

**Environment Impact Assessment (EIA) Report with  
Regional Environment Management Plan (REMP) for  
Morrum Mining from Riverbed of Betwa River**

**Located at Gata no.747, Khandsankhya -1, Pathreta, Kalpi, Jalaun  
Sanctioned Area – 40.02 ha**

**Proposed Production of Morrum – 323880 m<sup>3</sup>/year**

**Prepared on the basis of TOR issued by SEAC, UP**

**File No. 4384**

**Submitted by:**

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# INTRODUCTION

A Environmental Impact Assessment (REIA) is an environmental framework that evaluates environmental impacts and associated risks at a strategic level.

The EIA assesses the potential cumulative impact of the project on the environment in combination with other known developments in the wider area and will consider cumulative impacts. These may include carrying capacity of the area.

## 1.1 GENERAL

The spectacular growth of the construction industry has unforeseen consequences for every river in India through mining of sand — which is an essential part of construction. Modern cities are built with sand. Most of it is used in the construction industry to make concrete and asphalt. No surprise, then, that Asia is the biggest consumer of sand. The UN forecasts that, by 2030, there will be over 40 “megacities” home to more than 10million inhabitants (up from 31 in 2016), which means more housing and infrastructure will need to be built , this can explain the the country's breakneck pace of construction. Sand also has industrial uses: it is used to make glass, electronics, and to help extract oil in the fracking industry.

### 1.1.1 Sand mining in India

Sand is a good source of revenue for state governments. The huge gap between supply and demand of natural sand has seen an increase in the illegal filter sand business (washing of sandy loam soil and selling it as sand) in the state. The farmers along the riverbeds, tank beds and streams are extracting sand and selling it for Rs 6,000 to Rs 9,000 per truckload, depending on the quality. The increase in the construction of apartments, townships, roads and bridges has pushed up the demand for sand. Sand is an expensive commodity today, though the price varies in different markets. Soaring demand for sand due to massive construction poses a threat not just to the environment but to society at large, and urgent measures are needed to tackle the problem. With real estate mushrooming and construction of highways and roads booming, there is huge demand for sand. Apart from the big bucks, the livelihood of hundreds of thousands of people, from truck drivers to construction labourers, are linked to the business. Any disruption in supply is expected to push up the project costs, and slow down building activity. Already builders are facing the heat. The real estate sector is one of the largest employers. Officially blocks are earmarked and then auctioned by the state government after environment clearance is granted.

### **1.1.2 Present status of sand Mining**

The mining of sand and gravel has emerged as a major regulatory concern in the last decade, especially because of the global construction boom and the spread of urbanisation. The removal of sand, which was earlier only for low-scale, household purposes or as a management exercise to prevent flooding, is now one of the most unregulated mining sectors in India

### **1.1.3 Sand Mining in Uttar Pradesh**

The scale of mining happening for minor minerals including sand is difficult to ascertain. Information on various factors such as number of leases, production, and royalty earnings etc., is poorly documented. It is largely because a lot of mining happens illegally and there are no records. However, according to information obtained by CSE in 2016 from the Directorate of Geology and Mining of Uttar Pradesh through an RTI, there are more than 1,367 minor mineral leases in UP. Out of these, only 175 are of sand or

murrum mining—this translates into just 13 per cent of the total minor mineral leases. But this remains a gross underestimation of the scale of mining actually happening in the state. Nevertheless, the data available indicates that amount of sand mined in UP has been steadily increasing. Between 2012–13 and 2014–15, sand production more than doubled (see Table 1.1: Sand mining in Uttar Pradesh).

**Table 1.1: Sand mining in Uttar Pradesh**

There has been a relentless growth in the amount mined

Year	Royalty (in lakh Rs)	Production (cubic metre)	Estimated value (in lakh Rs)
2012–13 (72 districts)	8,905	29,681,667	53,427
2013–14 (74 districts)	6,619	22,062,467	39,712
2014–15 (74 districts)	3,875	13,840,393	24,913

## 1.2 PURPOSE OF EIA

The proposal for EIA has been put forth during various TOR presentations and detail outline was explained and SEAC was agreed with the proposal. The standard TOR will form the basis of this EIA as no additional TORs were issued by the SEAC, Uttar Pradesh. The total mine lease area of **M/s Eureka Mines and Minerals LLP is 40.02 ha and it is situated in study area-2 having mineable area of 631.51ha**(inclusive of upcoming projects for which Public Hearing/EC is awaited) and the total annual production will be 9903658(inclusive of upcoming projects for which Public Hearing/EC is awaited)cum/annum. These murrum sites are present in the Betwa River Bed between - 25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N& 80°16'12.74"E. This EIA study will lead to systematic assessment of the potential environmental effects including cumulative effects of strategic initiatives, policies, plans or projects for a particular region. It fulfills the need for macro-level environmental integration, which the project-oriented EIA is unable to address effectively.

If environmental effects are considered at regional level, then the cumulative environmental effects of all the projects within the region can be assessed & accounted for.

**Table 1.2 Various stages of Mining activities.**

<b>Mining Stages</b>	<b>Process Description</b>
<b>Precursors to mining</b>	
Prospecting	Searching for sand resources using multiple exploration techniques
Exploration	Determining the possible size and value of the sand deposit using different evaluation techniques
<b>Mining</b>	
Developing	Setting-up and commissioning facilities to extract, treat and transport sand
Exploitation	Large scale sand production
<b>Post mining</b>	
Closure and reclamation	Returning the land to its original state

*Source : Environmental Impacts of Sand Exploitation. Analysis of Sand Market by Marius Dan Gavriletea, Sustainability 2017, 9(7), 1118;*

#### LEGISLATION APPLICABLE TO MINING OF MINOR MINERALS

The mining sector has separate set of legislations covering management, conservation, grant and operation of mining lease. In addition there are environmental/forest regulation, applicable to mining of minor minerals as prescribed by MoEF& CC, attached as **Annexure-XXIII**

### 1.2.1 LEGISLATION

The mining sector has separate set of legislations covering management, conservation, grant and operation of mining lease. In addition there are environmental/forest regulation, applicable to mining of minor minerals as prescribed by MoEF& CC and CPCB.

**Table. No. 1.3: Acts, Policies and Rules applicable to the project**

S.No.	Acts and Legislations	Year
1.	The Mines Act	1952
2.	The Mines and Mineral (development and Regulation) Act	1957
3.	Mines Rules	1955
4.	Mineral Concession Rules	1960
5.	Mineral Conservation and Development Rules	1988
6.	Uttar Pradesh Minor Mineral Concession Rules	1963
7.	The Environment (Protection) Act,	1986
8.	Notification on Environment Impact Assessment of Development projects (and amendments) (referred to as the Notification on Environmental Clearance)	2006, 2009, 2015, 2018
9.	Wildlife Protection Act, MoEF	1972
10.	The Forest (Conservation) Act,	1980
11.	Water (Prevention and Control of Pollution) Act (and subsequent amendments)	1974

12.	The Water (Prevention & Control of Pollution) Rules	1975
13.	The Water (Prevention & Control of Pollution) Cess Act	1977
14.	The Water (Prevention & Control of Pollution) Cess Rules	1978
15.	Air (Prevention and Control of Pollution) Act (and subsequent amendments)	1981

In order to keep the local & regional environment intact and to achieve the goals of sustainable development, all the mining activities under mining operations of the proposed project will be carried out within the framework of governmental policies, acts and rules of mining, forest conservation and environmental protection. The Environment (Protection) Act, 1986, is the most comprehensive law on the subject. The law grants power to the Central and State Government to take all measures necessary to protect and improve the quality of environment and to prevent pollution of the environment. The following rules, notifications and standards under the Environment (Protection) Act, 1986 are particularly relevant in this case:

1. Environment (Protection) Rules, 1986 and its amendments.
2. The Water (Prevention and Control of Pollution) Rules, 1975
3. The Air (Prevention and Control of Pollution) Rules, 1982
4. Noise Pollution (Regulation & Control) Rules, 2003 and its amendments.
5. EIA Notification, 2006 and its amendments.
6. National Ambient Air Quality Standards and its amendments.
7. Solid Waste Management Rules, 2016

#### **1.4 Extract of EIA Notification**

As per the provisions of the EIA Notification issued on 14<sup>th</sup> September 2006 and subsequent amendments till date:

- All projects and activities are broadly categorized in to two categories - Category A and Category B

- Category 'A' in the Schedule requires prior environmental clearance from the MoEF&CC and Category 'B' in the Schedule, from the State/Union Territory Environment Impact Assessment Authority (SEIAA).
- An application seeking prior environmental clearance in all cases shall be made in the prescribed Form –I along with the pre-feasibility project report.
- "Scoping" refers to the process by which the Expert Appraisal Committee in the case of Category 'A' projects or activities, and State level Expert Appraisal Committee in the case of Category 'B1' projects or activities, determine detailed and comprehensive Terms of Reference (TOR) for the preparation of an Environment Impact Assessment (EIA) Report in respect of the project or activity for which prior environmental clearance is sought. However after the introduction of standard TOR for each sector amendment of EIA notification the issued on 10<sup>th</sup> April, 2016 it was stated that “Standard TOR developed by the Ministry in consultation with the sector specific Expert Appraisal Committees shall be the deemed approved TOR for the projects or activities. These standard TOR shall enable the Project Proponent to commence preparation of an Environment Impact Assessment Report after successful online submission and registration of the application.
- All Category 'A' and Category B1 projects or activities shall undertake Public Consultation. But now as per Gazette notification amendment S.O. 3977(E) dated on 14.08.2018 issued by the MoEF of India, the Public consultation are not required for B2 Sub-category under B category project.

**Table 1.4: Project Activity Schedule as per EIA Notification 2006 & Amendments**

PROJECT ACTIVITY	Category With Threshold Limit		Conditions, if any
	A	B	

1 (a)	Mining of minerals	> 100 ha. of mining lease area in respect of non-coal mine lease. > 150 ha of mining lease area in respect of coal mine lease Asbestos mining irrespective of mining area.	≤ 100 ha of mining lease area in respect of non-coal mine lease.	General Conditions shall apply except: (i) for project or activity of mining of minor minerals of Category 'B2' (up to 25 ha of mining lease area); (ii) for project or activity of mining of minor minerals of Category 'B1' in case of cluster of mining lease area; and (iii) River bed mining projects on account of inter-state boundary. Note: (1) Mineral prospecting is exempted; (2) The prescribed procedure for environmental clearance for mining of minor minerals including cluster situation is given in Appendix XI;
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#### 1.4.1 Environmental Clearance

Environmental Clearance of Cluster of mine leases of area ≥ 25 hectares with individual lease size ≤ 100ha will fall in category 'B1' . For Environmental clearance Form –I, PFR, DSR and Approved Mine Plan and one EIA/EMP for all leases in the Cluster will be submitted. The purpose of the preparation of EIA Report is not only to obtain Environmental Clearance from SEAC U.P., and State Pollution Control Board, but also to understand the likely impacts and to take Environmental Protection measures during and after commissioning of the project. This EIA report is prepared on the basis of primary data March 2018 to May 2018 generated and secondary data collected during year 2017& 2018

#### 1.4.2. Objective of EIA Study

The overall objective of this study is to identify all significant environmental repercussions arising from the construction and implementation of the project. The study seeks to establish present environmental conditions at the project site by available information supported by field studies and data available from secondary sources, wherever necessary; to predict the impacts on relevant environmental attributes due to the construction & operation of proposed project. It is essential, therefore to recommend adequate mitigation measures for minimal impacts and to prepare an Environmental Impact Assessment (EIA) report including Environmental Management Plan (EMP) so as the construction works to be carried out in sound environmental standards. An EIA study basically covers:

- Baseline Environmental Features.
- Project Specific Activities.
- Analysis of Impacts.
- Environmental Management Plan.

There are total 31 morrum mining sites at Betwa River Bed in inclusive of 21 B<sub>1</sub> category & 10 B<sub>2</sub> category mines in this group of leases.

Leases are granted by District Magistrate, Jalaun through e-tendering for excavation of Sand / Moram from River bed of Betwa River. LOI of the lease are annexed as **Annexure-II**. The Mining Plan has been approved by Directorate of Geology & Mining. The copy of model TOR issued by MoEF, GOI Delhi and SEIAA, UP (Annexure of MOM) is annexed as **Annexure-III**. Given below are the details of project included in Environmental Impact Assessment (REIA). The details of mining project in the area are presented in the following table:

## **1.5 PROJECT / PROPONENT DETAILS**

### **1.5.1 Details of Project and Project Proponents in the study area**

M/s Eureka Mines and Minerals LLP, Proprietor- Shrichandershekhar Chaurasia S/o Shri Deen Dayal Chaurasia H.No. 28, Brahmpuri Colony, Near Jugauli Crossing, Faizabad Road, District Lucknow, Uttar Pradesh.

## 1.5.2. Brief description of nature, size, location of the project and its importance to the country, region

### a. Nature

The proposed morrum mining projects are new mining lease where the PPs were granted morrum mining for the lease period of Five years In the meanwhile on the enforcement of



**Fig.1.3. Location of the study area.**

MoEF& CC notification dated, 2006 as amended in 2009, 2016 and 2018, DM, Jalaun has ordered the PPs to submit EC to commence the morrum mining in the sanctioned lease area to get Environmental Clearance. Copy of Letter of Intent is attached as **Annexure-II**. Copy model TOR issued by MoEF,GOI Delhi and SEIAA,UP (Annexure of MOM) is annexed as **Annexure-III** and copy of EC issued for the projects in the stretch are attached as **Annexure-IV**.

The proposed projects are to mine morrum from dry river bed sustainably and scientifically. Mining will be done by semi mechanized/OTFM (Other Than Fully Mechanized) method using light earth mover machines e.g. bar scrapers and loaders along the river bed keeping the banks unaffected. Google Map of 10 km radius from proposed project site showing surrounding features is given below:

**b. Brief History of Projects in the study area**

- c. The lease is granted by District Magistrate, Jalaun through e-tendering for excavation of Sand / Moram from River bed of Betwa River. LOI of the lease is annexed as **Annexure-II**. The Mining Plan has been approved by Directorate of Geology & Mining. The copy of standard TOR is annexed as **Annexure-III**.

**d. Size**

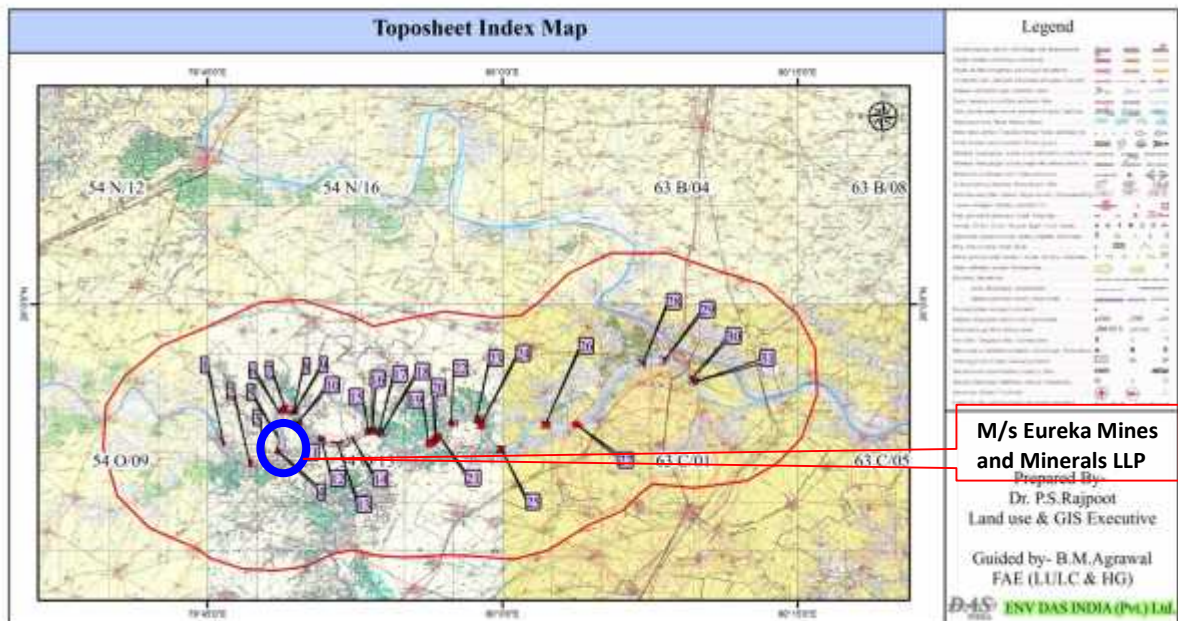
Proposed mine leases has been sanctioned over for period of five years. Only morrum will be excavated. It has been proposed that 3,23,880cum/ year of morrum will be excavated.

**e. Area and categorization of Projects in the study area**

- f. Although the area of the project is only 40.02 ha and it is B2 category project, but according to the cluster certificate another mine in 500 m radius of the proposed project having an area of 8.9 ha form a cluster. So it also becomes a B1 category project.

**1.5.3. Location, brief description of project & its topography and physiography**

Proposed project is situated in gata no.747, Khandsankhya -1, Pathreta, Kalpi, Jalaun Toposheet of the study area is attached as Fig.1.3



**Fig 1.4 Toposheet of the stretch of Betwa covered in EIA of study area-2**

**g. Location of Lease Area.**

Proposed project is situated in gata no.747, Khandsankhya -1, Pathreta, Kalpi, Jalaun

**1.6 PROJECT IMPORTANCE TO THE COUNTRY AND REGION**

Due to the increased industrial and infrastructural growth of the rural and urban areas demand of morrum is very high. Morrum has become a very important mineral for the expansion of society. With the increase of urbanization the demand for morrum is growing in infrastructure sector in our country. The mineral is used for making concrete, filling roads, building sites, brick making, making glass, morrum papers, reclamations etc. Individual and private companies are increasingly demanding morrum for construction purposes and this has immense pressure on morrum resources. This increasing demand makes this an environmental issue. Similar initiatives are also being taken up in road sector by National Highway Authority of India and Ministry of Transport. Achieving such a huge infrastructure requires basic building materials and morrum, bajri and boulders is one of primary building material required for the purpose. The mining activities are the

backbone of all construction and infrastructure projects as raw material for construction is available only from such mining. The mining being undertaken will support demand for morrum, stone and bajri in the area. Simultaneously, the morrum excavation helps in channelizing the river, which minimizes the hazards of floods and water logging in the region.

### **1.7 SCOPE OF THE STUDY**

The present REIA report of the study area is prepared as per requirement of the standard TOR issued by MoEF&CC and SEAC, UP attached as **Annexure II**. The monitoring and analysis study for the project was done during March 2018 – May 2018 around study area is also attached as **Annexure XII**. Toposheet of the study area is attached as **Annexure-XVIII**.

### **1.8 NATURE AND SIZE OF GROUP OF LEASE**

The mining lease area is 40.02 ha. It has been proposed that 3,23,880 cum/ year of morrum will be excavated. The plan period of the entire lease is 05 years.

#### **a. Nature of Mines**

b. The proposed project is sand/ morrum mining projects. Area wise the project is falling under category B2 having area of less than 25 ha but are treated as B1 category because of cluster situation. The spirit of EIA notification is the cumulative impact assessment of two small mines which individually are believed to cause less impact. The buffer zones of various mines on the stretch of river Betwa are overlapping each other, that is the need for impact assessment on the large scale and EIA is undertaken.

### **1.9 CARRYING CAPACITY OF AREA**

Predicting future growth and assessing the extent of infrastructural development (industrial, commercial other such activities) the region can support based on the load based discharge and pollutant concentration which does not adversely affect the natural resource base and existing ecosystem of the region. mining and removal of sand from in-stream and upstream of several rivers, which may have serious environmental impact on ephemeral, seasonal and perennial rivers and river beds

and sand extraction may have an adverse effect on bio-diversity as well. Further it may also lead to bed degradation and sedimentation having a negative effect on the aquatic life. Carrying capacity refers to the number of individual projects which can be supported in a given area within natural resource limits, and without degrading the natural social, cultural and economic environment for present and future generations. The carrying capacity for any given area is not fixed. It can be altered by improved technology, but mostly it is changed for the worse by pressures which accompany a population increase. As the environment is degraded, carrying capacity actually shrinks, leaving the environment no longer able to support even the number of people who could formerly have lived in the area on a sustainable basis. No population can live beyond the environment's carrying capacity for very long. We must think in terms of "carrying capacity" not land area. The effects of unfettered population growth drastically reduce the carrying capacity. Extraction of alluvial material within or near a river bed has an impact on the rivers physical habitat characteristics, like river stability, flood risk, environmental degradation, loss of habitat, decline in biodiversity, it is not an answer to say that the extraction is in blocks of less than 5 hectares, separated by 1 kilometre, because their collective impact may be significant, hence the necessity of a proper environmental assessment plan. Damaging lakes, riverbeds and groundwater leading to drying up of water beds and causing water scarcity on account of quarry/mining leases and mineral concessions granted by the State Governments, even if the area was small, the collective impact on environment was significant. Mining of minerals, whether major or minor have a direct bearing on the hydrological regime of the area. Besides, affecting the availability of water as a resource, it also affects the quality of water through direct run off going into the surface water bodies and infiltration / leaching into groundwater. Further, groundwater withdrawal, dewatering of water from mine pit and diversion of surface water may cause surface and sub surface hydrologic systems to dry up. An ideal situation would require that quarrying should be restricted to unsaturated zone only above the phreatic water table and should not intersect the groundwater table at any point of time. Sand is vital for sustenance of rivers. It has now been established beyond doubt that uncontrolled sand mining from the river bed leads to the

destruction of the entire system. If sand and gravel are extracted in quantities exceeding the capacity of the rivers to replenish them, they lead to changes in its channel form, physical habitats and food webs- the river's ecosystem. The removal of sand from the river bed increases the velocity of the flowing water, with the distorted flow-regime eventually eroding the river banks. Beside these on-site effects, the off-site effects are also quite lethal. Sand acts like a sponge, which helps in recharging the water table; its progressive depletion in the river is accompanied by declining water tables in the nearby areas, adversely impacting people's daily lives and ultimately, their livelihood. River sand, therefore, is vital for human well being. However, from the point of view of mineral conservation, it may not be desirable to impose blanket ban on mining operation below groundwater table. However, the activity as a whole is seen to have significant adverse impacts on environment. It is, therefore, necessary that the mining of minor minerals is subjected to simpler but strict regulatory regime and carried out only under an approved framework of mining plan, which should provide for reclamation and rehabilitation of the mined out areas. Reclamation and rehabilitation of mined out areas. Mining Plan should take note of the level of production, level of mechanisation, type of machinery used in the mining of minor minerals, quantity of diesel consumption, number of trees uprooted, export and import of mining minerals, environmental impact, restoration of flora. Regional environmental management plan which will take care of all environmental issues and also evolve a long term rational and sustainable use of natural resource base and also the bio-assessment protocol. Sand mining, it may be noted, may have an adverse effect on bio-diversity as loss of habitat caused by sand mining will affect various species, flora and fauna and it may also destabilize the soil structure of river banks and often leaves isolated islands.

IBM, Nagpur has developed guidelines, which states "Mineral occurrences in several cases found to shallow depth, isolated, detached and fragmented in nature in virtue of either origin or mode of emplacement or dislocation due to geological disturbances or mechanical weathering, transportation by wind, water and wave actions and deposited in shorter distance. In such conditions mining activities are undertaken in small scales in group of leases of mines on regional levels. Group of leases of minor

mineral mining for which environmental clearance is to be required on regional level. Regional environmental impact assessment for group of leases of mining is to be assessed and its mitigation measures need to be tackled in the Regional Environmental Management Plan.

Regional Environmental Management Programme for group of leases of Mining: The objective would be to manage the Regional Environmental risk by –

- Increasing awareness of environmental issues at the regional scale,
- Agreeing upon the planning, implementation and programme of actions that will help understand and improve the environmental situation at the regional scale,
- Elaborating an environmental fund to support the regional environmental actions
- Enforcing the regional environmental monitoring
- Pooling and communicate the results of the regional environmental monitoring
- Proposing mitigation measures based on the results of the regional monitoring
- Introducing environmental education programme among the workers and the villagers.

On Regional scale solutions are to be found concerning issues that are not directly under the responsibility of a mine owner such as

1. Water Treatment at the Regional scale At the regional scale, investigate the possibility of setting up a (or a few) regional waste water treatment plant(s) that will treat the effluents collected from a number of mines, and that will discharge a treated water of acceptable quality. The characteristics of the flows of water discharged from each mine to nalas has to be investigated in details in order to evaluate the feasibility study of a (or a few) regional waste water treatment plants.
  - Improvement of Infrastructure
  - Tap un-polluted ground water supply
  - There is a need for a specific geohydrological study in order to define the best location for a good quality water and a high yield

- Improvement of road :
2. Regional actions related to geotechnical engineering for EMP
    - Regional hydrogeology
    - Regional geology
    - Meteorological data
    - Related techniques and specific materials Communication and training for above techniques applied to mining industry has to be promoted by mining associations, educational system as well as regional government levels.
  3. Development of Green Belts
    - This helps in prevention of dust and screening noise
    - Maintaining ecological balance
    - Increasing aesthetic value
    - Plantation to be carried out on both sides of the roads.
    - Saplings will be planted at an interval of 2 m.
  4. Environmental Monitoring Items for monitoring based on observation:
    - Slope failure on mine faces, dumps, and barrier,
    - Land erosion in mined out areas, dumps, and flood protection barrier,
    - Blockage due to silting or loose material,
    - Plantation.
  5. Monitoring based on sampling and chemical analysis:
    - Surface water
    - Groundwater, to determine scale of contamination.
    - Ambient air quality is monitored by High Volume Sampler (HVS) for effectiveness of the dust prevention and control actions.
  6. Restoration, Reclamation and rehabilitation in a group of leases: - Where large numbers of small mines are situated and worked out in group of leases, at such places the provisions of quarrying of minor minerals should be done in a systematic and scientific manner. The programme of restoration and reclamation of the mined out area and rehabilitation must be made jointly in phased manner in the abandoned areas in an entire group of leases of the minor minerals. Environmental clearance may be obtained by corporate body or the concept of

Regional Environmental Assessment (REA) and Regional Environmental Management Plan (REMP) prepared accordingly

The group of leases lying in close vicinity and involving the same river stretch with common mineral beneficiation. The present group of leases lies at Betwa River Bed in Hamirpur and Jalaun District inclusive of 21B<sub>1</sub> category mines and 10 B<sub>2</sub> Category mines for morrum excavation (inclusive of upcoming projects of B<sub>1</sub>-sub-category for which Public Hearing is awaited and B<sub>2</sub>- sub-category projects for which EC is awaited).

#### **1.9.1 Environmental rationale considered for group of leasesing of mines**

##### **Ambient Air Quality in group of Mines leases**

The group of mines is having common transport and dispatch network. This will ensure better assessment and prediction of air pollution load, thereby enabling common control and mitigation measures.

##### **Surface Hydrology**

Water regime of group of leases can be effectively assessed and mitigated through common measures.

##### **Pre-dominant wind Direction**

The emission of air pollutants will remain confined to the group of leases area only hence merely affecting the nearby area

##### **Ecological Restoration**

Plantation of native species of plants in consultation with DFO, Hamirpur and Jalaun.

##### **Socio economic Environment**

Each mine has individual CSR plans which will be implemented in nearby areas. As a result the nearby areas will be economically improved. Below given are the activities that are proposed as a part of Corporate Social Resonsibility; however the execution of these proposed activities will be done in consultation of local authorities.

## 1.10 STRUCTURE OF EIA REPORT

- This EIA report has been presented as per requirements of ToR of the EIA Notification of Ministry of Environment and Forests (MoEF), Government of India. However after the introduction of standard TOR for each sector amendment of EIA notification the issued on 10<sup>th</sup> April, 2018 it was stated that “Standard TOR developed by the Ministry in consultation with the sector specific Expert Appraisal Committees shall be the deemed approved TOR for the projects or activities. These standard TOR shall enable the Project Proponent to commence preparation of an Environment Impact Assessment Report after successful online submission and registration of the application.

**Chapter-1: Introduction:** The present section deals with the EIA study, scope of work, magnitude of efforts, and methodology for EIA. It also provides the identification of the project proponent, location and of its importance to the country and background information.

**Chapter-2: Description of the Project:** This chapter includes the general features, manmade features, river valley project design and planning etc. The information on category, needs of the project with location is also provided.

**Chapter-3: Description of the Environment:** This section describes the existing environmental scenario (baseline data) in detail. The sections on meteorological baseline, components of the biophysical and natural environments, cultural properties along the project site and quality of life add up to give a comprehensive picture of the existing environment around the project site and its area of influence.

**Chapter-4: Anticipated Environmental Impacts and Mitigation Measures:** This section details out environmental impacts, mitigation, avoidance and enhancement measures including environmental management plans. In addition to the avoidance and mitigation measures for the biophysical and natural environmental components, this chapter discusses various environmental enhancements suggested by the project

**Chapter-5: Alternative sites:** In this chapter different sites are analyzed for suitability of the proposed irrigation project. Based on various criteria, the justification is given for selection of the most optimum site identified for setting up of the project

**Chapter-6: Environmental Monitoring Program:** This chapter covers the planned Environmental Monitoring Program. It includes the technical aspects of monitoring the effectiveness of mitigation measures.

**Chapter-7: Disaster Management Plan:** This chapter is intended to guide the concerned officers in identifying, monitoring, responding to and mitigating the emergency situations. It is also useful to assist the officials to take immediate action in a critical situation. This chapter also details about the families and persons who are going to be directly affected by the project. It further discusses about the displacement, resettlement, rehabilitation and compensation to the affected families

**Chapter-8: Project Benefits:** This chapter covers the benefits accruing to the locality, neighborhood, region and nation as a whole. It brings out the details of benefits by means of improvement in the physical infrastructure, social infrastructure, employment potential and other tangible benefits

**Chapter-9: Cost-Benefit Analysis:** This chapter discusses about the technique used for testing the financial viability of the project i.e. whether the investment to be made is worth and whether the project is financially rewarding. Costs here are described as the intended or unintended negative effects of project investment, whereas, benefits is described as the intended or unintended positive effects of the project

**Chapter-10: Regional Environment Management Program:** This chapter comprehensively presents the Regional Environmental Management Plan (REMP), which includes the administrative and technical setup, summary

matrix of EMP, the cost involved to implement the EMP, both during the construction and operational phases.

**Chapter-11: Summary & Conclusion:** This chapter forms the summary of the full EIA report. It provides the overall justification for implementation of the project and how the project is going to benefit the local people. It also explains how the adverse effects are proposed to be mitigated

**Chapter-12: Disclosure of Consultant:** This chapter includes the names of the consultants engaged, along with a brief resume and nature of consultancy rendered

**This report is based on scientific principles and professional judgment with resultant subjective interpretation. Professional judgments expressed herein are based on the available data/comments/feedback/modifications and comments from Functional Area Experts and finally compiled by EIA Coordinator.**

## CHAPTER- II

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2.5	RIVER PROFILE
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2.8	LIMITATIONS AND RESTRICTIONS OF MINING
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2.15	COST OF INDIVIDUAL MINE & WHOLE GROUP OF LEASES
2.16	OTHERS
2.17	FACILITIES TO LABOURS
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# PROJECT DESCRIPTION

## 2.1 DESCRIPTION OF THE PROJECT

The proposed morrum mining project is new mining lease where the PP was granted morrum mining for the lease period of Five years In the meanwhile on the enforcement of MoEF& CC notification dated, 2006 as amended in 2009, 2016 and 2018, DM Jalaun has ordered the PP to submit EC to commence the morrum mining in the sanctioned lease area to get Environmental Clearance. Copy of Letter of Intent is attached as **Annexure-II**.

The proposed projects are to mine morrum from dry river bed sustainably and scientifically. Mining will be done by semi mechanized/OTFM (Other Than Fully Mechanized) method using e.g. bar scrapers and loaders along the river bed keeping the banks unaffected. Although the area of the project is only 40.02 ha and it is B2 category

project, but according to the cluster certificate another mine in 500 m radius of the proposed project having an area of 8.9 ha form a cluster . So it also becomes a B1 category project. Proposed mine leases has been sanctioned over for period of five years. Only morrum will be excavated. It has been proposed that 3,23,880 cum/ yearof morrum will be excavated. The proposed project is situated in Gata No-747, Khand No.-1, Pathreta, Kalpi, Jalaun.

### **STUDY AREA DESCRIPTION**

The project is included in the study area-2 because there are 30 other leases (B1 and B2) are situated on the River Betwa between - 25°54'25.56"N& 79°39'42.55"E to 25°55'34.68"N& 80°16'12.74"E

The study includes information on:

- Type of mining areas (B1 and B2) proposed currently.
- Constraints to mining in terms of infrastructure, skilled labour, *etc.*
- Typical environmental impacts associated.
- Synergistic and cumulative impacts which can be identified
- Relative importance of each of these impacts

The study will allow the regulators to focus attention on priority environmental issues and mining regions. The study can be used by stakeholders and roleplayers to determine the level of small-scale mining on a regional basis. It can also be used by interested and affected parties to identify the type of environmental impacts that could be expected from the various mining lease area on a stretch.

The process include following steps:

- Inventarization of the leases on the stretch
- Undertake Initial Screening Site Visits
- Undertake regional site surveys
- Collate survey findings

- Utilization of Environmental assessment tools

Sand mining have a widespread impact on a national level, if mining is done by unscientific methods. Extraction of alluvial material from within or near a streambed has a direct impact on the stream's physical habitat characteristics. These characteristics include channel geometry, bed elevation, substrate composition and stability, instream roughness elements (large woody debris, boulders, etc.) depth, velocity, turbidity, sediment transport, stream discharge and temperature (Hill & Kleynhans, 1999). Altering these habitat characteristics can have deleterious impacts on both instream biota and the associated riparian habitat. The interconnectedness of channels and riparian systems requires the simultaneous evaluation of potential disruptions of the riparian zone and channel activities. For example, aggregate mining involves the channel and boundary but requires land access and material storage that could adversely affect riparian zones, e.g. construction and access roads. Singly, many of the effects of mining on the environment may well be non-significant. However, when they occur simultaneously, their significance may increase by orders of magnitude. The overriding principle is That the greater the number of small-scale mines in an area, the greater the cumulative impacts are on the water environment. The major cumulative impacts include:

- Loss of riparian habitat due to large areas of riparian vegetation being removed.
- Riverbank destabilisation after vegetation removed.
- Soil erosion of arable land adjacent to mined areas.
- Increased surface areas of discard (sand, rock and other forms of waste) that can be mobilised during rain and ultimately are deposited in the rivers.
- Increased mobilisation of sediments, which become available and clog the aquatic environment.
- Increased incidents of oils (from machinery) and chemical (if refinement takes place) spills into rivers.
- Increased potential of mobilisation of metals, sulphates,
- Loss of arable land due to no rehabilitation.
- Large tracts of land becoming a safety hazard (for people and livestock).

The duration of these impacts is mainly long term. For example, many areas along the Rivers and the environmental footprints will remain prevalent. Unless appropriate rehabilitation takes place in areas that are on the riverbanks, the land largely remains unusable unless the area is naturally restored by for example, floods. The mining that takes place within the riverbed or flood plain has more chance of being restored back to its original status over time due to floods. The majority of the water-related impacts of small-scale mining are localised to the immediate vicinity of the mine. If, however, many mines occur within the same area then the cumulative impacts will be felt over a much larger area. Typically, the major impact would occur during high rain events when the mined areas will produce large volumes of silt, which will be washed downstream. The size, type, and locality of each mining operation was assessed in order to compare the relative impact of each operation to the cumulative impacts.

### 2.3 CONNECTIVITY

NH 81 is passing through 10 km radius area of above mentioned leases. Two state highways SH-91 and SH-42 passes through the vicinity of the projects along with other metalled road.

**Table.2.4 Major roads of Study area**

S.No.	Sub Category	Name Of Road	Road Number	Length (In Km.)
<b>Hamirpur</b>				
1	National Highway	Kanpur Saagar Road	NH0086	61.000
	National Highway	Jhansi Mirzapur Road	NH0076	6.000
2	State Highway	Bilraya Lakhimpur Sitapur Hardoi Kannauj Jalaun Panwari Marg	SH0021	42.741

	State Highway	Hamirpur Rath Gursarai Jhansi Marg	SH0042	92.260
	State Highway	Hamirpur Kalpi Marg	SH0091	22.000
3	Major District Road	Muskara Maudaha Kapsa Banda Marg	MD010B	17.050
	Major District Road	Kalpi Dagwa Rath Marg	MD019B	29.350
	Major District Road	Tidwari Mailani Jaspura Sumerpur Marg	MD040B	15.500
	Major District Road	Rath Jalalpur Marg	MD041B	37.400
	Major District Road	Muskara Maudaha Kapsa Banda Marg	MD510B	10.050
	Major District Road	Muskara Maudaha Kapsa Banda Marg	MD610B	29.700
<b>Jalaun</b>				
1.	National Highway	Lucknow Kanpur Jhansi Shivpuri Road	NH0025	72.000
2.	State Highway	Jalaun Bhind Marg	SH0070	30.680
	State Highway	Bilraya Lakhimpur Sitapur Hardoi Kannauj Jalaun Panwari Marg	SH0021	66.107
	State Highway	Hamirpur Kalpi Marg	SH0091	29.900
3.	Major District Road	Kalpi Madaripur Marg	MD023B	40.049

	Major District Road	Jalaun Konch Marg	MD027B	23.066
	Major District Road	Kalpi Rath Marg	MD519B	22.00

The study area comprises of 04 districts namely, Hamirpur and Jalun along the stretch of Betwa River, and part of Kanpur Nagar & Fatehpur. The road network of Hamirpur and Jalaun given below:

## 2.4 TOPOGRAPHY & PHYSIOGRAPHY

Hamirpur and Jalaun District is situated on the southern part of the State of Uttar Pradesh and surrounded by the district Allahabad in the east, Fatehpur in the west, Chitrakoot in the south and district Pratapgarh in north. The total geographical area of the district is 1903.17 Sq.Km. It is an old town situated on the northern bank of Yamuna, about 55 km west of Allahabad. Total land area of district lies in between the holy rivers Ganga in north and Yamuna in south and comprises of alluvial soil group having sandy and sandy loam soil. In its general aspect the district is a level plain without any hills. The only variations in the surface are caused by the uneven land along the streams that drain it. Depressions of varying depth and extent are found here and there, in which the surface drainage of the interior collects. No mineral deposit is available in Hamirpur and Jalaun except for Ordinary Morrum reported in some parts of the district. Ganga and Yamuna River are the main rivers flowing through Hamirpur and Jalaun District. The plain area of the district is situated in between Ganga and Yamuna Rivers so these rivers play a very pivotal role in the agricultural development of the district. Hamirpur and Jalaun District has a moderate climate. Atmosphere of the district is pleasant. In the summer season weather is too hot and in the winter the weather is very cold. But in the rainy season the weather is good and pleasant. Soil of Hamirpur and Jalaun District is highly fertile. The present mining geological study area lies between the coordinates 25°54'25.56"N & 79°39'42.55"E to

25°55'34.68"N&80°16'12.74"E in which River Betwa flows has a major area covered by Banda Alluvium which has developed over the basement of Bundelkhand Granitoid Complex (BGC) which comes under the Group of Older Alluvium.

Banda Alluvium is spread all over the part of Jalaun district falling within the study area, and in Hamirpur also major part is covered with Banda Alluvium. Banda Alluvium is of Red to deep brown sand due to the presence of red-quartzofeldspathic with gravel lenses, of brownish silt and clay with kankar. The Bundelkhand Granitoid Complex (BGC) which forms the base of Banda Alluvium mainly consists of Granite and Gneiss with the origin of Archean to Proterozoic age.

There is also a palaeo-channel found within the study area below the confluence of River Betwa and River Yamuna around the Villages Narayanpur, Kundaura (25°51'22.54"N 80° 8'17.12"E) etc. and it indicates the remnant of inactive stream channel of River Yamuna which got filled with by younger sediment (Newer Alluvium)(Regional geology map is attached as **Annexure XXIV**).

Within the area of study of this particular cluster, there is a confluence of two rivers Betwa and Yamuna(25°55'6.61"N 80°12'37.38"E) around the point of confluence of two rivers is the low lying area towards the upper bank of river Yamuna which lies in the Kanpur Nagar district. On river Yamuna there is a patch of Channel alluvium found near Village Samuhi (25°55'48.02"N80°13'30.39"E) in Kanpur Nagar which is mostly partially or wholly submerged during monsoons. A patch of Channel alluvium is also found in the part of district Jalaun falling with the study area. It is found around Bhedi Khurd (25°53'0.21"N79°51'6.27"E) village along the water channel of River Betwa. Channel bars and point bars are formed within the channel of the river and these sediment deposits are called as Channel alluvium. Rest part of the district falling within the study area is covered with Varanasi Alluvium which is brownish yellow silty to clayey flat with relict fluvial features likes Tals and Palaeochannel. Varanasi alluvium is older alluvium laying on the low flood plains, originated as Early to Late Pleistocene age. In Hamirpur district towards North-east direction (80° 4'31.07"E80° 4'31.07"E) between the two rivers flowing in the district viz. Yamuna and Betwa lies Varanasi Alluvium towards the bank of Yamuna River which is a flat ground with relicts channels and inselbergs of granitoid too.

It is a low lying area which gets flooded in monsoon season and when flood water recedes it removes the soil along the drainage lines by surface run-off turned this area into waste land. The ground water table level around this area ranges from 10-20 m bgl as the bed rock is porous and the water is potable.

Terrace Alluvium is found all along the river stream flowing from west to east direction and is mostly deposited on the older flood plains which are low lying and this sediment deposition is younger in nature and mostly preserved by the incision of rivers as it keeps on getting deposited in the forms of terrace. In this particular stretch, the deposition of alluvium is mainly Morrum in nature which are coarse to very coarse in texture having red colour due to presence of quartzofeld spathic sand.

As the river Betwa progresses the deposition of sediments varies in depth within the 10km buffer zone of our study area around Chandaut Danda ( $25^{\circ}54'13.48''N$   $79^{\circ}40'28.95''E$ ) the thickness of sediment deposit varies from 31m-20m from the water level in the river which is on average 101m on the concave side of the river.

The course river Betwa is meandered through out this stretch and around villages like Himapura, Pathreta and Basrehi ( $25^{\circ}52'19.90''N$   $79^{\circ}47'47.82''E$ ) there is a bend and towards the concave side the sediment deposit are found of thickness of approx. 23m-17m from the average water level of the river which is approx. 99m.

The water level/zero level of the river Betwa around the the villages Bhedi kharka nd Bhedi Khurd ( $25^{\circ}54'3.69''N$   $79^{\circ}49'0.71''E$ ) along the steep bend in the water channel is approx. 97m and the thickness of sediment deposition is approx. 24m- 15m.

The meandering of the river facilitates the deposition of sediments further down the course around villages Beri and Bajheta Dariya ( $25^{\circ}53'32.65''N$   $79^{\circ}54'23.32''E$ ) with the thickness of 25m-13m from the average water level in the river which is approx. 95m. futher down the stream around the villages Sahijana, Tikhrauli, Ramedi etc.(  $25^{\circ}55'28.58''N$   $80^{\circ} 8'58.68''E$ ) just before the Yamuna Betwa confluence at Samuhi, the thickness of sediment deposits varies 24m- 15m from the water level which is approx. 92m.

Terrace Alluvium is also found in the Kanpur Nagar district within the study area on the older flood lowland plains which has got high permeability and low compressive strength and is suitable for monocrop cultivation. The water table level along the Yamuna river within this study area varies from 10-20m bgl.

## **2.5 RIVER PROFILE**

The Betwa forms the boundary with Jhansi along the southern border from a point a few kilometers east of the town of Erichh to its junction with Dhasan. Its course, which up to the junction runs due east tends then somewhat to the north-east and it meanders along the south-eastern side of tahsil Orai and Kalpi, separating them from Hamirpur. Like the Yamuna it leaves the district on Baoni border. It flows in a tortuous channel with many loops and bends. Its total length along the district border is approximately 96 kilometers, but from point to point it does not exceed 64 kilometers. Both the banks are fringed for some distance inland by unculturable ravines. Pahuj in Hamirpur - The Pahuj river rises in Gwalior district of Madhya Pradesh and flow through Jhansi, enters Jalaun in the south-western corner of tahsil Konch at the village of Savaiya-Buzurg. The river forms the western boundary, except at few points where the district projects here and there beyond the stream. It is a much smaller river than the Betwa and flows in a deep channel between high banks in a sinuous course along the western side of that tahsil and pursues its way north wards along the border of Madhogarh. Within 10 kilometers north-west of this town it flows through the erstwhile jagir of Rampura and the village of Jaghar joins the Sindh river. On both sides of the river the banks are to a considerable distance cut up into ravines and nullahs. The Pahuj has no tributaries in the district except, Dhumna, a small stream which rises in Kailia and joins it near Maheshpur.

### **a. Geology**

The study area is underlain by alluvial deposits of Pleistocene to Recent age. Of these Older Alluvium, believed to be Middle Pleistocene in age is not touched by highest flood level because it forms the high ground. The Newer Alluvium, which in general occupies the areas of lower altitude, is restricted to the present flood plains along river channels. The Older Alluvium belongs to Middle to Upper Pleistocene age while the Newer Alluvium belongs to upper Pleistocene to Recent age. The rocks of the Vindhyan system

comprising shale and limestone form the basement. These rocks are overlain by laterite and mottled clay, which are succeeded by the Gangetic alluvium and top soil. The thick beds of limestone are present at a depth of about 220 m below land surface. Limestones are hard, grey, fine grained and chert like in appearance. Shales are present at a depth of about 180 m to 190 m below the land surface. Shales are greenish gray in colour, moderately hard and cleavable. Some of the shale was sandy in nature indicating probably the presence of laminae of sandy shale in shale bed. Laterite and mottled clays – (clays of red, orange, pink, and yellow colour) - occur as a distinct zone above the bed rock (Vindhya). The clays of this group, which are deeply coloured, are distinct from the clays of the older alluvium, which are earthy brown or buff coloured. The mottled clays containing varying amounts of quartz, sand and lateritic gravel are hard to soft and plastic to gritty. Some times the mottled clays are ochreous in nature enclosing, occasionally, a core of ferruginous material. The Older Alluvium comprising clay, silt, sandy clay, fine to very coarse grained sand, gravel, a small proportion of pebbles, kanakar and indurated sand occur immediately above the laterite and mottled clay group. The Betwa river is a tributary of Yamuna River. Its basin extends from longitude 77° to 81°E and latitude 23°8' to 26°0'N. The Betwa River originates at an elevation of 470m in Bhopal district in M.P. After traversing a distance of 590m, the river joins the Yamuna River near Hamirpur at an elevation of 106.68m. The total catchment area of the Betwa River is 46580 sq. km of which 31,971 sq. km (68.64%) lies in M.P. and 14,609 sq. km (31.36%) lies in U.P. The basin is saucer shaped with sandstone hills around the perimeter. The Dhasan River is the important tributaries of the Betwa River.

Betwa River plays vital role in the formation of Alluvium in the Bundelkhand region. Alluvium deposit is the main source of morrum, which plays very important role in economy of the Bundelkhand region.

Betwa River flows from south west to north east in Jhansi, Jalaun and Hamirpur district, forming a large meanders. The deposition of sediments occur as point bars and channel bars. Geologically the catchment area of Betwa river comprises rocks of Bundelkhand Granitic complex of Archean to Proterozoic age and Alluvium of quaternary period.

Dhasan River flows from south to north and meet with river Betwa on the right bank of Betwa river in Jhansi district. The catchment of Dhasan river is occupied by Bundelkhand Granitic Complex which is overlain by alluvium of quaternary age.

Betwa river in Jalaun, Hamirpur and Kanpur District comprises rocks of Bundelkhand Granitic Complex . Bundelkhand Granitic complex consists of granite of different types , gneiss and migmatite intruded by dolerite and quartz dykes. Metamorphosed rocks occur as enclaves . Granites are porphyritic to fine grained , non foliated and jointed. Quartz dykes commonly known as (quartz reef) trend NE-SW and extends several km. around Jaitpur,Kulpahar , Charkhari and south of Gorahari.

The Alluvium unconformably overlying Bundelkhand Granitic Complex is divisible into Older Alluvium and Newer Alluvium. Older Alluvium contains oxidized (brown , yellow khaki color ) sediments and Newer Alluvium comprises unoxidised (grey and khaki color) sediments. Banda Alluvium and Varanasi Alluvium of Pleistocene period represent older Alluvium. The Banda Alluvium consist of brownish silt – clay with kankar, red-quartzofeldspathic and gravel .The Varanasi Alluvium overlies Banda Alluvium and contains polycyclic sequence of micaceous sand , silt and clay with Kankar.

The Newer Alluvium of Holocene age , consist of Terrace Alluvium and Channel Alluvium . Terrace Alluvium consisting of 8-15 m. thick sequence of sand, silt and clay occupies terraces of Betwa river . Loose sand of point and channel bars constitute Channel Alluvium of Betwa river.

**Table No. 2.5. The generalized stratigraphical sequence of area**

<b>Era/Period</b>	<b>Age/ Group</b>	<b>Formation</b>	<b>Lithology</b>
Quaternary	Recent to Upper Pleistocene	Newer Alluvium	Alluvium Sand, Silt and Clay
	Upper to Middle Pleistocene	Older Alluvium	Clay with kankar, fine to coarse grained sand and gravel
Unconformity			

Meso to Neo-Proterozoic	Vindhyan Supergroup	Rewa and Kaimur	Shale , Sandstone and Quartzite
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The southern hilly tract of Uttar Pradesh known as Bundelkhand is roughly parallel to the North Ganga Yamuna Lineament. It is underlaid by granitic complex and overlaid by rocks of Mahakoshal (Bijawar) and Vindhyan super groups. These formations are characterized by rock formations of Archean age (Bundelkhand Granite gneisses). These rock formations are further layered by old sediments fills of granitic rocks. Proposed mining site area comes under district Jalaun, which lies in the Bundelkhand plains near Betwa River. This region is covered with a thick belt of alluvium/sediments of morrum and soil of sandy to sandy loam texture of alkaline nature. The colour of the soil varies from light red to red or dark coloured. There are no major fissures on the ground from the nearby localities of the proposed mining lease areas.

**a. Local geology**

The region dominantly composed of sand/morum. The sand is coarse to medium grained, derived from cratonic rivers. The morrum occur all along with the Betwa River in Jhansi, Jalaun and Hamirpur District, which is red in color. The red color sediments is the product of weathering and disintegration of granitic gneisses of Bundelkhand Complex

Morum in this belt are gravelly in nature and mineralogically comprises of quartz , feldspar and other accessory minerals and is coarse to very coarse grained.

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Morum in this belt are gravelly in nature and mineralogically comprises of quartz , feldspar and other accessory minerals and is coarse to very coarse grained.

**Characteristic of Betwa Sands**

On the banks of River Betwa lies “coarse sand” which derive their feldspar from granitic gneisses of the Bundelkhand complex. Based on its coarse grain size, high feldspar content and gravel clast type, the red sediment was derived from Betwa River.

## **b. Soil**

In this region mainly four types of soils are found

1. Clay loam to sandy
2. Loam & Sandy Loam
3. Sandy loam to sodic soil
4. Sandy loam & clay are dominant

Different morphological units have different types of soil. The soil ranges from pure sand to stiff clays and including all combination of the two extreme litho units. The pure sand

is called Bhur and clay is called Matiar when the sand is mixed with clay in equal proportion, the soil may be termed as Dumat or Loam – a good agricultural soil. **Fig. 2.6** illustrate different soil types in different geomorphic setting in Hamirpur and Jalaun district, Uttar Pradesh. The soil found in the area under study shows different variations-

**Hamirpur district** comes under the doab region of Ken and Betwa rivers covered by the recent alluvium. Different erosion and depositional agencies contribute to the diversity of soil types. Different morphological unit have different type of soil ranges from pure to stiff clay and included all combinations of the two extreme litho units. The pure sand is called BHUR and clay is MATIAR. The soils consist of the well-known Bundelkhand varieties- **Mar, Kabar, Parua and Rakar**.

**Mar** is often called black cotton soil, containing soil lumps of kankar and varies greatly in colour.

**Kabar** ranges from a rich dark balck to light brown and due to extreme adhesiveness, hard blocks are formed.

**Parua** is a light coloured sandy soil, found in many forms. It is usually less rich in organic matter but its finer texture makes it more responsive to manure and irrigation.

**Rakar** is a refuse soil which occurs on sloping ground, where the action of water has trended to denude the earth of all its better qualities.

Soil of the district **Jalaun** can be grouped into four types that commonly occur in Bundelkhand region, which are **Mar, Kabar, Parwa and Rakar**.

**Mar** is a dark coloured clay soil mixed with calcareous nodules (Kankar) with swelling and shrinking character. The soil is friable in dry state, moisture retentive and highly fertile.

**Kabar** is also a fertile soil but contains fewer amounts of clay and lighter in colour than Mar. **Kabar** and **Mar** soils are commonly known as black cotton soil and occur in the area of central parts.

**Parwa** generally occurs in the northern parts of area. This is a loamy soil, usually having grey colour.

**Rakar** soil is coarse grained red soil, strewn with Kankar. It has less fertility and occurs on ravine slopes.

In **Jhansi**, the soil found may be classified into two group on the basis of colour and topography i.e. red (upland soils) and black (low land soils). On the basis of texture, the red soil is further divided into 'Rakar' and 'Parwa' and the black soil group into 'Kabar' and 'Mar'.

### c. Topography

The study area is situated in the southeastern part of the Indo-Gangetic alluvium plain, and is more or less flat having a few conspicuous topographical features. The plains of the area have been formed by the sediments brought down by rivers of the Ganga and Yamuna system and deposited over undulating surface of the Vindhya and suffered erosions to such an extent that it becomes peniplain. The plain area has slope from west to east. The area is situated in the drainage basin of the Yamuna and its tributary Kilanhigh and Sasur Khaderi rivers. These rivers are characterized by a slow tranquil flow wide flood plain and broad meander belts. The landforms observed

in the alluvial plane are meander, point bars, back swamps etc. The altitude of the land surface varies between 75 m to 180 m above mean sea level.

#### **d. Hydrology**

River Betwa along with Birma form the main drainage system of the area. District lies in the doab of Ganga and Yamuna. Groundwater occurs in thick zone of saturation of unconsolidated sediments.

Major water bearing formation is Quaternary sediments deposited over concealed basement making to major freshwater aquifer groups.

Groundwater Exploration by CGWB (As on 2012):

Depth Range (m): 10166-282.60 mbgl

Discharge (litres per minute): 1000-4000

Transmissivity (m<sup>2</sup>/day): 2935 to 3660

## **2.6 DRAINAGE**

Betwa river, flows on Bundelkhand Granitic Complex in Jhansi, Jalaun and Hamirpur District. The regional geological succession of the area is as follows :

<b>Geological Unit</b>	<b>Lithologic Composition</b>	<b>Group</b>	<b>Age</b>
Channel Alluvium	Red and quartzofeld-spathic sand	Newer Alluvium	Holocene
Terrace Alluvium	Red and quartzofeld-spathic sand		
Varanasi Alluvium	Brownish yellow silt, clay with kankar	Older Alluvium	Early to late Pleistocene
Banda Alluvium	Red to deep brown sand with gravel lenses, silt and clay with kankar		

Bundelkhand Granitic Complex	Granite and gneisses and outcrops of granitoid , metasedimentaries and basites, dolerite and quartz reef	B.G.C.	Archean To Proterozoic
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Betwa river in Jhansi, Hamirpur and Jalaun District comprises rocks of Bundelkhand Granitic Complex . Bundelkhand Granitic complex consists of granite of different types , gneiss and migmatite intruded by dolerite and quartz dykes. Metamorphosed rocks occur as enclaves . Granites are porphyritic to fine grained , non foliated and jointed. Quartz dykes commonly known as (quartz reef) trend NE-SW and extends several km. around Jaitpur, Kulpahar , Charkhari and south of Gorahari.

The Alluvium unconformably overlying Bundelkhand Granitic Complex is divisible into Older Alluvium and Newer Alluvium. Older Alluvium contains oxidized (brown , yellow khaki color ) sediments and Newer Alluvium comprises unoxidised (grey and khaki color) sediments. Banda Alluvium and Varanasi Alluvium of Pleistocene period represent older Alluvium. The Banda Alluvium consist of brownish silt – clay with kankar, red-quartzofeldspathic and gravel .The Varanasi Alluvium overlies Banda Alluvium and contains polycyclic sequence of micaceous sand , silt and clay with Kankar.

The Newer Alluvium of Holocene age , consist of Terrace Alluvium and Channel Alluvium . Terrace Alluvium consisting of 8-15 m. thick sequence of sand, silt and clay occupies terraces of Betwa river . Loose sand of point and channel bars constitute Channel Alluvium of Betwa river.

- a. **Drainage Pattern & Groundwater Trend:** Ground water is mainly controlled by drainage, topography and lithological behaviour; it occur underground water condition at shallow depths and under confined condition at deeper depths (Drainage map is attached as **Annexure-XIV**).

**Drainage system & Ground water trend in district Hamirpur:** Drainage of Hamirpur district is quite unique in characteristics because of diversified geological formation with lithological and chronological formations, complex tectonic framework, climatological dissimilarities and various hydro-chemical conditions. Studies have revealed that aquifer groups of alluvial soil/ soft rocks even transcend the surface drainage boundaries. These are ravenous terrain and drainage density is very high and various small streams flow into the major rivers.

**Table No. 2.7. Drainage of District Hamirpur**

Sl. Nos.	Name of River	Area covered ( in sq km)	% Area covered
1.	Yamuna	56	1.43%
2.	Betwa	94.60	2.42%
3.	Dhasan	23.20	0.59%
4.	Ken	8.87	0.23%

Due to various small streams flowing in major rivers of Hamirpur, drainage of the district has become very dense. To support the irrigation system of Hamirpur more than 25 minors, 10 canals and 5 distributaries are functional in Hamirpur. District contains more than 15 ponds which help in ground water recharge.

**Groundwater trend:** Depth to water level in pre-monsoon ranges between 4.08 mbgl at Kharela to 29.32 mbgl at Jalalpur with an average water level at almost places in district varies between 4.12 to 17.50 mbgl. Water level has become shallower and varies from 2.22 to 28.82 mbgl during the post-monsoon season. Annual seasonal fluctuation of water level has been determined from the pre-monsoon and post-monsoon (2012) water level data of ground water monitoring wells the fluctuation varies from minimum 0.02 mbgl at Kunheta and maximum 4.75 mbgl at Lalpura.

Ground water in shallow aquifers is colourless and slightly alkaline in nature, the specific conductance range from 550 to 1400 mhos/cm at 25°C. It is suitable for drinking and domestic uses. Groundwater withdrawal is mainly through dug well, hand pumps and

tubewells. The gross ground water draft for irrigation in the district (2009) was 20612.16ha-m whereas the ground water draft for the domestic and industrial was 2225.61ha-m. Hence, the existing gross groundwater draft for all uses in district was 22837.77 ha-m and net ground water availability for future and irrigation development in the district is 23393.51ha-m.

