MOEF (Vide GSR 742 (E) dated 25.9.2000).

Plantation Monitoring

The Project Authorities at field level will continue to monitor continuously, the growth and survival/mortality rates of the plantations till the end of 3 years. Once trees attain desired growth, no further monitoring is required.

### 2.21.10 Organizational Structure

For implementing the environment management plan (EMP) of the project, the organizational structure as shown in Figure 21.4 has been proposed.

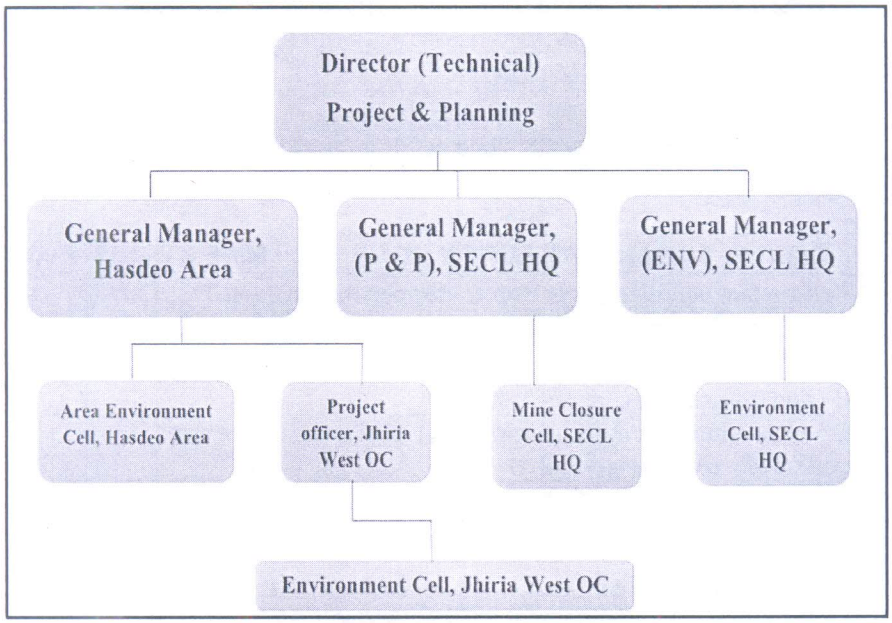


**Figure 21.4: Organizational structure**



क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.

### 2.21.11 Capital Provision

Statement showing the estimated capital requirement for environmental protection measures is as shown in Table 31.

**Table 31: estimated capital requirement for environmental protection**

| S.N. | PARTICULARS | AMOUNT |
|---|---|---|
| 1 | COST OF REHABILITATION | |
| i) | Total No. of Displaced Family likely to be rehabilitated | 220 |
| A. | CAPITAL ESTIMATE | Amt. Rs. in Lakhs |
| | Total Cost of R&R | |
| a) | Total cost of R&R as per second schedule of RFCTLARR Act 2013 | 3616.81 |
| b) | Total cost for provision of infrastructure as per third schedule of RFCTLARR Act 2013 | 888.48 |
| c) | Land for R&R site etc (5.825 Ha). | 227.48 |
| | **Sub-total of (1)** | **4732.77** |
| Note: 1. Total number of displaced family is as supplied by area authority.<br>2. Total cost of R&R as per RFCTLARR Act 2013 as supplied by SECL | | |
| 2 | CAPITAL FOR RESTORATION | |
| a | Piezometers for measuring water level (6 Nos) | 40.00 |
| b | Green belt fencing 15m width along safety zone of the Project (approx.11.0 km) | 22.00 |
| | **Sub-Total (2)** | **62.00** |
| 3 | CAPITAL FOR ANTI-POLLUTION MEASURE IN MINE & INDUSTRIAL AREA | |
| a | Settling tank for mine water disposal(Appendix-A.8.3.(A) | 47.20 |
| b | Chain Link Fencing double row around the Project (approx.2x11.0 km) (Appendix-A.8.1) | 220.00 |
| c | Oil and grease trap (Appendix-A.2.1 | 5.90 |
| d | Other development measures in industrial site viz. drains,tree guards etc. (Appendix-A.8.2.1) | 87.89 |
| e | Garland drains (Appendix-A.8.1) | 110.00 |
| f | Arboriculture/plantation in industrial area (Appendix-A.8.1.) | 2.50 |
| g | Misc. and Contingency | 200.00 |
| h | Dust suppression arrangement at CHP (Appendix-A.3.5, A.3.6) | 60.00 |
| i | Dust suppression at Railway siding (Appendix-A.5) | 20.00 |
| j | Water Treatment Plant for mines(LS) (Appendix-A.8.1) | 200.00 |
| k | Real Time Slope Monitoring System (AppA81) | 700.00 |
| | **Sub-Total (3)** | **1653.49** |
| 4 | ENVIRONMENTAL CONTROL MEASURES IN TOWNSHIP | |
| a | Aboriculture/plantation (Appendix-A.8.1) | 2.50 |
| b | Rain Water Harvesting (Appendix-A.2.2) | 10.62 |
| c | Water Treatment Plant for colony (Appendix-A.8.3) | 17.16 |
| d | Sewerage Treatment Plant (Appendix-A.8.3(A) | 472.00 |
| e | Other development measures in township to improve cleanliness & aesthetics parks-play- grounds & tree guards (App-A.8.2) | 5.90 |
| | **Sub Total (4)** | **508.18** |

| | | |
|---|---|---|
| 5. | Stone pitching of Embankment on nallah side (App.-A.8.1) | 50.00 |
| 6. | Cost of EMP preparation(Appendix-A.8.4) | 50.00 |
| 7. | Community development in surrounding villages (Appendix-A.8.1) | 20.00 |
| | **Total capital from 1 to 7** | **7076.44** |
| | | |
| B. | **Different type of Revenue nature cost to be considered in cost of production per tonne of Coal: -** | |
| 1. | Land reclamation/restoration@1.25 lakhs/Ha for technical and biological reclamation (lakhs/annum) | 50.280 |
| 2 | Environment Audit Rs @ 1.5 lakhs/annum | 1.500 |
| 3 | Environment monitoring Rs @250 lakhs/annum | 250.000 |
| 4 | Monitoring of landuse through satellite surveillance lakhs/annum | 8.000 |
| 5 | Mine Closure cost lakhs/annum | 420.154 |
| 6 | Monitoring of CSR and RR plan lakhs/annum | 2.000 |
| 7 | CTE | 6.250 |
| | **Total Revenue nature cost per annum** | **738.184** |

### 2.21.12 Commitment from the project proponent

All the relevant conditions stipulated in Environment clearance will comply by project proponent i.e SECL.

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क्षेत्रीय महाप्रबंधक
Area General Manager
हसदेव , एस.ई.सी.एल.
Hasdeo Area, SECL