**Drainage system & Groundwater trend in district Jalaun:** This district is principally drained by the rivers Yamuna, Betwa and Pahuj. Yamuna and Betwa generally flow an east to south-easterly course finally confluencing near Hamirpur. Pahuj arising from the Bundelkhand rocky terrains of U.P. and M.P. flows in a northerly direction to meet Sind, a tributary to Yamuna. The other major tributaries of Yamuna in the area are Kuchmalanga and Non. Which arise locally from southern highlands mainly along Konch and Orai. The Kunchmalanga-Non drainage basins occupy the major part of the area in the south and east. These streams become perennial in their lower reaches and are mainly fed by groundwater effluences. The overall drainage of the area forms dendritic pattern. Besides, there is good network of canal system draining from Betwa river through Kuthaund and Jalaun branches. The entire area of Jalaun district is underlain by quaternary alluvium, comprising mainly clay, Kankar, sand, and gravel over the basement of Bundelkhand granites. The thickness of alluvium increases towards north which has good potential. Ground water potential in granites is poor as they have little porosity. The weathered zone in the granite rock usually hold good quantity of water. The ground water in the alluvium occurs under water table conditions in phreatic zones and under semi-confined conditions in the lower zone.

The natural divisions into which the district falls are clearly marked. Along the outer edge is the ravine belt fringed by rich alluvial soil, but for most part consisting of low hummocks thickly strewn with Kankar. The upland which succeeds the ravines is poor in quality. It has a light coloured hard soil, to the north there is a tract of loam, the characteristics of which resemble those of the doab, but practically the whole of the south and centre of the district beyond the upland, excluding, the area in tehsil Kalpi affected by the Non and Melunga is occupied by the dark kakar and the black cotton soil Mar. With the exception of two rocky outcrops near Saiyidnagar in tehsil Orai, here are no hills in

the district and the red soil which is found in the hilly tracts of Jhansi is also absent but in other respects the district is a typical part of Bundelkhand.

**Table No. 2.8. Drainage of District Jalaun**

Sl. Nos.	Name of River	Area covered ( in sq km)	% Area covered
1.	Yamuna	21.2	0.46%
2.	Betwa	14	0.30%
3.	Pahuj	1.65	0.036%

**Groundwater trend:** As per depth to water level data of ground water monitoring stations pre monsoon water level varies from 0.56 to 31.20 mbgl. In post monsoon period depth to water level varies from 1.48 to 29.65 mbgl. Seasonal water fluctuation varies from 2.58 to 3.80 mbgl.

As per the report on Dynamic Ground Water Resources of Uttar Pradesh as in year 2009, the net annual ground water availability of the district is 121062.53 ham. The existing gross water draft for all uses is 46953.01 ham. The average of the stage of ground water development for the district is 38.78%.

**Groundwater trend in district Kanpur Nagar:** As per the reports of Central Ground water Board, the water level in the district varies between 2.20 to 27.13 mbgl during pre-monsoon period and the post monsoon water level has become shallower and varies from 2.08 mbgl to 27.13 mbgl along river Yamuna. The seasonal annual water level fluctuation varies between 0.0 to 1.70 meters in the district.

**Groundwater trend in district Fatehpur:** As per the reports of Central Ground water Board, the water level in the district varies between 8.60 to 20.90 mbgl during pre-monsoon period and the deepest water level occurs in the eastern part in the Mau Block. The post monsoon water level varies between 2.90 to 15.43 mbgl and the shallowest water level which is less than 5 meters occur in the southern part of the district in Manikpur block. The seasonal annual fluctuation varies between 1.15 to 10.38 meters in the district.

**b. Water Course & Hydrology:** The study of Regional Environmental Impact Assessment (REIA) is being done along the river Betwa for the various sand mining projects situated in the river bed of River Betwa in two districts Hamirpur and Jalaun. The Betwa river is the Tributary of Yamuna River System which is the Sub-Basin of Ganga River System.

**Yamuna Lower Sub-basin:**The geographical extent of the Yamuna Lower sub-basin lies between 77° 6' to 81° 55' east longitudes and 22° 51' to 28° 1' north latitudes of the country.

The Sind, the Betwa, the Dhasan, the Ken rivers are the major tributaries in the Yamuna lower sub-basin. The Yamuna Lower sub-basin is the largest sub-basin of the Ganga basin with a total catchment area of 1,24,867 Sq.km. The sub-basin majorly covers the states of Uttar Pradesh and Madhya Pradesh.

**Table No. 2.9 Major water Resource Asset**

Sl. No.	Name of Sub-Basin	Area( sq.km)	No. of Dam	No. of B/W/A	No. of Reservoirs	No. of Surface water bodies	No. of HO Stations
1.	Yamuna Lower	124867.19	201	17	199	16022	23

**Table No. 2.10 Watershed Statistics:**

Sl. No.	Name of Sub-basin	No. of Watersheds	Min. size of watershed(sq.km)	Max. size of watershed (sq.km)	Avg. size of Watershed (sq.km)
1.	Yamuna Lower	98	735.54	1781.43	1274.15

**c. Betwa River**

The Betwa River is a tributary of Yamuna River. Its basin extends from longitude 77° to 81° and latitude 23°8' to 26°0'N. The Betwa river originates at an elevation of

470 m in the Bhopal District in Madhya Pradesh. After traversing a distance of 590 km, the river joins the Yamuna River near Hamirpur at an elevation of 106,68 m. The total catchment area of the Betwa River is 46,580 sq km of which 31,971 sq km (68.64%) lies in M.P. and 14,609 sq km (31.36%) lies in U.P. The basin is saucer shaped with sandstone hills around the perimeter. The river has 14 principle tributaries out of which 11 are completely in Madhya Pradesh and 3 lies partly in Madhya Pradesh and partly in Uttar Pradesh. The Halali and Dhasan River are the important tributaries of the Betwa River.

#### **I. Landform & seismicity of the region:**

The area under study for this falls completely Zone II of the seismic zone as the all the four districts having their part included in the regional EIA study being conducted on the stretch of river Betwa namely Hamirpur, Jalaun, Kanpur Nagar and Fatehpur. Seismic zone II is liable to MSK VI or less and is classified as the Low Damage Risk Zone. The IS code assigns zone factor of 0.10 (maximum horizontal acceleration that can be experienced by a structure in this zone is 10% of gravitational acceleration) for Zone 2.

Hence, the study area of this regional EIA study is less prone to occurrence of earthquakes and no exclusive preparedness is required for the same.

**II.High Flood Status:** Rivers in alluvial plains are highly variable in their behavior and to an average man often unpredictable. A stream, which is quite trouble free during low flows, attains a threatening condition during high stages. It can develop unforeseen meanders, break through embankments, attack towns and important structures, outflank bridges and in general may create havoc. The highest flood level of the river Betwa flowing through districts Hamirpur and Jalaun was recorded at Sahijana as 108.67 HFL and Mohana as 133.35 HFL in the year 1983 respectively. The danger level for the flooding of river Betwa is 104.546 HFL & 122.664 HFL in Hamirpur and Jalaun districts respectively. The current status of river Betwa ( as recorded in year 2017) in the district Hamirpur and Jalaun is 89.27 HFL and 110.61 HFL with the difference of 15.276 and 12.054 HFL with the Danger level of Flood status.

## 2.7 TYPE OF THE PROJECT

The proposed project is to mine sand from river bed sustainably and scientifically. Mining will be done by opencast and semi-mechanized/OTFM (Other Than Fully Mechanized) method using Bar Scaper and loader; along the Betwa River bed keeping both the shores unaffected. Only sand will be extracted for the mining lease period of 5 Years. It has been proposed that approximately **3,23,880 cum/ annum**) of morrum will be extracted. During the lease period, the deposit will be worked from the top surface of river bed to 3 m bgl or 1 m above groundwater level whichever is less.

**Table. No. 2.11: Characteristics of minerals (Minor)**

S.No.	Ore Type	Chemical Constituent in percentage (%)				
		SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	Mn <sub>2</sub> O <sub>3</sub> + TiO <sub>2</sub>	Na <sub>2</sub> O +K <sub>2</sub> O
1.	Morrum	upto 93%	upto 3%	upto 2%	upto 1%	upto 1%
2.	Morrum	upto 90%	upto 2%	upto 5%	upto 2%	upto 1%

*Source: EIA Guidance Manual-Mining of Minerals*

### 2.7.1. Need of the project

Morrum is very important minerals found in abundance in the riverbeds as major sediment. These minor minerals have become very essential for the society for their many uses, they can be used for making concretes, filling roads and buildings, brick making and reclamation etc. These minor minerals are replenished during the heavy rains of monsoon season.

The sediment in the form of river bed material (RBM) deposited in the last many years have raised the river bed from a valley to an elevated land. Because of this, every year during monsoon season, heavy and devastating floods damage large tracts of land lying on both the banks of the river. Hence, it is necessary to remove the materials so that the

river gets channelized. The production of morrum will benefit the state in the form of revenue from mining lease. Apart from this project operation will provide employment directly and indirectly to the people residing in vicinity, thus improving the Socio-economic status of the area.

Achieving a huge infrastructure demand, as being envisaged by Government of India and state governments particularly in road and housing sector, requires basic building materials. The morrum, bajri and stone are primary building material required for the purpose. The mining activities are the backbone of all construction and infrastructure projects as such raw material for construction is available only from mining of this nature. Detailed mile stones of the projects are:

<b>Project Proponent(s) &amp; Name of Company (if any) &amp; Residential Address</b>	M/s Eureka Mines and Minerals LLP Proprietor- Shri chandershekhhar Chaurasia S/o Shri Deen Dayal Chaurasia H.No. 28, Brahmipuri Colony, Near Jugauli Crossing, Faizabad Road, District Lucknow, Uttar Pradesh.
<b>Gata No (s)/ Arajai No (s)/ Khand No (s)</b>	Gata No. 747, Khand No. 01
<b>Village</b>	Pathreta
<b>Tehsil/ District</b>	Kalpi/Jalaun
<b>Area (ha)</b>	Sanctioned Lease Area – 40.02 ha
<b>Date of issue of Letter of Intent (LOI)</b>	27.01.2018
<b>MP approved on</b>	9/2/2018
<b>Date of submission of EC application to MoEF's Portal with acknowledgement number &amp; File No.</b>	10/07/2018, SIA/UP/MIN/28125/2018; File No. 4384
<b>Report Submission date</b>	27.08.2018
<b>Date of presentation/ Agenda No. /Sl. No.</b>	29.08.2018, 353, 07
<b>Date of submission of draft EIA for</b>	27.07.2018

<b>Public Hearing</b>			
<b>Date of grant of TOR/EC</b>	TOR awaited		
<b>Public hearing conductance</b>	PH conducted on 19.09.2018		
<b>Co-ordinates</b>	<b>Points</b>	<b>Latitude</b>	<b>Langitude</b>
	<b>Coordinates Sanctioned MLA</b>		
	A	25°52'28.09" N	79°48'23.44 "E
	B	25°52'41.58" N	79°48'32.46 "E
	C	25°52'37.32" N	79°48'45.41 "E
D	25°52'24.27" N	79°48'33.20 "E	
<b>Annual Production</b>	3,23,880.00 m <sup>3</sup> /annum		

**2.7.2. Location (maps showing general location, specific location, and project boundary & project site layout)**

Toposheet attached in chapter 1 as Fig.1.3, also attached as **Annexure-XVIII**.



**Fig 2.7. Google Map showing general location of Study Area-2**

**2.7.2.1. Co-ordinates of Leasehold area of lease areas in riverbed of Betwa**

Points	Latitude	Longitude
<b>Coordinates Sanctioned MLA</b>		
A	25°52'28.09"N	79°48'23.44"E
B	25°52'41.58"N	79°48'32.46"E
C	25°52'37.32"N	79°48'45.41"E
D	25°52'24.27"N	79°48'33.20"E

**2.7.2.2. Production details of individual mines**

Proposed mine leases has been sanctioned over for period of five years. Only morrum will be excavated. It has been proposed that 3,23,880 cum/ year of morrum will be excavated.

MINE LEASE AREA (Ha)	WORKABLE AREA (Ha)	GEOLOGICAL RESERVE(cum)	PROPOSED PRODUCTION AS PER LOI (cum/annum)
40.02	15.6272	542721	323880

### **2.7.3. Size or magnitude of operation (incl. Associated activities required by or for the project)**

3. The area of the project is only 40.02 ha and it is B2 category project, but according to the cluster certificate another mine in 500 m radius of the proposed project having an area of 8.90 ha form a cluster. So it also becomes a B1 category project.

### **3.7.1. Estimation of the reserve**

Estimation of the morrum reserve of the area is calculated on the basis of the sand bars well exposed over the riverbed of sanctioned mining lease surface area of The total area of mining lease is **40.02 Ha** and **3,23,880 cum/annumis** proposed to be excavated from the river bed, which is well in proportion to the available reserve of the proposed mining lease area.

### **GEOLOGICAL RESERVES**

The geological reserves estimated by cross-sectional method can be categorized into two major categories namely: Mineral reserve & Remaining resources and further can be classified as under:

#### **1. Mineral Reserve**

##### **a) Proved Reserves (111):**

All the quantities of Morrum occurring up to 2 m below surface has been considered as under proved category.

##### **b) Probable Reserve (122):**

The probable thickness of minor mineral below the proved reserve is considered as probable mineral reserves.

#### **2. Remaining Resources**

##### **a) Feasibility in mineral resource (211):**

The mineral blocked with statutory barrier with in proved zone has been considered as 211.

### **b) Pre-feasibility Mineral Resource (222):**

Mineral blocked with in statutory barrier in probable zone has been considered as 222.

Mineable reserve has been taken as 60% of the geological reserve. In order to maintain the safety & stability of the river bank & riparian zone 40% of the lease area is to be left un-worked inside along the banks of the river.

### **3.7.2. Proposed schedule for approval and implementation**

Mining plans are approved by DGM for river bed mining of Morrurum and mining operation of the proposed morrum mining will be carried out as per rules of the act. The operation activities under the mining plan will be as follows:

#### **Opencast, OTFM, No drilling blasting, No dredging, day time, dry season.**

Mining activity will be purely opencast. To handle this quantity of Morrurum light earth movers will be deployed in the mining area. Tractor/trolleys/trucks/tippers will be used for transportation of minor mineral to the local markets and manual/hand equipments will be used as per the requirements. Apart from this water sprinkler will also be used for dust suppression on haulage road during transportation.

#### **Postulates of Mining methodology**

- Morrurum mining will be carried out strictly as per Mining Act/Rules.
- Dredging will not be done.
- Blasting and drilling not required.
- Main stream will not be disturbed.
- Mining from breaded, dune and accumulated areas.
- Mining in day time and in dry season only.
- No mining in rainy season.
- Required safe corridor will be maintained.
- Numbers of ramp will be less.
- Mining restricted to the depth of 3 m from the surface / 1 m above water level

whichever is less.

- Only Morrum will be extracted.
- Mining will be carried out in slices/ladder form of 30 cm to 60 cm.
- Ground water will not be disturbed.
- Angle of repose for mining will not be more than 30 degree.

## **(ii) Haulage and Surface Transport**

Mode of transportation of the mixed material is by trucks/ tractor trolleys. Trucks of larger size may also be used where the material is to be carried to a long distance to be used for out bound transportation. Mining areas are connected with a 'Kuccha' road up to the nearest pucca road and thereafter it is metalled road up to destination. The approach roads are adequate to permit easy maneuverability of trucks and it also provides cross-over and changing points. Water will be sprayed regularly by water sprinklers to suppress fugitive dust generation.

Above Figure represents the Haulage route which will be used by **M/s Eureka Mines and Minerals LLP**. The path shown in **Blue colour** represents the unpaved road and **Yellow colour** represents the paved road which is further connected with SH-42. It is >8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-Kalpi Marg), unpaved road which is 0.68 kmlong and paved road is approx. 0.93 km long.

## **(iii) Brief layout of mine working, layout mine faces & sites for disposal of overburden/waste.**

Bar scalping or skimming is extraction of Morrum and gravel from the surface of bars. Historical scalping commonly removed most of the bar above the low flow water level, leaving an irregular topography. Present method generally requires that surface irregularities be smoothed out and that the extracted material be limited to what could be taken above an imaginary line sloping upwards and away from the water from a specified level above the river's water surface at the time of extraction (typically 0.3 - 0.6 m (1-2 ft)) bar scalping or skimming. Bar scalping is commonly repeated year after year. To maintain the hydraulic control provided to upstream by the riffle head, the

preferred method of bar scalping is now generally to leave the top one-third (approximately) of the bar undisturbed, mining only from the downstream two-thirds.

1. Can create efficient channel.
2. Less disturbance on bar.
3. Smaller impact on riparian vegetation.
4. Can create pool habitat.
5. Can remedy channel braiding.
6. Useful for aggraded channels.

Mining faces shall be opened from top to down word. It will be advanced towards all directions. Approach & Haul roads of 6 m wide and 1:16 gradient shall be provided to each mining faces for transportation of mineral. No top soil exist within the area therefore, no proposal has been given for its management.

#### **2.7.5.1 Mining plan**

The proposed leases are simple open cast river bed morrum (minor mineral), and , mining plans, describing the methodology of mining operations, limitations, restrictions and mine closing along with layout, surface plan is prepared and discussed herewith:

##### **i) Location & Basic Information of the Mining Lease Area:**

Spreading over an area of 16.19 ha, the proposed project is to extract morrum from the river bed of BetwaRiver.

##### **Demarcation of Mining Lease Area:**

First of all the total proposed mining lease area will be demarcated by pucca pillars at the The area used for amenities include Site office, drinking facility, rest shelters for workers and the persons who will be staying on site during night as watchman/guards etc. ; portable toilets will also be using this space only.

**a. First year**

- The proposed mine leases falling within the Study Area-2 are confined to the extraction of morrum up to 9903658 m<sup>3</sup>/year from the riverbed of the effective workable area along the river bed
- Proposed mining project is an open cast mining where no drilling or blasting is required.
- Mining sites & points will be selected in the riverbed where the concentration of minor mineral is higher & preferably at places or points where the minor mineral is well exposed & present in dunes of higher elevation.
- The mining will be done by semi mechanized/OTFM (Other Than Fully Mechanized) method using Bar scrapers and loaders.
- To reduce the further chances of erosion & landslides at the bank of the river, mining will not be done in the concave areas of the rivers.
- To safe guard the river banks as per mining rules, mining will be done at least 7.5 m inside of the either banks inside the river bed in the lateral form. Mining will be done as given in SSMMG, 2016 and the depth of excavation shall not exceed 3 m or 1 m above water level, in proper bench form with suitable slope of gradient not more than 30°.
- Mining at any case will not be carried out below the water table.
- Mining will be done in the dry season only at places where the replenishment of sediments is high.
- Mining will be completely stopped during the monsoon.
- Mining operation will be carried out in the day time only.

**b. Subsequent years**

- Mining will be carried out in the dry season only & will be stopped completely during monsoon.
- Thus the mining area leftover will get replenished with the sediments of minor mineral in the monsoon itself.

- After the monsoon the filled excavated area will become re-mineable, and can be mined as per findings of the Replenishment study.

**2.7.5.2. Replenishment Study:** For calculation of actual replenishment, proposal of replenishment study on the basis of visit to extraction sites annually, reviews of cross-sectional survey data and estimation of the actual amount of replenishment during the flood season is proposed.

Replenishment term means refilling up-to former or previous level. Sediment transport process that determines the sand replenishment rate, hence, the volume of sand that can be extracted from the reach of the river channel.

In the first year following Letter of Intent a volume could be extracted from the reach of channel. Replenishment study would need to occur before subsequent extraction takes place.

The concept of annual replenishment accounts for the episodic nature of sediment transport. For example, during wet periods with high stream flows, and a high contribution of sediment from hill slopes and tributaries, monitoring data would show that sand and gravel bars are replenished quickly. During drought periods with low stream flow, and little sediment supply or transport, monitoring data would likely show that bars were replenished at a slower rate.

The use of monitoring data is essential in measuring when actual replenishment occurs. The use of the concept of annual replenishment protects long-term channel stability as well as aquatic and riparian habitat by extracting a volume sustainable by watershed processes. It is important to develop a system to allocate the total estimated annual replenishment between all of the operators.

- **Sediment transport process** determines the sand replenishment rate
- Replenishment study will be done **before the process of extraction** commence
- Concept of annual replenishment **protects long-term channel stability** as well as **aquatic and riparian habitat** by extracting the mineral sustainably by watershed processes.

**Table No.2.12. Popular methods for Replenishment Study**

Sediment Transport Equations	<ul style="list-style-type: none"> <li>• Yang Equation</li> <li>• Engelund-Hansen Equation</li> </ul>
River Modeling	<ul style="list-style-type: none"> <li>• River Modelling Using HEC-RAS</li> </ul>
Sediment Rating Curve Determination	<ul style="list-style-type: none"> <li>• Flow Discharge based on Surveyed Cross Section</li> <li>• Sediment Distribution Curve</li> <li>• Total Bed Material Load Computation</li> <li>• Historical Flood Hydrograph</li> <li>• Extraction Volume Determination</li> </ul>
Site Visits and Estimation of Actual Amount	<ul style="list-style-type: none"> <li>• Visits to extraction site annually, reviews cross section survey data &amp; estimates the actual amount of replenishment over the flood season.</li> </ul>

The replenishment study by site visit and estimation of actual amount is given in **Chapter-7: Additional studies.**

**LIMITATIONS AND RESTRICTIONS OF MINING**

1. The mine owner will carry out mining work as per UPMPCR, 1963 and under all the rules and regulations, term and condition laid down therein.
2. Mining in any case will not be done below the water table. During the lease period, the deposit will be worked from the top surface of the river bed to 3m BGL or 1 m above groundwater level whichever is less.
3. Mining shall not be undertaken in a mining lease located in 200-500 meter of bridge, 200 meter upstream and downstream of water supply / irrigation scheme, 100 meters from the edge of National Highway and railway line, 50 meters from a reservoir, canal or building, 25 meter from the edge of State Highway and 10 meters from the edge of other roads except on special exemption by the Sub Divisional Level Joint Inspection Committee.

4. In order to reduce the noise pollution in the vicinity only PUC certified vehicles will be allowed for the transportation of minor mineral.
5. The mining will not be allowed below the water table.
6. No mining operation will be allowed in forest area
7. The project proponent will abide by U.P. Minor Mineral Concession Rules, 1963.
8. The Project Proponents will abide at the time of mining with the terms and conditions as laid down under Mines Act, 1952 and Mines & Minerals (Regulation and Development) Act, 1957, Forest (Conservation) Act, 1980 and the stipulations of the EIA/EMP.
9. The Project Proponent with the satisfaction of competent authority will provide drinking water, temporary rest shelter, and first aid box, welfare facilities as per Central and State Govt. labour laws.
10. No mining will be done during monsoon season and during night times.
11. The reclamation of mined out areas will be natural, as during the next monsoon the void will be filled up with sand, which will be available for fresh quarrying for the next dry season.

### 2.8.1. Lease areas at a Glance

Sl. No.	Item	Details
1.	Name of the Applicant	Shri Chandershekhar Chaurasia S/o Shri Deen Dayal Chaurasia
2.	Mining Lease Area	40.02 acre (16.14 ha)
3.	Land Use	River Bed of Betwa River (Non Forest and Barren Land).
4.	Land Ownership	Government Land
5.	Lapse period	The proposed project proposal pertains to new mining lease which will be executed only after grant of EC from SEIAA, U.P.
6.	River	Betwa River
7.	Name of RF, PF, Wildlife Sanctuary, Eco-sensitive area	No, RF, PF, Wildlife Sanctuary, Eco-sensitive area is located within core and 500m radius of the proposed project site.
9.	Location	Gata No. 747 (Khand No. 01), Village-Pathreta, Tehsil-Kalpi, District- Jalaun, U.P.
10.	Topography	Plain River bed of Betwa River with minor slope towards main stream.

11.	Minerals of mine	Sand/Morrum(Minor Mineral)														
12.	Proposed production of mine	As per approved mine plan of the project the excavation/year is tabulated as under: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Year</th> <th>Production in cum</th> </tr> </thead> <tbody> <tr> <td>Ist</td> <td>3,23,880.00</td> </tr> <tr> <td>IInd</td> <td>3,23,880.00</td> </tr> <tr> <td>IIIrd</td> <td>3,23,880.00</td> </tr> <tr> <td>IVth</td> <td>3,23,880.00</td> </tr> <tr> <td>Vth</td> <td>3,23,880.00</td> </tr> <tr> <td><b>Total</b></td> <td><b>16,19,400cum</b></td> </tr> </tbody> </table>	Year	Production in cum	Ist	3,23,880.00	IInd	3,23,880.00	IIIrd	3,23,880.00	IVth	3,23,880.00	Vth	3,23,880.00	<b>Total</b>	<b>16,19,400cum</b>
Year	Production in cum															
Ist	3,23,880.00															
IInd	3,23,880.00															
IIIrd	3,23,880.00															
IVth	3,23,880.00															
Vth	3,23,880.00															
<b>Total</b>	<b>16,19,400cum</b>															
13.	Method of mining	Mining operations will be opencast, semi mechanised/OTFM (Other Than Fully Mechanized) using LEMM (Light Earth Moving Machinery) like bar scrapers and loaders.														
14.	Drilling/Blasting	No drilling and blasting is proposed.														
15.	Estimated cost	Approx.13 crore49lacs(excludingroyalty)														
16.	Water demand	Total water requirement of 12.42														
17.	Sources of water	Drinking water supply will be met by nearby dugwell/borewellsorprivatetankers.														
18.	Ultimate depth of Mining	3mor1mabovewaterlevelofriverwhicheveris less.														
19.	Man power	Approximately 65 workers including site and supervisorystaff(unskilledandsemi-skilled)														
20.	Solid Waste	Temporary laborers from nearby villages will be hired;nogenerationofsolidwasteisanticipateddue toproposedprojectactivity.														
21.	Nearest railway station	SumerpurRailwaystation-36.30km*(E)														
22.	Nearest state highway	SH-91(Hamirpur-KalpiMarg)-12.4km*(S)														
23.	Nearest Airport	KanpurAirportwhichis about84km*(NE)														
24.	Nearest city	Nearest City/Town: Hamirpur which is about 35km*(NE)														

## 2.9 CLOSURE OF MINES

The proposed projects are opencast riverbed mining of morrum for 5 years, where the extraction of morrum is only 3,23,880cum/annum from an estimated sustainable mineable deposits. Thus, the extracted quantity of morrum from the river bed will get replenished of the sediments during the monsoon seasons.

### 2.9.1 Closing Plan/Rehabilitation

- **SAND MINING AREA**

At the end of project operation a closing plan or a rehabilitation programme should be undertaken by the sand mining operators. The following measures can be undertaken to rehabilitate the site:

- ❖ The site should be cleared of any machinery, equipment and structures.
- ❖ Any access routes, especially if they are not beneficial to the local community would need to be ploughed and replanted with native species.
- ❖ River bank should be stabilized by means of compaction and then planting with vegetation.
- ❖ Close and restore river bank where access ramps have been restored.
- ❖ Ensure river channel is not obstructed and that repaired banks are adequately fortified.

- **REVEGETATION**

- ❖ Tree species endemic to the area should be planted.
- ❖ Re-vegetate with indigenous plants which were removed from areas for the mining of sand as far as is reasonably practical.
- ❖ Plant trees along the riverbanks with no or minimal vegetation, irrespective of signs of erosion or not (ensure that species selected are indigenous species).

- **IMPROVEMENT OF RIVER BANKS**

Channel erosion often occurs on riverbanks with no or minimum vegetation cover. Secondary rehabilitation measures could include:

- ❖ Plant trees along the riverbanks with no or minimal vegetation, irrespective of signs of erosion or not. However, careful selection of species is required to ensure that trees are suitable for banks improvement as well as not interfering with the existing species.

## 2.10 TECHNOLOGY AND PROCESS DESCRIPTION

As per EIA Guidance Manual – Mining of Minerals as prepared by MoEF & CC - the proposed project is a surface mining. The typical scheme involved in surface mining is:

### **Mining**

The mining process is opencast river bed mining of minor minerals. Before the mining process lease area will be demarcated with pucca pillars. Safety distance of 3.0 m or 10% of the width of the River whichever is more will be left intact as no mining zone. Drilling and blasting is not required.

### **Working Depth (below ground level)**

During the entire lease period, the deposit will be worked from the top surface to 3 m bgl or above the ground water level whichever comes first.

The mining process is also detailed below:

### **Mining Process:**

- ✎ Mining will be started at the farthest downstream end, moving upstream from there.
- ✎ At the cross section of the flood plain at the downstream end, the mining will be initiated from the middle of the cross section of the river bed.
- ✎ Mining will be continued in layers of 0.6 m depth to avoid ponding effect.
- ✎ Mining will be done in such a way that the process of mining remains confined to the middle of the flood plain. For achieving this purpose, a width of about 6m, suitable for locating the truck/trolley for simultaneous loading will be first excavated. To start with it may be covered with wooden plank or metal sheet if required to prevent any sagging.
- ✎ Having excavated that, the process will be continued to the flanks, of a truck width, alternating from one side to the other every time.
- ✎ After the first layer is excavated, the process will be repeated for next layers.
- ✎ 1.Can create efficient channel.

Fig 2.4: Surface Mining Scheme

- ✍ 2. Less disturbance on bar.
- ✍ Smaller impact on riparian vegetation.
- ✍ 4. Can remedy channel braiding.
- ✍ 5. Useful for aggraded channels.

## 2.11 MINING TECHNOLOGY

**Opencast, OTFM/Semi Mechanized, No drilling blasting, No dredging, daytime, dry season.**

Mining activity in river bed of Betwa River will be opencast and semi mechanized (OTFM). The mining method will be bar scalping/scraping (OTFM) using bar scraper for Morrum scraping for the lease area and collecting in designated area in MLA. Loader will be used for loading of Morrum in to the trucks/trolley for further transportation to the Local market. Bar scraping is the method approved in SMMGG, 2016 issued by MoEF&CC, GOI Delhi for environmental friendly mining.

Method		Tools/Machines
Bar Scraping	OTFM (Semi-Mechanized)	Bar scraper, Loader

### 2.11.1 Methodology

Bar scalping or skinning is extraction of Morrum and gravel from the surface of bars. Historical scalping commonly removed most of the bar above the low flow water level, leaving an irregular topography. Present method generally requires that surface irregularities be smoothed out and that the extracted material be limited to what could be taken above an imaginary line sloping upwards and away from the water from a specified level above the river's water surface at the time of extraction (typically 0.3-0.6m (1-2ft)) bar scalping or skinning.

Bar scalping is commonly repeated year after year. To maintain the hydraulic control provided to upstream by the riffle head, the preferred method of bar scalping is now generally to leave the top one-third (approximately) of the bar undisturbed, mining only from the downstream two-thirds. Mining faces will be opened from top to down word. It will be advanced towards all directions. Approach & Haul roads of 6.0 m wide and 1:16 gradient will be provided to each mining faces for transportation of mineral. No top soil exist within the area therefore, no proposal has been given for its management

### 2.11.2. Machines to be utilized

<b>Bar scrapper</b>
<b>Loader</b>
<b>Dumper</b>
<b>Trucks</b>
<b>Sprinkler</b>
<b>Bulldozer (optional) for rescue and salvage</b>

### 2.11.3. Hand tools for Sand Excavation:

These are generally used for smaller depths of excavations in small areas. Man power is required to operate these tools. The tools come under this category are explained below

<p><b>Spade</b></p> <p>Spade is a tool which consists metal plate having sharp edges, the plate is attached to long handle which is generally made up of wood. Because of its sharp edges the sand can be dig easily. The metal plate having less curvature in the spade so, we cannot lift the sand by spade.</p>
<p><b>Shovel</b></p> <p>Shovel is tool which is used for the purpose of lifting of excavated sand. It is also similar to spade the difference between spade and shovel is the difference in leading edge. The curvature of metal plate of shovel is generally higher when compared to spade so we can</p>

hold the soil easily and lifted it. Shovel can also be used for digging purpose in case of soft soils, sand etc.

**Hoe**

Hoe is an excavating tool which consists a metal plate attached to a long handle with acute angle. The plate having sharp edge is used to excavate the soil. For small work of excavation it is widely preferred tool. Sometimes metal plate is replaced by fork type plate.

**Rake**

Rake is a tools which is having a horizontal rod having metal teeth and is used to remove the small layers of soil.

**Trowel**

Trowel is hand sized tool which is generally used to dig the small trenches in soil or to remove the shallow roots in soil.

**Pick axe**

Pick axe consists hard spike attached perpendicular to handle. They are used for excavating small trenches in soil. Pick axe can cut the soil even if the soil is of hard type. The metal spike is pointed on one side and wide blade is provided on the other side.

**Mattock**

This looks like pickaxe. But serious digging is not possible with mattock. Generally it is used as lifting tool because of its curve shapes metal at its bottom.

**2.12. LAND USE PATTERN**

The various modifications due to mining allied & an activity during next 5 year is given below.

TOTAL MINE LEASE AREA (ha)	WORK ABLE AREA (ha)	NON-WORKABLE AREA (ha)	UNUSED AREA (ha)	AREA USED FOR AMENITIES (ha)	AREA LEFT AS SAFETY ZONE (ha)	MINEABLE AREA (ha)
40.02	15.6272	0	0.3825	0.18422	0.56672	15.06048

## 2.13 LIFE OF MINE

The total production of Morrum is 3,23,880cum/ annumfor plan period. Project tenure is 5.0 years.

## 2.14INFRASTRUCTURE FACILITIES

NH 81 is passing through 10 km radius area of above mentioned leases. Two state highways SH-91 and SH-42 passes through the vicinity of the projects along with other metalled road.

## 2.15. COST OF INDIVIDUAL MINE & WHOLE GROUP OF LEASES

The detail of Project cost, Manpower and water requirement of lease are given below:

### Cost of Project

TOTAL COST OF MACHINE (Rs.)	TOTAL LABOUR COST (Rs.)	EMP COST (Rs.)	TOTAL OPERATIONAL COST (Rs.)	CER COST
9,07,50,000/-	3,75,04,871/-	30,28,436/-	13,48,86,170/-	<b>26,98,133/-</b>

<b>Component of Environment Mangement Plan (EMP)</b>			
a	No. of plants (@5 plants/ha and 50% mortality rate)	121 saplings	12,146
b	Tree Guard (@2000/- per unit)	81 saplings	1,61,940
c	Water Demand for plantation (@ 0.5 litre/plant)	0.040 KLD	8,350
d	Sprinkling on haulage route for dust supression	10.88 KLD	14,96,000
e	Monitoring cost		13,50,000
Total			30,28,436/- (Rs. 30 Lakhs)

## 2.16 OTHER FEATURE

### WATER

Water Demand (KLD) for Sprinkling on	Water Requirement for plantation	Drinkin g water -Day	Drinking water - Floting	Drinking water - Fixed	Stored water (KLD)	Total Water
--------------------------------------	----------------------------------	----------------------	--------------------------	------------------------	--------------------	-------------

<b>Unpaved haulage road</b>	<b>(KLD)</b>	<b>worker (KLD)</b>	<b>population(KLD)</b>	<b>population(KLD)</b>		
10.88	0.040	0.54	0.35	0.51	0.10	12.42

### **MANPOWER**

The total manpower will include labours and supervisory staff .The light Earth Moving machinery operators are included in calculation regarding water consumption and waste generation.

<b>UNSKILLED LABOUR</b>	<b>SKILLED LABOUR</b>	<b>OTHERS</b>	<b>FLOATING POPULATION</b>
45	9	11	177

### **POWER**

All the activities will be carried out in semi mechanized/OTFM (Other Than Fully Mechanized) manner. The operation will be done in day time..Also the labours will be hired locally. Although generators will be arranged on the sites for different purpose.

### **WATER SUPPLY**

There will be very less requirement of water is anticipated to carry out operations as it will be done semi mechanized/OTFM (Other Than Fully Mechanized) using Bar scraper and loaders. The water will be required either for drinking purposes or for dust suppression. Hence, the total water requirement for the proposed project is given in project specific information.

The waste water from bathing and washing will be collected in the Mobile Sewage Treatment Plant for Camp and then will be reused for Dust suppression on Haulage Route. Mobile Sewage Treatment Plant for Camp is a compact system and occupies lesser area. Power requirement is much lower than conventional systems. Manpower requirement is less owing to its process design and features. Mobile Sewage for camp sites have following features

- It is a compact system and occupies lesser area.
- It is a modular system; capacity may be enhanced by adding modules.
- Power requirement is much lower than conventional systems.
- Manpower requirement is less owing to its process design and features.
- Pleasing appearance, no smell are among its many more advantages than conventional system.
- Treated water shall be used for horticulture application as well as toilet flushing.
- The sludge collected shall be used as manure for the plants

#### **WASTE GENERATION (LIQUID & SOLID)**

The entire mineral extracted is saleable. The labours from nearby villages will be hired to carry out work in day time only, hence there will be no or very less waste is expected to generated on individual leases. Though, liquid waste generated on sites by workers/labours while washing their hands, drinking and other losses will be balanced by using that discharged water excluding the transmission loss for dust suppression on haulage routes and sprinkling purposes.

The municipal workers or private contractors of district will be engaged in collection of un-segregated garbage (biodegradable and rubbish (non biodegradable) from bins from individual sites. Segregation of waste will be mainly of two types, Biodegradable and Non Biodegradable. These wastes will be collected individually from each site.

## Waste generation

MSW FOR FLOATING POPULATION (kg)	MSW FOR MANPOWER POPUL (kg)	MSW FOR RESIDENTIAL	TOTAL MSW GENERATION (kg)
26.55	13.5	5.5	45.55

## Water budgeting

TOTAL WATER (KLD)	DRINKING WATER(KLD)	FRESH WATER(KLD )	WASTE WATER(KLD)	LOSS OF WATER(KLD)
12.42	1.40	3.73	8.69	2.48

### 2.17 FACILITIES TO LABOURS

#### Health Check up Schedule

All workers will be subjected to Initial Medical Examination as per Mines Rule 1955 at the time of appointment. Periodical Medical Examination will be conducted at least once in a years. Medical camps will be organized. The detail of health check up and periodical medical examination schedule is given below.

S.N.	ACTIVITY	DETAIL
1.	Initial Medical Examination (Mine Workers)	At the time of appointment and before commencement ofminework all the mine workers will go through the initial Medical Examination like B.P., Weight, Height and other primary health

		parameters.
2.	Physical Check -up	Health checkup camp will be organized for mine workers as well as for Villagers in which physical parameters like height, weight and B.P. will be monitored and Psychological test & Respiratory Tests will be conducted.  However the medicines will only be given or prescribed by Recognized Doctors at PHC of concerned Villages.
3.	Psychological Test	
4.	Respiratory Test	
5.	Eye Check -up	
5.	Eye Check -up	Regular Eye checks up camps are being organized by Government at Village levels. The proponent will arrange for a Bus or Van to carry the mine workers for specific location of Eye Check Up camps. The Panchayat will let the proponent know about the dates of check up camp and proponent will arrange for the transportation to & fro.
6.	Training (Mine Workers)	<p><b>The Mine workers will be trained by Environment officer for –</b></p> <ul style="list-style-type: none"> <li>• Working conditions are hazardous details</li> <li>• Site specification</li> <li>• Emergency response</li> <li>• Providing first aid</li> <li>• Evacuation Plan</li> <li>• Report of Incidence</li> <li>• Emergency contact numbers</li> </ul> <p>The Mine Manager will be responsible for Training of Mine Workers.</p>

Basic medical facility (First aid box), PPE and drinking water will be provided by the mining leasee/mine holder for workers during all the working hours of the lease period

on site. PPEs like dust mask, Hard Hat, Shoes etc will be provided wherever necessary to the labors

## **2.17 DESCRIPTION OF MITIGATION MEASURES**

Although the river morrum is worlds most plentiful and has got the ability to replenish itself, even then morrum mining is a coastal activity referring to the process of actual removal of the minor mineral from the riverbed, stream which causes hazards and pollutions to the surrounding environment. In order to overcome these environmental problems the lessee will follow the following mitigation measures for mining:

1. The main stream will not be diverted to form inactive channels from mining.
2. Mining below subterranean water will not be done.

Detailed mitigation measures are discussed in **chapter.4.**

### **2.18.1. ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE**

No new or untested technology is adopted for the proposed mining. The project does not involve any processes as overburden removal, drilling, blasting and beneficiation. Mining will be done by Bar Scalping method which is approved in SSMMG, 2016. The sand will not be scraped more than 3 meter as proposed in mining lease and shall be in the lateral direction of the river. These pits get replenished during monsoon. The proposed mining lease project is a simple opencast mining where no drilling and blasting is required.

## CHAPTER-III

S. NO.	CONTENTS
3.0	STUDY AREA
3.1	LAND ENVIRONMENT
3.2	PHYSICAL ENVIRONMENT
3.3	WATER ENVIRONMENT (GROUND & SURFACE WATER)
3.4	AIR ENVIRONMENT
3.5	NOISE ENVIRONMENT
3.6	SOIL ENVIRONMENT
3.7	BIOLOGICAL ENVIRONMENT
3.9	SOCIO-ECONOMIC ENVIRONMENT

# DESCRIPTION OF ENVIRONMENT

Environmental Impact Assessment should include a description of the present state of the environment in the location of the mining project. The compilation of the information on the state of the environment is a vital aspect of the whole EIA process. This information will facilitate the identification of environmental impacts and alternatives. It will also provide a basis for comparisons between the various project alternatives.

Mining activities invariably affect the existing environmental status of the site. It has both adverse and beneficial effects. Hence, the methods are required to be selected in such a manner so as to maintain environmental equilibrium ensuring sustainable development, and in order to maintain the environmental commensuration with the mining operation, it is essential to undertake studies on the existing environmental scenario and assess the impact on different environmental components. This would help in formulating suitable management plans for sustainable extraction.

Data must be collected of the present state of the environment regarding environmental parameters that can be expected to be significantly affected by the process of mining, such as water (Surface and Ground) quality, ambient air quality, noise quality, soil quality and biodiversity. It is also beneficial to investigate any existing polluting activities in the study area/region that may already affect the environment and to also determine the loads caused by these factors.

### 3.0 Study Area:

The study area for this particular study on the stretch of River Betwa covers three

districts namely Hamirpur, Jalaun, and Jhansi. Total 31 Sand Mining projects (inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited) comprising 21 of Sub-category B1 and 10 of Sub-category of B<sub>2</sub> are situated on the river Betwa in two districts namely Hamirpur and Jalaun between - 25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N & 80°16'12.74"E in the river bed of Betwa.

### **Project Description**

The proposal for EIA has been put forth during various TOR presentations and detail outline was explained and SEAC was agreed with the proposal. The standard TOR will form the basis of this EIA as no additional TORs were issued by the SEAC, Uttar Pradesh. The total mine lease area of **M/s Eureka Mines and Minerals LLP is 40.02 ha**

**and it is situated in study area-2 having mineable area of 631.51 ha** (inclusive of upcoming projects for which Public Hearing/EC is awaited) and the total annual production will be 9903658 (inclusive of upcoming projects for which Public Hearing/EC is awaited) cum/annum. These morrum sites are present in the Betwa River Bed between - 25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N & 80°16'12.74"E. Proposed mine leases has been sanctioned over for period of five years. Only morrum will be excavated. It has been proposed that 3,23,880 cum/ year of morrum will be excavated. Although the area of the project is only 40.02 ha and it is B2 category project, but according to the cluster certificate another mine in 500 m radius of the proposed project having 8.9 ha form a cluster. So it also becomes a B1 category project. The proposed project is situated in Gata no.-747, Khand No.-1, Pathreta, Kalpi, Jalaun.

#### **a. Methodology:**

Baseline information is collected by field surveys, monitoring etc. for micro-meteorology, ambient air quality, ground and surface water quality, noise levels, present land use pattern, soil quality, biological environment, socio-economic status, health status etc. within the study area. Baseline environmental data was monitored and collected by a NABL Certified Lab "The Research Institute of Material Sciences", New Delhi, for one full season i.e. March- May, 2018. The baseline data monitoring

procedures conforms to the requirement of EIA Notification, 2006(amended in 2009 & 2016). The study area comprises of four districts Hamirpur, Jalaun, and Jhansi.

Additional information have been gathered from various secondary sources, to establish a correlation between existing physical, natural, socio-economic and cultural environment condition of the area under study which is been collected in consultation with the key persons. All relevant secondary data has been collected on environmental and social features from various reports pertaining to Government Agencies / Institutions and through literature reviews. Details regarding demographic and socio-economic features of the study area have been collected from the Census Data 2001 & 2011 (as available).

#### **b. Secondary Data Collection**

For getting the first hand information of study area we had collected and studied the secondary data regarding wind speed, annual rainfall, wind direction. The secondary data help us to set the course. Data collected indirectly from published records or documents such as project documents, village profile, maps, photos, internet sources etc. Secondary sources are mentioned in reference chapter.

### **3.1 LAND ENVIRONMENT**

Under this section, the study of natural features like Geology, physical features, topography, terrain, land use/land cover, drainage pattern, ground water trend and soil is given.

**a. Regional Geology & physical features:** The study area for this particular study includes part of four districts i.e Hamirpur, Jalaun, and Jhansi along the river Betwa. Hence, the regional geology given here is of four districts:

- **District Hamirpur:** The district Hamirpur is located in southern part of the state and is a part of Bundelkhand plateau. It lies between the latitude 25°27'00" and 25°57'00" N and longitude 79°11'00" and 80°19'00" E. The district falls in survey of India toposheet No. 54/0 and 63/0. The geographical area of district is 4139.09 sq.km.

Geographically, the area comprises Bundelkhand granite gneiss complex and Recent alluvium. The thickness of alluvium varies from 120 to 150 m. the master slope of the district is due north-east. The Quaternary alluvial material

overlies the granite. The district could be broadly divided into two physiographic regions.

- a) The southern part of district between latitude 25°30'00" and 25°42'00" N of is mainly plain area with average elevation of 250 mamsl. The region is underlain by the alluvial cover.
- b) The northern part of district that is north latitude 25°42'00" N represent the flat topography. The average elevation of the region 120 m above mean sea level.

The general geological sequence of the formation present is as under:

Age	Formation	Lithology
Quaternary Recent to sub recent	Alluvium	Sand, Silt, Clay
-----Unconformity-----		
Precambrian		Bundelkhand Massif

- **District Jalaun:** It forms the most portion of the Trans Yamuna tract of the country. Jalaun district is surrounded in all four directions by rivers Yamuna, Betwa, Pahuj and Dhasan. It encompasses a geographical area of 4544 sq.km. The area is bounded in the north by Yamuna river, in the south by Betwa river and its western boundary follows Pahuj river. The eastern border is shared with Hamirpur district. The area lies between latitude 26°26' to 25°45' N and longitude 79°57' to 78°00' E, falling in the survey of India Toposheet No. 54N and O.

The district forms a part of marginal Ganga, alluvial plains. Geomorphology bears tremendous control on the ground water regime. The relief, slope, depth of weathering, type material, nature of deposits and thickness and overall assemblage of different land forms plays an important role in the ground water regime in hard rock as well as in the unconsolidated sediments. Various geomorphic units identified in the area are grouped into four major categories, which are:

- 1) Pediment zone
- 2) Alluvial zone
- 3) Ravines land and
- 4) Flood plains.

The main physical features of the district are largely determined by the three rivers- the Yamuna, the Betwa and the Pahuj, which nearly encircle it. They are surrounded by a deep network of ravines running 1-3 km from the streams. These ravines are succeeded by a bank or belt of higher land, these high lands border on the Khadir valleys of the Betwa and Pahuj, while low lands occupy the central tract. The low lands have a wide flat basin encircled by a narrow rim of higher ground which breaks up into network of ravines along the river banks, stretching for some km inland from the streams. The levels are clearly indicated from the situation and direction of the branches of the Betwa canal which follows the watersheds closely. The drainage of the central tract is supplied by two minor streams, the Non and the Melunga which flowing north-eastwards unite some 12 kilometers from the Yamuna bank and join that river at an equal distance to the north of the town of Kalpi, Like the larger rivers they too have carved deep ravines which increase in extent the nearer the Yamuna is approached and as a consequence of their action, the Kalpi Tahsil is cut by a tracery of ravines which have scored the greater portion of soil and having more barren and sterile land than in any other part of the district.

**Topography & terrain:** The proposed area under study is a riverbed which is slightly undulating due to the deposition of sand/morrum minerals. The study area of this particular study includes part of four districts i.e Hamirpur, Jalaun, Kanpur Nagar and Fatehpur along the river Betwa. Hence, the topography and terrain given here is of four districts:

- **District Hamirpur:** The district can be divided into three topographical units:
  1. Bundelkhand Gneiss.
  2. Recent Alluvial Plain: The area occupied by the recent alluvium can be delineated all along Betwa and Ken river. These recent alluviums are semi-confined.
  3. Bundelkhand Granite Gneiss: the isolated hillocks and obstruction to topography of the regions.

- **District Jalaun:** The are forms part of the Gangetic alluvial plains which is bounded on the south by Bundelkhand rocky terrain of Jhansi. It si roughly demarcated by rivers Betwa, Pahuj and Yamuna in the South, west and North and North-east respectively. A few outliners of Bundelkhand granite forming low hillocks are met with in southern parts of the area protruding form the vast spread of alluvial plains. The area is otherwise characterised by monotonous a gradational surfaces of the Gangetic alluvial plains. The master slope is in a North to North-easterly direction becoming mainly easterly in the northern parts of the area. The bank zones of major streams are deeply eroded and ravenous forming bed lands which occur etensively along Pahuj and Yamuna rivers. The upper central portion of the area is significantly devoid of inland drainage and consequent land features which is however, prevalent in the southern and eastern parts of the area.

**b. Land use/Land cover:** Mining activities are subjected to the extensive land use changes even in the short period of time and have the direct impact on the land environment due to opencast mining. The total mine lease area is 631.51 ha. The core zone of the study area is taken as 500m all along the stretch of river Betwa and similarly the buffer zone as 10.0 km km from the river bank all along the stretch of river Betwa of the area under study. Other river which flow in the buffer zone is Dhasan river which flows for about 16.60 km towards South-west direction in the buffer zone which joins Betwa river at Kamtha village after which our mine leases start to appear on the stretch of river Betwa.

**c. Land use Pattern:** Land use pattern of the three district falling within the area under study of this particular Environmental Impact Assessment study on the stretch of River Betwa is as follows:

**Table No. 3.1 Land use Pattern of the districts under area under study**

Sl. Nos.	Land use Pattern of the districts	Hamirpur (in,000 ha.)	Jalaun (in,000 ha.)	Kanpur Nagar (in,000 ha.)	Fatehpur (in,000 ha.)
1.	Geographical Area	390.90	454.40	301.30	422.126
2.	Cultivable area	325.80	377.30	234.80	351.863
3.	Forest Area	24.50	28.20	5.60	7.615
4.	Land under non-agricultural use	32.90	39.0	42.40	49.707

5.	Permanent pastures	0.50	0.20	3.70	2.791
6.	Cultivable wasteland	8.60	1.50	8.90	10.186
7.	Land under Miscellaneous tree, crops and groves	0.70	1.60	3.10	5.461
8.	Barren and uncultivable land	7.10	9.80	14.80	10.150
9.	Current Fallows	16.90	20.70	25.0	32.819
10.	Other Fallows	5.30	6.80	8.70	14.426

### Description of Land use/land cover

The buffer zone of Study area is almost 46 % crop land and 28% of land area is scrub land or with no scrub. The total builtup area in 10 km radius is 8.67% and waste land is 1.34% of the total area covered in the buffer zone of study area.

**Table 3.2 : Land use of 500 m radius**

Land use types	Area ha	% Area
River and water bodies	1017.33	11.90%
Land with or without scrub	1869.6	21.87%
Crop land (Horticulture)	1222.01	14.30%
Sand	4439.21	51.93%

### Description of Land use/land cover within Impact Zone (within 500 m)

Within the impact Zone of Study area land use can be classified into mainly four categories *viz.* **River and water bodies, Land(with or without scrub), Crop Land and Sand.** The maximum percentage i.e 51.93% lies within the impact zone is of **Sand** as the area is mainly the river bed of the river Betwa which is covered by the alluvial deposits brought by the river from all along its course. The next category which has 21.87% in the impact zone is of **Land with or without scrub**, there is some part which is not covered by the alluvial deposits and falls within the government land category which can be further divided into scrub land and normal land and is either being used for different purposes or stays like that. The percentage of **River and water bodies** within the impact zone is 11.90%. The major river which flows within the study area and along which all the mine lease are located is river Betwa, there is River Birma which is also present within the Study area. But only river Betwa flows within the impact of the area of study. The **Crop** land has the percentage of 14.30% within the impact zone as the major portion of it is river bed of River Betwa hence, very less land is available for cropping and farming, still in few patches horticulture is being practiced.

**Table.3.3 : Land use of 10 km radius**

<b>Land use types</b>	<b>Area ha</b>	<b>% Area</b>
River and water bodies	2081.26	1.65%
Forest	13532.8	10.72%
Land with or without scrub	36337.2	28.79%
Crop land	59221.1	46.91%
Fallow land	1912.53	1.52%
Built-up land	1692.23	1.34%
Waste land	10946.7	8.67%
Sand	507.8	0.40%

### **Description of Land use/land cover within Buffer Zone (10 km)**

Within the buffer Zone of Study area, land use can be classified into mainly eight categories *viz.* **River and water bodies, Forest, Land(with or without scrub), Crop Land, Fallow land, Built-up land, Waste land and Sand.** The maximum percentage i.e 46.9% lies within the buffer zone is of **Crop land** as the buffer zone is of rural area, hence, the major landuse pattern is of cropping. The next categories which have 28.79% & 10.72% in the buffer zone are **Land with or without scrub and Forests** respectively, there is some part which is not covered by the alluvial deposits and falls within the government land category which can be further divided into scrub land and normal land and is either being used for different purposes or stays like that, and within this buffer zone there are numerous number of Reserved and protected forests are found, approximately around 12 RFs and 06 PFs as given in **Area Description(Chapter 2)** . The percentage of **River and water bodies** within the impact zone is 1.65%. The major river which flows within the study are and along which all the mine lease are located is river Betwa, there is River Birma which is also present within the Study area. The **Waste land** has the percentage which 8.67 %, **Built-up land** has 1.34% and **Fallow land** has 1.52% within the buffer zone as the major portion is of Crop land hence, very less land is available for Waste land, Built-up and Fallow land. And the least percentage if of **Sand** i.e. 0.40% within the buffer zone as it is majorly present within the impact zone comprising of River bed of Betwa River.

## **3.2 PHYSICAL ENVIRONMENT**

Under this section, the study of all-meteorological conditions viz. climate, rainfall and relative humidity and wind speed and wind direction of the study area/region is given. The study area for this particular study includes part of four districts i.e Hamirpur, Jalaun, Kanpur Nagar and Fatehpur along the river Betwa. Hence, the climate given here is of four districts:

- a. **Climate of the region/ area under study:** the study area includes the major part of two districts namely Hamirpur and Jalaun but it also includes part Kanpur Nagar & Fatehpur districts.

### **Hamirpur**

The climate of the district is subtropical, characterized by prolonged summer, mild winter and moderately heavy rainfall during monsoon season, about 90% of which is received from south-west monsoons. The summer season is from March to about middle of June is followed by the south-west monsoon season from mid-June to the end of September. The cold season is from mid- November to February. May is the hottest month with temperatures having upto 47°C and January is usually the coldest month with the temperatures as low as 2.6°C.

The average rainfall of the district is 864 mm. The relative humidity during south-west monsoon is highest in August (70-80%) and lowest (40%) during peak summer month of April & May. Hamirpur district comes under Agro-Ecological sub Region (ICAR) – Central Plains Zone (Bundelkhand).

### **Jalaun**

The climate of the district is sub-humid and is characterized by hot summers, humid monsoon and cold winters season. About 90% of the annual rainfall is received from south-west monsoon during the months from June to September. May and early June is the hottest part of the year with highest temperature recorded upto 47°C and mean daily minimum temperature as 27.1°C whereas mean daily maximum temperature as 42.6°C . With the advancement of monsoon by about mid-June, temperature drops appreciably in nights, January is the coldest month with daily mean temperature as 8.4°C. The average rainfall of the district is 862 mm. The mean monthly morning

relative humidity is 57% and mean monthly evening relative humidity 42%. The mean wind velocity is 703 kmph. The potential evapotranspiration is 1603.3 mm.

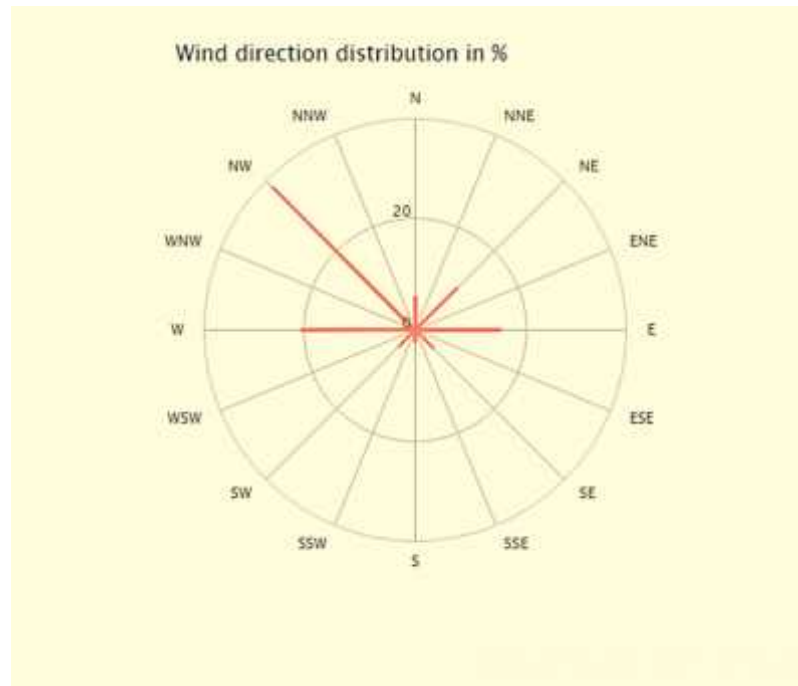
**b. Study Area:**

c. The climatic condition of the study area ranges from sub-tropical to sub-humid and the average rainfall ranges from 862 mm to 932 mm. May is the hottest month and January the coldest and more than 90% of the rainfall are received from the south-west monsoons. The average humidity of the region also varies from 60%-75% and August records the maximum monthly relative humidity approx. 80-85% while May records the lowest approx.. 20-25%. Winds of the region are generally high with some increase in force during summer and south-west monsoon season.

A) **Temperature:** The temperature during the months in which environmental monitoring has been done is shown below in Fig.3.10. The graph represents the mean monthly variation in the months of March, April and May. The rainfall data has been gathered from the IMD monitoring stations in each district of the past 5 years.

B) **Rainfall:** The variation in rainfall during the duration of environmental monitoring is shown below in Fig.3.12. The graph represents the mean monthly variation in the months of March, April and May. The rainfall data has been gathered from the IMD monitoring stations in each district of the past 5 years.

C) **Wind Speed and Wind Direction:** The winds are generally with an increase in force in summers and the early part of the south-west monsoon season. During the period from November to April winds are mostly from the west or North-west direction. With the advent of April strong and scorching winds locally called loo continue to blow till it is replaced by the rain bearing winds in the south-west monsoon season. By May easterlies and north- easterlies also appear. In the South-west monsoon season winds are either from the south-west and west or from the North-East and East direction. By October easterlies and North-easterlies become less common.



**Fig 3.16 Windrose Diagram of the Study Area**

D) **Ground water:** Seasonal fluctuation in water levels in the Study Area indicated minimal change in groundwater storage. Water table fluctuates in response to is direct function of the above. Recharge take place mainly during rainy season. The minimum depth to water level in area is expected sometime at the close of monsoon or in the middle of monsoon period depending upon the intensity and duration of rainfall as well as soil characteristics and maximum depth to water level is expected to the rain fall. generally occur below the surface clay and weathered material whose thickness is The Granitic base has got very uneven configuration. The fresh rock generally occur below the surface clay and weathered material whose thickness is variable. The maximum thick 120.00 mts observed in Sulempur block and north of Betwa river is over 150.00 mts. : Aquifer system prevails I tier – Ground water level to phreatic II tier – 150 m to 200 mts at base.

### **3.3 WATER ENVIRONMENT (GROUND & SURAFCE WATER)**

The working of the mine is unlikely to intersect with the groundwater as mining will be restricted well 1m above the ground water table. Water quality of surface and ground water resources in core and buffer zone of the study area has been studied for assessing the water environment. The two major aspects of the water environment related to mining activity is water availability and water quality. Water availability can be

understood in reference of water consumption and its sources which will be required for the process of mining and other related activities.

**Water Consumption and its sources:** Total water requirement for all the mine lease sites included in the study along the stretch or river Betwa situated in the district Hamirpur & Jalaun of Uttar Pradesh is approx. 1030.38 KLD. The water required for the drinking purpose will be procured from wells situated in nearby villages and for other purposes like plantation, dust suppression etc. will be taken care of by proponents of individual mine lease sites. The breakup of water requirement according to individual mine lease site is given .

Water Demand (KLD) for Sprinkling on Unpaved haulage road	Water Requirement for plantation (KLD)	Drinking water - Day worker (KLD)	Drinking water - Floting population (KLD)	Drinking water -Fixed population(K LD)	Stored water (KLD)	Total Water
10.88	0.040	0.54	0.35	0.51	0.10	12.42

**Water Quality:** Understanding of the water quality is essential in preparation of environmental impact assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation. The purpose of this study is to:

- Assess the water characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Prediction of impact on water quality through this project related activities.
- Suggest appropriate mitigation measures

The quality and quantity of ground water differ over area, as these depend on the physical and chemical parameters and also on topographical and hydro-geological characteristics of the area. To study the present water quality status of the area with respect to their physico-chemical, Biological & Bacteriological characteristics, 20 ground water & 21 surface water samples were collected and analyzed. Parameters for analysis of water quality were selected based on the utility of the particular source of water as per MoEF & CC guidance. Hence, quality of ground water was compared with IS: 10500 for drinking

purposes and surface water quality were compared with CPCB Water Quality Criteria against A, B, C, D & E class of water.

The analysis was done as per APHA and IS-3025 procedures. Ground water is the major source of potable water in the study area. The water quality standards are annexed and the analysis of the groundwater samples collected from different monitoring stations as part of this EIA study are summarized in Table No3.3.

### **Methodology:**

Monitoring locations were finalized based on following factors:

- Drainage pattern
- Location of major water bodies
- Location of residential areas representing different activities/ likely impact areas
- Areas which can represent baseline conditions

#### **A) Ground water:**

groundwater sources consisting of bore wells from site were examined during the study period for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of mining activities on ground water quality. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA) as well as IS 3025. Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1 ml HNO<sub>3</sub>. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like temperature, Dissolved Oxygen (DO), and pH were analyzed at the time of sample collection.

#### **Water Sampling Locations:**

Total 20 GW sampling locations 04 are dedicated to this project The ground water sampling locations are listed below in Table No3.4 and represented in Google Map in Fig No.3.19.

#### **Table No.3.4 Description of Ground water Monitoring Locations**

Sl. Nos.	Station Code	Location	Project Area	Coordinates	
1.	GW 1	Hajipur Saliya	Buffer Zone	25°53'19.68"N	79°47'49.90"E
2.	GW 2	Basrehi	Buffer Zone	25°52'55.45"N	79°46'19.63"E
3.	GW 3	Pathreta	Buffer Zone	25°52'3.01"N	79°48'58.25"E
4.	GW4	Jalalpur	Buffer Zone	25°51'37.36"N	79°48'24.47"E

**Table No 3.5 Analysis of Ground water Samples**

SN	PARAMETERS	UNIT	GW 1	GW 2	GW 3	GW 4	Acceptable Limit	Permissible Limit
			Hajipur Saliya	Basrehi	Pathreta	Jalalpur		
			2/3/2018	5/3/2018	9/3/2018	13/03/2018		
1	Colour	Hazen	< 1	< 1	< 1	< 1	5	15
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	pH Value at 25°C	-	7.41	7.52	7.62	7.34	6.5	8.5
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity	NTU	0.5	0.7	0.6	0.4	1	5
6	Total Dissolve Solids	mg/L	414	480	480	491	500	2000
7	Chloride (as Cl)	mg/L	70.4	74.3	65.2	67.8	250	1000
8	Fluoride (as F)	mg/L	0.16	0.14	0.13	0.15	1	1.5
9	Free Residual Chlorine	mg/L	BDL	BDL	BDL	BDL	0.2	1
10	Iron (as Fe)	mg/L	0.11	0.13	0.1	0.14	0.3	0.3
11	Total Hardness (as CaCO <sub>3</sub> )	mg/L	132	146	128	114	200	600
12	<i>E.coli</i>	MPN/10 0ml	<2	<2	<2	<2	note detected in 100ml sample	
13	Total Coliform	MPN/10 0ml	<2	<2	<2	<2	not detected in 100ml sample	

### Results of Primary Data (Ground water):

#### 1. pH

In general, a water with a pH < 7 is considered acidic and with a pH > 7 is considered basic. The normal range for pH for groundwater systems 6.5 to 8.5. water with a low pH (< 6.5) could be acidic, soft, and corrosive. Water with a pH > 8.5 could indicate that the water is hard.

***The analysis result of pH of samples is between 7.12 to 7.84 which is within acceptable limit of 6.5 to 8.5.***

## **2. Taste & Odour**

The taste problem includes Salty Brackish taste, Alkali Taste, Oily, Fishy Taste, Perfume like taste, or Metallic taste. Few causes are listed below-

<b>TASTE</b>	<b>CAUSE</b>
<b><i>Salty Brackish</i></b>	<b><i>High Sodium</i></b>
<b><i>Alkali</i></b>	<b><i>High Alkalinity, Hardness &amp; TDS</i></b>
<b><i>Oily, Fish, Perfume like</i></b>	<b><i>Surfactants</i></b>
<b><i>Metallic Taste</i></b>	<b><i>Low pH, High Metal Content, Corrosive Water</i></b>

The odour problem includes Rotten Egg odour, Musty odour, Earthy Odour, oily odour, chemical smell and others. Few causes are listed below-

<b>ODOUR</b>	<b>CAUSE</b>
<b><i>Rotten Egg odour</i></b> <b><i>Musty odour</i></b> <b><i>Earthy Odour</i></b> <b><i>Cucumber</i></b>	<b><i>Hydrogen sulfide, sulfate-reducing bacteria, Softwater reactions in electric water heaters, algal by-products, bacteria, algal by-products, surfactants</i></b>
<b><i>Oily smell</i></b>	<b><i>Gasoline or oil contamination</i></b>
<b><i>Methane like gas smell</i></b>	<b><i>Organic decomposition</i></b>
<b><i>Chemical smell</i></b>	<b><i>Organic chemicals, Industrial</i></b>

***The ground water samples of the present study area are up to the mark for taste and odour , i.e. agreeable and denies the presence of any factors affecting the taste and odour.***

## **3. TDS**

The amount and type of dissolved minerals within the ground water gives it the taste. Total dissolved solids (TDS), is defined as the concentration of all dissolved minerals in the water. TDS are a direct measurement of the interaction between ground water and subsurface minerals. High TDS, greater than 1000 mg/L, is commonly objectionable or offensive to taste. TDS levels over 2000 mg/L are generally considered undrinkable due to strongly offensive taste.

***The present analysis of Ground Water at different sampling points of study area is within acceptable limit, i.e. below 500.0 mg/l. The minimum and maximum values of TDS are 414.0 & 491.0 mg/L respectively.***

#### **4. Turbidity**

Turbidity refers to any solid or organic material that does not settle out of water. This means that the material is not dissolved but is in suspension. Such material includes dust particles and colloidal organic matter. Clear water has low turbidity and cloudy or murky water has a higher turbidity level.

***The turbidity level of every sample was below 1.0 NTU which is the Acceptable limit in case of ground water. The highest turbidity observed was 0.9 NTU and lowest 0.3 NTU.***

#### **5. Chloride**

Chloride in ground water originates from both natural and anthropogenic sources. High chloride content indicates heavy pollution. It can be due to the uses of inorganic fertilizer, landfills leachates, septic tank effluent and industrial and irrigation drainage.

***The highest value of chloride is 74.3 mg/L and lowest is 44.3 mg/L. There is no such potential source in the study area to elevate the concentration of Chloride in ground water, hence its concentration are within acceptable limit, i.e. below 250 mg/l.***

#### **6. Fluoride**

Most of the fluoride found in groundwater is naturally occurring from the breakdown of rocks and soils or weathering and deposition of atmospheric volcanic particles. Fluoride can also come from Runoff and infiltration of chemical fertilizers in agricultural areas , Septic and sewage treatment system discharges in communities with fluoridated water supplies & Liquid waste from industrial sources.

***The average analysis value of Fluoride is 0.15 mg/L and within the acceptable limit of 1.0 mg/l***

### **7. Iron**

The concentration of iron in natural water is controlled by both physico chemical and microbiological factors. It is contributed to ground water mainly from weathering of ferruginous minerals of igneous rocks such as hematite, magnetite and sulphide ores of sedimentary and metamorphic rocks.

***As per our analysis, the concentration of iron is below acceptable limit of 0.3 mg/l. The minimum and maximum concentration is 0.1 mg/L and 0.25 mg/L respectively.***

### **8. Total Hardness**

Water hardness in most groundwater is naturally occurring from weathering of limestone, sedimentary rock and calcium bearing minerals. Hardness can also occur locally in groundwater from chemical and mining industry effluent or excessive application of lime to the soil in agricultural areas.

Durfer and Backer Category of water depending upon Hardness

Hardness Category	Equivalent Concentration of CaCO <sub>3</sub>
Soft	< 60 mg/l
Medium Hard	60 mg/L to < 120 mg/L
Hard	120 to < 180 mg/L
Very Hard	180 mg/L or greater

***As per the analysis result , the minimum and maximum values for hardness are 84.0 & 154.0 mg/L respectively which indicates that the ground water of study area is Medium Hard to Hard.***

### **9. E.coli & Total Coliform**

Not detected in any of the ground water sample of the study area.

Total 21 GW sampling locations 03 are dedicated to this project The surface water sampling locations are listed below in Table No 3.5 and represented in Google Map inFig3.22.

**Table No 3.6.Description of surface water sampling sites**

Sl. Nos.	Station Code	Location	Project Area	Coordinates	
2.	SW 2	Himanpura	Core Zone	25°51'47.77"N	79°47'42.16"E
3.	SW 3	Pathreta	Core Zone	25°52'24.60"N	79°48'42.47"E
4.	SW 4	Hajipur Saliya	Core Zone	25°53'24.71"N	79°48'50.16"E

**Table No 3.7. Analysis of Surface water Samples**

SN	Parameters	Unit	Himanpura	Pathreta	Hajipur Saliya
			4/3/2018	8/3/2018	8/3/2018
1	Colour	Hazen	<1	<1	<1
2	Odour	-	Agreeable	Agreeable	Agreeable
3	pH Value at 25°C	-	7.49	7.66	7.7
4	Total Dissolve Solids	mg/L	434	464	518
5	Total Suspended Solids	mg/L	34	28	20
6	Total Solids	mg/L	468	492	588
7	Temperature	°C	29.5	29.7	29.7
8	Conductivity at 25°C	µmhos/cm	660	712	790
9	Calcium (as Ca)	mg/L	52.1	60.2	64.1
10	Ammonical Nitrogen	mg/L	2.45	1.52	1.52
11	Chloride (as Cl)	mg/L	47.6	50.6	56.8
12	Iron (as Fe)	mg/L	0.16	0.13	0.13
13	Magnesium (as Mg)	mg/L	48.5	40.5	44.5
14	Nitrate (as NO <sub>3</sub> )	mg/L	34.6	42.5	47.5
15	Potassium (as K)	mg/L	46.1	43.7	50
16	Phosphate (as PO <sub>4</sub> )	mg/L	0.52	0.83	0.83
17	Sodium (as Na)	mg/L	88	130	100
18	Sulphate (as SO <sub>4</sub> )	mg/L	43.5	40.2	45.1
19	Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	152	155	132
20	Total Hardness (as CaCO <sub>3</sub> )	mg/L	348	296	286
21	Biochemical Oxygen Demand	mg/L	12	10	16
	Dissolved Oxygen (DO)	mg/L	5.4	5.2	4.2
22	Chemical Oxygen Demand	mg/L	32	32	32
23	Faecal Coliform	MPN/100mL	43	28	34

### **Result of Primary Data**

#### ***CPCB Standards***

**A= Drinking water source without conventional treatment but after disinfection.**

**B= Outdoor Bathing (Organized).**

**C= Drinking Water source with conventional treatment followed by disinfection.**

**D= Propagation of wild life, fisheries.**

**E= Irrigation, Industrial, Cooling, Controlled Waste Disposal.**

### ***1. Colour & Odour***

***The surface water samples of the present study area are up to the mark for colour and odour, i.e. agreeable and denies the presence of any factors affecting the colour and odour. It matches the Class A Category of Surface Water as per CPCB Standards.***

### ***2. pH***

In general, water with a pH < 7 is considered acidic and with a pH > 7 is considered basic. The normal range for pH for Surface water systems is 6.5 to 8.5. Water with a low pH (< 6.5) could be acidic, soft, and corrosive. Water with a pH > 8.5 could indicate that the water is hard.

***The analysis result of pH of samples are between 7.38 to 7.96 which are within acceptable limit, i.e. between 6.5 to 8.5 of Class A Category of Surface Water as per CPCB Standards.***

### ***3. Total Dissolved Solids***

The TDS varied from a minimum of 434.0 mg/L to a maximum of 604 mg/L . The values are generally higher in the summer seasons due to reduction in water volume. When TDS > 1000 mg/L , the water is likely to have objectionable tastes; however, no water sample in the present work, had TDS ≥ 1000 mg/L. Total dissolved solids represent the amount of soluble inorganic substances in the water and originates from natural sources, sewage, urban runoff, industrial wastewater and chemicals used in the water treatment process.

***TDS results falls in Class A & B Category of Surface Water as per CPCB Standards.***

### ***4. Total Suspended Solid***

The suspended or colloidal particles, commonly referred to as total suspended solids (TSS), are all the extremely small suspended solids in water which will not settle out by gravity. The minimum and maximum TSS are 18.0 mg/L & 28.0 mg/L respectively. These values are well within the limit of 100.0 mg/L as per BIS 2296 : 1982.

### ***5. Conductivity***

Conductivity is directly related to the concentration of ions in water. The more ions that are present, the higher the conductivity of water. Likewise, the fewer ions that are in the water, the less conductive it is.

The minimum value of conductivity is 660.0  $\mu\text{mhos/cm}$  and Maximum 920.0  $\mu\text{mhos/cm}$  and falls under ***Class, A, B & C Category of Surface Water as per CPCB Standards***

### **6. Calcium & Magnesium**

Calcium and magnesium doesn't have wide variations in values. The minimum and maximum values of Calcium are 45.6 mg/L & 64.1 mg/L and that of Magnesium are 37.9 mg/L & 50.8 mg/L. None of the samples of Calcium crossed the limits of 75.0 mg/L as per the BIS Standards. The values for Magnesium are within the permissible limit of 100 mg/L as per BIS Standards..

### **7. Chloride**

The minimum and maximum values of Chloride in the study area are **46.2 & 60.5 mg/L** which are within ***permissible limits of Class A Category of Surface Water as per CPCB Standards.***

High concentration of chloride makes water unpalatable and unfit for drinking and livestock watering. However, all the surface water sources show Cl values below the permissible limit of 250 mg/L which can be attributed to-

- (i) The rate of percolation of agricultural and domestic wastes to the surface water bodies (the area is not industrial) is low .
- (ii) The contributions from the geological formations of the area are not much significant preventing the sources from excessive chloride accumulation.

### **8. Iron**

The iron content of surface water in the study area ranges from 0.13 mg/L (min) to 0.21 mg/L (max) in the months of March, April & May 2018.

These analysis reports are within the permissible limit (0.3 mg/L) ***of Class A Category of Surface Water as per CPCB Standards.***

### **9. Nitrate**

The surface water of the investigated area contains nitrate from 28.1 to 47.5 mg/L.

The higher values of nitrate indicate runoff from agricultural lands where manure and/or chemical fertilizers have been applied.

The values of Nitrate are far below than the permissible limit of 50 mg/L and falls in ***Class B & C Category of Surface Water as per CPCB Standards.***

#### ***10. Dissolved Oxygen***

The average Dissolved Oxygen levels in water quality of River Betwa is meeting the desired levels of **Class 'C'** (4.0 mg/l) and **Class 'B'** (5.0 mg/l) of Drinking water source with conventional treatment followed by disinfection, and Outdoor bathing (Organized) respectively.

***The minimum and maximum values of DO in the study area are 4.0 and 6.2 mg/L respectively.***

#### ***11. Total Hardness***

The total hardness of the surface water is dependent on the presence of Ca and Mg contents that enter the water bodies through residues of soaps, detergents and parent bed rock materials made up of Ca, Mg and other metal ions.

***The total hardness values of the surface water samples varied from 286 – 366 mg/L.. Using Durfer and Backer classification, the surface water bodies in the study area are Very Hard.***

#### ***12. Biological Oxygen Demand***

The BOD levels in water quality of River Betwa vary from 8.0 mg/l to 18.0 mg/l. These values are slightly higher than the standards because of great amount of microorganisms, mainly aerobic bacteria due to faecal contamination of humans and animals into river water.

#### ***13. Faecal Coliform***

The presence of faecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the faecal material of man or other animals.

***However in the study area, the Faecal Coliform ranges from 12.0 – 64.0 MPN/100 ml.***

River water can be considered fit for bathing if the faecal coliform count is between the desirable limit of 500 and maximum permissible limit of 2,500 mpn (most probable number) per 100 ml.

#### ***14. Total Alkalinity***

The minimum and maximum values of total Alkalinity in the study area are 120.0 – 191.0 mg/L which are well within the limit of BIS standards.

***As per BIS limit 1998, the desirable limit is 200 mg/L and permissible limit is 600 mg/L***

### **3.4 AIR ENVIRONMENT**

The ambient air quality for this region including core zone and buffer zone is studied for once complete season during **March, 2018 to May, 2018** which is Pre-Monsoon- Summer Season. The ambient air samples were collected to monitor the amount of pollutants in the buffer zone in the different directions from the individual mine lease site and also from the point source within the core zone. Since, this Environmental Impact Assessment study is undertaken to assess the impacts of individual mine lease areas and the cumulative impact of all mine sites on the complete stretch of the River Betwa under study. In this other point sources of pollution will also be identified (already existing ones) and a correlation will be established for the existing air quality and the anticipated impact of the new upcoming projects of Mining.

#### **3.4.1 Selection of monitoring locations**

The ambient air quality monitoring stations are selected in accordance with the wind rose drawn based on the wind direction, distance from the mine sites and the coverage factor of the sites are also taken into considerations. A general guide to the no. of minimum stations and its distribution needed for monitoring trends of the common pollutants in urban areas based on population consideration is recommended in IS 5182 Part 14; 2000.

#### ***Location of Sampling Stations***

Some of the principal factors governing the locations of the sampling stations are the objectives, the particular method of instrument used for sampling, resources available, physical access and security against loss and tampering. Sampling locations may be fixed

or mobile. Recommended procedures for insitu sampling are :- When the objective is to study the effects of the presence of a constituent in the atmosphere, namely, health hazards, material damage due to corrosion, etc, the sampling location should be as close as possible to specific locations where the effects are being studied. For example, the most appropriate location for studying health hazards are population centres and certain critical areas, such as hospitals and schools where more vulnerable section of the public is present. The ideal height, at which sampling should be done, is the breathing level. When the objective is to study material damage, similar principle should be followed. For example, for assessment of damage to vegetation, sampling-should be done at foliage level and that for damage to overhead electrical wire should be done at the level of the wires.

When the objective is to determine the background levels of pollution in a given area, an ideal system of location of the samplers is in the form of a grid, which may be rectangular or radial depending upon whether the sources of pollution may be treated as an area source or an effectively single source respectively. The minimum number of locations required for such a system depend upon the variability of pollutant concentration over the area under survey. The spatial distribution of the samplers should be such that variation between adjacent sampling locations is sufficient to obtain the corroboration of the dispersion model used or to determine the modification to the model, if necessary, to suit local conditions. Physical Requirements, the site where the station is located should fulfill one or more of the following requirements depending on the types of instruments used:

- a) it should be available for a long period;
- b) it should preferably be accessible any time throughout the year;
- c) electrical power of sufficient rating should be available
- d) it should be vandal-proof; and
- e) it may need to be protected from extreme of temperatures.

The network density appears to have a seasonal variation with fewer stations being required in the summer than in the winter. This is because concentrations of pollution in summer are uniformly low particularly at residential areas thus single station is a good predictor of air quality over a relatively large neighbourhood.

. For generating background data on the ambient air quality around the proposed site of a development project, ambient air quality monitoring is necessary. When proposal relates to air quality trend analysis, the main criteria for network density is population. A city with population of 0.5 to 1 million should have 5 to 10 monitoring stations distributed so that one station represents 10 to 20 km<sup>2</sup> In cities with large number of population with complex topography or with an unusually large large number of pollution sources one station per 5 to 10 km<sup>2</sup> is suggested.

**3.4.2. Recommended Minimum Number of Stations, Population-Wise (Clause 10.7.2.2)**

<b>Pollutant</b>	<b>Population of Evaluation Area</b>	<b>Minimum No. of AAQ Monitoring Station</b>
SPM (Hi-Vol)	< 100 000	4
	100 000 - 1 000 000	3+ 0.6 per 100-000 population
	1 000 000 - 5 000 000	7.5 + 0.25 per 100 000 population
	>5 000 000	12 + 0.16 per 100 000 population
SO <sub>2</sub>	< 100 000	3
	100 000 - 1 000 000	2.5+0.5 per 100 000 population
	1 000 000 - 10 000 000	6 + 0.15 per 100 000 population
	>10 000 000	20
NO <sub>2</sub>	< 100 000	4
	100 000 - 5 000 000	2 + 0.6 per 100 000 population
	>5 000 000	3 10
CO	< 100 000	1
	100 000 - 10 000 000	1 + 0.15. per 100 000 population
	>10 000 000	6 + 0.05 per 100 000 population
Oxidants	- do-	- do-

In cities with low traffic and a population of > 4 million, the no. of station can be reduced. A site is representative if the data generated from the site reflects the concentrations of pollutants and their variations, in the area. The stations are located at a place where interferences are not present or anticipated. Higher concentrations of pollutants are possible in the vicinity of roads, highways. The gradients vary in both time and space on the micro and on the neighbourhood scale. The recommended criteria for siting monitoring location and the values of base line data is based on compromise between

available resources and site specific parameters such as nearby sources, concentration gradients of pollutants etc. Most of the monitoring locations are TypeC – Type F.

Type C	Residential Station
Type D	Mesoscale Station
Type E	Non – urban station
Type F	Specialised source survey station

PM<sub>2.5</sub> & PM<sub>10</sub> have been estimated by Gravimetric method IS: 5182. Modified West and Gaeke method (IS-5182 part-II, 1969) has been adopted for estimation of SO<sub>2</sub> and Jacobs-Hochheiser method (IS-5182 part-VI, 1975) has been adopted for the estimation of NO<sub>x</sub>. Out of 35 ambient air monitoring location 04 stations are dedicatedly for this project. Description of sampling locations along with the Map is shown below:

**Table No 3.8. Description of Ambient air Quality Sampling Locations**

Sl. Nos.	Station Code	Location	Project Area	Coordinates
1.	AQ2	Basrehi	Buffer Zone	25°52'55.45"N 79°46'19.63"E
2.	AQ5	Pathreta	Buffer Zone	25°52'13.67"N 79°48'49.59"E
3.	AQ9	Bhedi Danda	Core Zone	25°53'53.16"N 79°49'34.78"E
4.	AQ10	Hasapur Sensa	Buffer Zone	25°51'22.10"N 79°51'27.83"E



**Fig3.28. Location of Ambient Air Quality Monitoring sites on Google Map**

In addition to ambient air quality monitoring the National Ambient Air Quality data published by Central Pollution Control Board for the locations close to the project has also been reviewed.

Composite samples were prepared using three 8-hr samples collected at each location. Monitoring was done with a frequency of twice a week at each location. The monitoring duration was 3 months. The samples were analyzed for pollutants of interest ( $\text{SiO}_2$ ,  $\text{NO}_x$ ,  $\text{SO}_2$ ,  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ) using the appropriate method prescribed by Bureau of Indian Standards and Central Pollution Control Board is given as an annexure. The ambient air quality monitoring was done for 3-month duration during March-May 2018.

The parameters monitored were:

- $\text{PM}_{10}$
- $\text{PM}_{2.5}$
- Sulphur dioxide ( $\text{SO}_2$ )
- Oxides of Nitrogen ( $\text{NO}_x$ )
- Carbon Monoxide (CO)
- Free Silica ( $\text{SiO}_2$ )

For gaseous samples, 8 hourly samples were collected, while 24 hourly sampling was conducted for PM<sub>10</sub> and PM<sub>2.5</sub>. NAAQS standards are attached as Annexure.

**Table No. 3.9. Sampling and Testing Methodology**

Parameter	Duration of Sampling	Recommended Analytical Procedure	Method of Test
PM <sub>10</sub> and	24 hours – continuous	Gravimetric Method as per IS: 5182	IS 5182 Part 23: 2006
PM <sub>2.5</sub>	24 hours – continuous		NAAQS Monitoring & Analysis Guidelines Volumes-1, 2011 CPCB
SO <sub>2</sub>	8 hours – continuous	Pararosaniline – Colorimetric method (Modified West & Gaeke Procedure)	IS 5182 Part 2: 2001
NO <sub>2</sub>	8 hours – continuous	Modified Jacob & Hochheiser Method	IS 5182 Part 2:2006
CO	8 hours – continuous		EPA Method 13
SiO <sub>2</sub>	8 hours – continuous		NIOSH

**Table No.3.10.. Analysis of Ambient Air Quality**

<b>Parameters</b>	<b>AQ 2</b>	<b>AQ 5</b>	<b>AQ 9</b>	<b>AQ 10</b>
<b>PM<sub>2.5</sub> (Max)</b>	<b>63</b>	<b>62</b>	<b>64</b>	<b>66</b>
<b>PM<sub>2.5</sub> (Min)</b>	<b>42</b>	<b>42</b>	<b>42</b>	<b>42</b>
<b>Parameters</b>	<b>AQ 2</b>	<b>AQ 5</b>	<b>AQ 9</b>	<b>AQ 10</b>
<b>PM<sub>10</sub> (Max)</b>	<b>104</b>	<b>98</b>	<b>104</b>	<b>108</b>
<b>PM<sub>10</sub> (Min)</b>	<b>78</b>	<b>74</b>	<b>76</b>	<b>76</b>
<b>Parameters</b>	<b>AQ 2</b>	<b>AQ 5</b>	<b>AQ 9</b>	<b>AQ 10</b>
<b>SO<sub>2</sub> (Max)</b>	<b>9.6</b>	<b>10.9</b>	<b>9.6</b>	<b>11.9</b>
<b>SO<sub>2</sub> (Min)</b>	<b>6.4</b>	<b>6.5</b>	<b>6.4</b>	<b>6.5</b>
<b>Parameters</b>	<b>AQ 2</b>	<b>AQ 5</b>	<b>AQ 9</b>	<b>AQ 10</b>
<b>NO<sub>x</sub> (Max)</b>	<b>12.2</b>	<b>13.4</b>	<b>12.2</b>	<b>12.8</b>
<b>NO<sub>x</sub> (Min)</b>	<b>8</b>	<b>8.8</b>	<b>8.8</b>	<b>8.8</b>

### Results of Ambient Air Quality

For Fugitive dust emission at any site, the most prevalent particulate sources, such as unpaved roads, bare ground, and loading. The upwind and downwind concentrations of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> were measured. Emission of fugitive dust are influenced by moisture content, silt content, wind speed, and vehicle activity on unpaved roads, which includes vehicle speed and vehicle counts. The value of PM<sub>2.5</sub> is higher on all the monitoring locations than the NAAQS, 2009 (Attached as annexure-) standards with exception of AQ 30 and AQ32 i.e. Ramedi and Bhilawa dariya. Higher PM<sub>2.5</sub> levels may be contributed due to traditional ways of cooking along with vehicular emission. PM<sub>10</sub> in the area may be formed by physical processes of abrasion of surfaces and agricultural activities. The anthropogenic source are coarse particles are produced by the mechanical break-up of larger solid particles, wind blown dust such as road dust,soot, agricultural processes, combustion of fossil fuel . It also causes visibility reduction Almost all the monitoring locations are having higher PM<sub>10</sub>. SO<sub>2</sub> and NO<sub>2</sub> are far below standards.

### **3.4.3. Free Silica**

The NAAQ standards prescribed for Industrial, Residential, Rural and other areas do not define limits for standards of free silica in ambient air. Silica is a component of PM<sub>10</sub>, standards for which are prescribed under the NAAQ. Crystalline silica is composed of SiO<sub>2</sub> whereas SiO<sub>2</sub> in the pure form (not combined with cations) is free silica.

Rock quarries, sand/morrum /minerals mining and rock crushing are potential crystalline silica sources. The size of crystalline silica particles is smaller than 4 µm (PM<sub>4</sub>). There are no generally accepted methods of monitoring in ambient PM<sub>4</sub> air.

PM<sub>10</sub> emissions as observed in the baseline study ranged from 74.0 to 118.0µg/m<sup>3</sup>, inclusive of free silica, which was well within the standards specified for PM<sub>10</sub> (100 µg/m<sup>3</sup>). U.S.E.P.A has assumed that 10% of total PM<sub>10</sub> in ambient air was crystalline silica.

This would indicate that the free silica content in ambient air based on PM<sub>10</sub> concentrations would generally not be more than 7.40 or 11.80 µg/m<sup>3</sup>. No corresponding studies for India are available.

The ambient air sampling protocol established as a guideline to the E.I.A clearance process by the CPCB also does not prescribe sampling for free silica in ambient air.

The incremental conc. of TSPM is expected to be 1.25µg/m<sup>3</sup>. It has been assumed in studies that 85% of the TSPM is composed of PM<sub>10</sub>. Under these circumstances, the maximum incremental PM<sub>10</sub> is not likely to be beyond 1.06µg/m<sup>3</sup>. It has also been reported that the percentage of silica in ambient air is almost the same as in the background source material. The percentage of SiO<sub>2</sub> in sand/morrum is about 90%. Assuming this, the incremental concentration of free silica is expected to be 0.954µg/m<sup>3</sup> (90% of 1.06µg/m<sup>3</sup>). No standards are prescribed but the PM<sub>10</sub> is within standards.

Inhaling finely divided crystalline silica dust in very small quantities overtime can lead to silicosis, bronchitis or cancer. The American Conference of Governmental Industrial Hygienists recommends 0.1 mg/m<sup>3</sup> (10µg/m<sup>3</sup>) crystalline silica as respirable free silica as exposure limits.

*Source: Ambient Levels and Non-cancer Health Effects of Inhaled Crystalline and Amorphous Silica: Health Issue Assessment EPA/600/R-95/115 November 1996, Report to the Natural Resources Board, August 2011 AM-407, Wisconsin Department of Natural Resources, Hazard Prevention and Control in the Work Environment- Air Borne Dust- WHO/SOE/OEH/99.14, Baseline Monitoring and Fugitive Dust Modeling.*

AQ Stn. Name	Remarks
AQ 2	Significant incremental value was observed in PM10 due to near and upwind direction from the haulage rout whereas all pollutants concentrations were below the NAAQS permissible limit due to haulage route (300m) and sand/morrum mines project more than 1000m. It was situated in core zone.
AQ 5	All pollutants concentrations were below the NAAQS permissible limit due to more distance from haulage and projects (about 1km).
AQ 9	PM10 concentration was above the NAAQS permissible limit due to near three haulage route (<300 m) and 2 sand/morrum mine project less than 200m. It was situated in core zone.
AQ 10	All pollutants concentrations were below the NAAQS permissible limit due to higher distance from project and haulage road (5km) &AQ station located near forest area.

### 3.5 NOISE ENVIRONMENT

Noise attributed to roads depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion and smoothness of road surface (IRC: 104-1988). High noise levels are a concern for sensitive receptors, i.e., hospitals, educational institutions, etc.

The Central Pollution Control Board has specified ambient noise levels for different land uses for day and night times. Importance was given to the timing of exposure and areas designated as sensitive. The noise standard specified by the Central Pollution Control Board is annexed in the end of report.

**Note:** (1) **Day-time:** 6 AM to 10 PM, **Night-time:** 10 PM to 6 AM;

The noise monitoring was conducted at **35 locations** within the study area. Normally, for selection of noise monitoring stations, sensitivity of sites is also considered. As per the CPCB standards, sensitive locations are covered under Silence Zone, which includes an area up to 100 m around premises as hospitals, educational institutions and courts.

The “A weighted” sound level was continuously measured using Noise meter at 60 minutes interval for one day in each survey locations as per the CPCB procedures. The parameters monitored are given as below:

- **L<sub>min</sub>** - Minimum Noise Level Recorded
- **L<sub>max</sub>** - Maximum Noise Level Recorded
- **L<sub>d</sub>** - Day Equivalent (6 AM to 10 PM)
- **L<sub>n</sub>** - Night Equivalent (10 PM to 6 AM)

The lists of location of ambient noise monitoring stations are given in the Table No3.11 and represented on the Google Map in Figure No3.38

**Table No3.11. Ambient Noise Quality Monitoring Stations**

Sl. No.	Station Code	Location	Project Area	Coordinates
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1	NQ 2	Basrehi	Buffer Zone	25°52'55.45"N 79°46'19.63"E
2	NQ 5	Pathreta	Buffer Zone	25°52'13.67"N 79°48'49.59"E
3	NQ9	Bhedi Danda	Core Zone	25°53'53.16"N 79°49'34.78"E
4	NQ 10	Hasapur Sensa	Buffer Zone	25°51'22.10"N 79°51'27.83"E

**Table No3.12. Noise Quality Monitoring Data**

<b>Location Code</b>	<b>N2</b>	<b>N5</b>	<b>N9</b>	<b>N10</b>
Maximum	62.4	58.8	56	58.2
Minimum	40.8	39	36.1	40.8
Ld	56.9	54	51.7	52.1
Ln	43.3	41.9	40.6	42.6
Ldn	56.1	53.4	51.4	52.9

### **3.6 SOIL ENVIRONMENT**

The normal mineral composition of plants is altered by alteration in the soil condition. To know the existing quality of the soil in and around the study area, **19** representative soil-sampling stations were located & set. Soil samples were tested for their physico-chemical & microbiological properties as per BIS specification.

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

The present study of the soils establishes the cumulative baseline characteristics of the entire mine leases lying in the study area, this will help in future in identifying the incremental concentrations if any, due to the enhancement of capacity and allied operations for the wholen region.

The sampling locations have been identified with the following objectives:

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

19 locations within the entire area under study were selected for soil sampling. At each location, soil samples were collected as per BIS specifications. The homogenized samples were analyzed for physical and chemical characteristics. Samples were taken four times during the study period covering various seasons. The samples have been analyzed as per the established scientific methods for physico-chemical parameters. Out of total 19 sampling locations, 03 are specifically for this project.

The list of all sampling location is given in Table No.3.15 and are depicted in Figure No.3.41 and the results for the same are discussed below.

**Table No. 3.15. Description of Soil Quality Sampling Locations**

Sl. Nos.	Station Code	Location	Project Area	Coordinates
1.	SQ 1	Hajipur Saliya	Buffer Zone	25°53'19.68"N 79°47'49.90"E
3.	SQ 3	Pathreta	Buffer Zone	25°52'3.01"N 79°48'58.25"E
4.	SQ4	Jalalpur	Buffer Zone	25°51'37.36"N 79°48'24.47"E

**Table No 3.16. Result of Soil Analysis**

Sl. No.	Parameters	SQ1	SQ3	SQ4
1	pH Value at 25°C	7.42	7.53	7.4
2	Conductivity at 25°C	652	654	685
3	Moisture	9.2	12.8	11.9
4	Sodium (as Na)	281	308	290
5	Potassium (as K)	128	119	120
6	Total Kjeldhal Nitrogen	712	642	587
7	Phosphorus	80	68	64
8	Organic Matter	1.09	1.19	1.19
9	Magnesium (as Mg)	132	162	110

<b>10</b>	Cation Exchange Capacity	16.4	15.5	14.6
<b>11</b>	Water Holding Capacity	23.5	21.8	21.8
<b>12</b>	Bulk Density	1.21	1.26	1.23
<b>13</b>	Porosity	14.3	13.1	13.9
<b>Soil Gran Size Analysis/ Texture</b>				
		<b>SQ<sub>1</sub></b>	<b>SQ<sub>3</sub></b>	<b>SQ<sub>4</sub></b>
<b>1</b>	Sand	52.5	53.3	55.1
<b>2</b>	Silt	22.7	21.8	21.8
<b>3</b>	Clay	24.8	24.9	23.1

### 3.7 BIOLOGICAL ENVIRONMENT

**A) WETLANDS:** The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty, which provides the framework for National action and International cooperation for the conservation and wise use of wetlands and their resources. As per the Ramsar Convention on Wetlands, 25 sites (as of February 2, 2007) in India are designated as Wetlands of International Importance. Only one wetland viz. Upper Ganga falls in Uttar Pradesh state, which is very far away from the project site.

**National Wetland Conservation Programme** identified 16 wetland sites in Uttar Pradesh as on June 26<sup>th</sup> 2009. Out of these, none of them is located within the study area of this EIA study.

**Hamirpur:** Hamirpur is located at 25.95°N latitude and 80.15°E longitude. It has an average elevation of 80 metres. The district is bounded by districts Jalaun (Orai), Kanpur and Fatehpur in the North, Banda in the East, Mahoba in South and Districts of Jhansi and Jalaun on the West.

The total wetland area in the district is **15283** ha. Major wetland types of the district are river/stream and reservoir/barrages and contribute 82 per cent area of the district. There are 3 reservoirs/barrages found in the district with 1336 ha area. There are 229 Tanks/ponds with 851 area (5.57%). In addition, 1373 small wetlands (<2.25 ha) identified and demarcated as point feature. Wetland area estimates of the district are summarized in Table No3.16.

Area under aquatic vegetation in pre-monsoon season is 533 ha during post-monsoon season while in pre- monsoon season it reduced to 259 ha. Water spread area in post-

monsoon season is 8726 ha. Where as in pre-monsoon season the water spread area is 7158 ha. Low turbidity is observed in many wetlands during both the seasons. Area estimates are high in low turbidity class (6363 ha during post-monsoon season and 5652 ha during pre-monsoon season).

**Table No 3.17. Area estimates of wetlands in Hamirpur (Area in ha)**

Sl. Nos	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% wetland Area	Open Water	
						Post Monsoon Area	Pre-Monsoon Area
	1100	Inland Wetlands- Natural					
1	1101	Lakes/Ponds	52	403	2.64	233	118
2	1102	Ox-bow lakes/cut-off meanders	3	49	0.32	7	2
3	1103	High altitude wetlands	--	--	--	--	--
4	1104	Riverine wetlands	3	4	0.03	0	0
5	1105	Waterlogged	31	118	0.77	84	43
6	1106	River/Stream	63	11083	72.52	6612	6092
	1200	Inland Wetlands- Man-Made					
7	1201	Reservoirs/Barrages	3	1336	8.74	1335	811
8	1202	Tanks/Ponds	229	851	5.57	417	92
9	1203	Waterlogged	13	66	0.43	38	0
10	1204	Salt Pans	--	--	--	--	--
		Sub-Total	397	13910	91.02	8726	7158
		Wetlands(<2.25 ha), mainly Tanks	1373	1373	8.98	--	--
		Total	1770	15283	100.0	8726	7158
Area under Aquatic Vegetation						533	259
Area under turbidity levels							
Low						6363	5652
Moderate						2342	71
High						21	1435

**Jalaun:** Jalaun district is adjoined by the districts of Etawah and Kanpur in the north across the river Yamuna, while Hamirpur District lies to the east and southeast, Jhansi District lies to the southeast, and Bhind District of Madhya Pradesh lies to the west. Jalaun district has its headquarters at Orai town, located at 25°59' to 25.98°N latitude and 79°28' to 79.47°E longitude. It has an average elevation of 131 metres.

The total wetland area in the district is 12719 ha. Major wetland types of the district are river/stream, tanks/ponds and waterlogged areas. There are 89 tanks/ponds, 214 natural waterlogged areas and accounts for 346 ha, 490 ha respectively There are 1411 small wetlands (<2.25 ha) identified and demarcated as point feature. Wetland area estimates of the district are summarized in Table No 3.17

Area under aquatic vegetation in pre-monsoon season is 203 ha during post-monsoon season while in pre- monsoon season it reduced to 94 ha. Not much variation is observed in open water area, which varied from 7286 ha in post-monsoon season to 6375 ha in pre-monsoon season. Low and moderate turbidity is observed in many wetlands during post-monsoon season. Most of the tanks have shown low turbidity.

**Table No 3.18. Area estimates of Wetlands in district Jalaun (Area in ha)**

Sl. Nos	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% wetland Area	Open Water	
						Post Monsoon Area	Pre-Monsoon Area
	1100	Inland Wetlands- Natural					
1	1101	Lakes/Ponds	6	39	0.31	10	3
2	1102	Ox-bow lakes/cut-off meanders	1	208	1.64	208	0
3	1103	High altitude wetlands	--	--	--	--	--
4	1104	Riverine wetlands	15	59	0.46	30	3
5	1105	Waterlogged	214	490	3.85	292	25
6	1106	River/Stream	51	10161	79.89	6527	6299

	1200	Inland Wetlands- Man-Made					
7	1201	Reservoirs/Barrages	--	--	--	--	--
8	1202	Tanks/Ponds	89	346	2.72	216	45
9	1203	Waterlogged	2	5	0.04	3	0
10	1204	Salt Pans	--	--	--	--	--
		Sub-Total	378	11308	88.91	7286	6375
		Wetlands(<2.25 ha), mainly Tanks	1411	1411	11.09	--	--
		Total	1789	12719	100.0	7286	6375
		Area under Aquatic Vegetation				203	94
		Area under turbidity levels					
		Low				3974	3596
		Moderate				3033	60
		High				279	2719

## B) FLORA AND FAUNA

Biological environment is a dynamic complex of plant, animal and microorganism communities and non-living (abiotic) elements, all interacting as a functional unit. The biological environment is another important component of the EIA of the mining activity which need to be studied, however the major impact will be on land environment and also to an extent on the environment of river as mining will be done in dry river bed. In this Chapter the diversity of flora and fauna and their interaction with the abiotic environment are expressed.

India's tree and forest cover has registered an increase of 1% or 8,021 sq. km in two years since 2015, according to the latest assessment by the government (ISFR) 2017. Uttar Pradesh is the fourth largest state of the country with an area of 2,40,928 km<sup>2</sup> constituting 7.33% of geographical area of the country. The recorded Forest area of the state is 16,580 km<sup>2</sup> which is 6.88 % of its geographical area. The Reserved Forests constitute (12,126 km<sup>2</sup>) 72.79%, Protected Forests (1,223 km<sup>2</sup>) 6.98% and Unclassed Forests (3,228 km<sup>2</sup>) 20.23% (FSI, 2017). Due to non-availability of digitized boundary of recorded forest area from the state, the updated

green wash which is 13,523 km<sup>2</sup> has been used and the analysis of forest covers within and outside this area.

**Table 3.19. Altitude-wise Forest cover (Area in sq km)**

Altitude zone (m)	Geo. Area	Very Dense Forest	Moderate Dense Forest	Open forest	Total
0-500	2,40,458	2,617	3,883	7,771	14,271
500-1000	670	0	186	222	408
Total	2,49,928	2,617	4069	7,993	14,679

(Source :FSI,2017)

**Table 3.20. Forest cover in different patch size classes**

S.No.	Patch size (Sq.Km)	No of patch	Area (Sq.Km)	%age
1.	0.01-1.0	64,469	3,627	24.71
2.	1.0-10.0	728	1,934	13.17
3.	10-100	97	2,508	17.09
4.	100-500	20	4,086	27.84
5.	500-1000	4	2,524	17.19
	<b>Total</b>	<b>65,318</b>	<b>14,679</b>	<b>100.00</b>

(Source :FSI,2017)

**Table No. 3.21. District wise list of forests**

District	Geographical Area	Very Dense Forest	Mod. Dense Forest	Open Forest	Total	% of GA	Change*	Scrub
Hamirpur	4021	00	80	147	227	5.65	50	14
Jalaun	4565	00	61	188	249	5.45	4	36
Jhansi	5024	00	42	261	303	6.03	88	40

## 1. FLORA

### QUALITATIVE STUDY OF TERRESTRIAL VEGETATION

In order to carryout qualitative study of the terrestrial flora, buffer zone of 10 km from river bank of Betwa all along the stretch under study has been surveyed extensively by criss-cross movement and records of field data were made. The plant species falling under dicots, monocots, pteridophytes, thalophytes, parasites, and epiphytes were enlisted in alphabetical sequence with botanical, common and family name. The list thus

produced is not absolute inventory but represents the maximum coverage.

The forests of Hamirpur, Jalaun and Jhansi districts belong to the Northern Tropical Dry-Deciduous type according to Champion & Seth Classification (group 4b). The forests of the district can be considered under the following broad sub-types:- (i) Teak forests: (a) Teak forest on alluvium, (b) Teak forest on sandstone, (ii) Mixed forests, (iii) Khair forests etc. The Forest cover of the State Uttar Pradesh is given in Fig. 3.20.

The area of study usually support a luxurious growth of teak saplings (*Tectona grandis*). Saj (*Terminalia tomentosa*) is the tree next in importance to teak, whose timber is largely used for houses and furniture. Koha (*Terminalia arjuna*) is another tree growing on river banks. Tendu or Ebony (*Diospyros tomentosa*) is fairly common. The black heartwood of this tree is valuable and is used for furniture and the fruit is edible. The southern half is almost bare without any sign of tree growth on black soil the hardy babul grows spontaneously and in the riverine tracts there is generally mixed jungle of small and stunted scrub type. The Khair (*Acacia catechu*) is a common tree and the other trees include the hingol, karaunda (*Carisa opaca*) and karil (*Caparia decidua*). Other common species besides the mahua (*Mudhuca indica*) are the semal (*Salmaal malabarica*) dudhi (*Holarrhena antidysentrica*), dhawa (*Anogeissus latifolia*) gurja (*Lannea coromandelica*), dhak (*Butea monospermal*), rioni khair and kardhai. Saleh (*Boswellia serrata*) is a common tree on the dry hillsides. It is considered of little value locally. The timber of this tree is of good quality when it grows to a large size but it is usually found as a small tree with little or no heartwood. The wood is sometimes used for planks and sports and is a bad fuel. The bark is used for tanning and the leaves for fodder. Kullu (*Sterculia urens*) is another tree characteristic of the hills and plateau and is conspicuous for its light coloured smooth bark. Sejo or Lendia (*Lagerstroemia parviflora*) is a common tree and is important as one of the best timbers of the mixed forests. Its wood is used for house pillars, rafters and agricultural implements.

Ghout (*Ziziphus xylopyrus*) is a small tree with grey or reddish brown bark and thick oblong exfoliating scales. This tree is a very frequent one and lac is grown on it. It has a large round fruit and three pointed leaves alike to that of the Bel tree (*Aegle marmelos*) but relatively small in size.

Hadlu (*Adina cordifolia*) is a fairly common and a beautiful, imposing tree with white rough bark and large round leaves. Chheola or Palas (*Butea monosperma*) is a tree of moderate size, common on both government and private forests. It has brilliant, scarlet orange flowers which are locally called Tesu and give a good, red, yellow dye. It exudes a

ruby coloured gum when cut, which is used as medicine for dysentery. Ropes are made from the fibres of the roots and are said to withstand the rains better than ordinary hemp. Aonla (*Embluca officinalis*) is a small but pretty tree found both in the forests and in villages. The bark and leaves are used for tanning and as a medicine and the fruit is edible. This tree is considered sacred by the local people.

Dhavari (*Woodfordia floribunda*) is a large shrub conspicuous on dry hillsides and rocky ground with red flowers from which a dye is obtained for colouring silk. Kumhi (*Cochlospermum gossypium*) is a small tree with thick spreading branches and is characteristic of the driest and stoniest slopes. It is always conspicuous and covered with large brilliant yellow flowers, or in full foliage with glossy green leaves.

Achar (*Buchanania lanzan*) is a very common tree in the forests and is only leafless for a short time. Its characteristic bark, dark grey or nearly black in colour and thick, rough and tessellated with regular boss-like prominences makes this tree conspicuous. The kernel of the fruit is called Chironji which is edible. Karonda (*Carissa carandas*) is a large thorny shrub whose branches are used for fencing. Neem (*Azadirachta indica*) is a common village tree and is also found in roadside avenues, for which it makes an excellent tree, giving shade in the hot season. Banyan, pipal and tamarind are other village trees. The ber or wild plum (*Ziziphus jujuba*) is a common village tree, as is also the Bel (Aegle marmelos), the tree sacred to Lord Siva, the fruit of which is used as medicine. The pretty Mununga (*Moringa pterygosperma*) is largely cultivated in villages for its edible fruits. The best grazing grasses in the district are Musyal (*Iseilema laxum*) and Kel or Kuila (*Andropogon annulatus*). The leaves of kel are long and those of musyal are short the latter is a small grass which keeps fresh for a long time. Parwariya (*Heteropogon contortus*) is also a good grazing grass especially when young.

Plantations of trees such as mango, mahua, jamun (*Syzygium cumini*), sissoo (*Dalbergia sissoo*), siris, amaltas (*Cassia fistula*), gulmohar (*Delonix regia*), pipal (*Ficus religiosa*), arjuna (*Terminalia arjuna*), kanji (*Pongamia pinnata*), bargad (*Ficus bengalensis*), and neem (*Azadirachta indica*) were raised along the PWD roads under the roadside avenues scheme. List of plant species found in the region, are given in the following tables.

**TableNo. 3.22 List of plant species that are commonly found in the area**

Trees		
Common name	Botanical name	Uses
Sagwan (Teak)	<i>Tectona grandis</i>	Used for house door and windows and furniture as a good timber -wood

Seja	<i>Lagerstroemia parviflora</i>	Best timber for house posts, rafts and agricultural implements
Aonia (Amla)	<i>Emblica officinalis</i>	Bark and leaves used tanning and as a medicure – fruit edible.
Mahua	<i>Madhuca longifolia</i>	For flower and fruit and to make country liquor
Neem	<i>Azadirachta indica</i>	Used as avenue trees, medicinal value and tooth brushing
Pipal	<i>Ficus religiosa</i>	Avenue tree for shade, religious value
Imli	<i>Tamarindus indica</i>	Avenue trees, fruit used for sour taste/ tartrees
Munga/ Sahjan	<i>Moringa olifera</i>	Cultivated in valleys for its fruit used as vegetables. Relieves knee pains
Karnoda	<i>Carissa carandas</i>	Used for fencing, fruits used in tarts and jam
Rusa	<i>Cymbopogon martinii</i>	Yields essential aromatic oil
Khus	<i>Vetiveria zizanioides</i>	Roots used for making khus, tati and aromatic oil

**Table No. 3.23 Flora at the Study Area -2 as per Forest data**

Botanical name	Local name	Botanical name	Local name
<i>Madhuca longifolia</i>	Mahua	<i>Mitragyna parvifolia</i>	Kem
<i>Albizia lebbek</i>	Kala siris	<i>Bauhinia variegata</i>	Kachnar
<i>Buchanania lanzan</i>	Chiraunji	<i>Azadirachta indica</i>	Neem
<i>Bombax ceiba</i>	Semal	<i>Butea monosperma</i>	Palash
<i>Diospyros melanoxyton</i>	Tendu	<i>Terminalia tomentosa</i>	Saaj
<i>Carissa spinarum</i>	Karonda	<i>Euphorbia hirta</i>	Dudhi
<i>Feronia limonia</i>	Kaitha	<i>Jatropha curcas</i>	Ratanjot
<i>Lantana camara</i>	Makoi	<i>Nymphaea nouchali</i>	Kumodini
<i>Terminalia arjuna</i>	Arjun	<i>Ficus glomerata</i>	Goolari
<i>Syzygium cumini</i>	Jamun	<i>Ziziphus mauritiana</i>	Ber
<i>Sterculia urens</i>	Kullu	<i>Emblica officinalis</i>	Amla
<i>Terminalia bellirica</i>	Bahera		

Among the flora given in the table above, some of the species are found at the Study Area -2 while others are found within the 10 km radius of the Study Area. Plant species found at project region and its surroundings are enlisted in the following tables:

**Table No. 3.24 Flora at the Study Area**

Botanical Name	Family	Common Name
<i>Tectona grandis</i>	Lamiaceae	Sagoan
<i>Terminalia tomentosa</i>	Combretaceae	Saaj
<i>Acacia nilotica</i>	Fabaceae	Babool
<i>Terminalia arjuna</i>	Combrataceae	Arjuna/ koha
<i>Biospyros tomentosa</i>	Ebenaceae	Viraala
<i>Ficus religiosa</i>	Moraceae	Pipal
<i>Acacia leucophloea</i>	Fabaceae	Revanja
<i>Dalbergia paniculata</i>	Fabaceae	Dhoban
<i>Terminalia bellirica</i>	Combretaceae	Bahera
<i>Mitragyna parvifolia</i>	Rubiaceae	Kem
<i>Ficus glomerata</i>	Moraceae	Goolar
<i>Diospyros melanoxylon</i>	Ebenaceae	Tendu
<i>Dodonaea viscosa</i>	Dodonaea viscosa	Dodonaea viscosa
<i>Sapindaceae</i>	Sapindaceae	Sapindaceae
<i>Cassia fistula</i>	Caesalpiniaceae	Amaltas
<i>Bauhinia racemosa</i>	Caesalpiniaceae	Aashto
<i>Sterculia urens</i>	Sterculiaceae	Kullu
<i>Lagerstroemia parviflora</i>	Lythraceae	Sejah
<i>Aegle marmelos</i>	Rutaceae	Bel
<i>Adina cordifolia</i>	Rubaceae	Haldu
<i>Azadirachta indica</i>	Meliaceae	Neem
<i>Ougeinia oojeinensis</i>	Fabaceae	Teshta
<i>Grewia tiliaefolia</i>	Malvaceae	Dhaman
<i>Dalbergia latifolia</i>	Fabaceae	Black Seesam
<i>Madhuca indica</i>	Sapotaceae	Mahua
<i>Tamarindus indica</i>	Caesalpiniaceae	Imli
<i>Holoptelea integrifolia</i>	Ulmaceae	Chilbil
<i>Ficus hispida</i>	Moraceae	Katumar
<i>Ziziphus xylopyrus</i>	Rhaminaceae	Kathber
<i>Holarrhena antidysenterica</i>	Apocyanaceae	Doogi
<i>Gardenia latifolia</i>	Rubiaceae	Papada
<i>Crataeva religiosa</i>	Capparidaceae	Barnov
<i>Limonia acidissima</i>	Rutaceae	Belsona
<i>Vitex negundo</i>	Verbenaceae	Nerogudi/ sambhalu
<i>Ipomoea pes-caprae</i>	Convolvulaceae	Besarama
<i>Cuscuta reflexa</i>	Convolvulaceae	Amarbel
<i>Ricinus communis</i>	Euphorbiaceae	Arandi
<i>Lantana camara</i>	Verbenaceae	Vedaysini

<i>Annona squamosa</i>	Annonaceae	Sitaphal
<i>Gardenia turgida</i>	Rubiaceae	Fatara
<i>Ziziphus jujuba</i>	Rhamnaceae	Ber
<i>Ziziphus oenoplia</i>	Rhamnaceae	Makoar
<i>Colebrookea oppositifolia</i>	Labiatae	Kalabansa
<i>Ixora arborea</i>	Rubiaceae	Lokandi
<i>Jatropha curcas</i>	Euphorbiaceae	Ratanjyoti
<i>Achyranthes aspera</i>	Amaranthaceae	Aapamarga
<i>Tribulus terrestris</i>	Zygophyllaceae	Gokharu
<i>Andrographis paniculata</i>	Acanthaceae	Chirota
<i>Ziziphus nummularia</i>	Rhamnaceae	Jadaneri
<i>Ocimum sanctum</i>	Lamiaceae	Tulsi
<i>Cassia tora</i>	Caesalpiniaceae	Puvar
<i>Thespesia lampas</i>	Malvaceae	Banakapas
<i>Embelia robusta</i>	Myrsinaceae	Baivirang
<i>Solanum nigrum</i>	Solanaceae	Batakatiya
<i>Grewia hirsuta</i>	Tiliaceae	Gudasakari
<i>Desmodium pulchellum</i>	Leguminosae	Chipati
<i>Cynodon dactylon</i>	Poaceae	Doob grass
<i>Euphorbia nerifolia</i>	Euphorbiaceae	Thuwar
<i>Indigofera pulchella</i>	Fabaceae	Neela
<i>Asparagus racemosus</i>	Liliaceae	Satavari
<i>Eclipta prostrata</i>	Asteraceae	Bhrungraj
<i>Vernonia indica</i>	Asteraceae	Mohati

**Table No. 3.25 Climbers & Grasses at the Study Area**

Botanical Name	Family	Common Name
<i>Ventilago calyculata</i>	Rhamnaceae	Kevto
<i>Abrus precatorius</i>	Leguminosae	Gunjha
<i>Ichnocarpus frutescens</i>	Apocynaceae	Demarbel
<i>Acacia pennata</i>	Leguminosae	Raini
<i>Butea superba</i>	Leguminosae	Palasbel
<i>Bauhinia vahlii</i>	Leguminosae	Mahul
<i>Saccharum spontaneum</i>	Poaceae	Kans
<i>Dendrocalamus strictus</i>	Poaceae	Baans
<i>Iseilema laxum</i>	Poaceae	Mushel
<i>Desmostachya bipinnata</i>	Poaceae	Khus
<i>Vetiveria zizanioides</i>	Poaceae	Khas
<i>Aristida setacea</i>	Poaceae	Jhani

**Table No. 3.26 Flora around the Study Area**

Botanical Name	Family	Common Name
<i>Tectona grandis</i>	Lamiaceae	Sagoan
<i>Terminalia tomentosa</i>	Combretaceae	Saaj
<i>Anogeissus latifolia</i>	Combretaceae	Dhaora

<i>Terminalia arjuna</i>	Combrataceae	Arjuna/ koha
<i>Syzygium cumini</i>	Myrtaceae	jamun
<i>Feronia limonia</i>	Rutaceae	Kaitha
<i>Bridelia retusa</i>	Euphorbiaceae	Kasayee
<i>Phyllanthus emblica</i>	Phyllanthaceae	Amalika
<i>Moringa oleifera</i>	Moringaceae	Shigru
<i>Cochlospermum gossypium</i>	Bixaceae	Galgal
<i>Lannea grandis</i>	Anacardiaceae	Kimul
<i>Emblica officinalis</i>	Euphorbiaceae	Amla
<i>Ficus religiosa</i>	Moraceae	Pipal
<i>Acacia leucophloea</i>	Fabaceae	Revanja
<i>Dalbergia paniculata</i>	Fabaceae	Dhoban
<i>Terminalia bellirica</i>	combretaceae	Bahera
<i>Mitragyna parvifolia</i>	Rubiaceae	Kem
<i>Ficus glomerata</i>	Moraceae	Gurari
<i>Acacia nilotica</i>	Fabaceae	Babool
<i>Cassia fistula</i>	Caesalpiniaceae	Kerabaro
<i>Alangium salvifolium</i>	Cornaceae	Akola
<i>Achyranthes aspera</i>	Amaranthaceae	Aapamarga
<i>Garuga pinnata</i>	Burseraceae	Khekda
<i>Sterculia urens</i>	Sterculiaceae	Kullu
<i>Lagerstroemia parviflora</i>	Lythraceae	Sejah
<i>Aegle marmelos</i>	Rutaceae	Bel
<i>Syzygium cumini</i>	Myrtaceae	Jamun
<i>Cedrela toona</i>	Meliaceae	Toon
<i>Hymenodictyon excelsum</i>	Rubiaceae	Bhnorsal
<i>Azadirachta indica</i>	Meliaceae	Neem
<i>Acacia nilotica</i>	Fabaceae	Babul
<i>Bassia latifolia</i>	Sapotaceae	Mahua
<i>Diospyros melanoxylon</i>	Ebenaceae	Tendu
<i>Madhuca longifolia</i>	Sapotaceae	Mahua
<i>Tamarindus indica</i>	Caesalpiniaceae	Imli
<i>Grewia tiliaefolia</i>	Malvaceae	Dhaman
<i>Chloroxylon swietenia</i>	Rutaceae	Bhirha
<i>Dalbergia latifolia</i>	Fabaceae	Black Seesam
<i>Cassia fistula</i>	Caesalpiniaceae	Kerabaro
<i>Holoptelea integrifolia</i>	Ulmaceae	Chinol/ chilbil
<i>Ficus hispida</i>	Moraceae	Katumar
<i>Ziziphus xylopyrus</i>	Rhaminaceae	Kathber
<i>Adhatoda vasica</i>	Acanthaceae	Adusa
<i>Helicteres isora</i>	Sterculiaceae	Marorphali
<i>Bauhinia racemosa</i>	Caesalpiniaceae	Aashto
<i>Crataeva religiosa</i>	Capparidaceae	Barnov
<i>Limonia acidissima</i>	Rutaceae	Belsona
<i>Randia dumetorum</i>	Rubiaceae	Mynophal
<i>Cuscuta reflexa</i>	Convolvulaceae	Amarbel
<i>Ricinus communis</i>	Euphorbiaceae	Arandi
<i>Lantana camara</i>	Verbenaceae	Vedaysini
<i>Annona squamosa</i>	Annonaceae	Sitaphal

<i>Vitex negundo</i>	Verbenaceae	Nerogudi
<i>Dodonaea viscosa</i>	Sapindaceae	Kharetha
<i>Holarrhena antidysenterica</i>	Apocyanaceae	Doogi
<i>Gardenia latifolia</i>	Rubiaceae	Papada
<i>Gardenia turgida</i>	Rubiaceae	Fatara
<i>Ziziphus jujuba</i>	Rhaminaceae	Bera
<i>Semecarpus anacardium</i>	Anacardiaceae	Belma
<i>Ixora arborea</i>	Rubiaceae	Lokandi
<i>Jatropha curcas</i>	Euphorbiaceae	Ratanjyoti
<i>Carissa carandas</i>	Apocyanaceae	Karonda
<i>Indigofera pulchella</i>	Fabaceae	Neela
<i>Grewia hirsuta</i>	Tiliaceae	Gudasakari
<i>Tribulus terrestris</i>	Zygophyllaceae	Gokharu
<i>Andrographis paniculata</i>	Acanthaceae	Chirota
<i>Ziziphus nummularia</i>	Rhamnaceae	Jadaneri
<i>Ocimum sanctum</i>	Lamiaceae	Tulsi
<i>Xanthium strumarium</i>	Asteraceae	Godhara
<i>Desmodium pulchellum</i>	Leguminosae	Chipati
<i>Colebrookea oppositifolia</i>	Labiatae	Kalabansa
<i>Euphorbia nerifolia</i>	Euphorbiaceae	Thuwar

**Table No. 3.23 Climbers & Grasses around the Study Area**

Botanical Name	Family	Common Name
<i>Ventilago calyculata</i>	Rhamnaceae	Kevto
<i>Abrus precatorius</i>	Leguminosae	Gunjha
<i>Ichnocarpus frutescens</i>	Apocynaceae	Demarbel
<i>Butea superba</i>	Leguminosae	Palasbel
<i>Bauhinia vahlii</i>	Leguminosae	Mahul
<i>Saccharum spontaneum</i>	Poaceae	Kans
<i>Dendrocalamus strictus</i>	Poaceae	Bhans
<i>Iseilema laxum</i>	Poaceae	Mushel
<i>Andropogon annulatus</i>	Poaceae	Karad
<i>Woodfordia floribunda</i>	Lythraceae	Dhataki
<i>Desmostachya bipinnata</i>	Poaceae	Khus
<i>Vetiveria zizanioides</i>	Poaceae	Khas
<i>Aristida setacea</i>	Poaceae	Jhani
<i>Cynodon dactylon</i>	Poaceae	Dhoob grass
<i>Dichanthium annulatum</i>	Poaceae	Bhuravel
<i>Eragrostis interrupta</i>	Poaceae	Bhurabhusi choti

## Medicinal plants

Lists of the medicinal plants found at Study Area and its surrounding regions.

**Table No. 3.27: List of medicinal plants used by the tribe**

No.	Botanical Name of the plant	Local name of medicinal plant	Disorder	Part of the plant used	Mode of use
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1	<i>Vitis quadrangularis</i>	Harjor/Haddijor	Bone fracture	Stem	Given internally and applied for fracture of bone
2	<i>Cleome gynandra</i>	Hurhur	Headache	Seeds	Paste is used externally for 3-7 days
3	<i>Litsea glutinosa</i>	Garbijaur	Vomiting	Bark	Powder used 2 dosage (Approx. 10gm's) in a day.
4	<i>Eclipta alba</i>	Vringraj	Inflammatory disorder	Seed/whole	Anti-inflammatory, digestive, hair tonic
5	<i>Vanda tessellata</i>	Banda/Rasana	Ear pain	Leaves	Decoction used orally
6	<i>Leucas aspera</i>	Dron d pushpin	Eye pain	Leaves	The juice put into eyes for 2 or 3 times daily to relieve burning sensation and redness of eyes

**Table No.3.28 RET Species of Study Area**

Sr. No.	Name of species	Status
1	<i>Abrus precatorius</i>	Near Threatened
2	<i>Acorus calamus</i>	Endangered
3	<i>Andrographis paniculata</i>	Vulnerable
4	<i>Aristolochia indica</i>	Near Threatened
5	<i>Asparagus racemosus</i>	Near Threatened
6	<i>Bacopa monnieri</i>	Vulnerable
7	<i>Butea monosperma var.lutea</i>	Endangered
8	<i>Caesalpinia bonduc</i>	Vulnerable
9	<i>Caesalpinia decapetala</i>	Vulnerable
10	<i>Capparis decidua</i>	Vulnerable
11	<i>Centella asiatica</i>	Vulnerable
12	<i>Ceropegia bulbosa</i>	Endangered
13	<i>Chlorophytum tuberosum</i>	Vulnerable
14	<i>Commiphora wightii</i>	Rare
15	<i>Costus speciosus</i>	Vulnerable
16	<i>Curculigo orchioides</i>	Endangered
17	<i>Curcuma amada</i>	Endangered
18	<i>Curcuma angustifolia</i>	Vulnerable
19	<i>Dioscorea bulbifera</i>	Vulnerable
20	<i>Gloriosa superba</i>	Vulnerable
21	<i>Gymnema sylvestre</i>	Under Threat
22	<i>Manilkara hexandra</i>	Near Threatened
23	<i>Mucuna pruriens</i>	Near Threatened
24	<i>Operculina petaloidea</i>	Endangered
25	<i>Oroxylum indicum</i>	Vulnerable

26	<i>Plumbago zeylanica</i>	Vulnerable
27	<i>Prosopis cineraria</i>	Endangered
28	<i>Psorelea corylifolia</i>	Vulnerable
29	<i>Rauvolfia serpentina</i>	Endangered
30	<i>Saraca asoca</i>	Endangered
31	<i>Spilanthes calva</i>	Vulnerable
32	<i>Tinospora cordifolia</i>	Vulnerable
33	<i>Tylophora indica</i>	Vulnerable
34	<i>Uraria picta</i>	Vulnerable
35	<i>Urginea indica</i>	Vulnerable

### **Biodiversity Assessment Method:**

#### **Transect/Quadrat method:**

Quadrat size laid down is 10×10 m in project area. Quadrat data has been given in Table No.3.26 in which Frequency, Density and Abundance calculated as per formula:

#### **Frequency:**

Frequency, as introduced by Raunkiaer (1934), indicates the number of sampling units in which a given species occurs (Mishra, 1968). Frequency of mangrove vegetation refers to the degree of dispersion of individual species in an area and is usually expressed in terms of percentage of occurrence.

$$\text{Frequency} = \frac{\text{No of occurrences of a species}}{\text{Total no of site samples taken}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{No of occurrences of particular species}}{\text{Total no of occurrences of all the species}} \times 100$$

#### **Abundance:**

The abundance and density represent the numerical strength of species in the community (Mishra, 1968). Abundance is described as the number of individuals occurring per sampling unit and density as the number of individuals per sampling unit. Abundance and density are calculated using the following formulae:

$$\text{Abundance (A)} = \frac{\text{Total number of individuals}}{\text{Number of Sampling units of occurrence}} \times 100$$

$$\text{Abundance (A)} = \frac{\text{Total number of individuals}}{\text{Number of Sampling units of occurrence}} \times 100$$

$$\text{Relative Abundance} = \frac{\text{Abundance of a particular species}}{\text{Sum of the abundances of all species}} \times 100$$

$$\text{Density} = \frac{\text{Total no of individuals of a species in all quadrats}}{\text{Total no of quadrats sampled}} \times 100$$

$$\text{Relative density} = \frac{\text{Density of a particular species}}{\text{Sum of the densities of all species}} \times 100$$

### **Importance Value Index (IVI):**

The concept of 'Important Value Index (IVI)' has been developed for expressing the dominance and ecological success of any species, with a single value (Mishra, 1968). This index utilizes three characteristics, viz. relative frequency, relative density and relative abundance. The three characteristics are computed using frequency, density and abundance for all the species falling in all the transects by using the following formula.

$$\text{IVI} = \text{Relative frequency} + \text{Relative abundance} + \text{Relative density}$$

Table No. 3.29. Phytosociology of the Project area

(Quadrat size 10 x 10 m)

Sl. No.	Name of the species	Quadrat										Total	Quad. Present	Total Quad.	Frequency	Abundance	Density	IVI
		1	2	3	4	5	6	7	8	9	10							
1.	<i>Sapindus emarginata</i>	1	0	3	0	0	1	0	1	1	0	7	5	10	0.5	1.4	0.7	3.02
2.	<i>Ailanthus excelsa</i>	0	1	0	0	1	0	0	2	1	1	6	5	10	0.5	1.2	0.6	2.8
3.	<i>Terminalia bellirica</i>	1	0	0	3	2	1	0	3	2	1	13	7	10	0.7	1.85	1.3	4.2
4.	<i>Terminalia arjuna</i>	1	3	0	0	1	0	2	0	0	0	7	4	10	0.4	1.75	0.7	3.2
5.	<i>Ficus hispida</i>	0	0	1	0	0	1	3	3	1	0	9	5	10	0.5	1.8	0.9	3.95
6.	<i>Mitragyna parvifolia</i>	0	2	1	0	1	0	0	0	1	2	7	5	10	0.5	1.4	0.7	2.85
7.	<i>Acacia leucophloea</i>	1	0	0	1	2	0	1	3	0	1	9	6	10	0.6	1.5	0.9	3.65
8.	<i>Haloptelea intergrifolia</i>	0	1	0	0	3	2	2	1	1	0	10	6	10	0.6	1.67	1	4.25
9.	<i>Moringa pterygosperma</i>	1	0	1	0	2	1	1	1	3	3	13	8	10	0.8	1.62	1.3	4.38
10.	<i>Cochlospermum</i>	2	0	1	1	0	0	0	0	1	1	6	5	10	0.5	1.2	0.6	2.85
11.	<i>Lannea grandis</i>	2	1	0	1	0	1	1	1	1	0	8	7	10	0.7	1.14	0.8	3.69
12.	<i>Emblica officinalis</i>	1	1	0	1	1	0	2	1	0	0	7	6	10	0.6	1.16	0.7	3.78
13.	<i>Ficus religiosa</i>	1	0	3	0	1	1	2	0	0	0	8	5	10	0.5	1.6	0.8	4.02
14.	<i>Garuga pinnata</i>	3	2	0	1	1	0	1	2	0	0	10	6	10	0.6	1.66	1	3.98
15.	<i>Sterculia urens</i>	1	0	1	2	2	0	1	1	0	1	9	7	10	0.7	1.28	0.9	4.23
16.	<i>Gardenia latifolia</i>	1	0	1	1	0	2	1	0	2	1	9	7	10	0.7	1.28	0.9	3.88
17.	<i>Acacia nilotica</i>	1	0	1	1	0	0	2	1	2	0	8	6	10	0.6	1.33	0.8	3.73
18.	<i>Ficus glomerata</i>	1	2	0	2	0	2	1	0	0	0	8	5	10	0.5	1.6	0.8	3.9

19.	<i>Butea frondosa</i>	1	2	0	1	0	3	3	1	0	0	11	6	10	0.6	1.83	1.1	4.53
20.	<i>Buchanania lanzan</i>	2	0	0	1	3	0	0	3	0	2	11	5	10	0.5	2.2	1.1	4.8
21.	<i>Azadirachta indica</i>	0	1	0	3	1	0	2	3	1	2	13	7	10	0.7	1.85	1.3	4.85
22.	<i>Acacia arabica</i>	0	1	2	0	0	2	1	0	2	0	8	5	10	0.5	1.6	0.8	3.9
23.	<i>Salmaalial malabarica</i>	3	2	1	0	0	3	5	1	2	0	17	7	10	0.7	2.42	1.7	5.82
24.	<i>Melia indica</i>	2	1	0	1	0	1	2	1	2	0	10	7	10	0.7	1.42	1	4.12
25.	<i>Diospyros melanoxylon</i>	1	0	2	1	0	0	0	1	1	2	8	6	10	0.6	1.33	0.8	3.73
26.	<i>Madhuca indica</i>	2	1	0	0	1	1	0	0	0	0	5	4	10	0.4	1.25	0.5	3.15
27.	<i>Tamarindus indica</i>	0	2	1	0	0	0	1	0	1	1	6	5	10	0.5	1.2	0.6	3.32
28.	<i>Cassia fistula</i>	2	0	1	2	0	1	0	1	0	0	7	5	10	0.5	1.4	0.7	3.62
29.	<i>Bauhinia racemosa</i>	1	0	2	1	0	1	2	3	0	1	11	7	10	0.7	1.57	1.1	4.37
30.	<i>Bauhinia purpurea</i>	1	0	2	2	0	1	0	0	2	0	8	5	10	0.5	1.6	0.8	3.9
31.	<i>Crataeva religiosa</i>	1	0	0	0	2	0	1	0	1	0	5	4	10	0.4	1.25	0.5	3.15
32.	<i>Limonia acidissima</i>	2	0	1	1	0	1	2	0	0	0	7	5	10	0.5	1.4	0.7	3.6
33.	<i>Randia duemetorum</i>	0	1	1	2	1	0	0	1	1	1	8	7	10	0.7	1.14	0.8	3.64
34.	<i>Ziziphus xylopyrus</i>	2	1	1	0	1	1	2	0	1	0	9	7	10	0.7	1.28	0.9	3.88
35.	<i>Holarrhena</i>	2	1	1	0	0	0	2	1	1	2	10	7	10	0.7	1.42	1	4.12
36.	<i>Gardenia pianta</i>	1	0	1	2	1	0	2	0	1	3	11	7	10	0.7	1.57	1.1	4.37
37.	<i>Gardenia turgida</i>	4	0	0	0	0	1	1	2	0	2	10	5	10	0.5	2	1	4.5
38.	<i>Ziziphus jujuba</i>	1	0	2	2	3	0	1	0	0	1	10	6	10	0.6	1.66	1	4.26
39.	<i>Semecarpus</i>	2	3	0	1	0	2	0	3	1	0	12	6	10	0.6	2	1.2	4.8

	<i>anacardium</i>																	
40.	<i>Ixora arborea</i>	1	0	1	0	1	2	3	2	0	0	10	6	10	0.6	1.66	1	4.26
41.	<i>Alangium salvifolium</i>	0	0	1	0	1	0	1	2	1	0	6	5	10	0.5	1.2	0.6	3.3
42.	<i>Achyranthes aspera</i>	1	0	2	0	1	2	1	1	0	2	10	7	10	0.7	1.42	1	4.15
43.	<i>Dodonaea viscosa</i>	2	1	0	0	0	0	2	1	0	2	8	5	10	0.5	1.6	0.8	3.01
44.	<i>Tribulus terrestris</i>	1	0	0	2	1	0	3	0	1	0	8	5	10	0.5	1.6	0.8	3.92
45.	<i>Andrographis paniculata</i>	0	1	0	0	2	3	1	0	0	1	8	5	10	0.5	1.6	0.8	3.92
46.	<i>Ziziphus nummularia</i>	1	0	2	1	0	0	0	2	2	0	8	5	10	0.5	1.6	0.8	3.92
47.	<i>Ocimum sanctum</i>	2	1	0	0	2	3	0	0	0	3	11	5	10	0.5	2.2	1.1	4.86
48.	<i>Vitex negundo</i>	1	0	2	3	1	0	2	1	1	0	11	7	10	0.7	1.57	1.1	4.4
49.	<i>Cassia tora</i>	1	0	2	1	0	0	0	2	2	1	9	6	10	0.6	1.5	0.9	4.12
50.	<i>Thespesia lampas</i>	2	1	0	0	1	0	1	0	1	0	6	5	10	0.5	1.2	0.6	3.42
51.	<i>Embelia robusta</i>	2	0	1	0	0	2	2	0	1	2	10	7	10	0.7	1.42	1	4.23
52.	<i>Solanum nigrum</i>	3	0	1	0	2	1	1	0	0	1	9	6	10	0.6	1.5	0.9	4.18
53.	<i>Eclipta prostrata</i>	2	1	0	1	1	1	0	2	1	0	9	7	10	0.7	1.28	0.9	3.92
54.	<i>Vernonia divergens</i>	1	2	2	0	1	0	1	1	0	1	9	7	10	0.7	1.28	0.9	3.92
55.	<i>Adhatoda vasica</i>	0	1	0	2	1	2	0	1	0	0	7	5	10	0.5	1.4	0.7	3.8
56.	<i>Ricinus communis</i>	0	1	0	2	1	0	0	0	1	0	5	4	10	0.4	1.25	0.5	3.19
57.	<i>Grewia hirsuta</i>	1	0	2	1	2	0	1	0	0	0	7	5	10	0.5	1.4	0.7	3.8
58.	<i>Xanthium strumarium</i>	0	0	1	2	0	1	0	1	2	2	9	6	10	0.6	1.5	0.9	3.78
59.	<i>Desmodium pulchellum</i>	3	0	1	0	2	0	2	1	2	0	11	6	10	0.6	1.83	1.1	4.6
60.	<i>Tamarix dioica</i>	1	0	1	2	1	0	1	0	1	1	8	7	10	0.7	1.14	0.8	3.68
61.	<i>Euphorbia</i>	2	1	0	3	1	0	2	0	2	0	11	6	10	0.6	1.83	1.1	4.59

	<i>nerifolia</i>																	
62.	<i>Indigofera pulchella</i>	1	0	0	2	1	2	2	0	1	0	9	6	10	0.6	1.5	0.9	4.26
63.	<i>Lantana camara</i>	1	0	3	0	0	0	1	2	1	1	9	6	10	0.6	1.5	0.9	4.4
64.	<i>Ziziphus oenopia</i>	0	3	2	0	1	0	2	2	0	0	10	5	10	0.5	2	1	4.58
65.	<i>Jatropha curcas</i>	3	1	0	2	0	2	1	2	0	1	12	7	10	0.7	1.71	1.2	4.67
66.	<i>Asparagus racemosus</i>	1	0	1	0	2	3	1	0	0	1	9	6	10	0.6	1.5	0.9	4.21
67.	<i>Annona squamosa</i>	1	0	0	2	0	2	0	2	1	1	9	6	10	0.6	1.5	0.9	4.21
68.	<i>Helicteres isora</i>	0	1	0	2	2	0	0	0	2	1	8	5	10	0.5	1.6	0.8	3.96
69.	<i>Abrus precatorius</i>	1	0	1	0	2	1	2	1	0	0	8	6	10	0.6	1.33	0.8	3.74
70.	<i>Terminalia chebula</i>	2	0	1	0	3	2	1	0	2	1	12	7	10	0.7	1.71	1.2	4.71
	<b>Total</b>											<b>627</b>	<b>409</b>		<b>40.9</b>	<b>107.16</b>	<b>62.7</b>	<b>278.5</b>

**Importance Value** is a measure of how dominant a species is in a given forest area. It is a standard tool used by foresters to inventory a forest related density, the number of individuals per area as a percent of the number of individuals of all species.

Therefore from the above Quadrat study it is observed that some species like *Salmalia malabarica*, *Annona squamosa* and *Terminalia chebula* are showing high Importance Value Index and in a given project area this species are dominant in nature.

### **Fauna**

Among the wildlife of the study area occasionally, wolf (*Canis luzus*) and hyena (*Hyena hyena*) are found in the hills and ravines throughout the district. Jackal (*Canis aureus*) and fox (*Bulbas bengalensis*) occur everywhere but are less numerous than north of the Betwa, while pig (*Sus cristatusindicus*) abound and play havoc with the fields. The nilgai (*Boselophus tragocamalus*) and large herd of sambar (*Cervus unicolor*) frequent the wide cotton plains. Species of wild animals, birds and reptiles commonly found in and around the submerged area and the Study Area are as given below.

### **Animals (Mammals)**

**Carnivore:** Indian Fox, Wild Dog.

**Herbivore:** Spotted deer, Nilgai, wild Boars, Rabbits, Black faced Monkeys, (Langoors), and Red faced Monkeys.

**Table No. 3.30. Fauna at the Study Area**

Zoological name	Family	Common name	Schedule
Animals			
<i>Gazelle gazelle</i>	Antilopinae	Indian gazelle	IV
<i>Macaca mulatta</i>	Cercopithecidae	Bandar	IV
<i>Felis chaus</i>	Felidae	Jungli billi	II
<i>Sus scrofa</i>	Suidae	Suwar	III
<i>Bandicota bengalensis</i>	Muridae	Field rat	V
<i>Golunda ellioti</i>	Muridae	The Indian bush rat	IV
<i>Muntiacus muntjak</i>	Cervidae	Indian muntjak	IV

<i>Cervus unicolor</i>	Cervidae	Sambhar	III
<i>Axis axis</i>	Cervidae	Cheetal	III
<i>Boselaphus tragocamelus</i>	Bovidae	Nilgai	IV
<i>Lepus nigricollis</i>	Leporidae	Kharghosh	IV
<i>Hyaena hyaena</i>	Hyaenidae	Lakadbagga	III
<i>Rattus rattus</i>	Muridae	Chuha	V
<i>Bos indicus</i>	Bovinae	Cow	V
<b>Reptiles</b>			
<i>Bungarus caeruleus</i>	Elapidae	Krait	IV
<i>Naja naja</i>	Elapidae	Naga	II
<i>Ptyas mucosus</i>	Colubridae	Dhaman	II
<i>Varanus bengalensis</i>	Varanidae	Godhi	II
<b>Fishes</b>			
<i>Labeo rohita</i>	Cyprinidae	Rohu	IV
<i>Catla catla</i>	Cyprinidae	Bhakur	IV
<i>Cirrhinus cirrhosus</i>	Cyprinidae	Mrigal	IV
<b>Amphibians</b>			
<i>Bufo melanostictus</i>	Bufonidae	Common toad	IV
<i>Rana tigrina</i>	Ranidae	Indian bull frog	IV

**Table No. 3.30. Fauna around the Study Area**

<b>Zoological name</b>	<b>Family</b>	<b>Common name</b>	<b>Schedule</b>
<b>Animals</b>			
<i>Hemiechinus auritus</i>	Erinaceidae	Hedgehog	IV
<i>Suncus murinus</i>	Soricidae	Musk-shrew	IV
<i>Presbytis entellus</i>	Colobinae	Langoor	IV
<i>Macaca mulatta</i>	Cercopithecidae	Bandar	IV
<i>Cynopterus sphinx</i>	Pteropodidae	Fruit bat	IV
<i>Felis chaus</i>	Felidae	Jungli billi	II

<i>Panthera pardus</i>	Felidae	Panther	III
<i>Sus scrofa</i>	Suidae	Suwar	III
<i>Cuon alpinus</i>	Canidae	Wild dog	II
<i>Bandicota bengalensis</i>	Muridae	Field rat	V
<i>Mellivora capensis</i>	Mustelidae	Honey badger	IV
<i>Golunda ellioti</i>	Muridae	The Indian bush rat	IV
<i>Muntiacus muntjak</i>	Cervidae	Indian muntjak	IV
<i>Cervus unicolor</i>	Cervidae	Sambhar	III
<i>Axis axis</i>	Cervidae	Cheetal	III
<i>Herpestes hyaena</i>	Hyaenidae	Spotted hyaena	IV
<i>Boselaphus tragocamelus</i>	Bovidae	Nilgai	IV
<i>Rattus rattus</i>	Muridae	Chuha	V
<i>Bos indicus</i>	Bovinae	Cow	V
<i>Funambulus pennanti</i>	Sciuridae	Squirrel	IV
<i>Vulpes bengalensis</i>	Canidae	Indian fox	IV
<i>Gazelle gazelle</i>	Antilopinae	Indian gazelle	IV
<b>Reptiles</b>			
<i>Bungarus caeruleus</i>	Elapidae	Krait	IV
<i>Naja naja</i>	Elapidae	Indian Cobra	II
<i>Ptyas mucosus</i>	Colubridae	Dhaman	II
<i>Varanus bengalensis</i>	Varanidae	Indian Bengal Monitor	II
<b>Fishes</b>			
<i>Labeo rohita</i>	Cyprinidae	Rohu	IV
<i>Catla catla</i>	Cyprinidae	Bhukur	IV
<i>Cirrhinus cirrhosus</i>	Cyprinidae	Mrigal	IV
<b>Amphibians</b>			
<i>Bufo melanostictus</i>	Bufo	Common toad	IV

<i>Rana tigerina</i>	Ranidae	Indian bull frog	IV
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### **Birds:**

About 125 species of birds are permanent resident of area under study. Pea fowl (*Pavo cristatus*), grey-partridge (*Francolins godicerianus*) and quail (*Coturnix coturnix*), the letter of the smaller variety called the button-quail are found throughout the district. The painted partridge (*Francolinus pictus*) is common in hilly tracts and the common dandgrouse, plovers, blue-rock (*Colubia livia*) and green pigeon (*Crocopus phoenlcopterus*) are found in most of the places. Of migratory waterfowl (*Anatidae*) various species of geese, duck and teal visit the district n cold season. In the same localities and in tanks the snipe (*Charadriidae*) is also common at the same season, while numerous varieties of cranes, storks and waders are found where water is found. The avi-fauna of the study area includes all the usual species of doves, shrikes, rollers, parrots and other passerine and non-passerine birds. These are listed below.

**Table No. 3.32 : Avifauna at the Study Area**

<b>Zoological name</b>	<b>Family</b>	<b>Common name</b>	<b>Schedule</b>
<b>BIRDS</b>			
<i>Phalacrocorax niger</i>	Phalacrocoracodae	Little comorant	IV
<i>Ardeola grayii</i>	Phalacrocoracodae	Pond herone	IV
<i>Bubulcus ibis</i>	Ardeidae	Cattle egret	IV
<i>Anastomus oscitans</i>	Ciconiidae	Open billed stork	IV
<i>Milvus migrans</i>	Accipitridae	Common kite	IV
<i>Perdica asiatica</i>	Phasianidae	Jungle bush quail	IV
<i>Grus grus</i>	Gruidae	Common crane	IV
<i>Psittacula krameri</i>	Psittacidae	Parrot	IV
<i>Eudynamys scolopaceus</i>	Cuculidae	Cukoo	IV

<i>Halcyon smyrnensis</i>	Halcyonidae	White breasted kingfisher	IV
<i>Acridotheres tristis</i>	Sturnidae	Common myna	IV
<i>Pycnonotus cafer</i>	Pycnonotidae	Bulbul	IV
<i>Apus affinis</i>	Apodidae	Ababil	IV
<i>Bubo bubo</i>	Strigidae	Owl	IV
<i>Columba livia</i>	Collumbidae	Blue rock pigeon	IV
<i>Streptopelia decaocto</i>	Collumbidae	Indian ring dove	IV
<i>Corvus splendens</i>	Corvidae	House crow	IV
<i>Corvus macrorhynchos</i>	Corvidae	Jungle crow	IV
<i>Passer domesticus</i>	Ploidae	House sparrow	IV

**Table No 3.32. Avifauna around the Study Area**

Zoological name	Family	Common name	Schedule
<b>BIRDS</b>			
<i>Ardeola grayii</i>	Phalacrocoracidae	Pond herone	IV
<i>Anastomus oscitans</i>	Ciconiidae	Open billed stork	IV
<i>Milvus migrans</i>	Accipitridae	Common kite	IV
<i>Coturnix coturnix</i>	Phasianidae	Common grey quail	IV
<i>Perdica asiatica</i>	Phasianidae	Jungle bush quail	IV
<i>Grus grus</i>	Gruidae	Common crane	IV
<i>Eudynamis scolopaceus</i>	Cuculidae	Cukoo	IV
<i>Alcedo atthis</i>	Alcedinidae	Small blue king	IV
<i>Halcyon smyrnensis</i>	Halcyonidae	White breasted kingfisher	IV
<i>Acridotheres tristis</i>	Sturnidae	Common myna	IV
<i>Spilornis cheela</i>	Accipitridae	Crested serpent	

		eagle	
<i>Accipiter badius</i>	Accipitridae	Crested hawk	
<i>Spizaetus cirrhatus</i>	Accipitridae	Cheel	IV
<i>Psittacula krameri</i>	Psittacidae	Parrot	IV
<i>Pycnonotus cafer</i>	Pycnonotidae	Bulbul	IV
<i>Centropus sinensis</i>	Cuculidae	Mokha	IV
<i>Eudynamys scolopaceus</i>	Cuculidae	Cukoo	
<i>Apus affinis</i>	Apodidae	Ababil	IV
<i>Bubo bubo</i>	Strigidae	Owl	IV
<i>Ploceus philippinus</i>	Ploceidae	Baya	IV
<i>Phalacrocorax niger</i>	Phalacrocoracidae	Little comorant	IV
<i>Columba livia</i>	Collumbidae	Blue rock pigeon	IV
<i>Streptopelia chinensis</i>	Collumbidae	Spotted dove	IV
<i>Coracias benghalensis</i>	Coracidae	Blue jay	IV
<i>Sturnus contra</i>	Strunidae	Indian myna	IV
<i>Corvus splendens</i>	Corvidae	House crow	IV

The project area does not have dense forest cover and thus is not habitat of many animals. Monkey and Fox etc. are found in the forest area near the Study area-There is no endangered, threatened or rare species found.

### **Reptiles:**

Snakes and scorpions are numerous and majority of snake species found in district are non-poisonous. Among the venomous snakes found in the district the chief are cobra (*Naja naja* or *Naja tripudian*), the krait (*Bungarus Caeruleus*) and the Russell's Vipera (*Vipera russellii*) The crocodile of both varieties, gharial and magar are found in the Betwa and all the larger and sometimes even in smaller streams while the former rivers abounds in turtles or kachhua (*Trionnyx gangeticus*) and tortoises. The chameleon and house lizards are common everywhere the monitor lizard being found in the hilly tracts.

## **4. AQUATIC ECOLOGY**

River Betwa is the right bank tributary of Yamuna river. It originates from the Northwards slope of the Vindhyan Mountains. The total length for which it flows is 590km. the average depth of the whole Betwa river ranges between 2.7-9.4 m. the river bed of Betwa river mostly aggregates stones, sand, riffle and pools; pebbles and cobble.

The study area has a wide range of biotic communities - Phytoplankton dominated by Chlorophyceae, Bacillariophyceae; and Myxophyceae, Zooplankton such as Copepods, Cladocerans Rotifers and Protozoans. The chief species found are mahseer, (*Barbus Tor*), rohu (*Labeo rohita*), Tengra or kantua (*Mystus seenghala*), parhin (*Wallagonia attu*), saul (*Opheocopholus sp.*) kalabanu (*Labeo colbasa*) and nain (*Cirrhina mrigala*). Other species such as moi (*Notopterus notopterus*), Bhakur (*catla catla*) and bam or eel (*Rhynchobdilla aculata*) are also found. Oil is extracted for medicinal purposes from the sus. Benthos is represented by insect larvae and nymphs, Oligochaeta, Nematods and Mollusca and a rich growth of Periphyton on submerged objects. However, the physico – chemical parameters will change after the construction is over and water is filled in the reservoir. This would result in high flushing in reservoir in the monsoon months.

### **1) Sampling collection method-**

- Take plankton net with the mesh size of 0.32 mm aperture.
- Drop the net into the water from the bank and haul up vertically. Collect about 25 litres of water with Phytoplankton in it and sieve by using mesh.
- A flow meter can be attached with the net to measure the water flow.

### **2) Preservation techniques-**

- Planktonic organisms are sensitive to temperature so should be collected in thermos flask.
- The samples should be examined within 24 hrs hours.
- Further preservation can be done by adding Lugol's solution to the samples.

### **3) Sample analyses-**

Number of individuals can be found either visually or through the microscope. Large

organisms are measured by visual count and the small organisms counted and recorded through binocular microscope. Results can be expressed in percentage as:

$$\text{No. of individuals per cm}^3 = A/B$$

Where, A – No. of individuals counted visually or under microscope.

B – Volume of water taken in cm<sup>3</sup>.

**Species Diversity Index** – Species diversity index (H) for aquatic population was determined separately from the Shannon Wiener's information function (Shannon and Weaver, 1963).

$$H = -\sum (ni / N) \log_2 (ni / N)$$

Where: ni = importance value for each species, N = total of importance values

Pi = importance probability for each species = ni/N

**Table No.3.33 Study of Phyto and Zooplankton's – Shannon Wiener Index**

Phytoplankton				
Sp. Name	Sp.	Ind.	(ni/N)	SWI - H-
<i>Pinularia sp.</i>	1	2	0.15	0.40
<i>Navicula sp.</i>	1	1	0.07	0.26
<i>Merismopedia sp.</i>	1	3	0.23	0.48
<i>Lyngbya sp.</i>	1	2	0.15	0.40
<i>Phacus sp.</i>	1	4	0.30	0.51
<i>Fragillaria sp.</i>	1	1	0.07	0.26
<b>Total</b>	<b>6</b>	<b>13</b>	<b>0.97</b>	<b>2.31</b>

Zooplankton				
Sp. Name	Sp.	Ind.	(ni/N)	SWI - H-
<i>Diaptonus sp.</i>	1	3	0.30	0.51
<i>Keratella</i>	1	1	0.10	0.33
<i>Nauplius larva</i>	1	3	0.30	0.51
<i>Pediastrum</i>	1	2	0.20	0.46
<i>Clostridium</i>	1	1	0.10	0.33
<b>Total</b>	<b>5</b>	<b>10</b>	<b>1.00</b>	<b>2.14</b>

**Table No. 3.34. Aquatic plants at the Study site**

S.No.	Botanical name	Habit	Family
1	<i>Alternanthera sessilis</i>	Herb	Amaranthaceae

2	<i>Bergia ammanioides</i>	Herb	Elatinaceae
3	<i>Caesulia axillaris</i>	Herb	Compositae
4	<i>Eriocaulon cinereum</i>	Sedge	Cyperaceae
5	<i>Limnophilla</i>	Herb	Scrophulariaceae

## **Fishery Development**

### **Aquatic resources**

Fish is of the most important species of the aquatic fauna as well as important source of protein in human food. Since, topographical and climatological condition of Betwa River varies from tropical to moderate temperature region; there are significant variations in the fish species observed at different elevations. Normally the varieties of fish Catla, Rohu, Bam, Padan are normally observed.

**Pisciculture:** A wide range of indigenous fishes are found in the Betwa River. The important commercial fish species in the river are *Cirrhinus mrigala*, *Catla catla*, *Labeo rohita*, *Labeo calbasu* among major carps; *Tor tor* among mahseer; *Spereta seenghala*, *Spereta aor*, *Wallago attu* and *Rita rita* among catfishes; *Chitala chitala* among featherbacks. A number of species of lesser size and importance are available in the river are reported as miscellaneous fishes and comprise *Aspidoparia morar*, *Salmophasia bacaila*, *Oxygaster gora*, *Labeo boggut*, *Labeo bata*, *Cirrhinus reba*, *Gudusia chapra*.

The water bodies that would be created by dam provide ample opportunity to develop fresh water fishery and should be developed for food and sport.

### **3.9 SOCIO-ECONOMIC ENVIRONMENT**

The Uttar Pradesh state constitutes of 75 districts as per Census 2011. The study area comprises of four districts i.e. Hamirpur, Jalaun, Kanpur Nagar and Fatehpur. It includes four sub-districts of Hamirpur namely Hamirpur, Rath, Sarila and Maudaha, similarly three sub-districts of Kanpur Nagar district Ghatampur, Kanpur and Bilhaur, and two sub-districts of Fatehpur namely Fatehpur and Bindki and one sub-districts of Jalaun district Kalpi. Total 194 villages fall under the area under study covering 4 districts. The detailed socio economic study is attached as Annexure XV

#### **Table No.3.36. Total Number of all villages and towns within 10km radius**

District	Tehsil	No. of Villages	No. of Towns
Hamirpur	Hamirpur	92	--
	Rath	01	--
	Sarila	27	
	Maudaha	12	--
Jalaun	Kalpi	26	--
<b>Total</b>		<b>158</b>	--

### 3.9.1. Population Profile:

The study area has a total population of 341198, out of which major percent which is 68% from district Hamirpur, and other districts viz. Jalaun, Kanpur Nagar and Fatehpur have percentages 12%, 16% and 4% respectively.

The figures below represents the demographic profile of the area under study showing percentages of Males, Females and the population below 6 years of age. The study area includes four districts namely Jalaun, Hamirpur, Kanpur Nagar and Fatehpur, hence the demographic profile of the individual districts is also represented in the figures given below. Mine leases are only located in the two districts of the study area viz. Jalaun and Hamirpur, only a very small portion of Kanpur Nagar and Fatehpur districts lies within the 10 km buffer zone of the study area.

### 3.9.2. Literacy profile:

There are parts of four districts which are falling under this EIA study namely Hamirpur, Jalaun, Kanpur Nagar and Fatehpur. Literacy profile of the study area is given below in Fig.3.51

### 3.9.3. Occupational profile:

The percentage of Worker and Non-Worker population out of the total population constituting the study area is given in Fig 3.52. number and percentage of Main worker,

which work as worker for major part of the duration of the year and Marginal Workers, which work as Workers for less than 6 Months in the duration of a year. Here, As per Census Of India, 2011. Marginal Workers have been categorised into two Categories:

- a) Marginal Workers who work for 3-6 Months
- b) Marginal Workers who work for less than 3 Months

Category of workers as per their occupation for both Main and Marginal workers is defined as Cultivators, Agricultural Laborers, Household Industry Workers and Other Workers.

## CHAPTER- IV

<b>S. NO.</b>	<b>CONTENTS</b>
<b>4.0</b>	<b>GENERAL</b>
<b>4.1</b>	<b>IMPACTS OF MORRUM MINING</b>
4.1.1	<b>Physical</b>
4.1.2	<b>Land Environment</b>
4.1.3.	<b>Waste Dumps</b>
4.1.4.	<b>Air Environment</b>
4.1.5.	<b>Water Environment</b>
4.1.6.	<b>Noise Environment</b>
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4.1.8.	<b>Socio-Economic Environment</b>
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4.1.13	<b>Occupational health</b>

# ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION METHODS

## 4. GENERAL

The mining projects along with other activities in vicinity may influence the existing physical, biological and social components of environment. In case of mining projects, impacts on biodiversity, air pollution, water pollution, waste management and social issues may be associated. These impacts could be minimized up to a significant level when scientific mining procedures, guidelines and rules are taken into account. The nature and characteristics of impacts are required to be taken into consideration while evaluating the magnitude of impacts. Open cast mining activities have different types of impacts on nearby environment with respect to both magnitude and significance. During the working life of mine, air, water, noise and land use are likely to be affected due to

mining of minerals and associated activities. The various anticipated impacts and mitigation measures are discussed in this chapter.

Environmental factors (“impacts”) associated with, or caused by, mining, as distinct from those associated with the subsequent use of the extracted minerals, are largely confined to relatively restricted areas in the vicinity of the appropriate geological formation and downstream in the catchment where the deposit is located. These impacts would normally be considered to be “direct” impacts that can be linked directly to the mining and ore processing operations.

In contrast, there are many other types of impacts that are associated with mining activities, but do not occur as a direct consequence of the mining activity itself. These would be considered to be “indirect” impacts. A typical example would be the variety of impacts caused by the activities of individuals and organizations that take place in areas peripheral to a mining operation. In several instances, these indirect impacts can exceed the total environmental impact of the original mining operation and thereby require a far greater degree of management attention.

The term “cumulative impacts” is generally applied to those situations where several impacts from different processes and activities combine to exert a greater set of (usually adverse) effects than those that would be predicted from the original activities. An example of this type of situation would be the combination of adverse effects that a community would experience if it were exposed simultaneously to atmospheric emissions of gases, wind blown dust and effluent discharged from a mining operation. A second example would be the situation where effluents and discharges from several mining operations or industries in a single catchment exerted a set of combined effects or impacts on the river system draining the basin. In some circumstances, there may be synergistic effects, where the combined (cumulative) effect of two different activities is greater than would be expected from a simple combination of the two isolated activities. Similarly, there are also certain circumstances where the impacts from two different activities effectively neutralize each other – this situation is often referred to as an “antagonistic” or “counteractive” interaction. Three typical wastes provide a simple example of this type of situation, namely: acid rock drainage, raw sewage and power station ash. Individually, these wastes exert serious adverse impacts on aquatic

environments; in combination, however, they neutralize and offset each other so that their combined effect on the aquatic environment is often innocuous.

#### **4.0.1. Regional Impacts**

Regional impacts are those impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors in the proposed study area. Regional impacts are therefore generally impacts that act with others in such a way that the sum is greater than the parts. This is, however, not always the case – sometimes they will simply be the sum of the parts, but that sum becomes significant. Regional impacts arise from the environmental effects which ranges from simple additive impacts to complex interaction of the stresses anticipated because of the proposed project. It occurs when;

- impacts on the natural and social environments take place so frequently in time or so densely in space that the effects of individual “impact” cannot be assimilated;
- the impacts of one activity combine with those of another in a synergistic manner.

Causes of environmental change also include natural variability and anthropogenic climate change. Four types of impact of mining are identified which combined to create regional impact.

1. **Space Crowding**-occurs when a system is disturbed by several similar activities, or by different activities producing a similar effect, in an area small to assimilate the combined impacts. (Rees 1995)
2. **Time Crowding**-occurs when impacts are so close in time that the impact of one action are not dissipated before the next occurs.(CEARC 1986)
3. **Interactive effects**- can be additive or compounding, reflecting the interactive nature of ecosystems. Additive is the simple linear addition of one impact on another, whereas compounding is when two or more agents combine to cause an impact. Antagonistic effects can also occur, where the combined impact of more than one agent is less than the sum of the individual impacts. (Canter and Kamanth 1995)
4. **Indirect effects**- are secondary impacts arising as a result of the direct effect, and include the impacts of activities facilitated by a project, including reasonably foreseeable impacts from downstream users.

This Chapter considers the regional impacts that would result from the combination of the Project and other actual or proposed future developments in the study Area.

#### 4.0.2. Shadow projection of impacts:

In addition to the proposed projects the study Area may experience impacts as a result to the following developments:

1. Other functional or proposed mining projects.

**Table No.4.1. List of Projected mine leases falling within the Study Area-2**

S. Nos.	District	Village	Number of mine leases
1.	Hamirpur	BhediKharka	02
2.		Teekapur	07
3.		Beri	12
4.	Jalaun	BhediKhurd	01
5.		Basrehi	01
6.		Kyotara	01

Given above are the numbers of leases (24 leases) which are falling within the Study Area-2, other than the existing leases for which EIA study has been done in this report. These leases (24-projected + 31-existing leases) would be included in the Regional EMP of Study Area-2, as these projected 24 leases will have impact on the leases located towards the downwind direction. The cumulative impact of all the leases will be assessed and will be addresses in the Regional EMP given in Chapter 10.

2. Development of new roads
3. Strengthening of existing roads
4. Construction of new bridges or other infrastructural facilities

These developments may worsen or enhance the impacts identified. Given the limited information available regarding such future developments, the assessment that follows is necessarily of a generic (qualitative) nature and focuses on key issues and sensitivities,

and how these might be influenced by cumulative impacts with other planned developments.

#### **4.0.3. Management and mitigation of regional impacts**

Managing cumulative effects in a Environmental Impact Assessment requires, as a start, the same type of mitigation and monitoring that would be recommended in an Environmental Impact Assessment for a stand alone mining project. Mitigating a local effect as much as possible is the best way to reduce regional effects. Mitigating and managing an individual project's impacts as far as possible, even when the project itself does not result in significant impacts, is an appropriate way to reduce impacts across a region. It is generally unreasonable to expect a single proponent however to bear the burden of mitigating effects attributable to other actions in the region. Such an approach can significantly disadvantage later projects and be a disincentive to investment. Ultimately, when threshold level of regional impacts required a broader intervention and mitigation of impact, regional impact assessment and regional environmental management plan comes into the picture. This may result in increased regulation of activities contributing to these impacts and regional collaborative initiatives. Following are specific management measures for mitigate and manage all impacts.

#### **4.0.4 Shared Infrastructure**

Proposed project will discuss and decide between them where possible, to share infrastructure (viz. access roads and transportation routes inside their project areas) to reduce the potential disturbance caused by installing several similar infrastructure in close proximity to each other.

#### **4.0.5.Undertaking a Strategic Regional Environmental and Social Impact Assessment**

In the context of this study, these examples of cumulative impacts are highly relevant as the river basins evaluated in this study contain very large numbers of mining operations as well as other forms of land use. In combination, therefore, there is a large potential for the impacts of mining operations to add to, or possibly even counteract, some of the impacts from these other activities. Keeping in mind the Environment Impact Assessment

(REIA) (due to numbers of leases (31) on Betwa river in district Jalaun and Hamirpur, the environmental baseline scenario as detailed in Chapter 3 and the proposed mining activity described in Chapter 2) is attempted to assess the likely impact and its extent on various environmental parameters and likely mitigation measures to be adopted. An impact matrix has also been made for the EIA considering all vital parameters of the physical & biological parameters of nearby environment in relation to their significance.

#### **4.0.5. Assessment of regional impacts**

It is very important to identify the contribution of individual mines in regional impact. Detailed scoping exercise has been undertaken to determine the relevant projects, environmental receptors and potential impacts to consider. An assessment of the regional impacts can be undertaken which include Individual environmental values, considering the impacts of all relevant projects (noting that these may not all be the same for each receptor). The following sections outline the steps in the recommended assessment process:

1. Determine the baseline
2. Determine what constitutes a significant impact
3. Set thresholds
4. Estimate cumulative impacts, and
5. Determine the significance of potential impacts.

**Table No. 4.2 Impact of Sand Mining and Consequences.**

	<b>Main Impact</b>	<b>Consequences</b>
Air	Increase level of air pollutants concentration	Human health risks
Flora and fauna	Habitat loss	Alteration on fish population
		Increasing level of weed infestation
	Physical disturbance of the habitat	Degradation of aquatic biota
		Alter number of animal species
	Vegetation is destroyed	Reduction of farmlands and grazing lands
Water	Increase water	Decrease plants photosynthetic activity

	<b>Main Impact</b>	<b>Consequences</b>
	turbidity	Changes in nutrient parameters
		Disturbing feeding activity for different aquatic animal species
		Reduce light penetration and oxygen levels that can affect aquatic animals activities and composition of phytoplankton
		Affect spawning and hatching
		Affect aquatic animals respiration (Cause respiratory distress)
		Negative changes in fish population diversity and trends (major decline in population)
		Increase infections and death risk for aquatic animals
		Redistribution of fine particles in the water
	Increase soil and coastal erosion	Seawater intrusion
		Affect infrastructure projects
	Water quality deterioration	Increase water salinity
		Alteration of water sources
		Increase water treatment cost
Water pollution	Affects the biodiversity	
	Sinking and deformation of riverbeds and banks	Drying up wells around the river
		Lateral channels erosion and instability
		Negative effect on groundwater
		Waterways siltation
		Influence the uncertainty of the slope and levee
Affects hydrological function	Change in water flows, flood regulation and marine currents	
Soil	Decrease soil quality	Increase dark areas (fertile land became unfertile due to lowering groundwater levels)
		Changes in soil geochemistry (increase concentration of lead, arsenic, mercury, etc.)
	Soil erosion	Watercourses, wetlands and lakes pollution
Land	Landscape	Dramatically change of the landscape

	<b>Main Impact</b>	<b>Consequences</b>
	disturbance	Deforestation
		Loss of bathing beaches
		Decrease sand reserve for natural beach storm response
	Mine-Induced Seismicity	
	Structures stability	Damage of the public and private property.

#### **4.0.6. Criteria of impact study**

It is a near impossibility to remove all subjectivity involved in making Present Status assessments such as those presented here. Descriptions of each criterion are provided to assist with the assessment.

Criterion 1	:	Water abstraction
Criterion 2	:	Inundation
Criterion 3	:	Water quality
Criterion 4	:	Flow modification
Criterion 5	:	Bed modifications
Criterion 6	:	Channel modifications
Criterion 7	:	Presence of exotic aquatic fauna (e.g. fish)
Criterion 8	:	Presence of exotic macrophytes
Criterion 9	:	Solid waste disposal
Criterion 10	:	Indigenous vegetation removal
Criterion 11	:	Exotic vegetation encroachment
Criterion 12	:	Bank erosion
Criterion 13	:	Ground water movement
Criterion 14	:	Change in particle size
Criterion 15	:	Lowering of ground water

#### **4.1. IMPACTS OF MORRUM MINING**

On a large scale, to carry out aEIA impacts of morrum mining can be broadly classified as given below:

#### **4.1.1. Physical**

The large-scale extraction of streambed materials, mining below the existing stream bed and the alteration of channel-bed form and shape may lead to several impacts such as erosion of channel bed and banks, increase in channel slope, and change in channel morphology.

##### **4.1.1.1. Regional Impact**

These impacts may cause:

- (1) the undercutting and collapse of river banks,
- (2) the loss of adjacent land and/or structures,
- (3) upstream erosion as a result of an increase in channel slope and changes in flow velocity, and
- (4) downstream erosion due to increase carrying capacity of the stream, downstream, downstream changes in patterns of deposition, and changes in channel bed and habitat type.

##### **4.1.1.2. Mitigation Measures**

- Ultimate working depth shall be up to 3.0 m from Riverbed level and not less than one meter from the water level of the River channel whichever is reached earlier.
- The River Bed Mining (RBM) will be done in unsaturated zone. Thus no loss to habitat is anticipated.
- Dredging will not be allowed. Mining activities will be done using bar scraper and loader.
- The mining procedure will also be made to conform to the recommendations of MoEF& CC's Standard Environmental Conditions for Sand Mining mentioned in SSMMG, 2016.
- The e-tendering of the leases were done by DM, Jalaun and Hamirpur keeping in view the points like availability of minor mineral reserves, sites specific problem like flooding, submergence crop lands/ fields, need of excavation rate of sediment deposition etc.

- RBM will be done in responsible manner.
- Head cutting will not be done.
- The RBM will be done in unsaturated zone.
- As per SSMMG, 2016, the required safety distances will be maintained when mining will be carried out near important structure like bridges, dam and other infrastructures to prevent any damage & bar skimming.

#### **4.1.2.Land Environment**

The impact on the landform morphophysiology will be limited to the modification of the slope. The landscape and land use will undergo a radical change due to open cast mining. The impact during next 5 years is limited as benches will be formed and will be replenished during monsoon. Besides these benches, roads will also modify the Physiography.

Mining activity causes an impact on flora and fauna due to land degradation, deforestation, etc. However, as the mining is restricted to a very small area in the river bed in dry condition. There is no likelihood of any land degradation or deforestation being caused. The impact on land use will also be limited. The mining activity is restricted along the river bed only. Since the site is government owned wasteland, no impact on existing land use is anticipated; also the mined area would get replenished on arrival of monsoon every year itself. The impacts of mining on land environment are predominantly governed by the area acquired and land use characteristics. The satellite imagery on land use, discussed in Chapter 3 of baseline information should form the basis of impact prediction on land. Cost- Benefit analysis is also carried out to see the overall benefits the project will bring and the economic benefits the land is providing to the area are to be estimated. The potential impacts of mining on land and their significance are compiled hereunder and summarized in table 4.4.

##### **4.1.2.1.Regional Impact**

Mining developments increased accessibility made possible influx of further people attracted to the study area by job opportunities, these ephemeral river systems may possibly come (i.e. – if not mitigated) under increasing pressure, not only in terms of water abstraction, but also in terms of the potential contamination of these river systems by diffusing sources of pollution, such as:

The ad hoc maintenance of vehicles and machinery;

- The washing of equipment and vehicles;
- Dirty run-off water from different mining company components and staff camps, etc.;
- Improper management of sewage; and
- Potential spillages of fuels and chemicals.

A number of the projects are proposed in the study area and some other projects are functional at the moment. This phase is unlikely to result in significant regional impacts to groundwater drawdown, as current water demand is relatively low; however, the combined operational phase water requirements for these companies will be needed for consideration.

#### **4.1.2.3. Anticipated impacts and evaluation**

The proposed morrum mining operations will have both positive and negative changes on the pre mining environmental and ecological status of the area. All mining companies proposed/ operating in the study area will require the good quality water for drinking. The water demand for sprinkling and plantation, when projected on the regional basis will be greater.

##### **a.Impact on quantity and characteristics of top soil**

The current EIA identifies the impact of 11 morrum mining projects (inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited) in a stretch of River Betwa between **25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N & 80°16'12.74"E**. The project will be restricted to scraping and loading of morrum deposit. The lease areas proposed in REIA are deficient of top soil, so no loss of top soil is anticipated and non-plastic and having many vertical tubular pores. It appears that due to the mixing of different soil horizons during mining, the soil profile changed to a great extent (Ghosh, 1989). The particle size analysis reveals that sand particles increased, and silt and clay decreased with respect to unmined soil. This trend may be due to increased erosion of aggregates and consequently a high rate of infiltration. The soil dumps were found to be sandy loam in texture, and gradually changed to loamy sand after that period. The high bulk density of the soil dumps may be attributed to the use of heavy machinery. This has the high bulk

density of the soil dumps may be attributed to the use of heavy machinery. This has a serious implication for subsequent changes in soil properties, because gaseous diffusion is made more difficult. Thus, restrictions on growth of deep-rooted plants may be one of the reasons for stagnation of plant succession at the shrub stage. However, if any layer of soil is found beneath the surface during mining it will be utilized for strengthening the haulage route as it is not biologically active/ fertile.

### **b. Impact on soil quality of the surrounding area**

Since it is RBM project, absence of topsoil in mining lease areas is observed, so no mitigation measures required. However, the following mitigation measures will be taken to prevent any impact on soil quality of the nearby areas due to operational aspects of the project:

- It will be ensured that the scraper and front-end loader are properly maintained.
- Equipments will be regularly serviced and inspected to make sure there are no leaks of oil, diesel, fuel, detergents or hydraulic fluids.
- Servicing and maintenance of vehicles as far as possible will occur outside of the boundaries of mining lease area. If maintenance does occur on site due to breakdown, all steps will be undertaken to avoid hydrocarbon spills/leakages.
- Under no circumstances will oil or diesel be stored and disposed of at the site.
- No night parking of vehicles in the mining lease area.
- Vendors of UPPCB will be contracted for collection of hazardous waste (used oil) & oil spill kit will be provided with each vehicle.

### **c. Impact On Existing Land Use**

These impacts may cause: (1) the undercutting and collapse of river banks, (2) the loss of adjacent land and/or structures, (3) upstream erosion as a result of an increase in channel slope and changes in flow velocity, and (4) downstream erosion due to increased carrying capacity of the stream, downstream changes in patterns of deposition, and changes in channel bed and habitat type. The mining activities will be restricted to the river bed only. Since the site is government owned waste land, no impact on existing land

use is anticipated. Also, the mined area would get replenished on arrival of monsoon every year.

**d. Impact of siltation in the morrum pits**

Since it is RBM project, no over burden or waste will be generated during mining activity. Impact of siltation will be very low to Nil as there will be no pit formation due to use of bar scraper.

**e. Impact on natural course of river/diversion of water flow due to bank erosion**

The mining activities will be confined to the river bed only, hence will help the river to remain channelized also avoiding natural hazards like erosion, flooding etc. thus the impact is positive and significant.

**e. Impact on riverine ecology**

In the current REIA, dredging or instream mining is not proposed in any of the 31 leases (inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited). Hence, the impact on riverine ecology would be negligible. However, it has been found that during site visit some part of the few lease areas was submerged in the active water channel. In such condition, the depth of the mining in contrast with LOI will be increased in the dry mining area to meet out the production from the respective leases. Ultimate mining depth will be kept at 03 m from surface limiting above 1 m above water level of the river.

Riparian ecology includes the vegetative cover on and adjacent to the river banks. The mining activity will be confined to the river bed only. No vegetation is adversely affected.

**f. Erosion potential and terrain: stability of river banks (which may lead to loss of chunks of land and make area flood prone)**

Kondolf (1993) reported that in stream mining resulted in channel degradation and erosion, head cutting, increased turbidity, stream bank erosion and sedimentation of riffle areas. All these changes adversely affect fish and other aquatic organisms either directly by damage to organisms or through habitat degradation or indirectly through disruption of food web. Further, effects on stream geomorphology (e.g., channel incision)

can result in infrastructure damage such as undermining bridge piers and exposure of buried pipeline crossings and water supply intake (Kondolf, 1997). The mining activity will be confined to the river bed only; hence will help the river to remain channelized also avoiding natural hazards like erosion, flooding etc. Thus, the impact is positive and significant.

#### **4.1.3. Waste Dumps**

This is RBM project, no drilling; blasting is proposed thus not involving any waste generation. The excavated material will be loaded and transported directly to the potential markets, not leaving any waste dumps behind. There may be incidental waste due to activities of mine workers which will be insignificant and provisions for dustbins will be available on site to collect the incidental waste.

##### **4.1.3.1 .Mitigation Measures**

- The Mineable reserves will be limited by
  - a) Free space of 3 m or 10% of the channel width of the river from riparian zone.
  - b) Bench height will be kept at max. of 0.6 m and width of minimum 10 m.
  - c) Bench slope not more than of 30° from vertical axis.
  - d) safety margins from civil structures for each site.
- The main stream will not be diverted to form inactive channels from mining.
- Mining below subterranean water will not be done.
- Riverbed mining will be carried out where maximum sedimentation occurs.
- Segments of braided river will be used preferably for mining.
- Mining at the concave side of the river channel will not be done so that the bank erosion may not occur.
- Mining will be carried out at places where sediment aggregations are maximum.
- Mining will be restricted during the monsoon season and at the time of floods.
- Mining schedule will be synchronized with the river flow direction and the gradient of the land.
- Care will be taken to ensure that ponds are not formed in the river bed.

- Access roads from public roads and up to river bank will be selected in such a way that it would cause least environmental damage.
- Productive land will not be utilized for storage and other purpose.
- Siltation on agriculture land will be prevented.

#### **4.1.4 Air Environment**

##### **4.1.4.1. Anticipated Impacts and Evaluation**

Air pollution is likely to be caused at various stages of morrum mining operations such as excavation, loading, transportation and screening of material. If we look at regional level, dust generated during loading, unloading and transportation of morrum is the main pollutants of morrum mining operations of which cumulative impacts would be very significant. Most of the dust will be generated from loading, screening and transportation operations. This dust becomes air borne and gets carried away to surrounding areas. The impact on air is mainly localized in nature as the dust particles are not carried to longer distances due to larger size and the effect is felt within the core zone of the all 06 mining leases. But combined impact of air borne dust from the mining lease areas will definitely give a relatively larger picture of fugitive dust emission in the area. Also, loading, transportation and unloading operations may cause deterioration in air quality due to handling dry materials.

In the present case, only wet materials will be handled by suitable water sprinkling during loading & on haulage routes, thus eliminating problems of fugitive dust. Also, the collection and lifting of minerals will be done manually without any blasting. Therefore the dust generated is insignificant as compared to mining process of other hard minerals like the process of drilling, blasting, mechanized loading etc.

##### **4.1.4.2. Regional impact of air pollution**

Other activities associated with the proposed mining projects in the study area have the potential to create significant negative cumulative impacts associated with the generation of total dust, PM<sub>10</sub> and PM<sub>2.5</sub>. The magnitude of these potential impacts may be minor, moderate or major, depending upon how the impacts from other mining projects will

combine with impacts arising from the proposed Mining Projects and the respective timing of each project. These impacts may be worsened by elevated wind speeds, increasing the potential for cumulative impacts during periods of adverse weather.

**4.1.4.3. Air Modeling**

In general, mining operations may generate airborne respirable dust, which leads to the development of respirable diseases in mine workers. The increasing trend of mining leads to release of huge amount of dust. These air borne dust particles, generally below 10 micron in size, are nuisance particulates and cause health hazards as an ill effect of mining activities. Mining activities like drilling, blasting, material handling and transport are a potential source of air pollution. Therefore, a detailed study on emission sources and quantification of pollutant concentration by means of dispersion modeling is required to assess the environmental impact of a mine. On the basis of the predicted increments to air pollutant concentrations, an effective mitigation and environmental plan can be devised for sensitive areas. In case of river bed morrum mining, as there are no blasting and drilling activities, the impacts are caused by material handling and transportation activities of mostly wet morrum and are minimal.

**4.1.4.4. Fugitive dust- modeling**

Concentration of the fugitive dust was calculated using the empirical equations for unpaved roads published by USEPA- AP42. The Concentration of the fugitive Dust is given below:

$$C = (2/\pi)^{1/2} (E / \sigma z v) \text{Exp-} [(h^2) / (2 \sigma z^2)] \times 10^6 \text{ ----- (2)}$$

Where

- C = Concentration in microgram/ m<sup>3</sup>
- E = Emission Rate = 0.012 g/sec/m
- v = Wind Speed =1 m/s
- h = 1m

Modelling was done for an infinite line source assuming unpaved road. For conservative calculation wind was assumed to blow at a velocity of 1 m/s perpendicular to the road. For fugitive emission control, the uncontrolled emissions from various source ranges from 1,00,000 to 4,00,000 µg/m<sup>3</sup> . As control efficiency of 95% could reduce this level to

5,000 to 20,000  $\mu\text{g}/\text{m}^3$ , close to source, measured at maximum 1 M distance. By applying Gaussian Model for neutral atmospheric conditions, the effect of SPM at different distance would be as mentioned below

For an average achievable SPM concentration value at source (<1Meter) of 10,000 microgram per cubic meter would have a projected SPM concentration in the range of 150 microgram per cubic meter at 30 Meter distance.

#### **4.1.4.5. Mitigation Measures**

During operational phase of mining, the only air pollution sources are fugitive dust emission due to movement, loading, unloading and transportation of minor minerals as drilling, blasting, crushing, DG Set/furnace or storage is not proposed at site. The following mitigation measures are suggested:

- Dust suppression measures like spraying/sprinkling of water on haulage route to keep the surface wet as well as during loading/ unloading of minor mineral.
- No overloading of the trucks/trolleys.
- Transportation of material in covered vehicles to prevent dust emission in case of long haulage or if the road passes through in close proximity to habitation.
- Provision of water spray on the dumper and roads to arrest fine dust before transportation.
- Suitable dust barriers in the form of green nylon curtains near excavation site.

#### **4.1.5. Water Environment**

##### **4.1.5.1. Baseline Status**

The source of water in the area is generally the ground water and rainwater. The River Betwa is one of the major flowing rivers of the district. Betwa River during its course from the source is joined by a number of sub-tributaries. As the proposed activity is a process involving scraping of morrum from the river bed & hence intersection of ground water does not arise.

#### **4.1.5.2. Anticipated impacts and evaluation**

During the mining operations, there will be no wastewater discharges to water bodies from the lease areas. The inflow of sewage or effluents from the surrounding locality is also considered nil as no temporary or permanent housing is proposed at mine sites. The only water contaminant is rainwater run-off during the monsoon season. There will be no impact due to the proposed mining on the water environment and the water flow pattern does not disturb the turbidity and velocity, hence no mitigation measures are suggested. There is no noticeable effect on surrounding ground water resource due to mining as the mining activity does not require ground water extraction. The collection of morrum is done on the river bed where excessive sedimentation has been noticed up to the required depth only. Excessivemining will reduce the thickness of the natural filter materials (sediments) through which the groundwater is recharged. The pollutants due to mining, such as washing of mining materials, wastes disposal, diesel and vehicular oil lubricants and other human activities may pollute the groundwater. Dumping of fine material, compaction of filter zone due to movement heavy machinery and vehicles for mining purposes may reduce the permeability and porosity of the filter material through which the groundwater is recharging, thus resulting in steady decrease of ground water resources. Deposition of silt on river bed can smother diatoms, benthic algae, macro-invertebrates and fish eggs. Composition of benthic and fish communities affected by changes in sediment texture and habitat loss arising from selective removal of fine aggregates from the river bed deposit. Many aquatic organisms, especially the benthos, are affected severely by sand mining. The organisms include different species of mayfly, dragonfly, chironomids, eaddisfly and other insects of the order Diptera. Sand mining can also negatively affect the survival and dispersal of benthic organisms belonging to the groups Polychaeta, Crustacea and Mollusca. Dispersal of eggs and larvae is an important aspect of the biological processes of aquatic organisms. In the fisheries point of view, loss of food in the form of benthic invertebrates is a major negative impact which will ultimately end up in the decline of inland fishery resource of the area.

The impact on the aquatic flora & fauna due to the proposed opencast mining is insignificant as mining involves only scraping of morrum from the river bed which will

not disturb the aquatic life present in the river. The detrimental effects to biota resulting from bed material mining are caused by three main processes:

- i. alteration of flow patterns resulting from modification of the river bed
- ii. an excess of suspended sediment
- iii. damage to riparian vegetation and in stream habitat

**4.1.5.3. Impact on water level:-**When mining is done in the sand pits above the ground water level, pit is not dewatered , no significant impact on ground water is observed. However when the mining is done from mining pit below the water table, mine altered the ground water flow direction in the sand and gravel deposits affecting the nearby ground water source for the area. Sand and gravel operations are found in deposits formed during the advance and retreat of glaciers and in alluvial floodplain deposits formed by streams. Both types of deposits often are critical ground-water aquifers and recharge areas in upland settings; they often are focused discharge zones in stream and river valleys where wetlands and springs depend on continued groundwater flows through the sand and gravel. Because sand and gravel deposits allow comparatively high infiltration rates and relatively rapid rates of water transfer within an aquifer, activities and land uses within and above granular aggregate can have negative effects on groundwater quantity and quality within aquifers. Excessive dewatering in mines

The red arrows represent the ground-water flow under these conditions and approximate the hydraulic gradient, or water surface slope, of Aquifer 1. Because the potentiometric surface of Aquifer 2 has been reduced, the hydraulic gradient of Aquifer 1 is steeply sloping toward the pit. Groundwater flow paths, water table elevations, groundwater gradients and both surface- and ground-water basins can be altered by mining below the water table. Excavation of the pit below the water table can cause water levels to decline near the mine and downgradient of the mine. The effect is due to redirection of ground-water flow to the pond and then to the ditch system and is due to evaporation from the pond surface. The greatest potential for alteration of water levels and flow patterns occurs where mines intersect a water-yielding zone. The magnitude and areal extent of changes in water levels and flow patterns are dependent on many variables including

1. The arial extent of the flow system penetrated by the mine,
2. The thickness of the saturated interval penetrated by the mine,
3. The hydraulic head at the mine site,
4. the horizontal and vertical dtstnbution and magnitude of hydraulic conductivity and storage coefficient surroundmg the mine site,
5. the distance to and types of hydrologic boundaries,
6. the stze and shape of the mine cut,
7. the length of time the mine is in operation

4.1.5.3. **Increase in turbidity** :-Turbidity is the cloudiness or murkiness of water, which is an expression of the optical properties of water, which cause the light to be scattered and absorbed rather than transmitted in straight lines. It is therefore commonly regarded as the opposite of clarity (Wasset *al.*, 1997). Turbidity impairs the suitability of the water for many purposes. High levels of mean turbidity in the mining and downstream sites is due to increased riverbed and bank erosion associated with sand mining which increases suspended solids in the water at the mining and downstream sites. Mining operation also release fine sand and small silt particles that are present in the stream. Silt particles (< 63  $\mu\text{m}$ ) can be transported over large distances by the river because of their small settling velocity (Kondolf,1994). Although water turbidity does not pose a serious problem to ground water since it is unable to migrate beyondthe immediate infiltration site, the continual infiltration of the turbid water does raise the potential for other sources of contaminant to migrate to the aquifer because it decreases the distance between the ground water table and land surface. In some cases, the excavation actually penetrates the shallow aquifers, leading a direct access to ground water (Despreze, 2000) mean depth of 3- 4 meters. Any chemical contaminants that are allowed to enter wash water or spills in the area would have quicker access to the aquifer. Once in the ground water, a chemical substance would be free tomove with the water in the aquifer. It should also be recognized that although it does not pose a threat to the health of water users, the impact of turbidity are many and include, its being as primary agent causing biological stresses; source of introduction of abnormal volumes

of organic material and nutrients and reintroduction of toxic substances uncovered by mining activities thus increasing the biological oxygen demand (BOD), which in turn reduces oxygen levels. Also it has been observed that sand mining operations reduce the buffering capacity of subsurface materials by removing the soil layer from an area. The reduction in buffering capacity makes the groundwater sensitive to pH change (Borges, *etal*, 2002). Other impact of turbidity is discoloration of water which more than anything renders groundwater appear bad.

#### **4.1.5.5. Regional Impact**

Surface water course is present in the study area, and drainage channels flow during rainy season. Mining companies active in the study area will establish infrastructure for their mining operations including offices, access roads. The establishment of infrastructure has the potential to interrupt run-off channels and result in cumulative negative impacts to the sensitive ecology that depend on small drainage lines that transport surface water during flash flood events.

#### **4.1.5.6. Mitigation Measures**

No mitigation measures are required as the project activity is carried out in the meandering part of the river bed; none of the project activities will affect the water environment or riparian habitats. In the projects, it is not proposed to divert or truncate any stream. No proposal is envisaged for pumping of water either from the river or tapping the ground water. Project Proponent will adhere to all guidelines and rules for proper and scientific method of mining during the period of extracting the morrum. Thus, the project activities shall not have any adverse effect on the physical components of the environment and therefore may not have any effect on the recharge of ground waters or affect the water quality.

#### **4.1.6. Noise Environment**

The proposed RBM project is predominantly semi-mechanized/OTFM, thus will generate very less noise, that too by the movement of vehicles as drilling blasting etc. are not proposed.

#### **4.1.6.1. Anticipated impacts and evaluation**

As there will be no heavy earth moving machinery hence there will not be any major impact on noise level due to the mining and other associated activities. A detailed noise survey has been carried out and results are discussed in Chapter 3. Drilling & Blasting technique is not required for morrum lifting, hence no possibility of land vibration. It is found that the mining activity will not have any significant impact on the noise environment of the region. The only impact will be due to transportation of materials by trucks/trolleys.

#### **4.1.6.2. Regional Impact**

In the event that present and proposed projects of mining leases falling within the Study Area-2 to run in parallel with the other activities of the study area, it is possible that the cumulative noise impact of activities carried out in these phases may increase from the direct impact predicted; however, this is dependent on how the impacts from other developments combine with the impacts from the proposed projects of mining leases falling within the Study Area-2, and the respective timing of these impacts. However, this said, proposed projects will vary in their locality and hence it is unlikely that there will be a cumulative increase in predicted noise.

#### **4.1.6.3. Traffic during operations**

It is likely that mining companies will use the same main haul road to transport product out of the study area and through road networks. Although this will result in an increase in the number of trucks utilising the road, the actual predicted noise level will not increase; rather, the predicted road noise levels will become less intermittent.

#### **4.1.6.3. Mitigation Measures**

As the only impact is due to transportation of morrum though village roads, emphasis will be given on the following points:

- Haulage route for transportation of the excavated minor mineral will be opted & constructed away from the habitation, schools, hospitals & other social areas.

- Trucks which are newer or less than 15 years old having fitness certificate will be deployed for transportation of minor minerals after obtaining pollution under control certificate.
- Minimum use of horns in the village area will be promoted and silence zone (if any) will be marked as applicable.
- Care will be taken to produce minimum sound during loading.
- Labourers will be provided with personal hearing protection device i.e. ear plugs or ear muffs if required.

#### **4.1.6.4. Traffic analysis of regional impact of additional traffic because of proposed projects**

Significant cumulative impacts can arise due to emissions from vehicle exhausts and from dust dispersion lifted from unpaved road surfaces. Impacts at roadside sensitive receptors caused by the vehicles associated with the proposed projects are however predicted to be of negligible negative significance (post-mitigation). On this basis, where air quality standards are to be approached or exceeded, these impacts would likely arise from vehicles other than trucks from the proposed mining projects. Where unpaved access roads are used however, major adverse impacts associated with dispersion of dust and PM 10/PM2.5 can potentially occur. These effects can be especially significant if the same unpaved road is used by various mining company traffic.

The vehicular movement within the site is inevitable. However, during operation phase, this activity would not cause any significant impact on the ambient air quality. To ensure this traffic analysis is carried out by:

- visiting each and every mine site & finalizing the opted haulage route away from the habitation, schools, hospitals & other social areas.
- categorizing the paved & unpaved length & width of the haulage route for each mine site in the region.
- identifying the common haulage route for two or more leases in the stretch.

- calculating the no. of trucks to be deployed for transportation of excavated minor mineral.
- understanding the existing carrying capacity of the roads near to the project site and the connecting main roads in the area. Then depending on the capacity of the mine, the number of trucks that will be added to the present scenario will be compared to the carrying capacity.

The details regarding length of haulage route, daily production and no. of trucks to be deployed per day is given in the Table 4.1 below:

**Table 4.2. Haulage route analysis & details of vehicular movement of leases falling in stretch of EIA**

Project Proponent (s) & Name of Company (if any) & Residential Address	Gata No (s)/ Khand No (s) ,Village Tehsil/ District	Details of Production		Haulage Route Length (km)			
		Daily Production (cum/day)	No. of Trucks to be deployed for transportation/day	Description	Unpaved Length	Paved Length	Total Length
<b>B1 Category Projects</b>							
M/s Ghanaram Infra Engineers Pvt. Ltd.	Gata No. 240, Khand No. 05	83	59	>8m wide road connected to MDR(Jalalpur-Kadaura) which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.34	0.92	1.26
M/s Pehalwan Traders	Khand No. 23/07	707	47	>6m wide road connected to MDR(Kadaura-Bewar) which is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	2.77	6.91*	9.68
ShriKanha Construction Company	Khand No. 23/13	707	47	>6m wide road connected to MDR(Kadaura-Bewar) which is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	2.67	6.91*	9.58

M/s Balaji Enterprises	Khand No. 23/20	707	47	>6m wide road connected to MDR(Kadaura-Bewar) which is further connected to SH-42 (Hamirpur-Gursarai-Jhansi Marg)	1.46	6.91	8.37
M/s Bindu& Ram Construction Company	Gata No. 1396 Ga, Khand No. 03	1,104	74	>10m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Road) which is further connected to SH 91 (Hamirpur-KalpiMarg)	1.2	8.56+10.7=19.26	20.46
M/s D. V. Construction	Khand No. 20/06	1,413	94	>8m wide road connected to MDR(Jalalpur-Kadaura) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur)	0.92	2.71+6.39=9.1	10.02
M/s Rama Traders	Khand No. 09/03	1,790	119	>8m wide road connected to SH 91 (Hamirpur-KalpiMarg which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur)[N] &  >8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Road) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur) [S]	3.5(N) & 2.49(S)	8.96 (N)+4.0*(N) & 2.88 (S)	5.99 (N) & 5.0 (S)
M/s Indus Mines And Minerals	Khand No.11/4	1,013	67	>8m wide road connected to NH 86 (Sagar Road) &>8m wide road connected to MDR (KuchhechhaDaller Road) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur) [S]	0.71(N) & 1.0 (S)	2.95 (N) & 1.67 (S)	3.66(N) & 2.67 (S)
M/s Harihar Minerals LLP	Khand No. 23/19	706	47	>8m wide road connected to MDR-41B which is further connected to SH 21 (Bilaraya-Lakhimpur-Sitapur-PanwariMarg)	1.32	6.91	8.23
M/s Kamtanath enterprises pvt ltd,	Khand 19/5	2119	141	>9m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	0.95	7.79	8.74

KanhaiyaLal& Sons,	khand 19/4	1719	115	>8m wide road connected to SH 42 (Hamirpur-Gursarai- Jhansi Marg)	0.94(N) 1.14 (S)	9.45 (N) 7.79 (S)	10.39(N) 8.95(S)
M/s New praveera infra height pvt ltd,	khand 10/33	1177	78	>9m wide road connected to SH 91 (Hamirpur- KalpiMarg)	1.14(N) & 0.56(S)	11.4	12.54 (N) &0.56 (S)
Shri Construction	Khand 18/1	2119	141	>8m wide road connected to SH 91 (Hamirpur- KalpiMarg) & 8m wide road connected to SH 42 (Hamirpur-Gursarai- Jhansi Marg)	1.10(N)& 0.74(S)	7.48(N)	8.58(N)& 0.74(S)
M/s Yadav& Sons,	khand 23/12	706	47	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur- KalpiMarg) &>9m wide road connected to MDR 41Bwhich is further connected to SH 42 (Hamirpur- Gursarai-Jhansi Marg)	2.83	6.91	9.74
Shri Rahul Kumar Gupta	khand 10/4	2119	141	>6m wide road connected to SH 91 (Hamirpur- KalpiMarg) & 8m wide road connected to SH 42 (Hamirpur-Gursarai- Jhansi Marg)	3.1(S) &2.48 (N)	6.90 (S) &4.16+10.24=14.4 (N)	10.0(S) &16.88 (N)
M/s Eureka Mines and Minerals LLP	Gata No. 747, Khand No. 01	1177	79	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur- KalpiMarg)	0.68	0.93	1.61
M/s Baba Bholenath Traders	Khand No. 10/36	707	47	>9m wide road connected to SH 91 (Hamirpur- KalpiMarg)	0.1 (N)& 0.10(S)	11.4 (N)	11.5(N)& 0.10 (S)
M/s UnnaoInfradevelopersPvt	Khand No. 10/3	2120	141	>6m wide road connected to MDR(Jalalpur- Kadaura) which is further connected to NH 86 (Kanpur- Ramaipur- Ghatampur	2.62(N)& 3.1(S)	4.16 (N) &6.35 (S)	6.78(N)& 9.45 (S)

KuberKamnaMarbels Pvt. Ltd.	Khand No. 8/4	2260	150	>6m wide road connected to SH 91 (Hamirpur-KalpiMarg) & 8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	1	1.86	2.86
ShriShailendraYadav	Khand No. 10/2	2119	141	>6m wide road connected to SH 42(Hamirpur-Gursarai-Jhansi Marg) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur	3.0(W) & 2.66(S)	4.16(W) & 6.91(S)	5.26(W) & 9.57(S)
M/s KaushalyaChaube Contractor	Khand No. 17/5	530	35	>8m wide road connected to SH 91 (Hamirpur-KalpiMarg)(N) & SH 42(Hamirpur-Gursarai-Jhansi Marg)	0.70(N) & 0.59 (S)	1.20 (S)	0.70(N) & 1.79(S)
<b>Total B1 Lease= 21</b>		<b>27372</b>	<b>1822</b>		<b>51.85</b>	<b>190.27</b>	<b>224.61</b>

## B2 Category Projects

Shri Suresh Chandra Gupta	Gata No. 596, Khand No. 01	883	59	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	1.6	1.29	2.89
M/s Sharad Enterprises	Gata No. 240, Khand No. 02	1,104	74	>7m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.28	0.17	0.45
M/s Chaudhary Traders	Khand No. 23/08	1,413	94	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	2.94	6.91	9.85
M/s MaaRaktdantika Contractors And Suppliers Pvt. Ltd.	Gata No. 1396 Ga, Khand No. 05	1,104	73	>7m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	2.13	19.26 (8.56 for loaded truck & 10.7 for empty truck)	21.39

M/s Silver Mist Retail Private Limited	Khand No. 23/30	707	47	>8m wide road connected to MDR(Lahara-Kadaura Road) which is further connected to SH 91 (Hamirpur-KalpiMarg)	2.20(N) & 0.96(S)	14.0 (N)	16.20 (N) & 0.96 (S)
M/s Silver Mist Retail Private Limited	Khand No. 23/28	707	47	>9m wide road connected to MDR which is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	0.69	9.67	10.36
M/s Rishabh Herbal Pvt. Ltd.	Khand No. 14/1	530	35	>8m wide road connected to SH 91(Hamirpur-KalpiMarg) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur)	0.62(N) & 1.21(S)	0.70 (N) & 0.70(S)	1.32 (N) & 1.91 (S)
M/s Indus Mines And Minerals	Khand No.11/5	707	47	>7m wide road connected to NH 86 (Kanpur-Ramaipur-Ghatampur)	0.14	2.95	3.09
M/s A.P.M. Mining And Infra Pvt.Ltd.	Khand No.10/29	707	47	>6 m wide road connected to SH 91 (Hamirpur-KalpiMarg)	2.30(N) & 0.75(S)	1.40(N) & 8.41 (S)	3.7(N) & 9.16(S)
Associate Commerce	Gata No. 747/16	246	16	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.65	0.93	1.58
<b>Total</b>	<b>10 Leases-B2</b>	<b>8638</b>	<b>575</b>		<b>17.76</b>	<b>67.59</b>	<b>85.35</b>
<b>Grand Total</b>	<b>31Leases-(B1+B2)**</b>	<b>36010</b>	<b>2397</b>		<b>69.61</b>	<b>257.86</b>	<b>309.96</b>

**\*Upcoming B1- sub-category Projects for which Public Hearing is awaited and EC from SEAC for B2- sub-category projects is also awaited & granted.**

**\*\* (inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited)**

**Table 4.3 : Existing Traffic Scenario & LOS**

Road	V	C	Existing V/C Ratio	LOS
Near project sites	82*	500	0.16	A

SH	328*	1500	0.22	B
NH	386*	2400	0.16	A

\* Source: local survey

V= Volume in PCU's/hr C= Capacity in PCU's/ hr LOS- level of service

The existing Level of Service for State Highway-21 is “B” i.e. Very Good and for National Highway-25 is “A” i.e Excellent.

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

Note: As per the IRC standard- IRC: 106-1990, the capacity of SH and NH given on page no. 11 table-2 for arterial road/ Highways:

The State and National which will be used for carrying sand/morrum from mine lease sites to the nearest market are:

SH-21- Two Lane (2 way)

NH-25- Two lane (1 way);

#### 4.1.6.5. During mine operation

Total extraction of morrum	: 9903658 cum (as estimated in LOI)*
No. of working days in a year	: 275
Total extraction/day	: 36013.3 cum
Truck Capacity	: 15 cum
No. of trucks deployed/day	: 2400.9 trucks (say 2401 trucks)
Working Hours per day	: 12 hours
No. of trucks deployed/hr	: 200.08 say 200 trucks

Increase in PCU/ hr : 400 (to and fro)

\*(extraction inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited)

**Table 4.4: Modified Traffic Scenario & LOS**

<b>Road</b>	<b>V</b>	<b>C</b>	<b>Existing V/C Ratio</b>	<b>LOS</b>
Near project site	482	500	0.9	E
SH	728	1500	0.49	C
NH	786	2400	0.33	B

#### **4.1.6.6. Results**

From the above analysis it can be seen that the V/C ratio will be modified to 0.90 on roads nearby project sites/ village roads with LOS being “E” which is very poor. While for National Highway V/C ratio and State Highways will slightly be modified to 0.33 and 0.49, respectively with LOS being changed to “B” and “C” respectively which is Very Good and Good category. So, the additional load on the carrying capacity will be affecting to a significant level.

#### **4.1.6.8 Anticipated impacts and evaluation**

Mining companies proposed in the area should collaborate and participate in a forum together with local authority, regional government and other key authorities so as to establish agreements regarding the use and maintenance of unpaved haul roads, the proposal of maximum plantation in the project area and in keeping the speed of all traffic using unpaved roads to below 20 kph.

#### **4.1.6.9. Mitigation Measures**

As such, there is the potential for cumulative noise impacts to arise as a result of potential noise contour overlap during the operational phases of all the proposed project and already functional mining projects in the study area. In this respect, proposed project proponent should collaborate with one another and participate in a forum so as to ensure

that impacts (viz. overlapping noise impacts) are discussed and agreed and that (if necessary) appropriate mitigation implemented.

#### **4.1.7. Biological environment**

##### **4.1.7.1. Anticipated impacts and evaluation**

The mining activity will have insignificant effect on the existing flora and fauna. Data have been collected from various Government Departments such as forests, agriculture, fisheries, animal husbandry and various offices to establish the pre-project biological environmental conditions. There are no endangered species, wildlife sanctuary, wildlife corridors or eco-sensitive area near the core zone. The purpose of the project itself is to save the flora around the project area from river widening, excessive erosion and floods. It is found that the morrum mining activity will not have any significant impact on the biological environment of the region.

##### **4.1.7.2. Impact On Biological Environment**

Mining of River bed material will not cause any significant impact on the ecosystem of Betwa River. Given below are the expected impacts can be arise due to proposed project:

- Disturbance to avifauna migratory routes/nesting grounds/wild fauna, birds, reptiles
- Damage to Riparian ecosystem/wetlands
- Micro flora and fauna in upstream and downstream water
- Impact on route of domesticated fauna viz. cow , buffalo etc. of nearby villages
- Disturbance to Fisheries found in natural river water

##### **4.1.7.3. Increased Habitat Loss and Disturbance of Wildlife**

The proposed projects are in the river bed of River Betwa. While mining activities are largely restricted to dry river bed, the location of offices and accommodation are focussed in safety zone of mining lease. The area is already is under habitation and fragmentation in

various places along its limited extent. The mining leases at these places were functional in past. Most of the faunal species present in the area are not listed as sensitive. No wildlife is reported or observed in the study area.

#### **4.1.7.4. Widespread Human Influx**

Each mining operation is expected to result in a large in-migration of people brought in to work there or attracted by potential opportunities there especially for peripheral employment opportunities. An influx of people will lead to pressures on the environment in the form of fuel wood harvesting, increased demands for water, increased pressure on ecosystem services such as the harvesting of fruits and vegetables, and greater disturbance effects on existing faunal species. There may also be an increase in numbers of livestock. The environment has a very limited grazing capacity and has a slow recovery following degradation through overuse.

#### **4.1.7.5. Mitigation Measure**

The mining operation will have positive and long term impact on river environment. In order to prevent flooding or related natural hazards, the operation will result in excavation of excessive morrum deposits from points where the maximum sedimentation occurs.

Since the project site is a river bank, mining activities will not have any major impact on environment and since the deposits are replenished naturally no reclamation is proposed. There is no migratory route of birds or grazing route of domesticated animal is reported on or near mining lease, hence there will be no impact anticipated. Mining activity will be confined upto a required depth of 3m from ground level or 1m above river water level whichever is less. No mining activity will be carried out in river stream. Since it is a RBM project and mining will be done along the river bed only leaving the free spaces as specified. No impact on fisheries, spawning ground or riparian ecosystem is anticipated

Project proponent along with local/ regional government will workout the solutions to adverse impacts originated as a result of increased pressure on the environment.

#### **4.1.7.6. Impact On Ecology Of The Area**

Mining which leads to the removal of channel substrate, re-suspension of streambed sediment, clearance of vegetation, and stockpiling on the streambed, will have ecological impacts. These impacts may have an effect on the direct loss of stream reserve habitat, disturbances of species attached to streambed deposits, reduced light penetration, reduced primary production, and reduced feeding opportunities.

For thousands of years, morrum has been used in the construction of roads and buildings. Today, demand for morrum continues to increase. Mining operators, in conjunction with cognizant resource agencies, must work to ensure that morrum mining is conducted in a responsible manner.

Excessive and unscientific Riverbed morrum mining causes the degradation of rivers. Riverbed mining lowers the stream bottom, which may lead to bank erosion. Depletion of morrum in the streambed causes the deepening of rivers, and the enlargement of river mouths. Any volume of morrum exported from streambeds is a loss to a system.

It may also be a threat to bridges, river banks and nearby structures. Morrum mining also affects the adjoining groundwater system and the uses that local people make of the river and sometimes result in destruction of aquatic and riparian habitat through large changes in the channel morphology. Impacts include bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability. These physical impacts cause degradation of riparian and aquatic biota and may lead to the undermining of bridges and other structures. Continued extraction may also cause the entire streambed to degrade to the depth of excavation.

Morrum mining generates extra vehicular traffic, which negatively impairs the environment. Where access roads cross riparian areas, the local environment may be impacted.

#### **4.1.7.7. Mitigation measures**

As the present mining will be done in a scientific manner as mentioned before, significant adverse impacts are not predicted; however the following mitigation measure will be taken to further minimize it.

- Re-suspension, turbulence, stream flow, channel substrate and associated species will be disturbed and could be lost due to mining. This loss of species is negligible in case of river bed mining as mining will be restricted to river bed only leaving the free space as per mining law.
- No mining will be done near to important structure like bridges, dam and others structures as per mining law. Safety distance as per SSMMG, 2016 will be maintained.
- No mining will be carried out during monsoons. This will minimize impact on aquatic life.
- Since it is a RBM project, it has no vegetation, therefore clearance of vegetation is not required.
- The mining activity will employ many vehicles (tractors/ trollies) to transport the morrum outside the mine to desired destination. Safe site/routes having less impact will be selected for transportation, all the vehicles will be employed for transportation purpose will be PUC certified.

#### **4.1.7.8. Flora and fauna of riparian habitat**

If morrum mining is done in an unscientific way, i.e. beyond the replenishment capacity, riverbed mining can have adverse effects at the mine sites. The fertile streamside land will be lost gradually and the wildlife in the riparian areas may start vanishing. Degraded stream habitats will result in loss of fisheries productivity, biodiversity, and recreational potential. Thus the severely degraded channels may lower the aesthetic value too.

All species require specific habitat conditions to ensure long-term survival. Native species in streams are uniquely adapted to the habitat conditions that existed before human began alterations. These have caused major habitat disruptions that

favoured some species over others and caused overall declines in biological diversity and productivity. In most streams and rivers, habitat quality is strongly linked to the stability of channel bed and banks. Unstable stream channels are inhospitable to most aquatic species. No dredging is proposed and hence there will be no possibility of sediments altering water quality.

Factors that increase or decrease sediment supplies often destabilize bed and banks and result in dramatic channel readjustment. For example, human activities that accelerate stream bank erosion, such as riparian forest clearing/ Riverbed mining cause stream banks to become net sources of sediment that often have severe consequences for aquatic species. Anthropogenic activities that artificially lower stream bed elevation cause bed instabilities that result in a net release of sediment in the local vicinity. Unstable sediments simplify and, therefore, degrade stream habitats for many aquatic species.

The most important effects of excessive and unscientific Riverbed morrum mining on aquatic habitats are bed degradation and sedimentation, which can have substantial negative effects on aquatic life. The stability of morrum -bed and morrum-bed streams depends on a delicate balance between stream flow, sediment supplied from the watershed, and channel form. Mining- induced changes in sediment supply and channel form disrupt channel and habitat development processes. Furthermore, movement of unstable substrates results in downstream sedimentation of habitats. The affected distance depends on the intensity of mining, particle sizes, stream flows, and channel morphology. Channel widening causes swallowing of the streambed, producing braided flow or subsurface inter gravel flow in riffle areas, hindering movement of fishes between pools. All such impacts can be reduced by following scientific mining practices and mitigation measures. All such impacts can be reduced by following scientific mining practices and mitigation measures.

#### **4.1.7.9. Environmental Management Plan (Biological Environment)**

Proper environmental management plan is proposed for “River Bed Material” mining project to mitigate the impact during the mining operation:

- Mining operation will be suspended during monsoon season.
- Mining operation will be carried out during day time only.
- No labour camps will be allowed on river bed.
- Prior to mining, short awareness program will be conducted for labours to make them aware about the finer nuances related to mining.
- If some casualty or injury to animal occurs, proper treatment should be given.
- No tree cutting, chopping, lumbering, uprooting of shrubs and herbs should be allowed.
- Corridor movement of wild mammals (If exists) should be avoided
- Care should be taken that noise produced during vehicles movement for carrying RBM materials are within the permissible noise level.
- No piling of RBM material should be done in agricultural areas.
- Care should be taken that no hunting of animals or collections of medicinal plant are carried out by labours.
- If wild animals are noticed crossing the river bed, it should not be disturbed or chased away, instead the labours should move away from their path.

#### **4.1.8. Socio-Economic Environment**

The proposed project will have direct and positive impact on socio-economic environment. The field survey conducted based on a social survey to understand the knowledge and the perception of the people living around the project area, gives a clear idea about the need for the project.

The project activities shall not have any adverse impacts on any of the common property resources of the village communities, as the morrum mine lease area is not being used for any purpose by any section of the society in this region. There is no R & R involvement in this project. There is no land acquisition in this project.

This activity will help raise the socio-economic status of the people who are directly and indirectly involved through primary direct employment of local workers to secondary employment through transportation. It has also come to light that if this activity is not activated, then the affected groups will tend to participate in other illegal

activities. This project will provide employment to the people residing in vicinity people will to be benefited directly or indirectly by the project. Only local labour will be used for the proposed mining operation and no will be approximately 2107 for all the mining leases in the riverbed of Betwariver in District Jalaun and Hamirpur.

#### **4.1.8.1. Project induced in-migration**

The proposed Project is expected to cause some in-migration into the study area and surrounds related to the arrival of opportunistic economic migrants and migrant labour. Other potential mining operations in the vicinity of the proposed Project may increase the scale and likelihood of this in-migration due to a perception that more benefits are available in the area. The presence of several mining Projects in the region is likely to increase the perceived desirability of the area for visitors, increasing the scale of in-migration. This increased in-migration is likely to contribute to in-migration related impacts.

#### **4.1.8.2. Mitigation Measure**

**Capacity Building:** Local administration along with the Project proponent will discuss and agree on a holistic approach to provide government with support and build the capacity of its staff to plan effectively for future development. Administrative capacity building could include training, provision of equipment and the provision of technical support (e.g. information technology support). The potential benefits may include improved local governance and greater efficiency in capacity development initiatives.

**Increasing Human Capital among the Local Population:** The residents of the study area will have access many of the potential benefits from economic activity related to the study area and other proposed mining developments. Increasing the capacity of the local population will allow for increased local benefits and increase the local resilience to potential in-migration related impacts. Early efforts to increase human resource capital through training and capacity building would assist in putting local inhabitants in a position to be employed or start business enterprises to service future developments.

**Recruitment Alignment:** Mining companies should agree a holistic approach to aligning recruitment strategies. This will help to ensure that there is a viable labour pool of local

employees for companies and help to build the skills and experience of local people. Combined efforts to align the approach to recruitment will help to reduce or avoid potential immigration.

The factors related to in-migration will be enhanced by the presence of mining projects in the area therefore collaboration in implementing measures to avoid and manage in-migration will boost the potential for successful implementation. This may include:

- Collaboration with the regional and local Government and other operators in the developing and implementation of a shared Environmental Management Plan
- Developing a shared approach to monitoring changes in specific baseline conditions related to in-migration. This would require the establishment of a shared monitoring capability to consider price inflation, demographics, changes in land cover and land use etc.

#### **4.1.9. Increased risk of road traffic accidents**

##### **4.1.9.1. Impact**

Existing vehicle traffic is not significant in the study area; local people tend to walk or use their personal vehicles to their destinations to transport their goods. Settlements tend to be located close to existing roads and children and livestock roam freely and are unsupervised. The proposed Projects will increase light and heavy vehicles using the local roads throughout the duration of the project period and during the life of mine. During operations, there will be 400 heavy vehicle movements per day related to YaraDallol BV leaving the processing site and travelling along the transport corridor to the market place, as well as returning. The anticipated number of light and heavy vehicles movements related to these other proposed mines is also taken into consideration; however, it can be assumed to be a significant number. The combined volumes of road traffic will place both human and livestock in danger of being injured or killed throughout the life of mine.

##### **4.1.9.2. Mitigation Measures**

Following are the proposed mitigation measures for potential cumulative impacts from other mining developers related to traffic accidents. A specialist and integrated Road

Traffic Risk Assessment is considered to understand the cumulative risks related to proposed projects using the transport corridor to the market place. This assessment will assist in planning and coordination of road traffic reducing risks related to traffic accidents. Where possible all operators should consider the use of shared access roads that join a shared transport corridor.

#### **4.1.10. Decreased Availability Of Water And Livelihood Impacts**

##### **4.1.10.1. Impact**

Fresh water is a resource, which has a livelihood impact on resident of study area. If the ground water is being withdrawl, decrease in available groundwater resources may be observed. This could have adverse impacts on local communities. Without systematic management the unplanned and uncoordinated abstraction of groundwater resources could contribute to water shortages and livelihood impacts. The unmanaged cumulative effect of these operators could exacerbate the impacts on natural resources assessed for the proposed Projects.

##### **4.1.10.2. Mitigation Measures**

The measures described in the assessment of cumulative groundwater impacts will help to avoid or mitigate these impacts. Specifically establishing a regional water committee will help to manage the abstraction of groundwater.

#### **4.1.11 Cultural heritage**

##### **4.1.11.1. Impact**

In terms of cumulative impacts, the main concern for cultural heritage is the potential for a substantial increase in population within the larger region as people from neighbouring regions move into the study area in search of work. Increased population is usually accompanied by the expansion of existing settlements or the establishment of new settlements. As settlements expand or are established, new areas are impacted by building activity and it is likely that archaeological resources will be impacted by this increased activity. Population growth may also prompt the development of roads and other civil infrastructure with ground disturbing components, which will also likely

impact archaeological sites. Increased traffic resulting from higher population density or other mining projects in the area could also generate additional vibration impacts.

#### **4.1.11.2. Mitigation Measure**

It is proposed that the residents of the study area will be educated about the region's important local heritage and what areas should be avoided when choosing new places to build or expand communities.

#### **4.1.12 Visual and landscape character**

##### **4.1.12.1. Impact**

Proposed mining leases and the leases which will be come up in future increase will caused impacts on the surrounding landscape and visual receptors/amenity during the operational phases, including:

- Landscape Impacts – the presence of additional development will increase the impact on the open desolate character of the surrounding landscape.
- Visual Impacts – the presence of additional infrastructure along with other mining leases in the area will increase the visual impact from receptors in relative proximity, and will also experience a greater visual impact although this is unlikely to result in significant cumulative effects.

##### **4.1.12.2. Mitigation Measure**

Project proponents of the study area will collaborate the potential to share infrastructure is discussed (*viz.* access roads and transportation routes).

#### **4.1.13. Occupational health**

There is no environmental pollution due to the proposed mining as it is proposed to be a mainly semi-mechanized/OTFM mining for extraction of morrum on the banks of River Betwa. Hence there will be no major occupational health hazards. The villagers avail medical facilities from the nearest public health centre locally and for specific treatments & health assistance they avail facilities from Govt. hospital located at district level.

#### **4.1.13.1. Anticipated Health Impact**

It is anticipated that the effect on public health will be primarily due to emanation of dust & smoke from the haulage of transport vehicles in the buffer zone. On continuous exposure to the proposed activities certain occupational health hazards are anticipated.

- Fungal infection of the hands and legs due to constant contact with the wet morrum.
- Due to lack of personal hygiene water borne diseases are also envisaged to the workers.
- Continuous exposure to morrum dust can lead to silicosis, Silica tuberculosis other pulmonary diseases.

Proposed mining activity may not pose any adverse health hazard to the people in & around the area as healthy mining practices are carried out during the course of mining and the activities are restricted to excavation of permitted volume in Environmental clearance. Further no one is residing in the core zone and regulatory restriction for the inhabitation will be maintained.

#### **4.1.13.2 Mitigation Measures**

An inventory of the risks involved during the proposed project would be delineated with the measures to mitigate the same and the same would be ensured to the people by conducting an awareness program in the surrounding areas. Other mitigation measures are given below:

- Mining activities will be carried out semi-mechanized/ OTFM using bar scraper and loader only.
- Laborers will have access to basic first aid (first aid box) facility on site.
- Awareness on safety and ensure using of personal protective equipments (PPE) by workers like gloves, helmets, boots ear plugs and ear muff etc. to avoid injuries.
- The workers will be trained on using personal protective equipments as a precautionary measure & thereby preventing any infectious diseases.
- Workers will be periodically made aware of health & safety and various other risks.
- Special emphasis to the women health regarding the pre-natal and post-natal care will be looked into which is very much neglected in the rural areas.

**Table. No. 4.5. Anticipated Impacts and proposed Mitigation measures**

Source: Consultant Analysis/ Findings

SL. NO.	IMPACTS	POSSIBLE IMPACTS						PROJECT SPECIFIC IMPACTS	MITIGATION MEASURES
		TYPE	NATURE	MAAGNITUDE	TIMING/DURATION	SIGNIFICANCE	REVERSIBILITY	SIGNIFICANCE	
<b>OPERATIONAL PHASE</b>									
<b>LAND ENVIRONMENT</b>									
1.	Impact on existing land use	+ve	Direct	High	Short term/temporary	Significant	Reversible	Long Term	<p>Mining will be done as per the mining plan in the designated lease area from government for a period of five years up to the required depth only and will be confined along the river bed only.</p> <p>Thus, there will be no impact on existing land use as the mined area gets replenished every year during monsoon season</p>
2.	Quantity and characteristics of top soil	Nil	Nil	Nil	Nil	Nil	Nil	No impact	Since it is a RBM project, does not involve removal of Top soil.
3.	Erosion potential and terrain	Nil	Nil	Nil	Nil	Insignificant	Nil	Least significant	Mining activities will be confined along the river bed.
4.	Excavation of Pits in mine lease area	Nil	Nil	Nil	Nil	Nil	Nil	Least significant	<p>There will be no pits.Sand will be scrapped.</p> <p>The mine section will be backfilled on arrival of Monsoon every year itself.</p>

5.	Waste dumps	NA	NA	NA	NA	Insignificant	NA	Significant	It is a morrum mining project, no waste generation is anticipated. Workers will also be hired locally to avoid permanent housing at site, thus the MSW waste generation is also Nil.
6.	Agricultural land and productivity	-ve	Indirect	NA	NA	NA	NA	Insignificant	Productive land will not be utilized for storage and other proposes.  Siltation on agriculture Land will be prevented.  Garland drain system will be provided to prevent excessive runoff from mine site.

#### AIR ENVIRONMENT

1.	Fugitive dust emission due to movement, loading, unloading and transportation of minor minerals	-ve	direct	moderate	Short term/temporary	Significant	Irreversible	Short Term/Insignificant	Dust suppression measures like spraying/sprinkling of water to keep the surface wet and provision of the dust barriers.  Overloading of the trucks/trolleys will not be done.  Transportation of sand/morrum will be in covered vehicles to prevent fugitive dust emission. The road will be properly maintained.
2.	Blasting and Drilling	NA	NA	NA	NA	NA	NA	No Impact	Not proposed
3.	Boiler/DG Set/furnace	NA	NA	NA	NA	NA	NA	No Impact	Not proposed

#### WATER ENVIRONMENT

1.	Interruption in natural Drain	+ve	direct	high	Long term/temporary	Significant	Reversible	Positive Direct Impact	RBM mining will maintain the natural course of River. In this project it is not proposed to truncate or divert any stream.
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2.	Impact on surface water source	+ve	direct	high	Long term/temporary	Significant	reversible	Positive Direct Impact	<p>The main stream will not be diverted to form inactive channels from mining.</p> <p>Mining will remove excess deposits and deepen river bed which will prevent flooding and related problems.</p>
3.	Impact on ground water source	Nil	Nil	Nil	Nil	Nil	Nil	No Impact; ground water extraction is not proposed	<p>The workers will be hired locally, drinking water demand will be met by providing earthen pots or private tankers at site for 50-52 labourers. Thus there will be no extraction of ground water.</p> <p>Mining will be restricted to max.depth of 3 m from the ground level or/ 1m above water level whichever is less.</p>
4.	Impacts on Riparian vegetation and stream habitat	+ve	Direct	Low	Short term/temporary	significant	Irreversible	Insignificant with proposed mitigation measures	Project activity will be carried out along the river bed only leaving free space as specified, thus do not affect water environment and riparian habitat.

#### NOISE ENVIRONMENT

1.	Movement of vehicles	-ve	Indirect	low	Short term/temporary	Significant	-	Insignificant with proposed mitigation measures	<p>Newer vehicles less than 15 year old will be used for transportation. PUC certificates shall be obtained.</p> <p>Labourers will be provided with personal hearing protection device.</p> <p>Noise &amp; dust barriers among areas of heavy vehicular movement and excavation site.</p>
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#### BIOLOGICAL ENVIRONMENT

1.	Disturbance to avifauna migratory routes/nesting grounds/wild fauna, birds, reptiles	-ve	Indirect	low	Nil	Insignificant	Nil	No Impact	Mining activities will be restricted to daytime only and along the riverbed.  No Migratory routes are identified within the stretch.
2.	Damage to Riparian ecosystem/wetlands	-ve	Indirect	Low	Nil	Significant	Nil	No Impact	Mining activities will be restricted along the riverbed and mining will be done upto the 3m/ 1m above water level whichever is lesser.
3.	Micro flora and fauna in upstream and downstream water	-ve	indirect	High	Short term/Temporary	Significant	Nil	Insignificant	The main stream will not be diverted to form inactive channels from mining.  Mining below subterranean water will not be done.
4.	Impact on route of fauna	Nil	Nil	Nil	Nil	Nil	Nil	No Impact	It is river bed plain thus do not serve any grazing land for grazing animals.
5.	Disturbance to Fisheries found in natural river water	-ve	indirect	Moderate	Short term/Temporary	Significant	Nil	Insignificant	Mining will be confined along the river bed. Main river course will not be disturbed.

### **SOCIOECONOMIC ENVIRONMENT**

1.	Generation of employment opportunities	+ve	direct	high	Short term/temporary	Significant	Reversible	Positive significant	The proposed project will generate employment opportunities to all the section of people, locally.
2.	Increase in aesthetic conditions	+ve	direct	high	Long term/permanent	Significant	Reversible	Positive significant	Will improve the livelihood condition of the nearby areas by providing employment opportunities.

3.	Occupational Health	-ve	direct	Moderate	Short term/temporary	Significant	-	Insignificant with proposed mitigation measures	<p>Mining activities will be carried out semi-mechanized/ OTFM using bar scraper and loader only.</p> <p>Laborers will be provided with onsite basic first aid (first aid box) facility on site.</p> <p>Awareness on safety and ensure using of personal protective equipments (PPE) by workers like mask and glasses.</p>
4.	R & R	-	-	-	-	-	-	No Impact	NA

**Table. No. 4.6 . EMP for General Project Impacts**

Activity	Issue	Duration / Extent	Magnitude	Action with Key Riders	Responsibility
Laborers activity	Consumption of water and discharge of sewage	Temporary	Low	<p>labourers will be required, which will be hired locally, rest shelters and portacabins are proposed..</p> <p>Drinking Water supply will be provided by way of Private tankers and earthen pots at site.</p>	Contractor
	Generation of solid waste	Temporary	Low	<p>It is a morrum mining project, no mine waste generation is anticipated.</p> <p>Workers will also be hired locally. Uncontrolled dumping will be discouraged. Dustbins shall be provided onsite to collect domestic waste generated. MSW management is given due consideration.</p>	Contractor
	Risks to occupational health and safety	Temporary	Moderate	<p>Mining activities will be carried out semi-mechanized/ OTFM using bar scraper and loader only.</p> <p>Onsite first-aid and primary</p>	Contractor

Activity	Issue	Duration / Extent	Magnitude	Action with Key Riders	Responsibility
				<p>medical facilities will be provided during operation period.</p> <p>Personal protective equipments will be used. Training and awareness programs related to significance and use of protective gear will be imparted to the workers.</p>	
	Possible transmigration	Temporary	Moderate	The contractor will be encouraged to give preference to local labour in the region.	Contractor
Earth Movement	Induced soil erosion, loosing of productive top soil.	Nil	Nil	<p>Mining will be done as per the mining plan in the designated lease area from government for a period of five years upto the required depth only and will be confined along the river bed only.</p> <p>No impact as the mined area gets replenished every year during monsoon season.</p> <p>Since it is a RBM project, availability of top soil is very rare.</p> <p>Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. The unpaved surfaces used for the haulage of borrow materials will be maintained properly. The haul roads and borrow areas will be managed and maintained by the contractor.</p> <p>Since dust is the only impact along the haul roads, sprinkling of water will be carried at least once or twice a day depending upon the weather.</p>	
Onsite activity	Extraction of natural resources such	5 years	Negligible	No impact as the mined area gets replenished every year during	Contractor

Activity	Issue	Duration / Extent	Magnitude	Action with Key Riders	Responsibility
	as morrum			monsoon season.	
	Noise generation due to the movement of Vehicles	Temporary	Moderate	<p>No heavy machinery is proposed for the extraction of morrum, mining activities will be carried out semi-mechanized/ OTFM using bar scraper and loader only.</p> <p>Noise generated due to movement of vehicles will be managed by the use of vehicles which are less than 15 years old and after obtaining the pollution under control certificate. Also silence zones will be demarcated and noise barriers will be put accordingly.</p> <p>Labourers should be provided with personal hearing protection device (if required).</p>	Contractor
	Air emissions	Temporary/ Short Term	Moderate	<p>The dust emissions will be minimized by following the good practices, for example, water sprinkling, provision of noise barriers, etc.</p> <p>Overloading of the trucks/trolleys should not be done.</p> <p>Suitable dust barriers shall be proposed.</p>	Contractor

## CHAPTER- V

S. NO.	CONTENTS
5.1	EXCAVATION METHODS AS PER SUSTAINABLE SAND MINING GUIDELINES 2016
5.2	OTHER POPULAR METHODS
5.3	ACCEPTIBILITY OF VARIOUS MINING METHODS FOR SUSTAINABLE MINING
5.4	WHY BAR SKIMMING/SCALPING
5.5	ANALYSIS OF ALTERNATIVE SITE

# ANALYSIS OF ALTERNATIVES

## ANALYSIS OF ALTERNATIVES (TECHNOLOGY)

### 5.1 EXCAVATION METHODS AS PER SUSTAINABLE SAND MINING GUIDELINES 2016

The important methods of sand and gravel mining operations are as below:

#### a) Bar scalping or skimming

Bar scalping or skimming is extraction of sand and gravel from the surface of bars. This method generally requires that surface irregularities be smoothed out and that the extracted material be limited to what could be taken above an imaginary line sloping upwards and away from the water from a specified level above the river's water surface at the time of extraction (typically 0.3 - 0.6 m (1-2 ft). Bar scalping is commonly repeated year after year. To maintain the hydraulic control provided to upstream by the Riffle head, the preferred method of bar scalping is now generally to leave the top one third (approximately) of the bar undisturbed, mining only from the downstream two- thirds. Bar skimming involves scraping off the top layer (of variable thickness) from a gravel bar without excavating below the summer water level (Kondolf, 1994b). Bars are temporary storage features in which sand and gravel pass through. Controlled bar skimming is a recommended sand extraction method in most of the developing countries as a means for achieving stream resource conservation while sustaining the extraction industry. Bar skimming is somewhat a controlled type of sand extraction. Usually, bar skimming would

be done above the water table and within a minimum width buffer that separates the excavation site from the low flow channel and the adjacent active channel bank. bar skimming consisting of removing all the material in a gravel bar, to which must be added floodplain pit mining. However, some authors recognise this practice as a benefit in aggrading channels . Bar scalping (or “skimming”) is extraction of gravel from the surface of gravel bars. Historical scalping commonly removed most of the gravel bar above the low flow water level, leaving an irregular topography. It is typically require that the bar, which originally would typically have a steep margin and relatively flat top, be left after scalping with a smooth slope upwards from the edge of the low water channel at a 2 percent gradient) to avoid stranding fish in shallow holes after high flows that inundate the bar. Bar scalping is commonly repeated year after year. To maintain the hydraulic control provided to upstream by the riffle head, the preferred method of bar scalping is now generally to leave the top one-third (approximately) of the bar undisturbed, mining only from the downstream two-thirds. Bars are temporary storage features in which sand and gravel pass through. Controlled bar skimming is a recommended sand extraction method in most of the developing countries as a means for achieving stream resource conservation while sustaining the extraction industry. Bar skimming is somewhat a controlled type of sand extraction Usually, bar skimming would be done above the water table and within a minimum width buffer that separates the excavation site from the low flow channel and the adjacent active channel bank. Sand and gravel mining could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability (Sreebha, 2008). Bar skimming or scalping requires scraping off the top layer from a gravel bar without excavating below the summer water level. Bar skimming or "scalping" should only be allowed under restricted conditions:

- Sand/gravel should be removed only during low flows and from above the low-flow water level.
- Berms and buffer strips must be used to control stream flow away from the site (Hill & Kleynhans, 1999).

In-stream gravel mining involves the direct removal of streambed sediments by heavy equipment, usually conducted during low water, resulting in a local depression in bed profile.

During subsequent high flows, bed material transported from upstream is deposited in this pit, depriving downstream reaches of bedload sediment supply, potentially inducing incision downstream of the gravel mine. In addition, the upstream end of the pit is a knickpoint in the bed profile, and this knickpoint typically migrates upstream, inducing incision upstream of the gravel mine as well (Kondolf 1993) In bar skimming, there is need for strictly limiting gravel removal quantities so that recruitment and accumulation rates are sufficient to avoid extended impacts on channel morphology and fish habitats (Kondolf, 2007). Lawal (2011) recommended the use of abandoned stream channels on terraces, inactive floodplains and deltas as the best sources of gravel and sand. He noted that gravel pits on floodplain should not go deeper than water table. Bar scalping are viewed as less deleterious to the aquatic environment since they do not cause immediate turbidity impacts or direct egg mortality.

Sand and gravel mining could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability. Retaining the upstream one to two thirds of the bar and riparian vegetation while excavating from the downstream third of the bar is accepted as a method to promote channel stability and protect the narrow width of the low flow channel necessary for fish. Sand and gravel would be re-deposited in the excavated downstream one to two thirds of the bar (or downstream of the widest point of the bar) where an eddy would form during sediment transporting flows. Riparian vegetation performs several functions essential to the proper maintenance of geomorphic and biological processes in rivers. It shields river banks and bars from erosion.

**TableNo.5.1. Comparative study of various mining methods:**

S.No.	Method	Advantages	Disadvantages
<b>Trenching</b>			<ul style="list-style-type: none"> <li>● Potential introduction of fines.</li> <li>● Potential low flow channel diversion.</li> <li>● Potential fish stranding.</li> <li>● Poor fish habitat value.</li> <li>● Potential bed load sink.</li> <li>● In non-aggraded channels, can result in head cutting, bank erosion, turbidity.</li> </ul>

<b>Bar skimming</b>		<p>Ideally, self-replenishing</p> <p>If within replenishment capacity following impacts can be negate</p> <ol style="list-style-type: none"> <li>1. Channel Confinement</li> <li>2. Channel widening and swallowing</li> <li>3. Potential braiding</li> <li>5. Potential channel Degradation</li> <li>6. Increased bank heights.</li> <li>7. Lowering of groundwater table.</li> <li>8. Loss of riparian vegetation.</li> </ol>	
<b>Pit mining</b>			<ul style="list-style-type: none"> <li>• Stream capture.</li> <li>• Fish stranding.</li> </ul>
<b>Extraction from meander scars, high terraces</b>		potentially limited direct impacts on fish	Channel shifts may result in stream capture. Potential fish stranding. "Permanent" land use change.

**b) Dry-Pit Channel Mining**

Dry-pit channel mines are pits excavated within the active channel on dry intermittent or ephemeral stream beds. Dry pits are often left with abrupt upstream margins, from which head cuts are likely to propagate upstream.

**c) Bar Excavation**

A pit is excavated at the downstream end of the bar as a source of aggregate and as a site to trap sand and gravel. Upon completion, the pit may be connected to the channel at its downstream end to provide side channel habitat.

**d) Channel-wide River bed Mining**

In rivers with a highly variable flow regime, sand and gravel are commonly extracted across the entire active channel during the dry season. The bed is evened out and uniformly (or nearly so) lowered.

## **5.2 OTHER POPULAR METHODS**

### **5.2.1 Bucket-Plow Method Of Sand Mining**

One of the most popular methods of riverbed sand mining is extraction of the sand with help of hydraulic excavators which operates with an assembly of a steel bucket which is driven by hydraulic pressure. This method of mining is sometimes also used to lifting up the instream bottom sediments which is referred as dredging. In other words, dredging is an excavation activity usually carried out underwater, in shallow seas or freshwater areas with the purpose of gathering up bottom sediments and widening with help of a bucket. This technique is often used to keep waterways navigable and creates an anti-sludge pathway for boats.

A bucket (also called a scoop to qualify shallower designs of tools) is a specialized container attached to a machine, as compared to a bucket adapted for manual use by a human being. It is a bulk material handling component.

The bucket has an inner volume as compared to other types of machine attachments like blades or shovels. The bucket could be attached to the lifting hook of a crane, at the end of the arm of an excavating machine, to the wires of a dragline excavator, to the arms of a power shovel or a tractor equipped with a backhoe loader or to a loader, or to a dredge. The name "bucket" may have been coined from buckets used in water wheels, or used in water turbines or in similar-looking devices.

### **5.2.2 Trenching Method of Mining**

Trenches are usually employed to expose steep dipping bedrock buried below shallow overburden, and are normally dug across the strike of the rocks or mineral zone being tested. Excavation can be either by hand, mechanical digger, or by bulldozer on sloping ground. Excavated depths of up to 3.0 m are common.

### **5.2.3 Pitting Method of Mining**

Pitting is usually employed to test shallow, extensive, flat-lying bodies of mineralization. An ideal example of this would be a buried heavy mineral placer. The main advantage of pitting over a pattern-drill programme on the same deposit is that pits are capable of

providing a very large volume sample. Large sample sizes are necessary to overcome problems of variable grade distribution, which are a characteristic feature of such deposits. In areas where the ground is wet, or labour is expensive, pits are best dug with a mechanical excavator. Pits dug to depths of 3 m are common and with large equipment excavation to 6 m can be achieved. In wet, soft ground any pit deeper than 1 m is dangerous and boarding must be used. Diggers excavate rapidly and pits 3 m deep can be dug, logged, sampled, and re-filled within an hour. In tropical regions, thick lateritic soil forms ideal conditions for pitting and, provided the soil is dry, vertical pits to 30 m depth can be safely excavated.

### **5.3 Acceptability of various mining methods for Sustainable Mining:**

**Table No. 5.2. Acceptability of Mining Method for sand**

<b>METHODS</b>	<b>Acceptability of method</b>
<b>Bar Skimming</b>	√
<b>Dry Pit Channel Mining</b>	X
<b>Wet Pit Channel Mining</b>	X
<b>Bucket Plow method</b>	X
<b>Trenching Method</b>	X
<b>Pitting Method</b>	X

Bars are temporary storage features in which sand and gravel pass through. Controlled bar skimming is a recommended sand extraction method in most of the developing countries as a means for achieving stream resource conservation while sustaining the extraction industry. Bar skimming is somewhat a controlled type of sand extraction. Usually, bar skimming would be done above the water table and within a minimum width buffer that separates the excavation site from the low flow channel and the adjacent active channel bank. Sand and gravel mining could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability. Bar skimming or scalping requires scraping off the top layer from a gravel bar without excavating below

the summer water level. Bar skimming or "scalping" should only be allowed under restricted conditions.

#### **5.4 WHY BAR SKIMMING/SCALPING**

- Sand/gravel should be removed only during low flows and from above the low-flow water level.
- Berms and buffer strips must be used to control stream flow away from the site

Instream gravel mining involves the direct removal of streambed sediments by heavy equipment, usually conducted during low water, resulting in a local depression in bed profile. During subsequent high flows, bed material transported from upstream is deposited in this pit, depriving downstream reaches of bedload sediment supply, potentially inducing incision downstream of the gravel mine. In addition, the upstream end of the pit is a knickpoint in the bed profile, and this knick point typically migrates upstream, inducing incision upstream of the gravel mine as well. In bar skimming, there is need for strictly limiting gravel removal quantities so that recruitment and accumulation rates are sufficient to avoid extended impacts on channel morphology and fish habitats. . Bar scalping are viewed as less deleterious to the aquatic environment since they do not cause immediate turbidity impacts or direct egg mortality.

#### **Fig 5.7 Aggregate being "skimmed" off the surface of a bar (Langer, 2003)**

Sand and gravel mining could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability. Retaining the upstream one to two thirds of the bar and riparian vegetation while excavating from the downstream third of the bar is accepted as a method to promote channel stability and protect the narrow width of the low flow channel necessary for fish. Sand and gravel would be redeposited in the excavated downstream one to two thirds of the bar (or downstream of the widest point of the bar) where an eddy would form during sediment transporting flows. Riparian vegetation performs several functions essential to the proper maintenance of geomorphic and biological processes in rivers. It shields river banks and bars from erosion.

## 5.5 ANALYSIS OF ALTERNATIVE SITE

The site selection is based on the following points :

Appropriate extraction sites are locations chosen based on knowledge of the local rate of aggradation or scour, a site-specific determination of channel stability and bank erosion and evaluation of riparian resources.

Site-specific evaluation is needed to evaluate each proposed operation to minimize disturbance and maximise stability of channel.

In-stream extraction sites should be located where the channel loses gradient or increases in width, and deposition occurs unrelated to regular bar-pool spacing in channel. Particular sites may include sites upstream of a bedrock constriction or backwater, or at deltas created near confluences.

It is not applicable because the lease area is e-auctioned and granted to lessee for sand excavation by District Magistrate. So no alternative site is analysed for the project.

### ***Identification of sand mining blocks:-***

Identification of sand blocks is one of the important activities in sand mining. The department should estimate the demand of the particular district and State and hence come out with the requirement of further allotment. Based on the requirement, the process of identification of sand reaches should be taken up by the relevant department responsible for sand mining in the State. The relevant department/ person needs to obtain the Khasra map of the area and conduct a spot inspection and confirm from other departments regarding availability of area to check if the area is not reserved for some other purpose and can be allotted for sand mining. Further, if the inspector finds that the block is not lying in the restricted zone based on the above parameters and that the area is available for sand extraction, the area should be presented for e-auction. The sand mining area is allotted only through e-auction process, so alternative site analysis is not opted and no other NOCs are required.

## CHAPTER- VI

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# ENVIRONMENTAL MONITORING PROGRAMME

## 6.1 INTRODUCTON

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation. The knowledge of baseline conditions & the monitoring program will serve as an indicator for any deterioration in environmental conditions due to operation of the project. A proper prior monitoring plan will lead to better understanding of impacts of project on environment and thus a sound mitigation plan can be furnished. This Environmental monitoring programe will be done through NABL accredited lab.

## 6.2 MONITORING SCHEDULE & PARAMETERS

**Table No. 6.1. Monitoring Schedule**

S.N.	POTENTIAL IMPACT	PARAMETERS	FREQUENCY OF MONITORING	LOCATION
1.	Air Emission	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>x</sub> , NO <sub>x</sub> , CO & SIO <sub>2</sub>	As per CPCB/MoEF&CC requirements i.e. 24 hourly monitoring for one month in each season except monsoon.	Total 35 Monitoring Stations in and around Core Zone.
2.	Noise	Spot Noise level recording Leq	periodic/As per CPCB norms i.e. quarterly	Total 35 Monitoring

		(day), Leq (night)		Stations in and around Core Zone.
3.	Water Quality	Ground Water Surface Water	once in each season except monsoon	Total 20 sampling sites including 09 GW & 21 SW (Upstream & Downstream )
4.	Soil Quality	Physical & Chemical Parameters	once in each season except monsoon	Total 19 Sampling Sites in and around Core Zone.
5.	Traffic	No. of vehicles	For all 10 mining leases.	
6.	Health	Total Health Parameters	Initial Medical Examination & Periodic Medical Examination	All employees

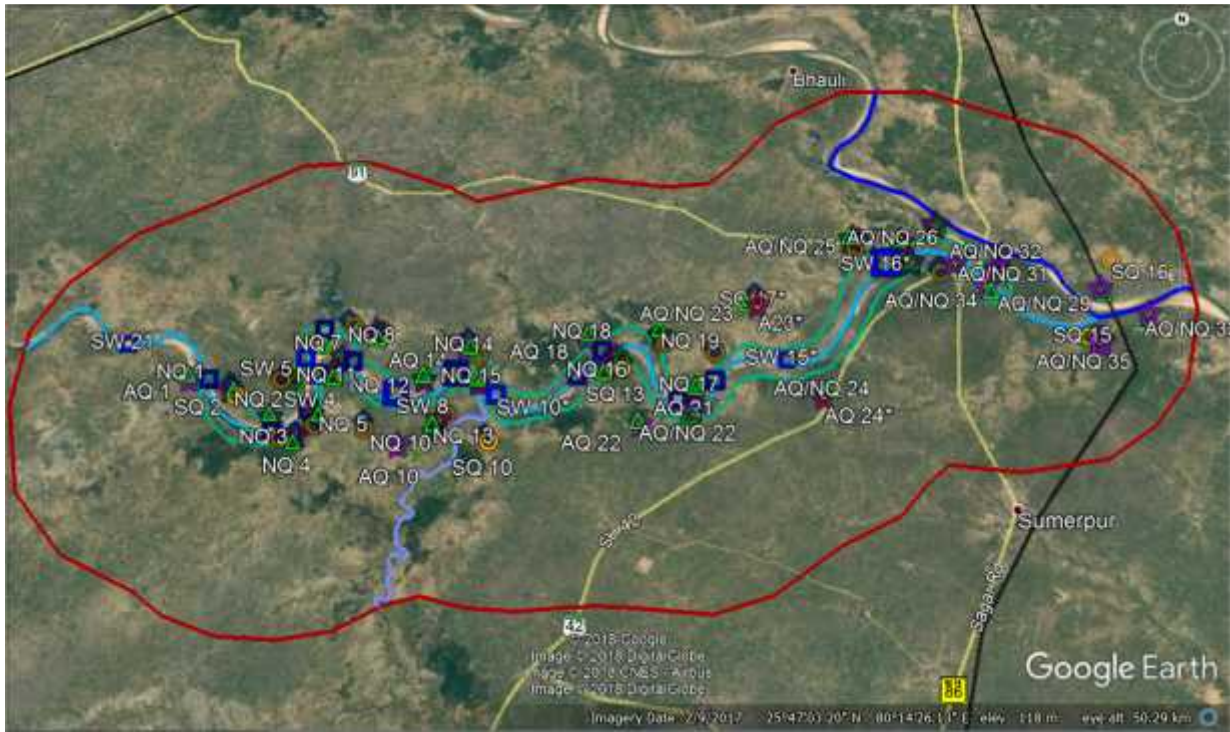
**Table No 6.2. Total no. of monitoring stations.**

S.N.	POTENTIAL IMPACT	Total Monitoring Stations
1.	Air Emission	35
2.	Noise	35
3.	Water Quality Surface	21
	Ground	20
4.	Soil Quality	19
<b>Total Monitoring Stations</b>		<b>130</b>

**TOTAL MONITORING STATIONS = 130**

**LEASEWISE JUSTIFICATION OF MONITORING STATIONS**

Monitoring stations for ambient air quality have been placed keeping in mind the prominent downwind direction of wind blow and for water sampling locations (surafece+ ground) according to any point sources of effluents/discharges into the river and aquifers, if any.



**Fig 6.2. Monitoring Stations for Study Area-2**

(AIR & NOISE MONITORING STATIONS)

S. No.	Station Code	Location	Distance & Direction from the Project Site	Project Area	Category
1.	AQ 3/NQ 3	Himanpura	Upwind	Buffer Zone	Rural
2.	AQ 5/NQ 5	Pathreta	Downwind within 500m	Impact Zone	Industrial
3.	AQ 6/ NQ 6	Hajipur Saliya	Crosswind	Buffer Zone	Rural
4.	AQ10/NQ 10	Hasapur Sensa	Downwind	Buffer Zone	Rural
5.	AQ11/NQ 11	Bhedi Danda	Downwind	Buffer Zone	Rural

(GROUNDWATER SAMPLING STATIONS)

S. No.	Station Code	Location	Project Area	Category
1.	GW 1	Hajipur Saliya	Buffer Zone	Rural
2.	GW 3	Pathreta	Buffer Zone	Rural
3.	GW4	Jalalpur	Buffer Zone	Rural

(SURFACE WATER SAMPLING STATIONS)

S. No.	Station Code	Location	Distance & Direction from the Project Site	Project Area	Category
1.	SW 2	Himanpura	Upstream	Impact Zone	Rural
2.	SW 3	Pathreta	On site	Core zone	Rural
3.	SW 4	Hajipur Saliya	Downstream	Impact Zone	Rural

(SOIL SAMPLING STATIONS)

S. No.	Station Code	Location	Project Area	Category
1.	SQ 1	Hajipur Saliya	Buffer Zone	Rural
2.	SQ 3	Pathreta	Buffer Zone	Rural
3.	SQ 4	Jalapur	Buffer Zone	Rural

M/s Eureka Mines and Minerals, LLP is located at village Pathreta in Kalpi Tehsil of Jalaun district. During the months of baseline monitoring viz. March to May, 2018, the prominent wind direction in the district is towards South and South-east direction. Hence, in the upwind direction AQ 3 ( in village Himanpura) monitoring station has been placed which is about 1.40km towards W direction from the mine lease site and AQ 5, AQ 10 and AQ 11 monitoring stations have been located in villages Pathreta (within 500m), Hasapur Sensa and Bhedi Danda towards the downwind direction which are approximately 5.30km and 2.20km respectively and AQ 6 located in village Hajipur Saliya which is also the crosswind direction of the wind is located at approximately 1.70km towards North direction. All the ambient air quality stations fall under Rural category except for the one located within the 500 m impact zone of mine lease site of B2 sub-category projects which means where the mine lease is in working condition/or the mining of sand/morrum has been started after obtaining Environment Clearance Certificate as that has categorized those stations under industrial category. Hence, the downwind ambient air quality monitoring station within the 500m radius has been categorized as industrial category since this lease has already obtained Environmental Clearance certificate. M/s Associated Commerce is situated adjacent to this mine lease site, so the monitoring stations will be the same for it also.

Sampling locations for Groundwater samples and soil samples are collected from the different villages in Buffer zone. Groundwater samples are collected from Borewells and handpumps marked as GW 1, GW 3 & GW 4 located in villages Hajipur Saliya, Pathreta and Jalapur respectively. Similarly, Soil samples were also collected from the agricultural fields marked as SQ 1, SQ 3 and SQ 4 from the same villages viz. Hajipur Saliya, Pathreta and Jalapur respectively. These villages have been selected as they represent that area since all the villages fall within the

5kms radius of the all the mine lease sites mentioned in this group. The represent the ground water Quality and soil Quality and the impact of mining activity on the villages found in the vicinity of the mine leases.

Surface Water samples were collected from Sampling station SW 2 which is located along the Village Himanpura in the river Stream of Betwa River. Since the Betwa river flows from west to east direction, SW 2 sampling station is the upstream for the lease and sampling station SW 4 which is along the village Hajipur Saliya is the downstream for these leases and a sample SW 3 from the stream is also collected along the village (Pathreta) in which mine lease is located.

## 6.3 MEASUREMENT METHODOLOGY

### 6.3.1 Air

The quality of the air that we breathe affects our health and quality of life. It can also have major impacts on the ecosystem. Measuring and understanding air pollution provides a sound scientific basis for its management and control.

The criteria pollutants measured are Particulate Matter <sub>10</sub> (PM<sub>10</sub>), Particulate matter <sub>2.5</sub> (PM<sub>2.5</sub>), Sulphur dioxide (SO<sub>2</sub>), Oxides of Nitrogen (NO<sub>x</sub>), and Carbon Monoxide (CO) etc. concentration in downwind direction considering predominant wind direction, at a distance of 500 metres from the following dust generating sources shall be measured in the manner indicated below:

**Table No. 6.3 Measurement Methodology**

S.N.	PARAMETERS	CODE OF PRACTICE	SAMPLER	INSTRUMENT USED FOR ANALYSIS
1.	PM <sub>10</sub>	IS: 5182 Part 23:2006	RDS Sampler	Balance, Desicator
2.	PM <sub>2.5</sub>	NAAQS Monitoring & Analysis Guidelines volume- 1, 2011 CPCB	Fine Dust Sampler	Balance, Desicator
3.	SO <sub>2</sub>	IS: 5182 (Part-V)	RDS Sampler	Spectrophotometer
4.	NO <sub>2</sub>	IS: 5182 (Part-IV)	RDS Sampler	Spectrophotometer
5.	SiO <sub>2</sub>	Molybdo silicate	RDS Sampler	Spectrophotometer

6.	CO	EPA Method 13	CO Analyzer	-----
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### 6.3.2 Water

Water quality monitoring is an important aspect of overall water quality management and water resources development. A well planned and well managed water quality monitoring system is required to signal, control or predict changes or trends of changes in the quality of a particular water body, so that curative or preventive measures can be taken to restore and maintain ecological balance in the water body.

Two liters of representative water samples will be collected in plastic container and transported to laboratory for physic-chemical analysis. For determination of BOD and bacteriological analysis, 250 ml pre-sterilized bottles will be used and care will be taken to maintain cool temperature by keeping the bottles in ice boxes during transportation to the laboratory for analysis.

**Table No. 6.4. Code of practice for water analysis**

S.N.	PARAMETERS	CODE OF PRACTICE
1	Colour	IS 3025 Part 4:1983
2	Odour	IS 3025 Part 5:1983
3	pH Value at 25°C	IS 3025 Part 11:1984
4	Total Dissolve Solids	IS 3025 Part 16:1984
5	Total Suspended Solids	IS 3025 Part 18:1984
6	Total Solids	IS 3025 Part 9:1984
7	Temperature	IS 3025 Part 14:1984
8	Conductivity at 25°C	IS 3025 Part 17:1984
9	Calcium (as Ca)	IS 3025 Part 40:1991
10	Ammonical Nitrogen	IS 3025 Part 34:1988
11	Chloride (as Cl)	IS 3025 Part 32:1988
12	Iron (as Fe)	IS 3025 Part 53:2003
13	Magnesium (as Mg)	IS 3025 Part 46:1994

14	Nitrate (as NO <sub>3</sub> )	IS 3025 Part 34:1988
15	Potassium (as K)	IS 3025 Part 45: 1993
16	Phosphate (as PO <sub>4</sub> )	IS 3025 Part 31:1988
17	Sodium (as Na)	IS 3025 Part 45:1993
18	Sulphate (as SO <sub>4</sub> )	IS 3025 Part 24:1986
19	Total Alkalinity (as CaCO <sub>3</sub> )	IS 3025 Part 23:1986
20	Total Hardness (as CaCO <sub>3</sub> )	IS 3025 Part 21:2009
21	Biochemical Oxygen Demand	IS 3025 Part 44:1993
22	Chemical Oxygen Demand	IS 3025 Part 58: 2006
23	Dissolved Oxygen	IS 3025 Part
24	Faecal Coliform	IS 1622:1981

### 6.3.3 Noise

Noise levels in the work zone environment shall be monitored. The frequency will be once in three months in the work zone. Similarly, ambient noise levels near habitations will also be monitored once in three months. Audiometric tests will be conducted periodically for the employees working close to the high noise sources.

As there will movement of trucks, the Noise level may be high in the area and after the accurate monitoring results; we can provide the suitable mitigation measures.

Noise Monitoring will be done in Day & Night Time quarterly. Day time shall mean from 6 AM to 10 PM & Night time shall mean from 10 PM to 6 AM

### 6.3.4 Soil

The main concern of soil monitoring is measurement of fertility of the area and impact of sand mining process on it. Composite Soil samples will be collected from surrounding agriculture fields that are likely to be impacted from the project.

**Table No. 6.5. Code of practice for soil analyses**

### 6.3.5

S.N.	PARAMETERS	CODE OF PRACTICE
1	pH Value at 25°C	IS 2720 (P-26)-1987, Reaff- 2007
2	Conductivity at 25°C	IS 2720 (P-21)-1977, Reaff- 2006
3	Moisture	IS 2720 (P-2)-2002
4	Sodium (as Na)	RIMSLAB/SOP/ENV/010-D
5	Potassium (as K)	RIMSLAB/SOP/ENV/010-D
6	Total Kjeldhal Nitrogen	RIMSLAB/SOP/ENV/010-C
7	Phosphorus	RIMSLAB/SOP/ENV/010-G
8	Organic Matter	IS 2720 (P-22)-1972, Reaf:2005
9	Magnesium (as Mg)	RIMSLAB/SOP/ENV/010-B
10	Cation Exchange Capacity	IS 2720 (P-24)-1976, Reaf:2005
11	Water Holding Capacity	RIMSLAB/SOP/ENV/010-H
12	Bulk Density	-
13	Porosity	-
14	Soil Grain Size Analysis	IS 2720 (P-4)-1985, Reaf:2001

### Traffic

Given in chapter 7 in additional studies

### 6.3.6 Health

Health checkups and Health camps will be organized as per The Mines Rules 1955.

### 6.3.7 Flora Fauna Study

**Table No. 6.6 .Mode of data collection & parameters considered during the survey**

ASPECT	DATA	MODE OF DATA COLLECTION	PARAMETERS MONITORED
Terrestrial Ecology &	Primary Data Collection	By field survey	Floral & Faunal diversity
	Secondary Data	From authentic sources	Floral & Faunal

Aquatic Ecology	Collection	like Forest Department of U.P., District Forest Officer, Hamirpur and Jalaun and other Literatures	diversity and study of vegetation, forest type, importance etc.
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### 6.3.8. Biodiversity Study

Given in chapter 3 in baseline data generation

## 6.4 Implementation of Environment Monitoring Plan

A centralized Environmental Monitoring Cell is proposed to be established for monitoring of important and crucial environmental parameters which are of immense importance to assess the status of environment during mine operation.

With the knowledge of initial parameters, deviations in environmental conditions due to operation of the mine will be assessed and suitable mitigation steps will be taken to safeguard the environment. The routine monitoring program will be implemented under the project monitoring as per CPCB & MoEF & CC guidelines. The core responsibilities of the Environmental Monitoring Cell will be:-

- Organization and interpretation of the environmental monitoring data to establish a record of change associated with the implementation of a project or the operation of an organization.
- The process of verification that all or selected parameters measured by Environmental Monitoring Program are in compliance with regulatory requirements, internal policies and standards, and established environmental quality performance limits.
- The assessment of the effectiveness of the environmental management system, practices and procedures.
- The environmental monitoring and audit work will be carried out by qualified personnel by NABL accredited lab and/or NABET accredited consultant.
- A summary of non-compliance of the environmental quality performance limits.

- To implement and monitor the control and protective measures based on the EMP.
- To coordinate the environment related activities to the top management within as well as with outside concerned agencies.
- To provide of health check up of workers and the people living in nearby villages.
- To develop greenbelt at transportation routes.

## 6.5 ENVIRONMENTAL POLICY

1. We are committed for the protection & improvement of Environment.
2. We will follow all the applicable Environment & Pollution laws and practice scientific mining as per the statutory guidelines.
3. We will not operate without Environment Clearance and follow the conditions mentioned in it. If any difficulty is found in the implementation of condition, it will be discussed with SEAC/SEIAA.
4. Efforts will be made so as to reduce Noise Pollution.
5. Promote Environment Management plan as per prescribed Guidelines.
6. Enhance environmental awareness amongst employees.
7. Encourage our associates to adopt right approach for environmental protection
8. Following information will be displayed in hindi at various places for contact in emergency situation.

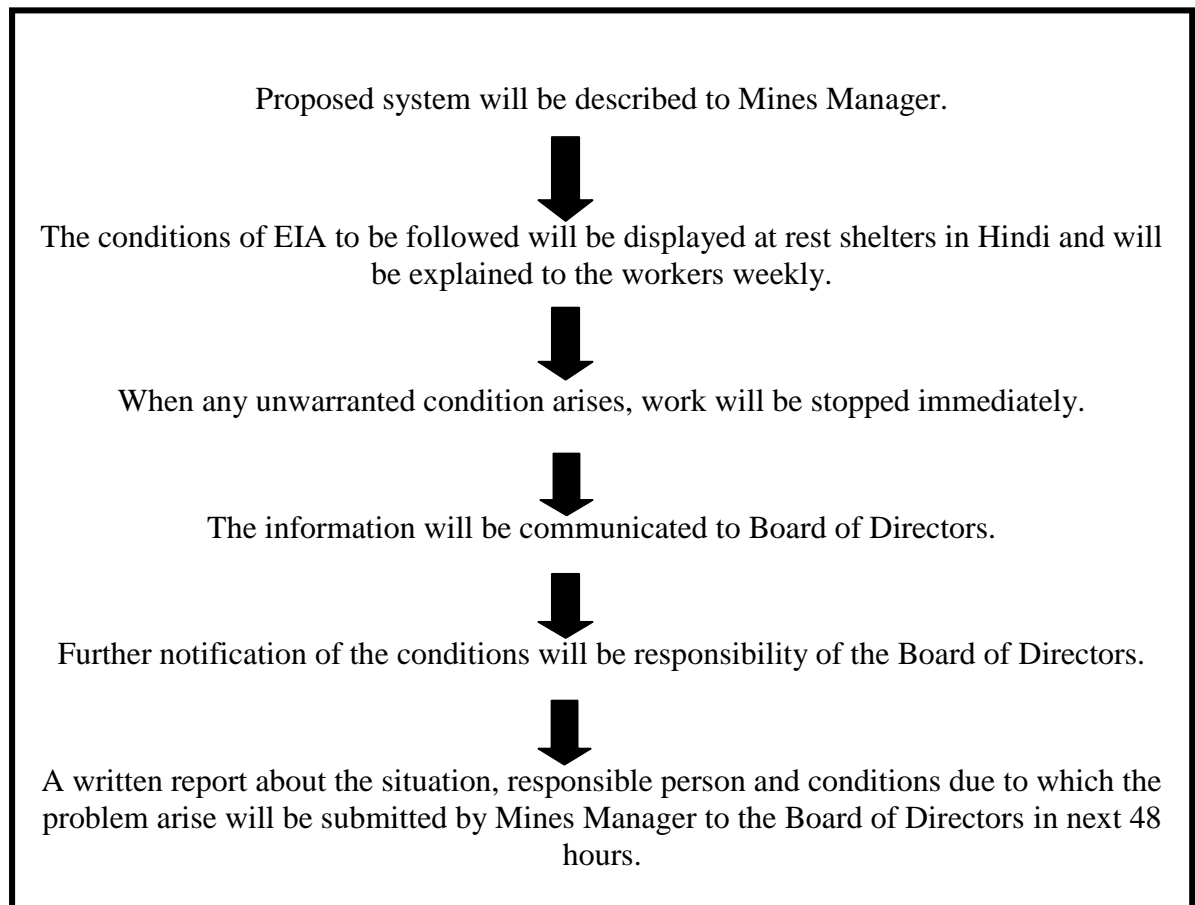
<b>NAME OF RESPONSIBLE PERSON</b>	
<b>POST</b>	
<b>SIGN</b>	
<b>PHONE NUMBER</b>	

### Reporting Structure:

- Mine manager will be responsible for compliance management.
- Before the start of mining operation and during the mining , we will follow Air Act, Water Act, MSW Rules as applicable and also retain the copy of guidelines on site.

- Mine manager will report to proponent every month about compliance.
- The management will ensure that the Name, Contact number of Mine Manager will be shared and posted on Site.
- If any discrepancy in compliance found, Mine manager will be responsible for it.
- Safe and Clean drinking water for all the persons working at Mine site
- Use of dustbin will be promoted.
- He will be responsible for-
  - ✓ Environment Management
  - ✓ Worker Safety
  - ✓ Social Responsibility
  - ✓ Mine Management

#### **6.6. STANDARD OPERATING PROCEDURES FOR REPORTING OF NON-COMPLIANCE OF EIA CONDITIONS:**



## **6.7 CO-ORDINATION WITH DISTRICT MAGISTRATE & RO, UPPCB FOR MONITORING PLAN.**

The letters regarding pre monsoon monitoring plan has been sent to Regional Officers, UPPCB & District Magistrates of Hamirpur and Jalaun. Copy of letter is annexed as **ANNEXURE-III.**

## CHAPTER VII

S. NO.	CONTENTS
7.1	PUBLIC CONSULTATION
7.2	RISK ASSESSMENT
7.3	IDENTIFICATION OF HAZARDS
7.4	MITIGATION OF HAZARDS
7.5	SEDIMENT INFLUX RATE
7.6	SOCIAL IMPACT ASSESSMENT
7.7	RESSETLEMENT & REHABILITATION PLAN
7.8	DISASTER MANAGEMENT
7.9	TRANSPORTATIONAL ROUTE ANALYSIS
7.10	INCREMENTAL NOISE IN THE STUDY AREA-2
7.11	GREEN BELT DEVELOPMENT

# ADDITIONAL STUDIES

### 7.1 PUBLIC CONSULTATION

Minutes of public hearing, clippings of news paper were attached as **annexure-VIII**

### 7.2 RISK ASSESSMENT

Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine should be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions should be such as not to be impair his working efficiency. This is possible only when there is adequate safety in mines.

### 7.3 IDENTIFICATION OF HAZARDS

There are various factors, which can create unsafe working conditions in mining of minor minerals from river bed. These hazards are as follows:

- a) Inundation / Flooding.
- b) Quick Morrum Condition.
- c) Drowning.
- d) Accident due to vehicular movement.

e) Accident during morrum loading, transporting and dumping.

### **7.3.1. Mineral loading**

- a. The minerals are loaded in the trucks using loader. There is no possibility of injury during loading with loaders.
- b. There is possibility that the workers standing on the other side while loading may get injury due to over thrown morrum with pebbles.
- c. There is possibility of workers getting injured during opening of side covers to facilitate loading.
- d. There is possibility of riverbank collapse.
- e. There is a chance of falling of cattle/children into pits in river bed.

### **7.3.2. Transport**

The minerals loaded in trucks (almost 2401) are being sent to through public roads.

- a. Possibilities of road accidents.
- b. Accident may also occur during movement in the mine.
- c. There are possibilities that due to overloading, pebbles or boulders may injure the passersby.

### **7.3.3. Inundation/flooding**

- a. The possibility of inundation/flooding of the mines are very high during monsoon or during heavy rains as the mine area lies in the riverbed.
- b. There is danger to the trucks and other machineries due to flooding.
- c. There is danger to the workers working in the mines.

Inundation or flooding is expected and beneficial for these mines as during this time only the mineral reserve gets replenished.

### **7.3.4. Quick sand condition**

Quickmorrum is a colloidhydrogel consisting of fine granular material (such as morrum or silt), clay, and water.

Quickmorrum forms in saturated loose morrum when the morrum is suddenly agitated. When water in the morrum cannot escape, it creates liquefied soil that loses strength and cannot

support weight. This condition occurs when the permeability of the strata is very high. This condition occurs when the effective stress in the morrum becomes zero due to influx of water i.e.

$$i = i_{cr} = y' / y_w;$$

where  $i$  = Hydraulic gradient,

$i_{cr}$  = Critical Hydraulic gradient,

$y'$  = submerged unit weight,

$y_w$  = unit weight of water.

This creates danger condition to the trucks and other machineries plying over the morrum dunes on the river banks.

### **7.3.5. Drowning**

There are no possibilities of drowning in the river, since mining operations are carried out only in the dry seasons. All mining activities will be stopped during the monsoon season.

## **7.4. MITIGATION OF HAZARDS**

### **7.4.1. Measures to prevent accidents during loading**

Loading will be done by using front end loader in general. In case of manual loading following

Precautions will be taken

1. The truck will be brought to a lower level so that the loading operation suits to the ergonomic condition of the workers.
2. The loading will be done from one side of the truck only.
3. The workers will be provided with gloves and safety shoes during loading.
4. Opening of the side covers (pattas) will be done carefully and with warning to prevent injury to the loaders.
5. Operations during daylight only.
6. No foreign material will be allowed to remain/spill in river bed and catchment area, or no pits/pockets are allowed to be filled with such material.
7. Stockpiling of harvested material on the river bank will be avoided.

#### **7.4.2. Measures to prevent accidents during transportation**

1. All transportation within the main working will be carried out directly under the supervision and control of the management.
2. The Vehicles will be maintained in good repairs and checked thoroughly at least once a week by the competent person authorized for the purpose by the Management.
3. To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of lorries will as far as possible be made man free, and.
4. A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.
5. Generally, overloading will not be permitted.
6. The truck will be covered and maintained to prevent any spillage.
7. The maximum permissible speed limit will be ensured.
8. The truck drivers will have proper driving license.

#### **7.4.3. MEASURES TO PREVENT DANGEROUS INCIDENTS DUE TO INUNDATION/FLOODING**

Inundation of flooding is expected and beneficial for these mines as during this time only the mineral reserve gets replenished.

1. During monsoon months and heavy rains the mining operations are ceased.
2. There will be mechanism/warning system of heavy rains and discharges from the upstream dams.

#### **7.4.4. Measures to prevent quick sand condition**

1. The only way to avoid quick morrum condition is by avoiding mineral lifting below water table.
2. The critical hydraulic gradient ( $i_{cr}$ ) will be maintained at less than 1 to prevent high artesian pressure in a coarse morrum area.
3. 1/3<sup>rd</sup> of sand will be left in Mine Lease Area as the provision of Bar scalping.

#### **7.4.5. Measures to prevent drowning**

1. The mining will be done under strict supervision and only during the dry season.

2. Mining will be done in dry bed zone.
3. No go zones will be clearly marked and made aware to the mine workers.

#### **7.4.6. Natural resource conservation**

Marking of mining lease at the concave side of the river channel is avoided by Directorate of Geology and mining to prevent bank erosion. Similarly meandering segment of a river are be selected for mining in such a way as to avoid natural eroding banks and to promote mining on naturally building (aggrading) meander components. These precautions are taken at the time of lease demarcation.

### **7.5 SEDIMENT INFLUX RATE**

Sediment influx in Ephemeral streams is generally confined to the beginning of the rainy season as velocity of the water washes down medium to fine sand and silt depending on the velocity and gradient of land. Cobbles, pebbles and boulders will be transported but only over short distance. Boulders are normally 256 mm and above are normally transported either by dragging action. As waters flow from high elevation to sea level, their potential energy is converted to other forms as they sculpt the landscape, developing complex channel networks and a variety of associated habitats. Rivers accomplish their geomorphic work using excess energy above that required to simply move water from one point on the landscape to another. In natural channels, the excess energy of rivers is dissipated in many ways: in turbulence at steps in the river profile, in the frictional resistance of cobbles and boulders, vegetation along the bank, in bends, in irregularities of the channel bed and banks, and in sediment transport. The transport of sand- and gravel-sized sediment is particularly important in determining channel form, and a reduction in the supply of these sediments may induce channel changes. Supply of sand and gravel is influenced by many factors, including changes in land use, vegetation, climate, and tectonic activity. Sediment is transported mostly as suspended load. Whereas clay, silt, and sand held aloft in the water column by turbulence, in contrast to bedload, sand, gravel, cobbles, and boulders transported by rolling, sliding, and bouncing along the bed. The idealized watershed can be divided into three zones: that of erosion or sediment production (steep, rapidly eroding headwaters), transport (through which sediment is moved more or less without net gain or loss), and deposition. The size of sediment typically changes

along the length of the river system from gravel, cobbles, and boulders in steep upper reaches to sands and silts in low gradient downstream reaches, reflecting diminution in size by weathering and abrasion, as well as sorting of sizes by flowing water. Over time scales of centuries, the river channel in the transport reach can be likened to a “conveyor belt”, which transports the erosional products downstream to the ultimate depositional sites below sea level. Transport of sediment is highly flow dependent, an “event-based” process that varies widely from year to year. At time scales of years to decades, the transport of sediment tends to be episodic, in contrast to the continuous transport implied by the conveyor belt analogy. Moreover, individual grains may not move very far per flood – often jumping just from one bar to the next bar downstream, and material transport is heterogeneous spatially within the channel. Transport of sediment through the catchment and along the length of the river system is continuous (on geologic time scales). Increased erosion in upper reaches of the catchment can affect the river environment many miles downstream (and for years or decades) as the increased sediment loads propagate downstream through the river network. Rivers and streams draining the western slope of the Cascade Mountains in Western Washington typically transition abruptly from steep, eroding uplands to relatively flat coastal plains. Gravel mining activities are typically situated near urban areas in these transitions, where the coarse portion of the sediment delivered from steep uplands during floods is deposited. These are also typically zones of naturally pronounced channel activity. Along the river channel “conveyor belt”, channel forms (such as gravel bars) may appear stable but the grains of which they are composed may be replaced annually or biannually by new sediment from upstream. Similarly, the sediments that make up the river floodplain (the valley flat adjacent to the channel) are typically mobile on a time scale of decades or centuries. The floodplain acts as a storage reservoir for sediments transported in the channel, alternately storing sediments, by deposition, and releasing sediment to the channel, by bank erosion. Downstream, water released from the dam possesses the energy to move sediment, but so long as the reservoir continues to trap more sediment, the water released has little or no sediment load. This “clear water” released from the dam is often referred to as hungry water, because the excess energy is typically expended on erosion of the channel bed and banks for some years following dam construction, resulting in incision (downcutting of the bed) and coarsening of the bed material (termed armoring in fluvial geomorphology) until equilibrium is reached and the material

cannot be moved by the flows (Kondolf 1997). The reduced sediment supply below dams has profound implications for the siting of sand and gravel mines, because mines located in sediment starved reaches below a dam are not replenished by sediment yield from the basin, only by downstream tributaries and channel erosion. In many cases, reduction of flood peaks can more than offset reduced sediment availability, causing net aggradation of the river channel below the dam. By removing sediment from the active channel bed, instream mines interrupt the continuity of sediment transport through the river system, disrupting the sediment mass balance in the river downstream and inducing channel adjustments (usually incision) extending considerable distances (commonly 1 km (0.6 mi) or more) beyond the mine site itself. Instream gravel mining directly alters the channel geometry and bed elevation and may involve extensive clearing of vegetation, flow diversion, sediment stockpiling, and excavation of deep pits. Regardless of the mining technique, the preexisting channel morphology is disrupted and a local sediment deficit is produced. Recharge is in two forms, one general deposition of coarse, medium and fine sand when the velocity of the river water decreases below the carrying capacity. However, flash floods due to heavy rains in the upper reaches often causes rapid transportation of boulder, sand etc., along with silt which can never deposit.

Recharge Rate: It is dependent upon the following 4 factors

1. Velocity of the water and change of velocity
2. Size of particles
3. Temporary increase in density of carrying media due to presence of silt load.
4. Artificial or natural barriers being encountered within the river course, where due to the sudden check in velocity, materials are deposited.

The numerical sedimentation rate varies from 50cm medium sand to as much as 3m of medium and fine sand where the slope of the river bed is less than 10° slope per season. For silt and clay, these only be deposited in the flood area and normally varies between 1-5m over 6 months period. To maintain sediment transport continuity, Extraction rates should be less than the amount estimated to be transported to the site from upstream on an annual average basis. Recognizing the large variability in annual sediment transport (actual sediment transport to the site in any given year is typically much less than or much more than the

annual average rate), and site-specific considerations, The cumulative effects of gravel mining over time and upstream/downstream, and the cumulative effects of multiple mines on one river system, have rarely been addressed. As discussed above, the real impacts of gravel mining are cumulative – additive effects of extractions on the sediment budget, increasing extent of floodplain pits, multiple captured pits, etc. Small extractions are often viewed as having only small, insignificant impacts. However, a small extraction on a small stream can take a large fraction of the annual load, and multiple small extractions on a larger stream can add up to be equivalent to a large proportion of total load. In some cases, small extractions may be practiced to avoid scrutiny entailed by fewer, larger extractions. A large timber company in northern California had 42 small extractions in one county in 1992, each declared at less than 764 m<sup>3</sup> (1000 yd<sup>3</sup> ) and thus exempt from most requirements of the state’s surface mine reclamation act. Even when the extractions are all legitimately small, they can add up to have a significant cumulative effect on channel form, especially in small channels, where the sediment load would be naturally low. Instream mining results in removal of mass (gravel) from the reach, thereby lowering the average elevation, and in that sense making future deposition more likely. Even using environmentally preferred extraction techniques from bars, leaving the head of the bar and in some cases the stream margin in place, and lowering the interior of the downstream part of the bar surface, mining creates a site for deposition of gravel and sand. Thus, at a minimum bar scalping represents a loss term in the sediment budget. Because “...bars are temporary storage sites through which sand and gravel pass, most bars are in approximate equilibrium so that the influx and downstream transport of material are equal when averaged over a number of years. If all of the sand and gravel reaching such a bar is removed, the supply to bars downstream will diminish. Since sand and gravel will continue to be transported from these downstream bars by the river, their size will decrease.” (Dunne et al. 1981:89) The magnitude of this impact basically depends on the magnitude of the extraction relative to bedload sediment supply and transport through the reach.. Erosion from the bed has made up the difference in volume. Gauge and cross-section data indicate that the beds in reaches of each river with intensive gravel extraction have been lowering at the rate of 30 mm/yr (0.1 ft/yr) (Collins and Dunne 1986). As described below, incision can reduce overbank flooding, increase in-channel shear stress and sediment transport potential, destabilize bed and banks, lower the alluvial water table, and change the distribution and

structure of riparian vegetation While individually many of these pits would be considered relatively insignificant, the net effect of multiple pits in one reach results in cumulative, off-site impacts. Bank protection constructed to protect these pits has reduced the potential channel migration zone, resulting in reduced riparian habitat values on a large percentage of the Yakima's active floodplain. Numerous pits also change hyporheic zone dynamics and groundwater flow patterns, effects that remain largely undocumented approach to managing gravel mining is to estimate the annual bedload sediment supply from upstream, the "replenishment rate", and to limit annual extraction to that value or some fraction thereof, considered the "safe yield". The replenishment rate approach has the virtue of scaling extraction to the river load in a general way, but bedload transport can be notoriously variable from year to year. Thus, this approach is probably better if permitted extraction rates are based on new deposition that year rather than on long-term average bedload yields. More fundamentally, however, the popular notion that one can extract at the replenishment rate without affecting the channel ignores the continuity of sediment transport through the river system. The mined reach is the "upstream" sediment source for downstream reaches, so mining at the replenishment rate could be expected to produce hungry water conditions downstream. Dunne et al. (1981) stressed because actual bedload transport is variable from year to year, estimated average annual bedload inflow rates may not be applicable in most years. Replenishment can be estimated year-to-year, either riverwide (based on sediment rating curves), or based on site-specific deposition. The latter approach is **applied here in this study, where a team of experts visited the sites in post monsoon season and taken the readings of the sampling mast planted in pre-monsoon season, thus** estimates the amount of deposition over the flow season, and recommends an extraction amount, location,. In estimating annual (or annual average) replenishment rates, it is important to recognize that using sediment transport equations yields an estimate of theoretical bedload sediment transport capacity, which is commonly less than actual load, as the latter is limited by actual sediment supply from the basin. **To avoid this problem method of physical verification is applied here.**

#### **Components of Replenishment study:**

##### ***7.5.1.River description***

**Betwa:** River Betwa enters in Hamirpur in Chandawari Danda reserved forest. and subsequently passes through Ghuraull and Mangrauth villages. In Chandwari Danda, river Dhasan meets with river Betwa. In between village Baragaon and Sultanpur, Betwa joins Yamuna river.

**Table 7.1:** List of Villages through which River Betwa passes in Hamirpur

S.No.	Name of Place/Village	S.No.	Name of Place/Village
1.	Chandrawari	2.	Kherma
3.	Ghuraull	4.	Raniganj P.F.
5.	Manrauth	6.	Bajetha
7.	Chikasi P.F	8.	Tiknipur
9.	Sulgawan	10.	Mamhenpur
11.	Hardua	12.	Parsaul
13.	Barera Khalsa	14.	Kumhaupur
15.	Birhat	16.	Harehata
17.	Jampur	18.	Kewaura
19.	Barera P.F.	20.	Suharapur
21.	Barera Muafi	22.	Pauthiya buzurg
23.	Bindhauri	24.	Nethi
25.	Benda	26.	Kiratpur
27.	Jitkari	28.	Sahijan
29.	Chaura	30.	Bangiyaon
31.	Jitkari P.F.	32.	Gimhur
33.	Chandaurt P.F.	34.	Badanpur R.F.
35.	Basaria R.F.	36.	Sankari Tipar
37.	Rirua Buzurg	38.	Sindra
39.	Harsudi P.F.	40.	Jarali Madaiya
41.	Khandaut	42.	Surauli Khurd
43.	Jalalpur P.F.	44.	Baragaon

**Betwa** River enters in Jalaun District at village Kanjusa situated 120 m elevation. It further passes through Marhepura and Shivganj. Subsequently river flows through various villages and the exit from district, near village Ikauna.

**Table 7.2:** List of Villages through which River Betwa passes in Jalaun.

S.No.	Name of Place/Village	S.No.	Name of Place/Village
1.	Dhera R.F.	2.	Kahta
3.	Maruna-ke-khod	4.	Makrechha P.F.

5.	Sala R.F.	6.	Airpatti R.F.
7.	Thurat R.F.	8.	Mohana
9.	Rukhana R.F.	10.	Haidalpur P.F.
11.	Rukhana	12.	Bindaula R.F.
13.	Amror R.F.	14.	Gurha
15.	Rajapur	16.	Simhariya
17.	Saidnagar	18.	Tikua
19.	Sudhauri R.F.	20.	Kharka
21.	Karthara R.F.	22.	Kuruana
23.	Kishor R.F.	24.	Dadri
25.	Kotra	26.	Sonahata
27.	Sati	28.	Kahta Hamirpur
29.	Nandha R.F.	30.	Parason
31.	Sikri R.F.	32.	Almari
33.	Kamtha	34.	Purwa Kunheta
35.	Shri Kahta P.F.	36.	

**Table 7.3: Drainage System of River Betwa**

S.No.	Name of District	Length in the district	Area Covered (sq km)	% Area Covered
1.	Jalaun	28	20	0.5%
2.	Hamirpur	132	94.6	2.42 %

The Betwa river is a tributary of Yamuna River. Its basin extends from longitude 77° to 81°E and latitude 23°8' to 26°0'N. The Betwa River originates at an elevation of 470m in Bhopal district in M.P. After traversing a distance of 590m, the river joins the Yamuna River near Hamirpur at an elevation of 106.68m. The total catchment area of the Betwa River is 46580 sq. km of which 31,971 sq. km (68.64%) lies in M.P. and 14,609 sq. km (31.36%) lies in U.P. The basin is saucer shaped with sandstone hills around the perimeter. The Dhasan River is the important tributaries of the Betwa River.

Betwa River plays vital role in the formation of Alluvium in the Bundelkhand region. Alluvium deposit is the main source of morrum, which plays very important role in economy of the Bundelkhand region.

Betwa River flows from south west to north east in Jhansi. Jalaun and Hamirpur district, forming a large meanders. The deposition of sediments occur as point bars and channel bars

Geologically the catchment area of Betwa river comprises rocks of Bundelkhand Granitic complex of Archean to Proterozoic age and Alluvium of quaternary period.

Dhasan River flows from south to north and meet with river Betwa on the right bank of Betwa river in Jhansi district. The catchment of Dhasan river is occupied by Bundelkhand Granitic Complex which is overlain by alluvium of quaternary age.

### 7.5.2. Geology

Betwa river, flows on Bundelkhand Granitic Complex in Jhansi, Jalaun and Hamirpur District. The regional geological succession of the area is as follows:

<b>Geological Unit</b>	<b>Lithologic Composition</b>	<b>Group</b>	<b>Age</b>
Channel Alluvium	Red and quartzofeld -spathic sand	Newer Alluvium	Holocene
Terrace Alluvium	Red and quartzofeld -spathic sand		
Varanasi Alluvium	Brownish yellow silt, clay with kankar	Older Alluvium	Early to late Pleistocene
Banda Alluvium	Red to deep brown sand with gravel lenses ,silt and clay with kankar		
Bundelkhand Granitic Complex	Granite and gneisses and outcrops of granitoid , metasedimentaries and basites, dolerite and quartz reef	B.G.C.	Archean To Proterozoic

Betwa river in Jhansi, Hamirpur and Jalaun District comprises rocks of Bundelkhand Granitic Complex. Bundelkhand Granitic complex consists of granite of different types , gneiss and migmatite intruded by dolerite and quartz dykes. Metamorphosed rocks occur as enclaves. Granites are porphyritic to fine grained, non foliated and jointed. Quartz dykes commonly known as (quartz reef) trend NE-SW and extends several km. around Jaitpur, Kulpahar , Charkhari and south of Gorahari.

The Alluvium unconformably overlying Bundelkhand Granitic Complex is divisible into Older Alluvium and Newer Alluvium. Older Alluvium contains oxidized (brown, yellow khaki color) sediments and Newer Alluvium comprises unoxidized (grey and khaki color) sediments. Banda Alluvium and Varanasi Alluvium of Pleistocene period represent older Alluvium. The Banda Alluvium consists of brownish silt – clay with kankar, red-quartzofeldspathic and gravel. The Varanasi Alluvium overlies Banda Alluvium and contains polycyclic sequence of micaceous sand, silt and clay with Kankar.

The Newer Alluvium of Holocene age, consists of Terrace Alluvium and Channel Alluvium. Terrace Alluvium consisting of 8-15 m. thick sequence of sand, silt and clay occupies terraces of Betwa river. Loose sand of point and channel bars constitute Channel Alluvium of Betwa river. However over the years the construction of dams changed the mineralogical specialities of depositional sediments.

### **7.5.3 Local Geology**

The morrum occur all along with the Betwa River in Jhansi, Jalaun and Hamirpur District, which is red in color. The red color sediments is the product of weathering and disintegration of granitic gneisses of Bundelkhand Complex

Morrum in this belt are gravelly in nature and mineralogically comprises of quartz, feldspar and other accessory minerals and is coarse to very coarse grained.

### **7.5.4. Topography of the study area-2**

The present mining geological study area lies between the coordinates 25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N & 80°16'12.74"E in which River Betwa flows has a major area covered by Banda Alluvium which has developed over the basement of Bundelkhand Granitoid Complex (BGC) which comes under the Group of Older Alluvium.

Banda Alluvium is spread all over the part of Jalaun district falling within the study area, and in Hamirpur also major part is covered with Banda Alluvium. Banda Alluvium is of Red to deep brown sand due to the presence of red-quartzofeldspathic with gravel lenses, of brownish silt and clay with kankar. The Bundelkhand Granitoid Complex (BGC) which forms the base of

Banda Alluvium mainly consists of Granite and Gneiss with the origin of Archean to Proterozoic age.

There is also a palaeo-channel found within the study area below the confluence of River Betwa and River Yamuna around the Villages Narayanpur, Kundaura (25°51'22.54"N 80° 8'17.12"E) etc. and it indicates the remnant of inactive stream channel of River Yamuna which got filled with by younger sediment (Newer Alluvium).

Within the area of study of this particular cluster, there is a confluence of two rivers Betwa and Yamuna (25°55'6.61"N 80°12'37.38"E) around the point of confluence of two rivers is the low lying area towards the upper bank of river Yamuna which lies in the Kanpur Nagar district. On river Yamuna there is a patch of Channel alluvium found near Village Samuhi (25°55'48.02"N 80°13'30.39"E) in Kanpur Nagar which is mostly partially or wholly submerged during monsoons. A patch of Channel alluvium is also found in the part of district Jalaun falling with the study area. It is found around BhediKhurd (25°53'0.21"N 79°51'6.27"E) village along the water channel of River Betwa. Channel bars and point bars are formed within the channel of the river and these sediment deposits are called as Channel alluvium. Rest part of the district falling within the study area is covered with Varanasi Alluvium which is brownish yellow silty to clayey flat with relict fluvial features likes Tals and Palaeochannel. Varanasi alluvium is older alluvium laying on the low flood plains, originated as Early to Late Pleistocene age. In Hamirpur district towards North-east direction (80° 4'31.07"E 80° 4'31.07"E) between the two rivers flowing in the district viz. Yamuna and Betwa lies Varanasi Alluvium towards the bank of Yamuna River which is a flat ground with relicts channels and inselbergs of granitoid too. It is a low lying area which gets flooded in monsoon season and when flood water recedes it removes the soil along the drainage lines by surface run-off turned this area into waste land. The ground water table level around this area ranges from 10-20 m bgl as the bed rock is porous and the water is potable.

Terrace Alluvium is found all along the river stream flowing from west to east direction and is mostly deposited on the older flood plains which are low lying and this sediment deposition is younger in nature and mostly preserved by the incision of rivers as it keeps on getting deposited in the forms of terrace. In this particular stretch, the deposition of alluvium is mainly

Morrums in nature which are coarse to very coarse in texture having red colour due to presence of quartzofeldspathic sand.

As the river Betwa progresses the deposition of sediments varies in depth within the 10km buffer zone of our study area around ChandautDanda (25°54'13.48"N 79°40'28.95"E) the thickness of sediment deposit varies from 31m-20m from the water level in the river which is on average 101m on the concave side of the river.

The course river Betwa is meandered through out this stretch and around villages like Himapura, Pathreta and Basrehi (25°52'19.90"N 79°47'47.82"E) there is a bend and towards the concave side the sediment deposit are found of thickness of approx. 23m-17m from the average water level of the river which is approx. 99m.

The water level/zero level of the river Betwa around the the villages BhedikharkandBhediKhurd (25°54'3.69"N 79°49'0.71"E) along the steep bend in the water channel is approx. 97m and the thickness of sediment deposition is approx. 24m- 15m.

The meandering of the river facilitates the deposition of sediments further down the course around villages Beri and BajhetaDariya (25°53'32.65"N 79°54'23.32"E) with the thickness of 25m-13m from the average water level in the river which is approx. 95m. further down the stream around the villages Sahijana, Tikhrauli, Ramedi etc.( 25°55'28.58"N 80° 8'58.68"E) just before the Yamuna Betwa confluence at Samuhi, the thickness of sediment deposits varies 24m- 15m from the water level which is approx. 92m.

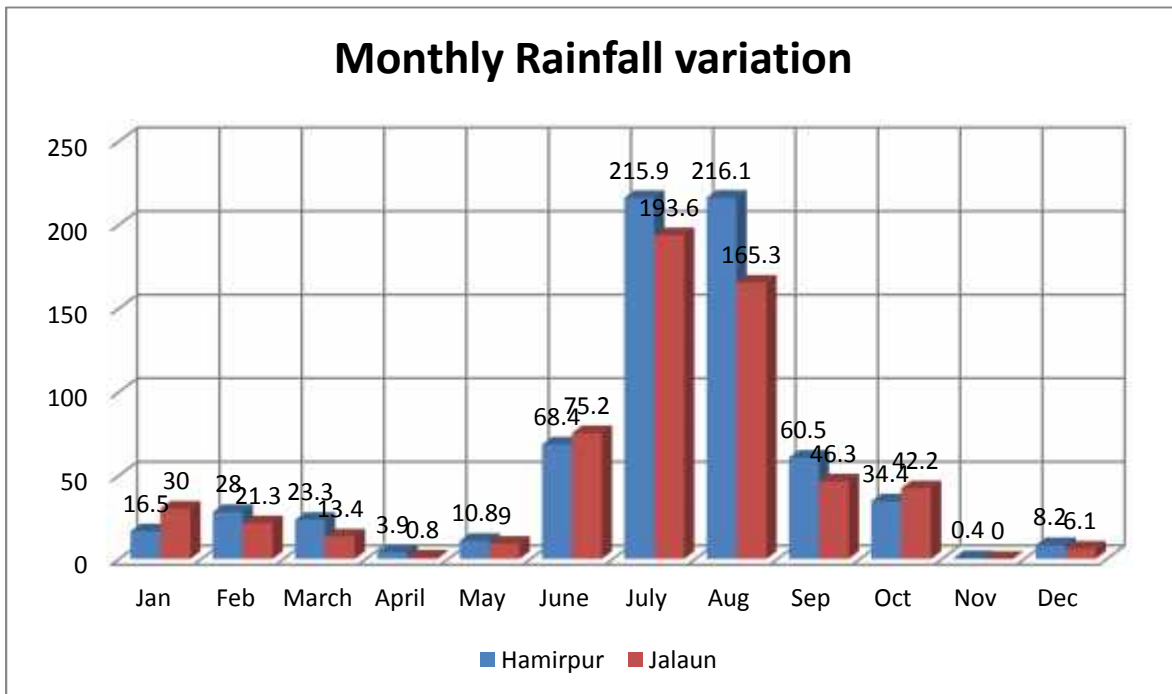
Terrace Alluvium is also found in the Kanpur Nagar district within the study area on the older flood lowland plains which has got high permeability and low compressive strength and is suitable for monocrop cultivation. The water table level along the Yamuna river within this study area varies from 10-20m bgl.

**Betwa in Jalaun:** The Betwa forms the boundary with Jhansi along the southern border from a point a few kilometers east of the town of Erichh to its junction with Dhasan. Its course, which up to the junction runs due east tends then somewhat to the north-east and it meanders along the south-eastern side of tahsil Orai and Kalpi, separating them from Hamirpur. Like the Yamuna it leaves the district on Baoni border. It flows in a tortuous channel with many loops

and bends. Its total length along the district border is approximately 96 kilometers, but from point to point it does not exceed 64 kilometers. Both the banks are fringed for some distance inland by unculturable ravines.

**Betwa in Hamirpur:** This river flows along the north-eastern border of the district from the point where Dhasan joins Betwa separating tehsil Rath from district Jalaun. It joins Yamuna at 10 km east of Hamirpur. The total distance of river is almost 65 km but it is almost doubled due to numerous loops formed in tortuous course. After joining Yamuna its channel curves gently from north to south. The banks except at the end of its course are precipitous and very little alluvial soil is formed between the river and cliff. In the upper reaches rocks and boulders occur in a few places in its bed, but for the most part the bed is sandy. The banks except in the last few km are usually scoured with ravines. The river brings down large volume of water in the rains and for the rest of the year, the river shrinks to a narrow stream.

**7.5.5. Rainfall:** The variation in rainfall during the duration of environmental monitoring is shown below in Fig.3.12. The graph represents the mean monthly variation in the months of March, April and May. The rainfall data has been gathered from the IMD monitoring stations in each district of the past 5 years.



### Fig 7.3. Mean monthly Rainfall variation in the study area

#### 7.5.6. Soil

In this region mainly four types of soils are found

1. Clay loam to sandy
2. Loam & Sandy Loam
3. Sandy loam to sodic soil
4. Sandy loam & clay are dominant

Different morphological units have different types of soil. The soil ranges from pure sand to stiff clays and including all combination of the two extreme litho units. The pure sand is called Bhur and clay is called Matiar when the sand is mixed with clay in equal proportion, the soil may be termed as Dumat or Loam – a good agricultural soil. **Fig. 1.4 and Fig 1.5** illustrate different soil types in different geomorphic setting in Hamirpur and Jalaun district, Uttar Pradesh. The soil found in the area under study shows different variations-

**Hamirpur district** comes under the doab region of Ken and Betwa rivers covered by the recent alluvium. Different erosion and depositional agencies contribute to the diversity of soil types. Different morphological unit have different type of soil ranges from pure to stiff clay and included all combinations of the two extreme litho units. The pure sand is called BHUR and clay is MATIAR. The soils consist of the well-known Bundelkhand varieties- **Mar, Kabar, Parua and Rakar.**

**Mar** is often called black cotton soil, containing soil lumps of kankar and varies greatly in colour.

**Kabar** ranges from a rich dark balck to light brown and due to extreme adhesiveness, hard blocks are formed.

**Parua** is a light coloured sandy soil, found in many forms. It is usually less rich in organic matter but its finer texture makes it more responsive to manure and irrigation.

**Rakar** is a refuse soil which occurs on sloping ground, where the action of water has trended to denude the earth of all its better qualities.

Soil of the district **Jalaun** can be grouped into four types that commonly occur in Bundelkhand region, which are **Mar, Kabar, Parwa and Rakar.**

**Mar** is a dark coloured clay soil mixed with calcareous nodules (Kankar) with swelling and shrinking character. The soil is friable in dry state, moisture retentive and highly fertile.

**Kabar** is also a fertile soil but contains fewer amounts of clay and lighter in colour than Mar. **Kabar** and **Mar** soils are commonly known as black cotton soil and occur in the area of central parts.

**Parwa** generally occurs in the northern parts of area. This is a loamy soil, usually having grey colour.

**Rakar** soil is coarse grained red soil, strewn with Kankar. It has less fertility and occurs on ravine slopes.

In **Jhansi**, the soil found may be classified into two groups on the basis of colour and topography i.e. red (upland soils) and black (low land soils). On the basis of texture, the red soil is further divided into 'Rakar' and 'Parwa' and the black soil group into 'Kabar' and 'Mar'.

#### 7.5.6. Land Use/Land cover

**Table no.7.5. Land use of 500 m radius**

Land use types	Area ha	% Area
River and water bodies	1017.33	11.90%
Land with or without scrub	1869.6	21.87%
Crop land (Horticulture)	1222.01	14.30%
Sand	4439.21	51.93%

#### Description of Land use/land cover

The buffer zone of study area-2 is almost 46.9% crop land and 28.8% of land area is scrub land or with no scrub. The total builtup area in 10 km radius is 11.34% and waste land is 8.67% of the total area covered in the buffer zone of study area-2.

#### 7.5.7. Process of deposition

Sediment transport is critical to understanding how rivers work because it is the set of processes that mediates between the flowing water and the channel boundary. Erosion involves removal and transport of sediment (mainly from the boundary) and deposition

involves the transport and placement of sediment on the boundary. Erosion and deposition are what form the channel of any alluvial river as well as the floodplain through which it moves. The amount and size of sediment moving through a river channel are determined by three fundamental controls: competence, capacity and sediment supply. Competence refers to the largest size (diameter) of sediment particle or grain that the flow is capable of moving; it is a hydraulic limitation. If a river is sluggish and moving very slowly it simply may not have the power to mobilize and transport sediment of a given size even though such sediment is available to transport. So a river may be competent or incompetent with respect to a given grain size. If it is incompetent it will not transport sediment of the given size. If it is competent it may transport sediment of that size if such sediment is available (that is, the river is not supply-limited). Capacity refers to the maximum amount of sediment of a given size that a stream can transport in traction as bedload. Given a supply of sediment, capacity depends on channel gradient, discharge and the calibre of the load (the presence of fines may increase fluid density and increase capacity; the presence of large particles may obstruct the flow and reduce capacity). Capacity transport is the competence-limited sediment transport (mass per unit time) predicted by all sediment-transport equations, examples of which we will examine below. Capacity transport only occurs when sediment supply is abundant (non-limiting). Sediment supply refers to the amount and size of sediment available for sediment transport. Capacity transport for a given grain size is only achieved if the supply of that calibre of sediment is not limiting (that is, the maximum amount of sediment a stream is capable of transporting is actually available). Because of these two different potential constraints (hydraulics and sediment supply) distinction is often made between supply-limited and capacity-limited transport.

Most rivers probably function in a sediment-supply limited condition although we often assume that this is not the case. Much of the material supplied to a stream is so fine (silt and clay) that, provided it can be carried in suspension, almost any flow will transport it. Although there must be an upper limit to the capacity of the stream to transport such fines, it is probably never reached in natural channels and the amount moved is limited by supply. In contrast, transport of coarser material (say, coarser than fine sand) is largely capacity limited.

### **7.5.9. Modes of Sediment Transport**

The sediment load of a river is transported in various ways although these distinctions are to some extent arbitrary and not always very practical in the sense that not all of the components can be separated in practice:

1. Dissolved load
2. Suspended load
3. Intermittent suspension (saltation) load
4. Wash load
5. Bed load

### **7.5.10. Sediment Transport in Rivers**

The loose boundary (consisting of movable material) of an alluvial channel deforms under the action of flowing water and the deformed bed with its changing roughness (bed forms) interacts with the flow. A dynamic equilibrium state of the boundary may be expected when a steady and uniform flow has developed (Nalluri & Featherstone, 2009). The resulting movement of the bed material (sediment) in the direction of flow is called sediment transport and a critical bed shear stress ( $\tau$ ) must be exceeded to start the particle movement. Such a critical shear stress is referred as incipient (threshold) motion condition, below which the particles will be at rest and the flow is similar to that on a rigid boundary.

#### **Sediment Influx Rate**

Sediment influx in Ephemeral streams is generally confined to the beginning of the rainy season as velocity of the water washes down medium to fine sand and silt depending on the velocity and gradient of land. Cobbles, pebbles and boulders will be transported but only over short distance. Boulders are normally 256 mm and above are normally transported either by dragging action or by saltation.

**Recharge Rate:** It is dependent upon the following 4 factors

- Velocity of the water and change of velocity

- Size of particles
- Temporary increase in density of carrying media due to presence of silt load.
- Artificial or natural barriers being encountered within the river course, where due to the sudden check in velocity, materials are deposited.

The numerical sedimentation rate varies from 50cm medium sand to as much as 3m of medium and fine sand where the slope of the river bed is less than 100 slope per season. For silt and clay, these only be deposited in the flood area and normally varies between 1-5m over 6 months period.

#### **7.5.11. Estimation of Sedimentation**

The sedimentation rate in India is estimated using empirical formula, actual observed data and reservoir sedimentation survey. In addition the sediment data is also collected by the state governments on river systems in their respective territories. Thus there is enough data to estimate both the average annual sediment yield and also the distribution of annual sediment yields. There are also situations where the gauging stations provide nested systems of catchments. In these situations data can be used to identify the contribution to the total sediment yield from individual sub-catchments. Though this data is extremely useful and is recommended to be fully used for estimation of sediment rate, the data need to be interpreted with care. The sediment measurements are, in general, based on bottle sample taken from near the water surface. In general, the suspended sediment concentration varies with depth, with the sediment concentration being greatest at the lower levels. This means that the measurement may under estimate the suspended sediment concentrations. The sediment yield depends on catchment area, the average catchment slope, the lithology of the catchment, the land use, the drainage density, the annual/seasonal precipitation and storm events etc. There are a number of empirical methods developed in USA and still used worldwide to assess sediment erosion, including the Universal Soil Loss Equation (USLE), MUSLE, and Revised Universal Soil Loss Equation (RUSLE). Some work has been done in India and certain empirical relations have been developed linking annual sediment yield with some of these parameters. Estimation of sediment yield from the catchment area above the reservoir is usually made using river sediment observation data or more commonly from the experience of

sedimentation of existing reservoirs with similar characteristics. On adopting the first procedure, it is usually necessary ( though often not complied with in practice ) to evolve proper sediment water discharge rating curve and combine it with flow duration ( or stage duration curve ) based on uniformly spaced daily or shorter time units in case of smaller river basins. Where observed stage/flow data is available for only shorter periods, these have to be suitably extended with the help of longer data on rainfall to eliminate, as far as possible, the sampling errors due to shortness of records. The sediment discharge rating curves may also be prepared from hydraulic considerations using sediment load formulae, that is, modified Einstein's procedure but this has not yet become popular. It is also necessary to account for the bed load which may not have been measured. While bed load measurement is preferable; when it is not possible, it is often estimated as a percentage generally ranging from 5 to 20 percent of the suspended load. However, practical means of measuring bed load of sediment needs to be undertaken particularly in cases where high bed loads are anticipated. To assess the volume of sediment that would deposit in the reservoir, it is further necessary to make estimates of average trap efficiency for the reservoir in question and the likely unit weight of sediment deposits, time averaged over the period selected. The trap efficiency would depend mainly on the capacity inflow ratio but would also vary with location of controlling outlets and reservoir operating procedures. The density of deposited sediment would vary with the composition of the deposits, the location of the deposit within the reservoir, the flocculation characteristics of clay and water, and the age of the deposit. For coarse material ( 0.0625 mm and above), variation of density with location and age may be unimportant. For silt and clay, this may be significant. Normally, a time and space average density of these fractions, applicable for the period under study is required for finding the overall volume of deposits. For this purpose, the trapped sediment for the period under study would have to be classified in fractions by corrections in inflow estimates of the fractions by trap efficiency. Most of the sediment removed from the reservoir should be from the silt and clay fraction. In some special cases, local estimates of densities at a point in the reservoir may be required instead of average density over the reservoir. Estimates of annual sediment yield/sedimentation rate assessed from past data are further required to be suitably interpreted and where necessary, the unit rates which would apply to the future period are computed by analysing data for trends or by making subjective adjustments for the likely future changes. Where the contributing drainage

area is likely to be reduced by upstream future storages, only such of the projects as are under construction or which have the same priority of being taken up and completed as the project in question are considered for assessing the total sediment yield. Sediment observation data (is necessary if the yield is being assessed from hydrometric data. If observational methods are inadequate, the possibility of large errors should be considered. For drawing conclusions from reservoir re-surveys, it is important that reduction of at least 10 percent or more has been observed in the capacities of the two successive surveys; if this is not done, inaccuracies in the successive surveys will distort the estimation of the capacity reduction between the surveys. If the loss of capacity is small, useful conclusions may not be forthcoming, and in such cases, river sediment measurements with its large observational errors may still provide a better estimate. It is essential to make a proper assessment of sediment yield for reservoir under study taking relevant factors into account.

A proper assessment of the effects of sediment transport and of the measures that may be necessary for its control requires knowledge of the processes of sediment erosion, transportation, and deposition, and of their interaction with the hydrological processes in the catchment.

**Erosion of catchments** The most significant agent for eroding sediments from land is running water. Other agents of land erosion include wind, ice, and gravity. The processes by which water degrades the soil are complicated and depend upon the rainfall properties, soil properties, land slope, vegetation, agricultural methods, and urbanization process. The last two factors account for the most important effects of man's activities on erosion. Empirical equations have been developed for the determination of soil loss (sheet erosion) from agricultural lands. One of them, developed by Musgrave for conditions prevailing in the United States, is given as an example:  $E = 1.35 I^{0.35} R^{1.75} S^2 l^2 p^2$  (59.1) where E is the mean annual soil loss, in millimetres, I is the inherent erodibility of the soil, in millimetres, R is a land-cover factor, S is the land slope, in per cent, l is the length of the slope, in metres, and p is the 30-minute, two-year rainfall depth, in millimetres. The values of the parameters I and R are determined empirically from regional studies.

**Channel erosion** Channel erosion is caused by the forces of the concentrated flow of water. Its rate depends on the hydraulic characteristics of channel flow and on the inherent erodibility of channel materials. In non-cohesive materials, the resistance to erosion is affected

by the size, shape, and specific gravity of the particles and by the slope of the bed. In cohesive materials it also depends on the bonding agents. The relationships between the hydraulic variables and the parameters influencing the erodibility of channels are not fully understood and are often expressed by empirical formulae. Stream- and river-control works may have a serious local influence on accelerating channel erosion if they cause an increase in channel depth, flow velocity, change the direction of the flow, or reduce the natural sediment load. The latter effect occurs frequently below dams and may persist for many kilometres downstream. Bare land and badlands may develop gullies with rates of advance that can be computed by empirical formulae containing such parameters as the drainage area of the gully, slope of the approach channel, depth of rainfall, and clay content of the eroding soil .

**Transportation of sediments in channels** Fine (suspended) sediments transported in rivers originate mainly from the topsoil of the catchment and from the banks of the channels. However, fine sediments also originate from sewage and other return flows, e.g., such sediments comprise about onethird of the suspended-sediment load in the lower Rhine river. A large portion of the transported material comes to rest on flood plains especially upstream from hydraulic structures. The settled material undergoes compaction and other physical and chemical changes that can sometimes prevent its re-erosion by flows that would have carried it previously. A decrease is usually found in the mean annual sediment transported per unit area of the catchment as the area of the catchment increases. The concentration of suspended sediment in runoff is described by formulae such as  $\log cs = C \log Q + B$  (59.2) in which  $cs$  is the concentration expressed in weight per unit volume of water,  $Q$  is the water discharge,  $C$  is a dimensionless coefficient, and  $B$  is a function of the rainfall depth, of the antecedent discharge, or of other meteorological and hydrological variables. The concentration of suspended sediment varies within the channel crosssection. It is relatively high in the lower portion and may also be non-uniform laterally . so that its sampling at several points or along several verticals of the cross-section is often necessary for obtaining its mean. The mean concentration should be evaluated to yield the total sediment weight per unit time when multiplied by the water discharge. The graph of suspended sediment against time usually has a peak that does not occur simultaneously with the peak discharge. This lag is a result of the specific conditions in a watershed, and no generalization has yet been formulated for the evaluation of this difference.

**Bed-load transport** Coarse sediments (bed load) move by sliding, rolling, and bouncing along channels and are concentrated at or near the channel bed. The variables that govern transport are the size and shape of the particles and the hydraulic properties of the flow. As a consequence of the interaction between the hydraulic forces and the coarse sediment, the channel bed assumes different configurations known as plane, ripples, dunes, flat, standing waves, and antidunes. They exert resistance to the flow of water that varies within a wide range and assumes a maximum value for the dune configuration.

**Sedimentation** When approaching its mouth, the flow velocity of a river decreases along with its ability to carry sediment. Coarse sediments deposit first, then interfere with the channel conveyance, and may cause additional river meanders and distributaries. The area of the flowing water expands, the depth decreases, the velocity is reduced, and eventually even fine sediments begin to deposit. As a result, deltas may be formed in the upper portion of reservoirs. The deposited material may later be moved to deeper portions of the reservoir by hydraulic processes within the water body. Sediments are deposited in accordance with their settling velocity. A significant concentration of suspended sediments may remain in the water column for several days after its arrival in a reservoir. This may interfere with the use of the stored water for certain purposes, e.g., for water supply or recreation. It should be emphasized that not all of the sediment deposits in a reservoir. A large portion of it remains in the upper zones of the watershed, some is deposited upstream from reservoirs, and some is carried downstream by the released water. The sediment-trapping efficiency in a reservoir depends upon the hydraulic properties of the reservoir, the nature of the sediment, and the hydraulic properties of the outlet. The density of newly deposited sediments is relatively low but increases with time. The organic component in the sediment may undergo changes that may reduce its volume and enhance biochemical processes in the stored water.

Some of the famous sediment transport equations are:-

1. Dandy – Bolton Equation
2. Modified Universal Soil Loss Equation (MUSLE) developed by Williams and Berndt
3. Yang Equations
4. Engelund-Hansen Equation

### 7.5.12. Study of Replenishment of the stretch

#### Objective

A realistic estimation of the sand resource in a lease area.

Estimation of replenished sand by measuring pre and post monsoon sand level in the mining area.

Drawing and overall picture of sand budgeting in the study area.

#### Review of literature

The transport of sediment by rivers has been studied extensively by engineers and earth scientists or more than a century. The use of Bed load transport is a famous one for this analytical type of approach. Recent studies on bed load transport incorporated the stochastic nature of the river sand inflow. Several such studies related to river sand mining have been reported for the rivers of Kerala also. For a clear direction for the local bodies, for the limit for safe sand mining from different stretches, an analytical study based on bed load transport model combined with actual sand flow measurement is necessary. This study develops a reach wise assessment of actual sand inflow and the optimal removal from rivers.

- Methodology and data collection
- Field mapping using cadastral scale map
- Local survey
- Sand survey by sample mining

The scientific solution for the crisis of sand mining needs an optimization of sand removal. Knowledge of sand inflow is the key part of determination of optimal sand removal. To determine this sand inflow an analytical study is carried out by using bed load transport model. The bed load transport can be estimated using different analytical model such as Meyer-Peter's, Einstein's Model, Shield's Formula, Du-Boy's Formula etc. However, in the present study, the most practical approach is used for estimation of bed load transport.

**Table No7.7. Popular methods for Replenishment Study**

Sediment Transport Equations	<ul style="list-style-type: none"><li>• Yang Equation</li><li>• Engelund-Hansen Equation</li></ul>
River Modeling	<ul style="list-style-type: none"><li>• River Modelling Using HEC-RAS</li></ul>

Sediment Rating Curve Determination	<ul style="list-style-type: none"> <li>• Flow Discharge based on Surveyed Cross Section</li> <li>• Sediment Distribution Curve</li> <li>• Total Bed Material Load Computation</li> <li>• Historical Flood Hydrograph</li> <li>• Extraction Volume Determination</li> </ul>
Site Visits and Estimation of Actual Amount	<ul style="list-style-type: none"> <li>• Visits to extraction site annually, reviews cross section survey data &amp; estimates the actual amount of replenishment over the flood season.</li> </ul>

The monsoon in the Uttar Pradesh is regular. Thus, the actual observation of flow and silt which is essential for determination of replenishment is utilized for the study purpose. With this situation in mind, a two-stage sand replenishment study, described hereunder, was undertaken. In stage one; preliminary study with field data collection was done. During the field visit, the installation of marked observation rods was undertaken in every leasehold area in the pre-monsoon period. The rise of river bed level in the post monsoon season was then ascertained. While installing the marked observation rods, it was also kept in mind that depending upon the rainfall intensity and duration. The second stage includes observation of level of sand at the end of the monsoon season. The difference obtained between the pre and post monsoon level of sand is the actual amount of sand replenished during the rainy season. **The actual results will be collected after rainy season and same will be given in first compliance report.**

#### 7.6 SOCIAL IMPACT ASSESSMENT

Detail Social Impact Assessment study has been done and given in Chapter-3.

#### 7.7 RESETTLEMENT & REHABILITATION PLAN

Not applicable.

#### 7.8 DISASTER MANAGEMENT

All types of industries face certain types of hazards which can disrupt normal activities abruptly and to disaster like fires, inundation, failure of machinery, explosion, to name a few.

Similarly Sand mines also have impending dangers or risk which need be addressed for which a disaster management plan has been formulated with an aim of taking precautionary steps to avert disasters and also to take such action after the disaster which limits the damage to the minimum. Nevertheless, the following natural/industrial problems may be encountered during the mining operation.

1. Inundation- filling of the mine pit due to excessive rains.
2. Slope failures at the mine faces or stacks.
3. Accident due to storage of explosive and blasting.
4. Accident due to fire.

As per proposal made under the mining plan, during proposed working the area will be developed by means of opencast and OTFM mining method. Exploitation and transportation of minerals are to be carried out by manual means. Water table will not be touched during processed working. No high risk accidents like landslides, subsidence flood etc. have been apprehended. But, possibility of accidental disaster is also not ruled out. Therefore, all the statutory precautions should be taken for quick evacuation as per; the Mines Act 1952, the Mines Rules 1955, MMR-1961 and MCDR-1988. There will be no storage of explosives or blasters and sae is not required in River bed Mining.

### **7.8.1. Risk Assessment and Disaster Management Plan**

The possible risks in the case of river bed mining project are bank erosion, floods, accidents due to transportation etc. Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine should be able to work under condition, which are adequately safe and healthy. At the same time, the environment should be such as not to impair his working efficiency. This is possible only when there is adequate safety in mines. Hence, safety at the mine of all the employees is taken care of by the mining rules & regulations, which are well defined with laid down procedure for safety, which when scrupulously followed safety is ensured not only to manpower but also to machines & working environment.

### **Possible Risks Due To Inundation & Its Control**

Mining will be done during the non monsoon periods; therefore, problem of inundation is not likely to happen.

### **Dewatering**

Depth of mine is limited to 3m/ water level whichever less is whereas the ground water flows far below the bed level. Fig 3.17 in chapter 3 depicted pre and post monsoon water level and depth of mining.

### **Possible Risks Due To Failure Of Pit Slope & Its Control**

Pit will be created of limited depth only i.e. 3 m water level whichever is less thus the chance of failure of pit slope does not exist.

### **Possible Risks Due To Failure Of Waste Dump & Its Control**

No waste dump is created; therefore the question of failure of waste dump does not exist.

### **Possible Risks Due To Fire & Its Control**

The operation does not anticipate any fire disaster.

## **7.8.2 Measures to Prevent Accidents Due to Trucks and Dumpers**

- ❖ All transportation within mining lease working should be carried out directly under the supervision and control of the management.
- ❖ The vehicles will be maintained in good condition and checked thoroughly at least once a month by the competent person authorized for the purpose by the management.
- ❖ Road signs will be provided at each and every turning point up to the main road (wherever required).
- ❖ To avoid danger while reversing the equipments/ vehicles especially at the working place / loading points, stopper should be posted to properly guide reversing/ spotting operating, otherwise no person should be there within 10 m radius of machine.
- ❖ A statutory provision of the fences, constant education, and training etc.will go a long way in reducing the incidents of such accidents.

## **7.8.3. Other Possible Measures to Avoid Risks/ Disaster Due to River Bed Mining.**

- ❖ Unwanted material including mineral or spillage (if any) should not be stacked on the banks as it will hinder the flow of water in monsoon season.
- ❖ Mining of minerals / working shall be started from the centre from dip to rise and then laterally in 0.6 Meter slice so that the river course could not get affected.
- ❖ The minerals will be mined out in a uniform way so that the river flow/ course shall not get disturbed.
- ❖ River banks will not be excavated to form access ramps. Only excavated river gravel should be used to deposit against the river bank to form access ramps.

### 7.9 TRANSPORTATIONAL ROUTE ANALYSIS

The table given below is the basis for calculation of additional load of air pollutants due to the transportation of excavated sand in the region. The contribution of different factors like emission due to unpaved length, paved length and tail pipe are calculated and represented in graphs.

**Table No. 7.8Transportational Route analysis**

Project Proponent (s) & Name of Company (if any) & Residential Address	Gata No (s)/ Khand No (s) ,Village Tehsil/ District	Details of Production		Haulage Route Length (km)			
		Daily Production (cum/day)	No. of Trucks to be deployed for transportation	Description	Unpaved Length	Paved Length	Total Length
M/s Ghanaram Infra Engineers Pvt. Ltd.	Gata No. 240, Khand No. 05	883	59	>8m wide road connected to MDR(Jalalpur-Kadaura) which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.34	0.92	1.26
M/s Pehalwan Traders	Khand No. 23/07	707	47	>6m wide road connected to MDR(Kadaura-Bewar) which is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	2.77	6.91*	9.68
ShriKanha Construction Company	Khand No. 23/13	707	47	>6m wide road connected to MDR(Kadaura-Bewar) which is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	2.67	6.91*	9.58

M/s Balaji Enterprises	Khand No. 23/20	707	47	>6m wide road connected to MDR(Kadaura-Bewar) which is further connected to SH-42 (Hamirpur-Gursarai-Jhansi Marg)	1.46	6.91	8.37
M/s Bindu& Ram Construction Company	Gata No. 1396 Ga, Khand No. 03	1,104	74	>10m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Road) which is further connected to SH 91 (Hamirpur-KalpiMarg)	1.2	8.56+10.7=19.26	20.46
M/s D. V. Construction	Khand No. 20/06	1,413	94	>8m wide road connected to MDR(Jalalpur-Kadaura) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur	0.92	2.71+6.39=9.1	10.02
M/s Rama Traders	Khand No. 09/03	1,790	119	>8m wide road connected to SH 91 (Hamirpur-KalpiMarg which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur)[N] & >8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Road) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur) [S]	3.5(N) & 2.49(S)	8.96 (N)+4.0*(N) & 2.88 (S)	5.99 (N) & 5.0 (S)
M/s Indus Mines And Minerals	Khand No.11/4	1,013	67	>8m wide road connected to NH 86 (Sagar Road) &>8m wide road connected to MDR (KuchhechhaDaller Road) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur) [S]	0.71(N) & 1.0 (S)	2.95 (N) & 1.67 (S)	3.66(N) & 2.67 (S)
M/s Harihar Minerals LLP	Khand No. 23/19	706	47	>8m wide road connected to MDR-41B which is further connected to SH 21 (Bilaraya-Lakhimpur-Sitapur-PanwariMarg)	1.32	6.91	8.23

M/s Kamtanath enterprises pvt ltd,	Khand 19/5	2119	141	>9m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	0.95	7.79	8.74
KanhaiyaLal& Sons,	khand 19/4	1719	115	>8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	0.94(N) 1.14 (S)	9.45 (N) 7.79 (S)	10.39(N) 8.95(S)
M/s New praveera infra height pvt ltd,	khand 10/33	1177	78	>9m wide road connected to SH 91 (Hamirpur-KalpiMarg)	1.14(N) & 0.56(S)	11.4	12.54 (N) &0.56 (S)
Shri Construction	Khand 18/1	2119	141	>8m wide road connected to SH 91 (Hamirpur-KalpiMarg) & 8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	1.10(N)& 0.74(S)	7.48(N)	8.58(N)& 0.74(S)
M/s Yadav& Sons,	khand 23/12	706	47	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg) &>9m wide road connected to MDR 41Bwhich is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	2.83	6.91	9.74
Shri Rahul Kumar Gupta	khand 10/4	2119	141	>6m wide road connected to SH 91 (Hamirpur-KalpiMarg) & 8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	3.1(S) &2.48 (N)	6.90 (S) &4.16+10.24=14.4 (N)	10.0(S) &16.88 (N)
M/s Eureka Mines and Minerals LLP	Gata No. 747, Khand No. 01	1177	79	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.68	0.93	1.61
M/s Baba Bholenath Traders	Khand No. 10/36	707	47	>9m wide road connected to SH 91 (Hamirpur-KalpiMarg)	0.1 (N)& 0.10(S)	11.4 (N)	11.5(N)& 0.10 (S)

M/s UnnaoInfradevelopersPvt	Khand No. 10/3	2120	141	>6m wide road connected to MDR(Jalalpur-Kadaura) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur	2.62(N)& 3.1(S)	4.16 (N) &6.35 (S)	6.78(N)& 9.45 (S)
KuberKamnaMarbels Pvt. Ltd.	Khand No. 8/4	2260	150	>6m wide road connected to SH 91 (Hamirpur-KalpiMarg) & 8m wide road connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	1	1.86	2.86
ShriShailendraYadav	Khand No. 10/2	2119	141	>6m wide road connected to SH 42(Hamirpur-Gursarai-Jhansi Marg) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur	3.0(W) & 2.66(S)	4.16(W) & 6.91(S)	5.26(W) & 9.57(S)
M/s KaushalyaChaube Contractor	Khand No. 17/5	530	35	>8m wide road connected to SH 91 (Hamirpur-KalpiMarg)(N) & SH 42(Hamirpur-Gursarai-Jhansi Marg)	0.70(N) & 0.59 (S)	1.20 (S)	0.70(N) & 1.79(S)
<b>Total B1 Lease= 21</b>		<b>27372</b>	<b>1822</b>		<b>51.85</b>	<b>190.27</b>	<b>224.61</b>
Shri Suresh Chandra Gupta	Gata No. 596, Khand No. 01	883	59	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	1.6	1.29	2.89
M/s Sharad Enterprises	Gata No. 240, Khand No. 02	1,104	74	>7m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.28	0.17	0.45
M/s Chaudhary Traders	Khand No. 23/08	1,413	94	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	2.94	6.91	9.85

M/s MaaRaktantika Contractors And Suppliers Pvt. Ltd.	Gata No. 1396 Ga, Khand No. 05	1,104	73	>7m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	2.13	19.26 (8.56 for loaded truck & 10.7 for empty truck)	21.39
M/s Silverr Mist Retail Private Limited	Khand No. 23/30	707	47	>8m wide road connected to MDR(Lahara-Kadoura Road) which is further connected to SH 91 (Hamirpur-KalpiMarg)	2.20(N) & 0.96(S)	14.0 (N)	16.20 (N) & 0.96 (S)
M/s Silverr Mist Retail Private Limited	Khand No. 23/28	707	47	>9m wide road connected to MDR which is further connected to SH 42 (Hamirpur-Gursarai-Jhansi Marg)	0.69	9.67	10.36
M/s Rishabh Herbal Pvt. Ltd.	Khand No. 14/1	530	35	>8m wide road connected to SH 91(Hamirpur-KalpiMarg) which is further connected to NH 86 (Kanpur-Ramaipur-Ghatampur)	0.62(N) & 1.21(S)	0.70 (N) & 0.70(S)	1.32 (N) & 1.91 (S)
M/s Indus Mines And Minerals	Khand No.11/5	707	47	>7m wide road connected to NH 86 (Kanpur-Ramaipur-Ghatampur)	0.14	2.95	3.09
M/s A.P.M. Mining And Infra Pvt.Ltd.	Khand No.10/29	707	47	>6 m wide road connected to SH 91 (Hamirpur-KalpiMarg)	2.30(N) & 0.75(S)	1.40(N) & 8.41 (S)	3.7(N) & 9.16(S)
Associate Commerce	Gata No. 747/16	246	16	>8m wide road connected to MDR which is further connected to SH 91 (Hamirpur-KalpiMarg)	0.65	0.93	1.58
<b>Total</b>	<b>10 Leases-B2</b>	<b>8638</b>	<b>575</b>		<b>17.76</b>	<b>67.59</b>	<b>85.35</b>
<b>Grand Total</b>	<b>31Leases-(B1+B2)**</b>	<b>36010</b>	<b>2397</b>		<b>69.61</b>	<b>257.86</b>	<b>309.96</b>

\*Upcoming B1- sub-category Projects for which Public Hearing is awaited and EC from SEAC for B2-sub-category projects is also awaited & granted.

\*\* (inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited)

In the above figure, the transportational route of Study area -1 is represented, in which **Blue** path represents the unpaved road, **Yellow** path represents the paved road and violet path represents the main roads like SH and NHs.

Details of transportational routes are given in Chapter-2 under lease wise details.

### **7.9.1. Air pollutants level prediction using modeling for worst case scenerio (Incremental +baseline data) in study area**

#### **Additional emission load of air pollutant emission from heavy vehicles using sand/morrum transportation in sand mining project surrounding, Betwa River District Jalaun/ Hamirpur**

Sand/morrum mining minerals have been transported through roads using motor vehicles. Motor vehicles have been producing various air pollutants through exhaust such as PM, CO, NO<sub>2</sub>, and SO<sub>2</sub>. Dusts are also released from vehicle tires while play on unpaved (haulage road) and paved road. This dust is well known as suspended dust.

The ambient air quality might get degraded of sand/morrum mining project site surroundings from vehicular emissions through transportation of sand/morrum. Vehicular emissions and resuspension of road dust which may lead to respirable diseases of human beings at project sites and surroundings. The emission load contribution at the receptor sites in atmosphere depends upon multitude of factors such as local meteorology, location, height of release and atmospheric removal processes.

The incremental air pollutant level for worst case scenerio was predicted using modeling in study area. The methods have been discussed in the next section.




#### **Methodology**

Air Quality Modeling is a method used to predict air quality in study area for sand/morrum. The emission factor one of input parameter for modeling. The emission factor of vehicles has taken from "The Automotive Research Association of India (ARAI)", Pune (ARAI, 2016). The heavy vehicle populations have been count daily movements up and down trip for transportation of sand/morrum. Emission factor from paved and unpaved road has been

calculated using USEPA AP-42 method. Air quality modeling was done using line source model as published by USEPA for transportation through roads and the empirical emission factor equations from article, “Emission Factor Equations for Haul roads: The Indian Perspective” (Singh et al., 2006). Concentration of the fugitive dust was calculated by using empirical equations for unpaved roads. Gaussian plume a model has been predicted the downwind air pollutants (CO, SO<sub>2</sub>, NO<sub>2</sub>, and Particulates) concentrations from line source through exhaust (Goyal, P. 2007; Demirarslan et al. 2017).

Air Quality Index (AQI) is a tool for effective communication of air quality status to people in terms, which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour. There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each of these categories is decided based on ambient concentration values of air pollutants and their likely health impacts (known as health breakpoints) (CPCB 2014). AQI range is also associated with possible health impacts and presented in Table 1 as prescribed by CPCB, 2014. Air pollutants concentration and air quality index (AQI) has been plotted using GIS tool. GIS mapping was done in this study using spatial interpolation technique by inverse distance weighted (IDW) (Jha et al., 2011; Wong et al. 2004). Contour map was also plotted using ArcGIS tool for distribution of air pollutants and AQI value in the study area.

**Table No. 7.9. AQI category, ranges and their associated health impacts (Source: CPCB, 2014)**

AQI	Color Code	Associated Health Impacts
Good (0-50)		Minimal Impact
Satisfactory (51-100)		May cause minor breathing discomfort to sensitive people
Moderately polluted		May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and

(101-200)		older adults
Poor (201-300)		May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease
Very poor (301-400)		May cause respiratory illness to the people on prolonged exposure. The effect may be more pronounced in people with lung and heart diseases
Severe (>401)		May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced light physical activity even during

### Analysis of emission load of air pollutants from heavy trucks.

Projects production: 36013.3 cum/day)

**Table No.7.10 Emission load of PM<sub>2.5</sub> from heavy capacity truck employed at sand mining project sites on Betwa River area**

Monitoring stations	Baseline concentration of PM <sub>2.5</sub>	Incremental value in concentration of PM <sub>2.5</sub>	Total (Baseline + Incremental) concentration of PM <sub>2.5</sub>	Increase in % of PM <sub>2.5</sub>
AQ 1	56.5	1.4	57.9	2%
AQ 2	53.6	2.4	56.0	4%
AQ 3	51.4	4.5	55.9	8%
AQ 4	50.5	4.7	55.2	8%
AQ 5	50.8	2.5	53.3	5%
AQ 6	52.0	2.7	54.7	5%
AQ 7	50.2	5.8	56.0	10%
AQ 8	52.5	1.8	54.3	3%
AQ 9	51.1	7.6	58.7	13%
AQ 10	52.7	1.1	53.8	2%
AQ 11	50.5	7.8	58.3	13%
AQ 12	48.6	9.3	57.9	16%
AQ 13	51.6	3.2	54.7	6%
AQ 14	51.8	7.0	58.7	12%
AQ 15	50.6	6.0	56.6	11%
AQ 16	51.6	10.5	62.1	17%

AQ 17	52.5	6.2	58.7	11%
AQ 18	52.1	1.5	53.6	3%
AQ 19	51.5	3.0	54.5	6%
AQ 20	53.4	3.8	57.2	7%
AQ 21	54.4	3.9	58.3	7%
AQ 22	51.7	2.6	54.3	5%
AQ 23	52.0	2.3	54.3	4%
AQ 24	54.2	2.6	56.8	5%
AQ 25	54.4	3.7	58.1	6%
AQ 26	55.0	4.1	59.1	7%
AQ 27	52.5	3.9	56.4	7%
AQ 28	53.5	4.5	57.9	8%
AQ 29	53.8	1.4	55.2	3%
AQ 30	52.8	6.2	59.0	11%
AQ 31	52.7	3.6	56.3	6%
AQ 32	49.8	2.1	51.9	4%
AQ 33	51.4	1.4	52.8	3%
AQ 34	54.6	8.1	62.6	13%
AQ 35	55.3	1.5	56.8	3%

**TableNo.7.11Emission load of PM<sub>10</sub> from heavy capacity truck employed at sand mining project sites onBetwa River area**

Monitoring stations	Baseline concentration of PM <sub>10</sub>	Incremental value in concentration of PM <sub>10</sub>	Total (Baseline +Incremental) concentration of PM <sub>10</sub>	Increase in % of PM <sub>10</sub>
AQ 1	94.0	1.5	95.5	2%
AQ 2	86.5	5.3	91.7	6%
AQ 3	92.5	7.4	99.8	7%
AQ 4	86.9	7.7	94.6	8%
AQ 5	89.2	3.6	92.8	4%
AQ 6	89.8	3.3	93.1	4%
AQ 7	86.5	9.9	96.4	10%
AQ 8	89.2	0.0	89.2	negligible
AQ 9	88.4	13.7	102.1	13%
AQ 10	87.2	2.0	89.2	2%
AQ 11	86.9	11.4	98.2	12%
AQ 12	86.1	17.7	103.8	17%
AQ 13	89.5	6.3	95.8	7%
AQ 14	89.0	9.2	98.2	9%
AQ 15	88.8	8.7	97.5	9%
AQ 16	89.3	19.6	108.9	18%
AQ 17	87.7	8.5	96.2	9%

AQ 18	89.3	2.5	91.8	3%
AQ 19	89.0	5.0	94.0	5%
AQ 20	87.2	6.2	93.4	7%
AQ 21	91.0	8.6	99.6	9%
AQ 22	88.8	3.5	92.3	4%
AQ 23	87.5	3.5	91.0	4%
AQ 24	89.0	3.5	92.5	4%
AQ 25	91.2	5.6	96.8	6%
AQ 26	91.4	6.6	98.0	7%
AQ 27	90.6	5.6	96.2	6%
AQ 28	89.7	7.7	97.4	8%
AQ 29	92.0	2.2	94.2	2%
AQ 30	85.6	14.8	100.5	15%
AQ 31	91.5	4.3	95.8	4%
AQ 32	88.3	2.5	90.8	3%
AQ 33	86.8	0.0	86.8	negligible
AQ 34	92.3	17.7	110.0	16%
AQ 35	94.2	0.0	94.2	negligible

Ambient Air Quality Monitoring stations with Station Code AQ 8, AQ 33, AQ 35 shows negligible % increase in PM<sub>10</sub> because of the more distance from the nearest mine site. Other Monitoring stations were placed on an average of less than 2km from nearest mine sites, hence not much dispersion has taken place.

**Table No.7.12 Emission load of SO<sub>2</sub> from heavy capacity truck employed at sand mining project sites on Betwa River area**

Monitoring stations	Baseline concentration of SO <sub>2</sub>	Incremental value in concentration of SO <sub>2</sub>	Total (Baseline + Incremental) concentration of SO <sub>2</sub>	Increase in % of SO <sub>2</sub>
AQ 1	94.0	1.5	95.5	2%
AQ 2	86.5	5.3	91.7	6%
AQ 3	92.5	7.4	99.8	7%
AQ 4	86.9	7.7	94.6	8%
AQ 5	89.2	3.6	92.8	4%
AQ 6	89.8	3.3	93.1	4%
AQ 7	86.5	9.9	96.4	10%
AQ 8	89.2	0.0	89.2	negligible
AQ 9	88.4	13.7	102.1	13%
AQ 10	87.2	2.0	89.2	2%
AQ 11	86.9	11.4	98.2	12%
AQ 12	86.1	17.7	103.8	17%

AQ 13	89.5	6.3	95.8	7%
AQ 14	89.0	9.2	98.2	9%
AQ 15	88.8	8.7	97.5	9%
AQ 16	89.3	19.6	108.9	18%
AQ 17	87.7	8.5	96.2	9%
AQ 18	89.3	2.5	91.8	3%
AQ 19	89.0	5.0	94.0	5%
AQ 20	87.2	6.2	93.4	7%
AQ 21	91.0	8.6	99.6	9%
AQ 22	88.8	3.5	92.3	4%
AQ 23	87.5	3.5	91.0	4%
AQ 24	89.0	3.5	92.5	4%
AQ 25	91.2	5.6	96.8	6%
AQ 26	91.4	6.6	98.0	7%
AQ 27	90.6	5.6	96.2	6%
AQ 28	89.7	7.7	97.4	8%
AQ 29	92.0	2.2	94.2	2%
AQ 30	85.6	14.8	100.5	15%
AQ 31	91.5	4.3	95.8	4%
AQ 32	88.3	2.5	90.8	3%
AQ 33	86.8	0.0	86.8	negligible
AQ 34	92.3	17.7	110.0	16%
AQ 35	94.2	0.0	94.2	negligible

Ambient Air Quality Monitoring stations with Station Code AQ 8, AQ 33, AQ 35 shows negligible % increase in SO<sub>2</sub> because of the more distance from the nearest mine site. Other Monitoring stations were placed on an average of less than 2km from nearest mine sites, hence not much dispersion has taken place.

**Table No.7.13 Emission load of NO<sub>2</sub> from heavy capacity truck employed at sand mining project sites on Betwa River area**

Monitoring stations	Baseline concentration of NO <sub>2</sub>	Incremental value in concentration of NO <sub>2</sub>	Total (Baseline +Incremental) concentration of NO <sub>2</sub>	Increase in % of NO <sub>2</sub>
AQ 1	10.6	1.5	12.1	12%
AQ 2	10.6	1.2	11.8	10%
AQ 3	10.4	2.9	13.4	22%
AQ 4	10.9	2.9	13.8	21%
AQ 5	10.2	2.1	12.3	17%
AQ 6	10.1	1.8	11.9	15%
AQ 7	10.5	2.8	13.3	21%

AQ 8	10.5	0.0	10.5	negligible
AQ 9	10.4	3.7	14.1	26%
AQ 10	10.6	0.0	10.6	negligible
AQ 11	10.9	3.0	13.9	22%
AQ 12	10.7	4.9	15.6	31%
AQ 13	10.4	2.4	12.8	19%
AQ 14	10.2	3.3	13.5	24%
AQ 15	10.2	2.5	12.7	19%
AQ 16	10.6	5.8	16.4	36%
AQ 17	10.4	2.5	12.9	20%
AQ 18	10.2	0.0	10.2	negligible
AQ 19	9.9	2.1	12.0	17%
AQ 20	10.6	2.1	12.7	16%
AQ 21	10.5	2.1	12.6	16%
AQ 22	10.2	2.1	12.3	17%
AQ 23	10.4	2.1	12.5	17%
AQ 24	10.2	2.3	12.5	18%
AQ 25	10.2	2.9	13.2	22%
AQ 26	10.3	2.9	13.3	22%
AQ 27	10.9	2.9	13.9	21%
AQ 28	10.6	2.5	13.1	19%
AQ 29	10.8	0.0	10.8	negligible
AQ 30	10.4	4.4	14.8	30%
AQ 31	10.3	2.3	12.5	18%
AQ 32	10.0	2.0	12.1	17%
AQ 33	10.4	0.0	10.4	negligible
AQ 34	11.0	3.3	14.3	23%
AQ 35	11.2	0.0	11.2	negligible

Ambient Air Quality Monitoring stations with Station Code AQ 8, AQ 10, AQ 18, AQ 29, AQ 33 & AQ 35 shows negligible % increase in NO<sub>2</sub> because of the more distance from the nearest mine site. Other monitoring stations showing varied incremental percentage depending upon the distance of monitoring stations from the pollution sources causing less dispersion of the pollutants.

**Table No. 7.14 Emission load of CO from heavy capacity truck employed at sand mining project sites on Betwa River area**

Monitoring stations	Baseline Air pollutants concentration	Incremental value of Air pollutants concentration	Total Air pollutants concentration
AQ 1	BDL	0.02	0.02
AQ 2	BDL	0.08	0.08
AQ 3	BDL	0.04	0.04

AQ 4	BDL	0.08	0.08
AQ 5	BDL	0.01	0.01
AQ 6	BDL	0.00	negligible
AQ 7	BDL	0.08	0.08
AQ 8	BDL	0.00	negligible
AQ 9	BDL	0.04	0.04
AQ 10	BDL	0.00	negligible
AQ 11	BDL	0.16	0.16
AQ 12	BDL	0.14	0.14
AQ 13	BDL	0.08	0.08
AQ 14	BDL	0.06	0.06
AQ 15	BDL	0.04	0.04
AQ 16	BDL	0.16	0.16
AQ 17	BDL	0.10	0.10
AQ 18	BDL	0.00	negligible
AQ 19	BDL	0.08	0.08
AQ 20	BDL	0.08	0.08
AQ 21	BDL	0.08	0.08
AQ 22	BDL	0.04	0.04
AQ 23	BDL	0.04	0.04
AQ 24	BDL	0.05	0.05
AQ 25	BDL	0.11	0.11
AQ 26	BDL	0.07	0.07
AQ 27	BDL	0.14	0.14
AQ 28	BDL	0.01	0.01
AQ 29	BDL	0.00	negligible
AQ 30	BDL	0.16	0.16
AQ 31	BDL	0.07	0.07
AQ 32	BDL	0.00	negligible
AQ 33	BDL	0.00	negligible
AQ 34	BDL	0.16	0.16
AQ 35	BDL	0.00	negligible

Ambient Air Quality Monitoring stations with Station Code AQ 6, AQ 8, AQ 10, AQ 18, AQ 29, AQ 32, AQ 33 & AQ35 shows negligible % increase in CO because of the distance from the nearest mine site. Other monitoring stations showing varied incremental percentage depending upon the distance of monitoring stations from the pollution sources causing less dispersion of the pollutants.







**Table 7.15: Air quality index of AAQ monitoring locations.**

Location/AQI	Sub-index of air pollutant					AQI	Health statements for AQI
	IPM10	IPM2.5	ISO2	INO2	ICO		

AQ 1	95.5	96.4	10.9	15.1	0.9	96.4	Satisfactory
AQ 2	91.7	93.2	10.5	14.7	4.0	93.2	Satisfactory
AQ 3	99.8	93.1	10.8	16.7	2.1	99.8	Satisfactory
AQ 4	94.6	91.8	10.4	17.3	4.0	94.6	Satisfactory
AQ 5	92.8	88.7	9.6	15.3	0.7	92.8	Satisfactory
AQ 6	93.1	91.0	10.5	14.9	0.0	93.1	Satisfactory
AQ 7	96.4	93.2	9.6	16.6	4.0	96.4	Satisfactory
AQ 8	89.2	90.3	9.8	13.1	0.0	90.3	Satisfactory
AQ 9	101.7	97.8	10.1	17.6	2.0	101.7	Moderately polluted
AQ 10	89.2	89.6	9.9	13.3	0.0	89.6	Satisfactory
AQ 11	98.2	97.0	10.3	17.4	8.0	98.2	Satisfactory
AQ 12	103.8	96.4	10.3	19.5	7.2	103.8	Moderately polluted
AQ 13	95.8	91.1	9.9	16.0	4.0	95.8	Satisfactory
AQ 14	98.2	97.8	10.4	16.9	2.9	98.2	Satisfactory
AQ 15	97.5	94.3	9.7	15.8	2.0	97.5	Satisfactory
AQ 16	106.3	104.8	10.2	20.5	8.0	106.3	Moderately polluted
AQ 17	96.2	97.7	9.9	16.1	4.8	97.7	Satisfactory
AQ 18	91.8	89.2	10.0	12.8	0.0	91.8	Satisfactory
AQ 19	94.0	90.7	9.8	15.1	3.8	94.0	Satisfactory
AQ 20	93.4	95.2	10.1	15.9	3.8	95.2	Satisfactory
AQ 21	99.6	97.1	10.3	15.7	3.8	99.6	Satisfactory
AQ 22	92.3	90.3	9.9	15.3	1.8	92.3	Satisfactory
AQ 23	91.0	90.4	10.3	15.7	1.8	91.0	Satisfactory
AQ 24	92.5	94.6	10.0	15.6	2.7	94.6	Satisfactory
AQ 25	96.8	96.8	10.8	16.5	5.4	96.8	Satisfactory
AQ 26	98.0	98.5	11.1	16.6	3.6	98.5	Satisfactory
AQ 27	96.2	93.8	10.9	17.3	7.2	96.2	Satisfactory
AQ 28	97.4	96.5	10.3	16.4	0.5	97.4	Satisfactory
AQ 29	94.2	91.8	10.2	13.5	0.0	94.2	Satisfactory
AQ 30	100.5	98.4	10.1	18.5	8.0	100.5	Moderately polluted
AQ 31	95.8	93.7	10.4	15.7	3.6	95.8	Satisfactory
AQ 32	90.8	86.4	9.4	15.1	0.0	90.8	Satisfactory
AQ 33	86.8	87.8	10.2	13.0	0.0	87.8	Satisfactory
AQ 34	107.0	106.6	11.5	17.9	8.0	107.0	Moderately polluted
AQ 35	94.2	94.6	11.3	14.0	0.0	94.6	Satisfactory

- Air Quality status at four monitoring stations (Example: AQ9, AQ12, AQ16, AQ30 and AQ34) of Betwa River Study Area-2 are moderately polluted due to near haulage route, paved road and Sand/Morrum mine projects.
- Air quality at other stations out of above mentioned stations (Example: AQ1- AQ8, AQ10-AQ11, AQ13-AQ15, AQ17- AQ29, AQ31-AQ33 and AQ35) are satisfactory condition due to more distance from haulage road, upwind direction of wind and existing forest area.

**Table 7.16: IND-AQI category, ranges and their associated health impacts (Source: [www.cpcb.nic.in](http://www.cpcb.nic.in))**

AQI	Color Code	Associated Health Impacts
Good (0-50)		Minimal Impact
Satisfactory (51-100)		May cause minor breathing discomfort to sensitive people
Moderately pollute (101-200)		May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults
Poor (201-300)		May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease.
Very poor (301-400)		May cause respiratory illness to the people on prolonged exposure. The effect may be more pronounced in people with lung and heart diseases
Severe (>401)		May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced light physical activity even during

## 7.10 INCREMENTAL NOISE IN THE STUDY AREA-2

In opencast mines most of the mining machineries produce noise levels in the range of 90-115 dBA, exposure to which may affect the general health of human beings in accordance with the WHO definition of health.

Many machines do not operate constantly or at a constant noise level. Exposure to noise varies due to mobility of workers, mobility of noise sources, variations in noise levels or a combination of these factors. If the survey indicates that worker is exposed to noise > 115 db (A) then he should be provided with hearing protection.

#### **7.10.1. Work Place Noise Standards:**

DGMS Circular No.18 (Tech), 1975 A warning limit of 85-dB (A) may be set as the level below which very little risk to an unprotected ear of hearing impairment exists for an eight-hour exposure.

- The danger limit value shall be **90-dB (A)** above which the danger of hearing impairment and deafness may result from an unprotected ear.
- A worker should not be allowed to enter, without appropriate ear protection, an area in which the noise level is **115-dB (A)** or more.
- Personal protective equipment shall be worn, if there are single isolated outbursts of noise, which can go above **130-dB (A)** "Impulse", or **120-dB (A)** "Fast". " No worker shall be allowed to enter an area where noise level exceeds **140-dB (A)**.

#### **7.10.2. Noise Generation, Transmission and Reception**

Before steps are taken to develop noise control solutions, the problem should be analyzed in terms of; the source of the noise, the pathway of transmission and the receivers being exposed.

- **Identify the Source** - Frequently, a single piece of mining equipment will combine several individual sources of noise.
- **Determine the Transmission Pathways** - Sound can be propagated over long distances through structures and noise from individual sources may reach the receiver through different pathways.
- **Consider the Receivers** - Consider options on the amount of exposure to the noise rather than the noise itself
- **Distance Considerations** – Sound, which propagates from a point source in free air, attenuates (reduces by) **6 dB** for each doubling of the distance from the source. Sound

propagating in an enclosed space is attenuated less than this value, because of contributions to the sound level brought about by reflection from walls and ceilings.

- **Addition of Noise from Several Sources** - Noises from different sources combine to produce a sound level higher than that from any individual source. Two equally intense sources operating together produce a sound level that is 3 dB higher than one alone. It is also noticeable that decibels cannot be directly added, as they are logarithmic values.
- **Sound Insulation** - When a sound meets a wall or partition, only a small proportion of the sound energy passes through as most is reflected.
- **Sound Absorption** - Sound energy is absorbed whenever it meets a porous material. Porous materials that are intended to absorb sound are called sound absorbents and they absorb between 50 to 90% of the incident sound energy.

**Table No. 7.17. Equipment Types, and Their Noise Levels.**

<b>EQUIPMENT TYPE</b>	<b>USAGE FACTOR</b>	<b>Lmax at 50 feet (dBA)</b>	<b>Leq at 50 feet (dBA)</b>
Air Compressor	40%	78	74
Blackhoe	40%	78	74
Blasting	1%	94	74
Compactor	20%	83	76
Concrete Mixer Truck	40%	79	75
Concrete Pump Truck	20%	81	74
Crane	16%	81	73
Dozers	40%	81	77
Dump truck	40%	77	73
Excavator	40%	81	77
Front end Loader	40%	80	76
Generator	50%	81	78
Generator (<25 kVA)	50%	73	70
Grader	40%	85	81
Jackhammer	20%	81	74
Mounted Impact Hammer	20%	90	83
Pickup Truck	40%	75	71
Pumps	50%	77	74
Scrapper	40%	84	80
Tractor	40%	81	77

Source: FHWA, 2006. Siskiyou, 1978.

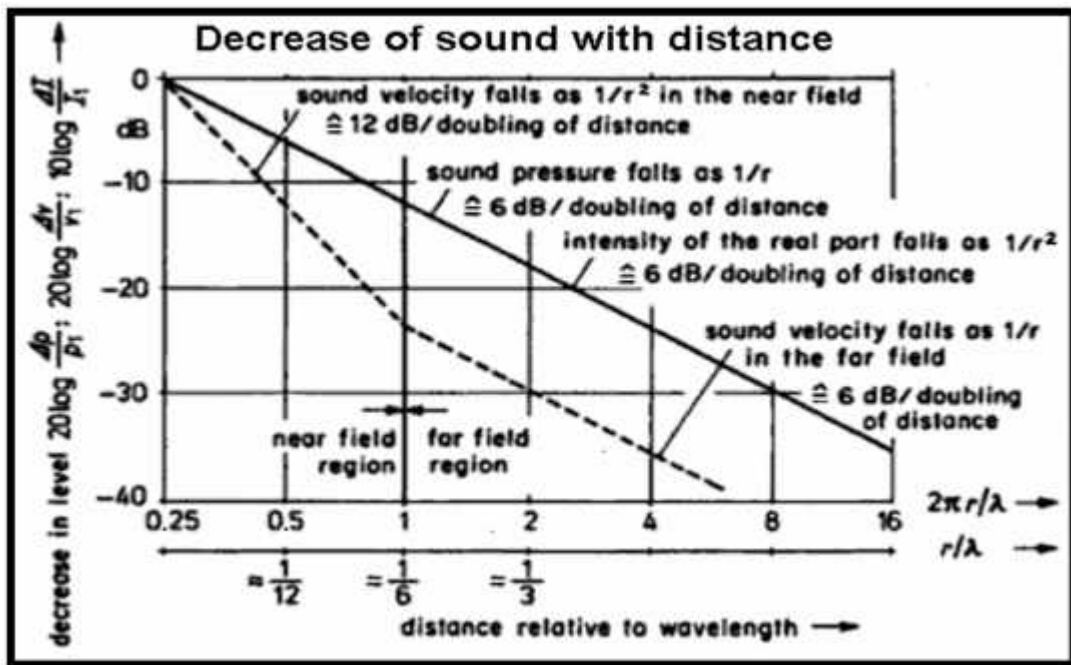
### 7.10.2. Sound Level Variation VS Distance:

Distance variation of sound level calculated by using below equation-

**Sound level  $L$  and Distance  $r$**

$$L_2 = L_1 - \left| 20 \cdot \log \left( \frac{r_1}{r_2} \right) \right| \quad L_2 = L_1 - \left| 10 \cdot \log \left( \frac{r_1}{r_2} \right)^2 \right|$$

$$r_2 = r_1 \cdot 10^{\left( \frac{|L_1 - L_2|}{20} \right)} \quad r_1 = \frac{r_2}{10^{\left( \frac{|L_1 - L_2|}{20} \right)}}$$



**Fig 7.20: Decrease of Sound with Distance**

For a spherical wave of a point source we get:

- The sound pressure level (SPL) decreases with doubling of distance by (-) 6 dB.
- The sound intensity level decreases with doubling of distance by (-) 6 dB.

Based on the above calculations and formula,  $L_D$ ,  $L_N$  &  $L_{DN}$  have been calculated depending upon the Noise source and distance from it. As the distance increases from source, the Noise level decreases. The projection of Noise levels during mine operations is derived from Baseline

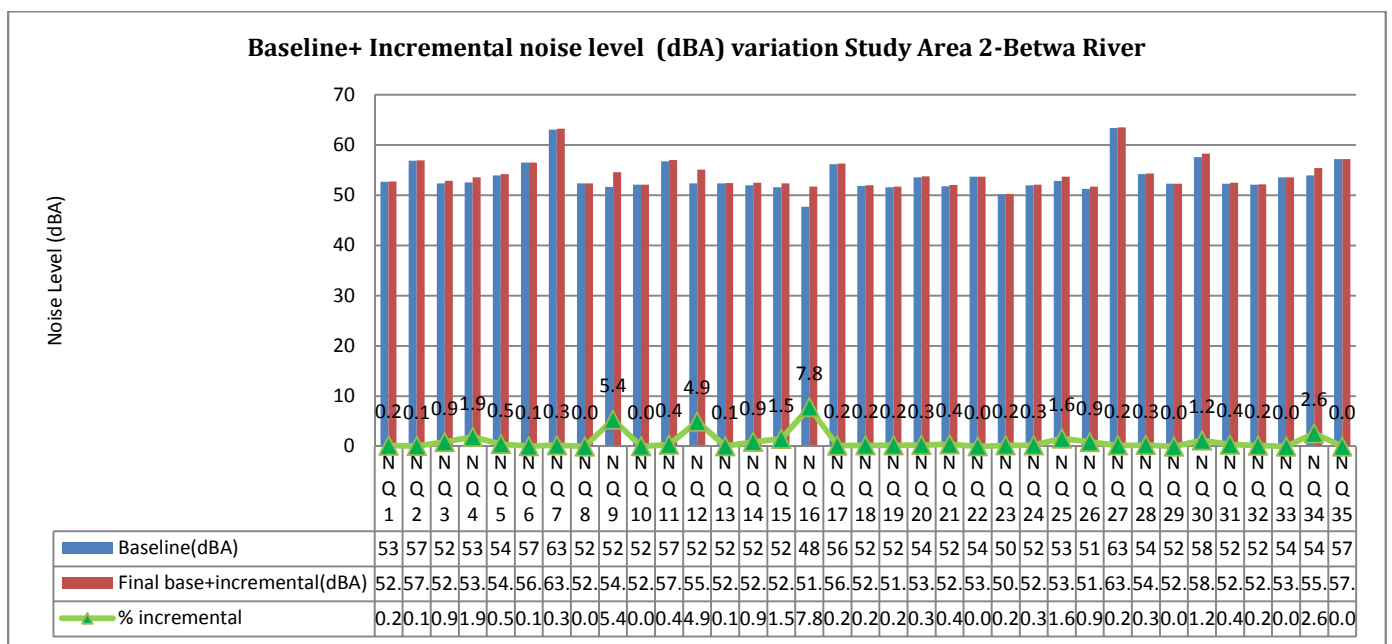
Monitoring data of Noise. Depending upon the number of trucks and Machineries on each lease area, the Noise levels were calculated and shown in figure NoFig.11 the propagation of Noise along the stretch of Study area.

**Table No. 7.18. Noise emission(Baseline +Incremental) at different monitoring Locations**

<b>NQ stn.</b>	<b>Baseline(dBA)</b>	<b>Final base+incremental(dBA)</b>	<b>% incremental</b>
NQ 1	52.7	52.8	0.2%
NQ 2	56.9	57.0	0.1%
NQ 3	52.4	52.9	0.9%
NQ 4	52.6	53.6	1.9%
NQ 5	54	54.2	0.5%
NQ 6	56.5	56.5	0.1%
NQ 7	63.1	63.3	0.3%
NQ 8	52.4	52.4	negligible
NQ 9	51.7	54.6	5.4%
NQ 10	52.1	52.1	negligible
NQ 11	56.8	57.0	0.4%
NQ 12	52.4	55.1	4.9%
NQ 13	52.4	52.4	0.1%
NQ 14	52	52.5	0.9%
NQ 15	51.6	52.4	1.5%
NQ 16	47.7	51.7	7.8%
NQ 17	56.2	56.3	0.2%
NQ 18	51.9	52.0	0.2%
NQ 19	51.6	51.7	0.2%
NQ 20	53.6	53.8	0.3%
NQ 21	51.8	52.0	0.4%
NQ 22	53.7	53.7	negligible
NQ 23	50.2	50.3	0.2%
NQ 24	52	52.1	0.3%
NQ 25	52.9	53.7	1.6%
NQ 26	51.3	51.8	0.9%
NQ 27	63.4	63.5	0.2%
NQ 28	54.2	54.4	0.3%
NQ 29	52.3	52.3	negligible
NQ 30	57.6	58.3	1.2%
NQ 31	52.3	52.5	0.4%
NQ 32	52.1	52.2	0.2%
NQ 33	53.6	53.6	negligible
NQ 34	54	55.4	2.6%
NQ 35	57.2	57.2	negligible

- Noise levels at monitoring stations with station code NQ 8, NQ 10, NQ 22, NQ 29, NQ 33, NQ 35 shows negligible % increase
- Noise levels were increased significantly at NQ9, NQ12, NQ16 and NQ34 due to near more than one mine site and roads (500 m) and also existing core zone.

<b>NQ9</b>	Bhedidanda	Core zone	03 sources within 500m range
<b>NQ12</b>	Beri	Core zone	within 100 m one source
<b>NQ16</b>	Teekapur	Core zone	within 100 m one source
<b>NQ34</b>	Sedradaanda	Core zone	within 100 m one source



**Fig 7.21. Graph of Baseline+ Incremental noise level (dBA) variation Study Area 2-Betwa River**

### 7.11 GREEN BELT DEVELOPMENT

The proposed green belt for the cluster on river Betwa extending between (25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N & 80°16'12.74"E) is to be developed taking into consideration the availability of area as the efficiency of green belt in pollution control mainly depends on tree species, its width, distance from pollution sources, side of the habitat from mining sites and tree height. The proposed green belt has been designed to control PM, gaseous pollutants, noise, surface run off and soil erosion etc. While considering the above aspects due care will be taken for selecting the suitable characteristics of plant

species such as fast growing, locally adoptable plant species, resistant to specific pollutant and those which would maintain the regional ecological balance, soil and hydrological conditions.

As plants are universal sink for air pollutants, they trap the carbon dioxide and store it within them as reserve food material. Plants being the initial acceptors of air pollutants act as a scavenger to the pollutants. Leaves provide surface area for impingement, absorption and adsorption of air pollutants as well settlement for dust particles in the atmosphere equally. Few plants are sensitive to certain air pollutants while others are tolerant. The plants sensitive to pollutants act as pollution indicators while the plants tolerant to pollutants act as sink. While selecting the species for pollution control the following are the important characteristics could be considered. Plants should be evergreen, large leaved, rough bark, indigenous, ecologically compatible, low water requirement, minimum care, high absorption of pollutants, resistant pollutants, agro-climatic suitability, height and spread, canopy architecture, growth rate and habit (straight undivided trunk), aesthetic effect (foliage, conspicuous and attractive flower colour), pollution tolerance and dust scavenging capacity. Hence, plantation needs to be done on haul routes to curb air pollution in respect to dust emission.

For sand mining projects, there is one more important function of plantation along the river bank is river bank protection from water erosion. As the vegetation along river bank contributes to bank stability by retarding water speeds and tractive forces near the soil surface. Following are the various functions of river bank protection by plantation:

#### **7.11.1.Function of vegetation in river bank protection**

- a) **Catching:** Loose materials have a tendency to roll down a slope because of gravity and erosion, and this can be controlled by planting vegetation. The stems and fine roots can catch and hold loose material.
- b) **Armoring:** Some slopes are very water sensitive. They start moving and/or are easily liquefied when water falls on them. Vegetation can protect the surface runoff and promotes water infiltration and control erosion by rain splash.
- c) **Reinforcing:** The shear strength of the soil can be increased by planting vegetation. The roots bind the particles of soil. The level of reinforcement depends on the nature of the roots. Species having more adventitious roots are more suitable than the surface of top roots forms

d) **Supporting:** Lateral earth pressure causes a lateral and outward movement of slope materials. Large and mature plants can provide support and prevent movement.

e) **Anchoring:** Layers with a tendency to slip over each other can be pinned to each other and the stable underlying layer by penetration of and ramification roots from the vegetation functions as anchors.

f) **Draining:** Water is the most common triggering factor for slope instability. Surface water drains away more easily in areas with sparse rooted vegetation. Thus, draining can be managed by planting small and dense rooted vegetation such as durva grass.

Under the afforestation plan, plantation in nearby villages and connecting roads will be done. The implementation for development of greenbelt will be of paramount importance as it will not only add up as an aesthetic feature but will also act as a pollution sink. The species to be grown in the areas will be dust tolerant and fast growing species so that a permanent greenbelt is created. Plantation in the barrier zone and roads is necessary as these areas will contain fine particulates resulting from mining operation and vehicle movement. Plantation will also be carried out as social forestry program in village, school and the areas allocated by the Panchayat/State authorities. Native plants like Neem, Peepal, and other local species will be planted. A suitable combination of trees that can grow fast and also have good leaf cover shall be adopted to develop the greenbelt. It is proposed to plant almost 2200 Nos of native species along with some fruit bearing and medicinal trees during the plan period. The greenbelt development program is given in Table below:

**Table No.7.19. Green belt development Plan for 5 years**

Year	Saplings to be planted (Survival rate (@ 100 %))	Species	Place of Plantation
I	3158	Local species found in the region after consultation with DFO Jalaun and Hamirpur	<ul style="list-style-type: none"> <li>• Along the Haul routes which will be used by empty and loaded vehicles (especially bushes)</li> <li>• Plantation in nearby villages towards Prominent downwind direction from the mine lease sites</li> </ul>
II	395*		
III			

IV			<ul style="list-style-type: none"> <li>• Plantation along the river bank for its protection</li> <li>• Plantation in the vacant places in the region(transition region between the Dariya and Danda regions)</li> </ul>
V			

### 7.11.2. Guidelines for plantation:

The plant species identified for greenbelt development shall be planted using pitting technique. The pit size will be of 60 cm x 60 cm x 60 cm. bigger pit size will be considered at marginal and poor quality soil. Soil used for filling the pit should be mixed with well decomposed farm yard manure or sewage sludge at the rate of 2.5 kg (on dry weight basis) and 3.6 kg (on dry weight basis) for 60 cm x 60 cm x 60 cm size pits respectively. The filling of soil should be completed at least 5-10 days before the onset of monsoon. Healthy sapling of identified species should be planted in each pit with the commencement of monsoon. Provision for regular and liberal watering during the summer period during the commissioning stage of the plant will be arranged from the local available resources. The authorities responsible for plantation will also make adequate measures for the protection of the saplings. While making choices of plant species for plantation in green belt, weightage has been given to the native species, bio climatic condition, plants which can be grown as per normal silvicultural practices. Plant species are identified for greenbelt development, considering the bioclimatic and soil condition.

### 7.11.3. Selection of Plants for Greenbelts:

The main limitation for plants to function as scavenger of pollutants are, plant's interaction to air pollutants, sensitivity to pollutants, climatic conditions and soil characteristics. While making choice of plants species for plantation in green belts, due consideration has to be given to the natural factor of bio-climate. Xerophyte plants are not necessarily good for greenbelts; they with their sunken stomata can withstand pollution by avoidance but are poor absorber of

pollutants. Character of plants mainly considered for affecting absorption of pollutant gases and removal of dust particle are as follows.

**a.For absorption of gases:**

- Tolerance towards pollutants in question, at concentration, that are not too high to be instantaneously lethal
- Longer duration of foliage
- Freely exposed foliage
- Adequate height of crown
- Openness of foliage in canopy
- Big leaves (long and broad laminar surface)
- Large number of stomatal apertures

**b.For Removal of Suspended Particular matter:**

- Height and spread of crown.
- Leaves supported on firm petiole
- Abundance of surface on bark and foliage
- Roughness of bark
- Abundance of axillaries hairs
- Hairs or scales on laminar surface
- Protected Stomata

**c.Main objectives of plantation:** The main purpose of developing green belt is to meet with specific purposes by the completion of the lease period:

1. For aesthetic enhancement of the project corridors and places of importance by planting selective ornamental trees, landscaping and turfing with grasses and ornamental shrubs.
2. To reduce the impacts of air pollution and dust as trees and shrubs are known to be natural sink for air pollutants.
3. To provide much needed shade on glaring hot roads during summer.

4. To reduce the impact of ever increasing noise pollution caused due to increase in number of vehicles.
5. To arrest soil erosion and dust emission.
6. Moderating the effect of wind and incoming radiation.

As envisaged in the Official issue vide letter No. **H16405/220/2018/02** on subject- **“Green belt development for the carbon offsetting and Air Pollution control”** by **Uttar Pradesh Pollution Control Board** issued on 16.02.2018, protocol for Green Belt Development has been given; the total area which should be under green cover to maintain ecological balance in the region. The species proposed should be long rotation, ornamental, evergreen, hardy, wind firm and also have the capacity to combat pollution(air and noise).

**d. Model of Green Belt Development:**

- Spacing between plants : 3m X 3m
- Plantation Pattern : Staggered rows
- Spacing between plantation of trees and bushes : 1m X 1m

**e. Plantation Program**

The present cluster includes the river bed mining projects, so the dense plantation will be done along the haul routes, any land earmarked by Gram Panchayats in Schools and other village lands. Details of plantation are given below in the table:

**Table No. 7.20. Details of row Plantation**

Total Mine leases	31*
Mine Area(in ha)	631.51 ha**
Total Number of plants/saplings(@ 5 sapling per hectare)	3158
Total Lease Period	5 Years
Total length of haul road( in km)	309.96km

**f. Plantation pattern:**

- The first row along the highways will be of small to medium size ornamental trees

- Subsequent rows depending on the availability of width will comprise of ornamental and/or shade bearing species of medium height more than those in the first row.
- In rural sections the last row shall always be shade bearing tall trees.
- Plantation shall be done in a staggered (zigzag) manner.

**Table No. 7.21. Details of row Plantation pattern**

Specification	I row	II row	III row
Distance from embankment	3.3 ft away from the toe of embankment	20.3 ft	37.3 ft
Spacing between plant to plant	10 ft	10 ft	20 ft
Canopy Shape & Size	Cylindrical/oblong with small CSA	Round/oblong with medium CSA	Spreading with medium CSA
Spacing between rows	-	15 ft	15 ft
Size of the pits	60 X 60 X 60 cm	60 X 60 X 60 cm	60 X 60 X 60 cm
Height of the plant	1.5 m to 2 m	More than 2m	More than 3m

**Table No.7.22.Varieties and species of plants and bushes to be planted on the basis of Major Air Pollutants:**

Major Pollutants	Varieties of Trees	Varieties of Bushes	Varieties of Grasses
Particulate Matter	Cassia siamea, Siris, Chitwan, Kadamb, Neem, Sheesham, Mahua, Amaltas, Ficus	Kadi Patta, Croton, Tecoma stans, Cassia glauca, Dhak	Beard Grass, Bluestem, Buffalo Grass, Anjan. Birdwood Grass, Durwa Grass(Bermuda Grass), Guriya Grass
Sulphur oxides	Siris, Arroo, Chitwan, Kadamb, Neem, Bamboo, Mahuli, Semal, Mahua,	Amla, Dhak, Subabool, Lantana camara	Beard Grass, Bluestem, Buffalo Grass, Anjan. Birdwood Grass, Durwa Grass(Bermuda Grass),

	Tamarind, Ficus		Guriya Grass
Nitrogen oxides	Chilbil, Mangifera indica, Siris, Mahua, Jamun, Neem, Sheesham	Mahuli, Subabool, Dhak, Lantana, Camara	Beard Grass, Bluestem, Buffalo Grass, Anjan. Birdwood Grass, Durwa Grass (Bermuda Grass), Guriya Grass

**g. Operation Model for Plantation Species Matrix:**

To develop a plantation matrix various characteristics of plant species are taken into considerations like tolerance factor, ecologically compatible, growth rate of plant species, canopy surface area, leaf area, stomatal index, canopy shape, flowering seasonality and utility etc. as per the geographical features of the cluster of all mine lease sites and score obtained by varieties of species of trees and bushes naturally found in that region. The species which scored high are preferred over the species scored less for the plantation to curb air pollution.

**Table No. 7.23. Matrix for plant selection.**

S.No.	Characteristic	Score	Remarks
1.	Tolerance/stressed	1/0	Any species which have shown tolerance for primary pollutants of vehicular emission will be rated tolerant and given a fixed score of 1 mark and sensitive species are given 0 mark.
2.		1/0.5/0	Evergreen tree/shrubs have been given 1 marks, semi deciduous have been given 0.5 marks and deciduous have got 0 mark.
3.	Growth rate	1/0.5/0	Growth rate of trees/ shrubs have been classified in to three categories. Fast- 1 mark for the trees which grow in a very short span of time. Quick 0.5 mark for the trees which grow in a very short span of time. Slow-0 mark for the trees which grow in a very short span of time.
4.	Canopy surface	1	Trees/ shrubs with highest canopy surface have been given 1 mark and

			others have been rated relative to the tree /shrubs with highest CS.
5.	Leaf area	1	Trees/ shrubs with highest leaf area have been given 1 mark and others have been rated relative to the tree /shrubs with highest LA.
6.	Stomatal index.	1	Trees/ shrubs with highest stomatal index have been given 1 mark and others have been rated relative to the tree /shrubs with highest SI.
7.	Canopy shape- Spreading/Round /oblong/Flat crown/Conical	1/0.75/0.5/0.25/0	Spreading-1 mark Round -0.75 mark Oblong-0.5 mark Flat crown-0.25 mark Conical-0 mark
8.	Flowering seasonality	0.5	Tree/shrubs having the round year flowering season have been given 0.5 marks and others have been rated relative to them.
9.	Utility	1	Trees with highest recorded uses have been given 1 mark and others have been rated relative to the tree /shrubs with highest uses.
10.	Total	8.5	

**Table No.7.24 Suitability of plant species for plantation throughout the country.**

Scientific name	Comman name	Type	Stressed/ Tolerent	Growth rate	Evergreen/ Deciduous	Score
<i>Azadirachta indica</i>	Neem	Tree	Tolerent	Quick	Evergreen	5.71
<i>Tamarindus indica</i>	Tamarind	Tree	Tolerent	Quick	Evergreen	5.46
<i>Cocos nucifera</i>	Coconut	Tree	Tolerent	Slow	Evergreen	5.1
<i>Bombusa arundinacia</i>	Bomboo	Tree	Tolerent	Fast	Evergreen	4.92
<i>Ficus benghalensis</i>	Banyan	Tree	Tolerent	Quick	Evergreen	4.79
<i>Zizyphus marutiana</i>	Ber	Tree	Tolerent	Quick	Evergreen	4.71
<i>Caesalpinia pulcherrima</i>	White gold mahur	Tree	Tolerent	Quick	Evergreen	4.56
<i>Trema orientalis</i>	Charcoal	Tree	Tolerent	Quick	Evergreen	4.53
<i>Alstonia scholaris</i>	Devil tree	Tree	Tolerent	Quick	Evergreen	4.51
<i>Peitophorum pterocarpum</i>	Copper pod tree	Tree	Tolerent	Quick	Evergreen	4.45
<i>Samanea saman</i>	Rain tree	Tree	Tolerent	Quick	Evergreen	4.45
<i>Duranta repens</i>	Duranta	Tree	Tolerent	Quick	Evergreen	4.4

<i>Anonasquamosa</i>	Custard Apple	Tree	Tolerent	Fast	Evergreen	4.4
<i>Dendrocalamusstrictus</i>	Lathi bans	Shrubs	Tolerent	Fast	Evergreen	4.4
<i>Thespesiapopulnea</i>	Umbrella tree	Tree	Tolerent	Quick	Evergreen	4.39
<i>Cassia siamea</i>	Iron wood tree	Tree	Tolerent	Fast	Evergreen	4.37
<i>Anthocephaluschinensis</i>	Kadam	Tree	Tolerent	Fast	Deciduous	4.34
<i>Prosopiscineraris</i>	Khejari	Tree	Tolerent	Quick	Evergreen	4.32
<i>Acacia nilotica</i>	Babul	Tree	Tolerent	Quick	Evergreen	4.29

**h. Recommended Species for Various Soil Types:**

Uttar Pradesh is the fourth largest state of the country and is been drained by one of the major river of India Ganga and its biggest tributary Yamuna and several other distributaries. Hence, across the state all along the rivers sediment gets deposited according the flow of the river which somehow defines the soil of that region. Selection of suitable plant species for the plantation on haul routes, river bank protection and also in the transition region between Khadar and Bangar region is the key of successful plantation programme. Given below are the few species suitable for plantation according the soil types found in that region.

**Table No.25 Suitable species for different soil types.**

<b>Soil Type</b>	<b>Suitable Species</b>
Clay Soil	Azadirachataindica, Pongamiapinnata, Swieteniamahagoni, Pterocarpusmarsupium, Terminaliatomentosa, Meliadubia, Delbergialatifolia, Delbergiasissoo
Red soil with 10 ft minimum soil depth	Swieteniamahagoni, Pterocarpusmarsupium, Terminaliatomentosa, Meliadubia, Delbergialatifolia, Azadirachataindica, Pongamiapinnata, Ailanthus exceisa
Red soil with 5 ft minimum soil depth	Tectonagrandis, Swieteniamahagoni, Santalum album, Pterocarpusmarsupium, Delbergialatifolia, Azadirachataindica, Meliadubia, Ailanthus exceisa
Alluvial soil	Tectonagrandis, Swieteniamahagoni, Pterocarpusmarsupium, Meliadubia, Delbergialatifolia, Neolamarckiacadamba, Pongamiapinnata
Uncultivable soil	Azadirachataindica, Albezialebeck, Delbergiasissoo, Ailanthus exceisa, Pterocarpussantanalius
	Terminaliaarjuna, Casurinajunghuniana, Pongamiapinnata

Plants experience physiological changes before getting damaged when the leaves are exposed to air pollutants. The tolerant species are preferred over the sensitive species for plantation. To analyze the species, various variables are used like Air Pollution Tolerance Index (APTI) which is based on biochemical parameters, Anticipated Performance Index (API) which is based on biological and socio-economic aspect of a plant. The carbon trapping and dust accumulating potential also varies from species to species.

**Table No. 7.26 APTI score of different trees and their efficacy in Pollution control.**

S.Nos.	Botanical Name	Family	Common Name	APTI	Effective in Control
1.	<i>Cassia siamea</i>	Caesalpinioideae	Kassod tree	10.41	Dust
2.	<i>Albizia lebbek</i>	Fabaceae	Siris tree	15.9	Air pollution
3.	<i>Alstonia scholaris</i>	Apocynaceae	Chitwan tree(Blackboard tree)	6.6	Dust
4.	<i>Neolamarckia cadamba</i>	Rubiaceae	Kadamb tree(Burflower tree)	15.5	Dust
5.	<i>Azadirachta indica</i>	Meliaceae	Neem tree	18.73	Dust, air pollution and Noise pollution
6.	<i>Dalbergia sissoo</i>	Papilionaceae	Sheesham	16.59	Air pollution , noise pollution
7.	<i>Madhuca indica</i>	Sapotaceae	Mahua	22.57	Air pollution
8.	<i>Mangifera indica</i>	Anacardiaceae	Mango	20.80	Air pollution
9.	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Booganbel	20.32	Air pollution
10.	<i>Nerium indicum</i>	Apocynaceae	Kaner	18.94	Air pollution
11.	<i>Ficus benghalensis</i>	Moraceae	Banyan	15.92	Air pollution, noise pollution
12.	<i>Ficus religiosa</i>	Moraceae	Peepal	12.41	Air pollution , noise pollution

**Table No. 7.27 APTI score of different shrubs.**

S.Nos.	Botanical Name	Family	Common Name	APTI
1.	<i>Murraya koenigii</i>	Rutaceae	Kadi Patta	8.47
2.	<i>Codiaeum variegatum</i>	Euphorbiaceae	Croton	10.91
3.	<i>Tecoma stans</i>	Bignoniaceae	Yellow trumpetbush, Yellow Bells(Pilia)	10.60
4.	<i>Cassia glauca</i>	Fabaceae	Scrambled Egg Bush(Pila Amaltas)	8.43
5.	<i>Butea frondosa</i>	Leguminoceae	Dhak	13.40
6.	<i>Phyllanthus emblica</i>	Phyllanthaceae	Amla	40.93
7.	<i>Lantana camara</i>	Verbenaceae	Raimuniya	10.95

**Table No. 7.28 Recommended grass species**

S.Nos.	Botanical Name	Family	Common Name
1.	<i>Polypogon</i>	Poaceae	Beard Grass
2.	<i>Andropogon</i>	Poaceae	Bluestem Grass
3.	<i>Bouteloua dactyloides</i>	Poaceae	Buffalo grass
4.	<i>Pennistum purpureum</i>	Poaceae	Anjan
5.	<i>Cenchrus setiger</i>	Poaceae	Birdwood grass
6.	<i>Cynodon dactylon</i>		Durva(Bermuda grass)

**Table No. 7.29. Plan of plantation for green belt development:**

S. Nos.	Lease Details	Number of saplings to be planted	Description (saplings to be planted for all leases included in Study area-2)
1.	I	3158	First year plantation for all leases included in Study area-2
2.	II	395*	Recurring Plantation to maintain 100% survival rate
3.	III		
4.	IV		
5.	V		

Total Cost of projects included in Cluster = Rs. 3,87,03,27,032\*

Cost for Green Belt Development for five year = Rs. 13,53,34,140

Other Maintenance Charges(Fencing/Tree guards) = Rs. 63,15,400

Annual Irrigation = Rs. 3,25,638

\*(inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which Ec is awaited)

**Table No. 7.30. List of plants, shrubs and herbs found in Bundelkhand Region:**

<b>Bundelkhand Region</b>		
<i>Dillenia indica</i>	<i>Butea superba</i>	<i>Wendlandia heynei</i>
<i>Dillenia pentagyna</i>	<i>Dalbergia lanceolaria</i>	<i>Ardisia solanacea</i>
<i>Milusa tomentosa</i>	<i>Dalbergia sissoo</i>	<i>Madhuca longifolia</i>
<i>Milusa velutina</i>	<i>Erythrina stricta</i>	<i>Diospyros exsculpta</i>
<i>Capparis decidua</i>	<i>Pongamia pinnata</i>	<i>Diospyros malabarica</i>
<i>Cochlospermum religiosum</i>	<i>Pterocarpus marsupium</i>	<i>Diospyros melanoxylon</i>
<i>Casearia graveolens</i>	<i>Bauhinia purpurea</i>	<i>Nyctanthes arbor-tristis</i>
<i>Casearia tomentosa</i>	<i>Bauhinia racemosa</i>	<i>Schrebera swietenoides</i>
<i>Flacourtia indica</i>	<i>Bauhinia variegata</i>	<i>Salvadora oleoides</i>
<i>Tamarix indica</i>	<i>Bauhinia tomentosa</i>	<i>Carissa spinarum</i>
<i>Shorea robusta</i>	<i>Cassia fistula</i>	<i>Holarrhena pubescens</i>
<i>Kydia calycina</i>	<i>Acacia catechu</i>	<i>Wrightia tinctoria</i>
<i>Bombax ceiba</i>	<i>Acacia leucophloea</i>	<i>Calotropis gigantean</i>
<i>Eriolaena hookeriana</i>	<i>Acacia nilotica</i>	<i>Cordia dichotoma</i>
<i>Helicteres isora</i>	<i>Acacia tomentosa</i>	<i>Cordia sinensis</i>
<i>Pterospermum acerifolium</i>	<i>Albizia lebeck</i>	<i>Ehretia laevis</i>
<i>Sterculia urens</i>	<i>Albizia odoratissima</i>	<i>Solanum incanum</i>
<i>Sterculia villosa</i>	<i>Albizia procera</i>	<i>Dolichandrone falcate</i>
<i>Grewia abutilifolia</i>	<i>Dichrostachys cinerea</i>	<i>Millingtonia hortensis</i>
<i>Grewia asiatica</i>	<i>Pithecellobium dulce</i>	<i>Oroxylum indicum</i>
<i>Grewia flavescens</i>	<i>Prosopis cineraria</i>	<i>Pajanelia longifolia</i>
<i>Grewia helicterifolia</i>	<i>Prosopis juliflora</i>	<i>Stereospermum chelonoides</i>
<i>Grewia hirsuta</i>	<i>Anogeissus latifolia</i>	<i>Tecomella undulate</i>

<i>Grewia orbiculata</i>	<i>Terminalia elliptica</i>	<i>Tecoma stans</i>
<i>Grewia tiliifolia</i>	<i>Terminalia arjuna</i>	<i>Clerodendrum phlomidis</i>
<i>Balanites roxburghii</i>	<i>Terminalia bellirica</i>	<i>Gmelina arborea</i>
<i>Murraya koenigii</i>	<i>Terminalia chebula</i>	<i>Premna barbata</i>
<i>Murraya paniculata</i>	<i>Syzygium cumini</i>	<i>Tectona grandis</i>
<i>Ailanthus excelsa</i>	<i>Syzygium heyneanum</i>	<i>Litsea chinensis</i>
<i>Boswellia serrata</i>	<i>Careya arborea</i>	<i>Litsea glutinosa</i>
<i>Azadirachta indica</i>	<i>Lagerstroemia parviflora</i>	<i>Antidesma ghaesembilla</i>
<i>Melia azedarach</i>	<i>Lawsonia inermis</i>	<i>Bridelia retusa</i>
<i>Soymida febrifuga</i>	<i>Alangium salviifolium</i>	<i>Bridelia squamosal</i>
<i>Elaeodendron glaucum</i>	<i>Catunaregam spinosa</i>	<i>Mimusops elengi</i>
<i>Gymnosporia senegalensis</i>	<i>Ceriscoides turgida</i>	<i>Drypetes roxburghii</i>
<i>Ziziphus mauritiana</i>	<i>Gardenia latifolia</i>	<i>Flueggea virosa</i>
<i>Ziziphus rugosa</i>	<i>Haldina cordifolia</i>	<i>Mallotus philippensis</i>
<i>Ziziphus xylopyrus</i>	<i>Hymenodictyon orixense</i>	<i>Trewia nudiflora</i>
<i>Buchanania lanzan</i>	<i>Mitragyna parvifolia</i>	<i>Holoptelea integrifolia</i>
<i>Lannea coromandelica</i>	<i>Morinda pubescens</i>	<i>Trema orientalis</i>
<i>Semecarpus anacardium</i>	<i>Neolamarckia cadamba</i>	<i>Artocarpus lakoocha</i>
<i>Butea monosperma</i>	<i>Tamilnadia uliginosa</i>	<i>Ficus arnottiana</i>
<i>Ficus benghalensis</i>	<i>Ficus racemosa</i>	<i>Ficus rumphii</i>
<i>Ficus hispida</i>	<i>Ficus religiosa</i>	<i>Ficus tomentosa</i>
<i>Ficus virens</i>	<i>Streblus asper</i>	

**i. Recommended species for haulage route plantation:**

The species of shrubs & bushes recommended for plantation at on haulage route have the high dust tolerant tendency, fast growing and heavy canopy. List of the recommended species of shrubs are given below:

**Table No.7.31 List recommended species for haulage route plantation**

S.Nos.	Botanical Name	Family	Common Name	APTI
1.	<i>Tecoma stans</i>	Bignoniaceae	Yellow trumpetbush, Yellow Bells(Pilia)	10.60
2.	<i>Butea frondosa</i>	Leguminoceae	Dhak	13.40
3.	<i>Phyllanthus emblica</i>	Phyllanthaceae	Amla	40.93
4.	<i>Lantana camara</i>	Verbenaceae	Raimuniya	10.95

**Table No. 7.32. Recommended species for River bank protection:**

Species of grasses recommended for plantation on river bank for its protection have the dense root system which binds the soil of the river banks. List of the recommended species of trees are given below:

S.No.	Botanical Name	Family	Common Name
1.	<i>Polypogon monspeliensis</i>	Poaceae	Beard Grass
2.	<i>Andropogon geradi</i>	Poaceae	Bluestem Grass
3.	<i>Bouteloua dactyloides</i>	Poaceae	Buffalo grass
4.	<i>Pennistenum purpureum</i>	Poaceae	Anjan
5.	<i>Cenchrus setiger</i>	Poaceae	Birdwood grass
6.	<i>Cynodon dactylon</i>	Poaceae	Durva(Bermuda grass)

**Table No. 7.33. Recommended species for downwind wind direction:**

The species of trees recommended for plantation at the places or villages situated in the downwind direction of the wind blow have the highest APTI, which indicates that they are highly tolerant to dust and air pollutants. List of the recommended species of trees are given below:

S.Nos.	Botanical Name	Family	Common Name	APTI
1.	<i>Azadirachta indica</i>	Meliaceae	Neem tree	18.73
2.	<i>Madhuca indica</i>	Sapotaceae	Mahua	22.57
3.	<i>Mangifera indica</i>	Anacardiaceae	Mango	20.80

4.	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Booganbel	20.32
5.	<i>Nerium indicum</i>	Apocynaceae	Kaner	18.94

## CHAPTER VIII

S. NO.	CONTENTS
8.1	BENEFITS OF SUSTAINABLE/SCIENTIFIC MINING
8.2	ROAD MAINTAINANCE
8.3	EMPLOYMENT POTENTIAL- SKILLED, SEMISKILLED AND UNSKILLED
8.4	ECONOMICAL BENEFITS
8.5	POSITIVE ASPECTS OF MINING
8.6	SUMMARY

# PROJECT BENEFITS

Nature has given us morrum as a natural resource. The man has to use it wisely for the larger benefit of the society and sustainable development. The extraction of minerals not only provides the building materials but also generate employment to the locals engaged directly in extraction of morrum as well as indirectly transportation and sale of mineral. It also earns huge sum of revenue in the form of mineral royalty for the State Exchequer.

### 8.1 BENEFITS OF SUSTAINABLE/SCIENTIFIC MINING

- Channelize and maintain the natural course of River
- Protection of banks
- Reducing excessive sedimentation
- Maintains and controls the natural flow or river.
- Generates employment opportunity
- Revenue generation to Government.
- Improves the socio-economic condition and add beautification

- Prevent natural hazards i.e. flooding, bank erosion, subsidence etc.
- Prevention of Illegal Mining

### **8.1.1 Environmental Benefits**

- a It controls river bank erosion by deepening of river channel, thus prevents flooding and other natural hazards.
- b It helps in Regeneration & Establishment of Pioneer Species like Shisham & Khair on the banks of rivers besides saving agricultural land & land cutting.
- c It regulates & maintains the existing course of the river, and improves the water holding capacity of channels.

### **8.1.2 Improvement in physical infrastructure**

Mining and agriculture are the only industries from which the mankind receives directly. In the fast growing economics of vibrant India, both the sectors play important role, one in developing infrastructure and the other in maintaining food securities. Morrum is an integral part of soil. When present in common in right proportions it imparts favourable properties and improves soil productivity. Similarly, morrum is an important aggregate used in bulk in construction industry. Beginning 21<sup>st</sup> century, India is witnessing a spurt in infrastructure sector. Construction of high rise group housing and commercial complexes, growth of new private townships, lanes to highways, expressways, flyovers, and bridges, modernization of airports, metros, game villages, stadiums and construction of abodes by ordinary people has given ample impetus for mining. Rivers are the major sources of morrum as they replenish themselves every year during monsoons.

### **8.1.3 Improvement in social infrastructure**

Nearby villages shall be benefited in several ways like, protected water supply, basic health camps, improved infrastructure facilities, employment opportunities etc., besides enhancing the local economy through the benefits from the project activities and personnel.

### **b. CER activities**

- Various Project proponents will implement various activities taking into account the local conditions after consultation with local administration. The indicative activities which can be undertaken by a company under CER.
- Various Project proponents will implement its CER activities through the following methods:
  1. Directly on its own
  2. Through its own non-profit foundation set- up so as to facilitate this initiative
  3. Through independently registered non-profit organisations that have a record of at least three years in similar such related activities
  4. Collaborating or pooling their resources with other companies
- Various activities which will be taken into the CER activities may include:
  - Eradicating hunger and poverty;
  - Promoting education;
  - Promotion of gender equality and women empowerment;
  - Reduction of child mortality and improving maternal health;
  - Combating HIV/AIDS malaria and other diseases;
  - Ensuring environmental sustainability;
  - Vocational skills development for enhancing employment;
  - Social business projects;
  - Contributing to the PM's National Relief Fund,
  - Development of funds for the welfare of the SCs/STs, OBCs, minorities and women

## **8.2. ROAD MAINTAINANCE**

Access roads are maintained during the period of time they are required. The level of maintenance on an access road varies depending on its use at any given time. For example,

during wood extraction operations, when numerous heavily loaded trucks are using a road, it is maintained to keep the riding surface very smooth. Later, if the road is no longer used for timber management, the road use may change. It can either be maintained at minimal levels for light recreational and other traffic uses. The operations carried out for road maintenance can be broken into two main groups: routine and non-routine. Routine operations include those day-to-day activities necessary to maintain the road for the traffic using it. These may include grading and the maintenance of drainage by cleaning out blocked ditches and culverts. Non-routine maintenance includes major repairs and restoration. Since roads gradually deteriorate with time, there is a periodic need to restore the condition of roads serving a long-term need. These roads may require major maintenance or re-construction to restore their original condition every ten to twenty years. Example operations falling into this category include: brush control with mechanical and chemical methods; replacement of gravel surfacing material; repair of major flood damage, and, replacement of substandard bridges. Remove roadside vegetation that shades the road, for safety (visibility) and for drying of the road. In erodible soils, do not expose the mineral soil during the brushing operation. Special mitigative techniques such as sediment traps and check dams should receive regular maintenance as long as they are needed.

### **8.2.1 Construction of motarable roads**

The construction of access roads will cause significant disturbance to the natural environment, if not properly maintained. Construction of access road activities will be subdivided into a series of operations that take place in a chronological sequence. Using this sequence, the good practices have been grouped into the following components:

- ***Road planning and location***- This phase comprises finalization of route that will have the minimal environmental and social effect. the preconstruction components of the route study, road location and road design. The level of technical evaluation, layout and design required on a particular road depends on the geometric standard, the terrain through which the road will be built and the method of construction. At this stage, the final route is selected. Decisions about the location of a particular road have an important influence on the impact the road will have on the natural environment. For environmental as well as practical considerations, road alignments will follow the contours of the land. Gentle grades (1-4%) for proper drainage and economical construction will be taken into

consideration • Construction of a road to a higher standard than necessary increases costs and has the potential for more environmental damage. Landings, loading areas and turnarounds will be located when the road is being laid out

- **A clearing-** To avoid any vegetation clearing the existing haulage route. If the need arise the normal practice will be to specify a minimum width of clearing. This will be done for several reasons: to allow space for construction equipment to operate without knocking down standing trees; to provide safe sight lines around curves; and, to allow drying of the roadway in wet weather and spring break-up. Maximum widths should also be specified to minimize the areal extent of disturbance caused by road construction. However in the study area clearing is not required as path for haulage route is already decided.

- **Grubbing-** Grubbing, or stripping, consists of the removal and disposal of stumps, roots, brush, small trees, embedded logs and organic material overlying the mineral soil. Grubbing is done to expose the mineral soil for three reasons: • To prepare for earth grading operations. • To improve roadway performance by eliminating weak organic material in the zone carrying wheel loads; and • To minimize future sight distance problems that roadside vegetation could cause.

- **Earth Grading-** Earth grading reshapes the original ground contours to the shape of the road, in profile and cross-section. The operation includes the excavation of earth cuts and the construction of earth fills. Lower standard roads tend to follow the original ground contours more closely, because their geometric requirements are less critical; this means that cut and fill depths will be less than those for a higher- standard road constructed along the same route.

- **Graveling-** This operation refers to the placing of sand and gravel materials to form the structural road sub-base and surface that supports the wheel loads. A sand cushion may be used as a sub-base under the gravel surface if the underlying earth cut or fill materials are poor and of low strength. The operation generally involves importing select material from a gravel pit nearby. The equipment normally used includes front-end loaders, dump trucks, bulldozers, graders and back- hoes. Occasionally, crushing units, compaction equipment and water trucks are also used.

- **Road Maintenance-** Access roads are maintained during the period of time they are required. The level of maintenance on an access road varies depending on its use at any given time. For example, during wood extraction operations, when numerous heavily loaded trucks are using a road, it is maintained to keep the riding surface very smooth.

- **Road Abandonment-** Physical Abandonment occurs when there is a deliberate act to render a road unusable by vehicular traffic. Physical abandonment could include taking steps which will minimize the environmental impacts of non-maintenance. Natural Abandonment occurs when road maintenance has ceased, yet steps are not taken to prevent the use of the road by vehicles. With natural abandonment, no physical changes are made to the road.

### **8.3 EMPLOYMENT POTENTIAL- SKILLED, SEMISKILLED AND UNSKILLED**

Morrum mining and agriculture is the basic sector of employment for the local people in this area. This project will lead to indirect employment opportunity. Employment is expected during morrum excavation, morrum transportation, in trade and other ancillary services. Employment in these sectors will be primarily temporary or contractual and involvement of unskilled labour will be more. A major part of this labour force will be mainly from local villagers who are expected to engage themselves both in agriculture and project activities. This will enhance their income and lead to overall economic growth of the area.

### **8.4 ECONOMIC BENEFITS**

- Extraction of minerals provides the building materials.
- Generates employment to the locals engaged directly in extraction of morrum as well as indirectly transportation and sale of mineral.
- Earns huge sum of revenue in the form of mineral royalty or dead rent for the State Exchequer.

### **8.5 Positive Aspects of Mining**

- **Employment generation** Any mine in the area creat opportunities for employment. Besides of direct employment in mine, satellite occupation in

surrounding areas flourish at the time of mining operations. As a part of the social responsibilities mine owners provide vocational training in various streams, training for rural enterprises, self help group , alternative livlyhood opportunity project and income generation programme for women.

- **Afforestation** During and/or post mining operations is the major and most common after-use sanctioned through reclamation. Where specific usefulness of land could be decided, afforestation is normally planned through the site could have been considered for better possibilities of land use.
- **Agriculture** Some form of agricultural use may be possible in sites that are adjacent to farmland provided the soil and topography are favorable. Agricultural and horticultural crops can be grown in a variety of materials. The range of possibilities include arable cropping, grazing in either productive low land or over upland pasture. The only constraint apart from the site is that there must be some integration into the local rural agricultural pattern. But it would be inappropriate to establish pasture in an area of arable cropping, even though the grazed pasture would recreate the soil structure more rapidly.
- **Housing and Industry** Many quarries specially of building materials are the basis of development for residential accommodation, infrastructure and industrial activities.

Sl. No.	Project/ Owner	Village/ Tehsil/ District	Total Project Cost (Rs.)	CER Cost (Rs.) (2% of Total Project Cost)
1.	M/s Shri Kanha Construction Company	Bhedi Kharka, Sarila, Hamirpur	10,45,87,156/-	20,91,743/-
2.	M/s Baba Bholenath Traders	Beri, Sadar, Hamirpur	10,89,79,456/-	21,79,589/-
3.	M/s D. V. Construction	Tikapur, Maudaha, Hamirpur	15,37,15,450/-	30,74,309/-
4.	M/s Pehalwan Traders	Bhedi Kharka, Sarila, Hamirpur	10,47,52,156/-	20,95,043/-

5.	M/s Balaji Enterprises	Bhedi Kharka, Sarila, Hamirpur	10,25,90,656/-	20,51,813/-
6.	M/s Bindu and Ram Construction Company	Bhedi Khurd, Kalpi, Jalaun	13,41,49,333/-	26,82,987/-
7.	M/s Indus Mines and Minerals	Ramedi, Sadar, Hamirpur	12,93,81,130/-	25,87,623/-
8.	M/s Smt. Kaushilya Chobey Contractor	Sahjana, Sadar, Hamirpur	9,47,54,764/-	18,95,095/-
9.	M/s Rama Traders	Kandaur, Sadar, Hamirpur	13,71,58,058/-	27,43,161/-
10.	M/s Eureka Mines and Minerals LLP	Pathreta, Kalpi, Jalaun	13,49,06,666/-	26,98,133/-
11.	M/s Harihar Minerals LLP	Bhedi Kharka, Sarila, Hamirpur	10,30,85,656/-	20,61,713/-

## 8.6 SUMMARY

The in situ mining activity in any area is on one hand bring revenue and employment (Primary and secondary) and on other hand if not done properly potential pollution and ecological imbalance increases. The ability of the ecosystem to fix nitrogen can also be reduced. Particulate matter transported by the wind as a result of excavations, blasting, transportation of materials, wind erosion (more frequent in open-pit mining), fugitive dust from tailings facilities, stockpiles, waste dumps, and haul roads. Exhaust emissions from mobile sources (cars, trucks, heavy equipment) raise these particulate levels; and Gas emissions from the combustion of fuels in stationary and mobile sources, explosions, and mineral processing. The direct impact of activities will be from mining and transportation. The indirect impacts comprises adjacent areas affected through mining activities and changes in the landscape that can propagate ecological changes for various distances; this includes such items as fragmentation, changes in forest type within the direct effect, changes in wildlife migration and habitat use patterns, noise, light, windblown dust, dispersal of invasive species established on the mine site, and watershed areas affected by water withdrawals and mine drainage. Mining will directly

displace forests and potentially change the composition of any forest. Certain species require large tracts of unfragmented forest, Wildlife species living within the primary mining footprint would be directly displaced, due to loss of forest and other vegetation. Employment generation and social upliftment along strengthened infrastructure will be the beneficial aspects. The mining activity along with precaution and mitigation measure will be beneficial.

## CHAPTER-IX

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9.6	COST BENEFIT ANALYSIS OF THE PROJECTS IN THE STUDY AREA:

# ENVIRONMENTAL COST BENEFIT ANALYSIS

## 9.1 INTRODUCTION

Since sand/ morrum are the basic requirements in construction industry and due to the recent boom in the sector, indiscriminate river sand mining has created a number of environmental and social problems. Within this context, this chapter attempts to identify environmentally safe options for sustainable river sand mining that minimize environmental degradation while meeting the requirements of the construction industry and local people. It is essential to have a cost benefit impact analysis of a project. It lies in a range of project and plan appraisal methods that seek to apply monetary value to cost and benefits. It is more compressive in scope. It takes long view of the project (further as well as nearer future) and a wide view (in the sense of allowing for side effect). It is the comparison of any positive or negative changes in the value of mine environment amenities with costs (or benefits) of implementing the proposed change. It is based in welfare, economics and seeks to include all the relevant cost and benefits to evaluate the net social benefits of a project. In proposal for de-reservation or diversion of forest use, it is essential that ecological and environmental losses and sufferance cause to the people, who are displaced are weighted against the economic and social gain. It contains simply the work necessary to present a decision taken with the information, which require in order to make a decision.

### 9.1.1 General Application of Costs-Benefits Analysis

1. In calculation of environmental impact of a proposed mining activity
2. In transportation
3. In evaluating alternative planning policy,
4. In optimum allocation of resource to activities,
5. In water resource planning,

### **9.1.2 Types of Impact of Mining**

Three distinctive process of mining can be isolated as causative agents of environmental deterioration. Possible impacts may be siltation, impact on aquiflora and aquifauna, siltation, change in flow and current pattern, alteration of the sand budget, change in erosion and deposition rates, change in ground water level. Loading process may creates clouds or plumes of sand. A bottom plume will be created at the point of excavation and asurface plume will be created from the loading itself.

### **9.1.3 Benefits of Mining**

#### ***Methodology***

There are various methodologies to calculate the CBA

- Project definition
- Identification
- Enumeration of cost and benefits
- Evaluation of cost and benefits
- Discounting and presentation of result

Cost - benefit analysis typically involves reducing an innumerable of com-plex physical and social-economic variable to simple, quantifiable categories of costs and benefits.

The mine environment can be structured in several ways- include components, scale, space and time. A narrow definition of mine environmental component would focus primarily on all media susceptible to mine pollution, including air, water, soil; flora and fauna, and human being; landscape, urban and rural conservation and the built heritage.

The net benefits of sand mining are analyzed from a social (cost-benefit analysis) and a private (financial analysis) perspective. Sand mining of the riverbeds has huge social and environment impacts on the rivers and communities depending on the rivers.

One of the most important concepts in residual management is costs and benefits involvement in term of mine environmental pollution and waste minimization. Proper decision making involves a comparison of total project cost and benefit in order to choose an alternative that returns the appropriate benefit for the least cost, thereby allocating resources in the most efficient way. The ultimate goal of residual management is to provide the level of protection necessary for the prevention of significant damage to ecological and social system at a minimum cost.

Pollution because development cannot took place free of cost. However, as sharply minimize the losses of crops and forests, improve the life system etc. It reduces protection cost of buildings attested by pollutant; minimize expenditure on imports of energy and raw materials. Mine environmental quality controls can offer more suitable benefits. Mine Environmental controls reduce the need for defensive products, such as medical care health and life insurance burglar alarms and soon by improving the health and living condition of the general populate. The economic, health, physical, and social benefits of mine environmental quality controls clearly outweigh the costs. In true economics sense, mine environmental controls provide a valuable service to citizens by promoting health, safety, welfare, peace, and permanence.

After the system's capacity to assimilate mine pollution has been exceeded. The cost benefit analysis is a useful tool to predict the damage caused by the mining in term of its impact of cost which can help management to take precautionary measure to minimize the damage and reduce the cost. It will heavily reduce the costs of health service, improved productivity, minimize the losses of crops and forests, improve the life system etc. It reduce s protection cost of buildings attested by pollutant, minimize expenditure on imports of energy and raw materials. Mine environmental quality controls can offer more suitable benefits. Mine Environmental controls reduce the need for defensive products, such as medical care health and life insurance burglar alarms and soon by improving the health and living condition of the general populate. The economic, health, physical, and social benefits of mine environmental quality controls clearly outweigh the

costs. In true economics sense, mine environmental controls provide a valuable service to citizens by promoting health, safety, welfare, peace, and permanence. The cost benefit analysis is a useful tool to predict the damage caused by the mining in term of its impact of cost which can help management to take precautionary measure to minimize the damage and reduce the cost. It will heavily reduce the costs of health service, improved productivity,

#### **9.1.4 Environmental cost-benefit analysis at regional level**

The specific purpose of the CBA is to express measures of impact from a plan on environmental quality. Beneficial effects from a plans implementation may be a result of management, preservation and restoration etc under regional development. It will provide regional concerns resulting from environmental activities in a given area. Imqapct of regional nature are divided into two separate sub accounts, Regional development and social well being. Regional development in turn is partitioned into five categories of effects:

1. Regional income
2. Regional employment
3. Population distribution
4. Regional economic base and stability
5. Regional environmental

#### **9.2 ANALYSIS OF PROJECT COMPONENTS (ECONOMIC AND FINANCIAL ANALYSIS)**

An **Economic analysis** is conducted from the perspective of the community as a whole. It focuses on “real” resource costs and benefits, including any “external” environmental costs and benefits that affect the broader community.

In **Financial analysis**, from a private perspective, similar concepts apply as in the economic analysis, but the benefits and costs are estimated in terms of the financial benefits received and costs borne by private producers. Because the financial analysis focused only on the project proponent’s private financial prospects and did not take into account externalities or external environmental costs, it is inadequate in determining the efficiency of resource allocation.

## **9.3 QUANTITATIVE ANALYSIS**

**9.3.1 Financial analysis:** The total profit per year that a project proponent can receive from sand mining is calculated as follows:

Total Profit = Unit Profit x Sand Extract Volume

Unit Profit = Market Value of 100 m<sup>3</sup> of Extracted Sand – Total Costs of Extraction of 100 m<sup>3</sup>

The market value of sand was calculated based on the market price of sand; the cost of sand extraction includes cost of labour, fuels, equipment depreciation, and other costs.

However some measure cost components are

- 1. Cost of Labour**
  - a Unskilled
  - b Semi skilled
- 2. Cost of Equipments**
  - a **Scraping and Loading**
    - i Bar scraper and Light Earth Mover
    - ii Fuel and Contingency Charges
    - iii Manual Hand equipments
- 3. Environment Management Plan (EMP)**
  - Plantation**
    - a No of plants
    - Tree Guard
    - Water Demand for plantation
  - b Air Pollution Control**
    - Sprinkling on haulage route for dust suppression
  - c Environmental Monitoring**
- 4. Site Services**
  - a Portable toilets
  - b PPE for Health and Safety of labours
  - c Drinking water for site workers

## 5. Miscellaneous

Site Development (Pole Marking, soil & debris

- a removal etc.)
- b Training and Awareness Camps for labours
- c River bank plantation
- d Channel flow conservation (Hume pipe)
- e Road maintainance
- f Installation of waste water treatment.

Above components will include for the Total Cost of project. Suppose this cost is 'X' for current production 'P' per annum.

Now equation is -

Production P per annum = Rs. X

So, cost of production per cum = Rs. X/ P

Now, Selling Cost per cum = Rs. S

(which can be calculated on the basis of Cost per truck, say it 15 cum)

We can clearly compare the values of S & X

**9.3.2 Economic analysis:** The net benefit that a society receives from sand mining was calculated as follows:

$$NPV = \sum_{i=0}^n \frac{Bi - Ci}{(1+r)^i}$$

Where *NPV* is net social benefit from sand mining;

*Bi* is the financial benefits of sand mining for society through the years;

*Ci* is the cost of sand mining through the years, including the financial cost (cost of labour, fuel, and equipment that the dredgers have to pay), external costs of riverbank erosion, dike breakage and degradation, agricultural loss, and aqua-resource degradation; and *r* is the discount rate.

## **9.4 QUALITATIVE ANALYSIS**

The analysis is expected to show if the external cost of current sand mining does outweigh the combined gains/profits of all the individuals involved in sand mining. It is out of the scope of the report to quantify the Environmental Cost Benefits resulting from the proposed mining activity, thus a general quantitative description is discussed as under:

### **9.4. 1. Environmental Costs**

Expenditures incurred to prevent, contain, mitigate or remove environmental contamination throughout the life cycle of a product or an activity. These costs include remediation or restoration costs, waste management costs or other compliance and environmental management costs. The various environmental costs identified, qualitatively for the proposed sand / morrum mining in riverbed are:

- On-site effects such as the erosion of riverbanks
- Lowering of water tables in the adjoining areas
- Dust and air pollution due to fugitive air emissions of free silica
- Noise pollution due to movement of heavy machinery and transporting vehicles
- Riverbank erosion, soil quality deterioration due to movement of heavy vehicles
- Spillage of diesel oil from machines and vehicles, which may pollute the soil and may leach to pollute the ground water.
- Damage to Riparian biodiversity
- Reduced vegetative bank cover.
- Loss of habitat of the aquatic population
- Alteration of flow patterns due to the modification of riverbeds, overloading of suspended sediment
- Damage to the channel beds due to the use of heavy equipment
- Disturbance of the natural hydrology of the riparian zone because of infrequent elevated flow levels

- Drying up of irrigation channels, thus reduced flooding of paddy fields with nutrient-laden water
- Presence of water puddles in lease vicinity and haulage road, thus increase in mosquito-related health problems
- Breakout of epidemics leading to loss of life. Expenditure on control of these breakouts, vaccines, medicines, scientific research and quarantining the area.
- Off-site effects include the impairment of rural roads, causing damage to the road infrastructure due to heavy loads carried on weak rural roads.

Sand mining is a global activity in both developed and developing countries. Exploiting sand from different sources has both multiple benefits (poverty reduction, economic growth, new habitats for plants and animals, new water reservoirs are created, and a series of negative impacts on the environment. Based on the studies, several factors must be taken into account when the environmental impact of sand mining is analyzed:

- location of sand mine;
- size of mining area;
- time of exploitation;
- secondary mineralogy;
- habitats and vegetation diversity across the mining area; and
- Technical conditions for exploitation.

#### **9.4.2 Environmental Benefits**

Expenditures saved on safeguard, management or upkeep of environment, through direct or indirect practices, implemented during the course of life cycle of a product or an activity. In the case of sand mining for the Proposed Sand / Morrums mining projects the environmental benefits are:

The proposition is to mine morrums from the riverbeds to cater to the increasing demands of the construction industry. This can help desilt the riverbeds that have been silted up over the years. This in turn has a number of benefits:

- Prevention of floods due to channelization of river. Restoring of banks and safety, if and when undertaken, will cost in crores to Govt.
- Prevention of losses due to flooding.
- Prevention of Loss of life

- Prevention of Loss of homes or other items of utility
- Prevention of Agricultural losses
- Prevention of loss of cattle and aquatic resources.

### **1. Prevention of Change of Course of river**

As the yearly deposition of morrum is excavated, the change in course of river, which might have occurred in absence of such extraction, is prevented. It thus has following benefits:

- Continual use of infrastructure along the course of the river such as bridges, dams, hydro-electric power plants, sewer lines, purification units or other industrial units.
- Continued access to river resources to those dependent on it, involving activities like fishing, washing, fisheries unit and other associated industries such as freezing units etc.
- Natural irrigation through canals, along the agricultural field, orchards along the river course.

### **2. Social Benefits and Associated Environmental Benefits**

The proposed mining will generate revenue for the government and for the lease holder. It will generate direct employment for almost 800 people, who will work as manual labours on site. Employment will also be generated for machine operators and truck drivers. The benefits of these are as:

- Generation of employment, thus improvement in life style and increase in standard of living.
- Paradigm shift from environment polluting activities such as burning of woods or coal to cleaner or less polluting fuels such as LPG or electricity, resulting in reduced dust, smoke and GHG emissions.
- Education of masses instils the importance and need of preservation of environment, which in long run, will improve the environmental conditions.
- Revenue generation to Government gives them the opportunity to carry out researches on new improved scientific methods for environmental preservation and sustainable development.

**Table No. 9.1: Qualitative Environment Cost Benefit Analysis of Mining in Different Scenarios**

S. No.	Evaluation Criteria	Complete ban	Restrict/access to vulnerable sites	Make allowance For environmental trust fund	Illegal Mining	Introduce community based sand mining
<b>A</b>	<b>Social</b>					
1	Effect on livelihood	--	0	+	++	++
2	Effect on health	++	++	+	--	+
3	Loss of residences	-	+	+	+	0
4	Water for cattle rearing	+	+	+	-	+
5	Loss of domestic utility water	++	++	+	-	+
6	Pollution of drinking water	+	+	+	-	0
<b>B</b>	<b>Economic</b>					
7	Cost of repairing infrastructure	++	+++	+	-	0
8	Effect on crop production	+	++	0	-	++
9	Income of	---	--	-	++	0

	mine owners					
10	Income of labourers	---	--	0	++	+
11	Income of sand transporters	---	--	0	++	0
12	Income of building material suppliers (alternatives to sand)	+++	++	0	-	0
13	Income of building material suppliers (except alternatives to sand)	---	-	0	+++	-
14	Cost of river bank conservation	++	+	+	-	0
15	Effect on inland fisheries	++	+	0	-	0
16	Price of sand	--	-	0	++	0
<b>C</b>	<b>Environmental</b>					
17	Loss of biodiversity	++	++	+	--	0
18	Loss of riverine	++	++	+	--	0

	vegetation					
19	Decline in ground water levels	0	++	0	-	0
20	Imbalance In the natural flow system of rivers	--	+	+	-	0
21	Quality of soil	++	++	0	-	0
<b>D</b>	<b>Technical</b>					
22	Use of technology	0	0	--	-	+
23	Scale of mining	++	++	--	-	+

### 9.5 INFERENCE

The analysis done for study area indicates the balance in favour of Environmental Benefits. That is to say, the financial expenditures incurred in preventing, containing, mitigating or removing environmental contaminations occurring as a result of the proposed mining activity are superseded by the expenditures saved (on environment, both short and long term) as a result of project activity.

### 9.6 COST BENEFIT ANALYSIS OF THE PROJECTS IN THE STUDY AREA:

The expenditure here will include relevant operation, maintenance and replacement costs. So far no other activities are recorded from the river stretch of project area. The specific purpose of the CBA is to express measure of impact from an activity. Beneficial effects from a plans implementation may be result of management, preservation, restoration etc. Regional income appears similar to that of national economic development. It represents a scheduled influx of money in form of salaries of locally employed people for next five years. This would be regardless of the alternative eventually employed persons. As adverse effect the cost of scrapping is taken in to

consideration. The stretch is not used for fish catch or navigation, so adverse effect will be limited to cost of scrapping only. The amount (DMF + taxes + CER) funded by the government and project proponents when utilized on regional basis will create a positive scenario.

**Table No. 9.2.- Beneficial and adverse effects : *Regional development***

S.No.	Componenets	Measures of Effects
<b>1. Regional Income</b>		
Beneficial Effects		
a.	Value of Sand produced	It may vary from place to place
b.	External components (Other river based activities like fishing)	Nil
Adverse Effects		
a.	Cost of Excavation	Cost of labour and machines project wise given in chapter 2a.
b.	Additional cost	
c.	Lack of other activities	Nil
Total Net benefit		
<b>2. Regional Employment</b>		
Beneficial Effects		
a.	Increase in number of employed person (Direct and Indirect)	<b>Almost 8200</b>
Adverse Effects		
b.	None	-
Total Net benefit		
<b>3. Population Distribution</b>		
a.	Beneficial and adverse Effects	Incoming of people for satellite ioccupation can deplete the livelihood

		resources.
	Total Net benefit	None
<b>4. Regional Economic Base and Stability</b>		
	Beneficial Effects	<b>Yes</b>
a.	Provide a source of Economic stability and economic diversification.	
b.	Provide for regional mining capability	<b>Yes</b>
	Total Net benefit	
<b>5. Regional Environmental Concerns</b>		
	Adverse Effects	
a.	Areas of natural beauty	Visual impacts from mining
b.	Natural resources and ecological systems	Impact on aquiflora and aquifauna, Impact of fugitive emission from loading sites, Impact of tailpipe emission.
c.	The quality of air, water and land resources	Change in sand budget, Creates turbid water, Impact of fugitive emission from loading sites, Impaac of tailpipe emission.
d.	Deterioation of Environment	Proper Implication of mitigation measures for anticipated impacts.
	Total Net benefit	

**Table no. 9.3.- Beneficial and adverse effects : *Social well being***

S.No.	Componenets	Measures of Effects
<b>1. Regional Income Distribution</b>		
	Beneficial Effects	

<b>a.</b>	Gross Earnings from Excavated sand	
<b>b.</b>	Beneficiaries	
	<u>Primary</u>	
	a. Project proponent	<b>31</b>
	b. Local people who are employed	<b>2400 aprox</b>
	c. Government	-
	<u>Secondary</u>	
	Contractors and allied industries	<b>4800 aprox</b>
	<u>Tertiary</u>	
	Consumers	
	Peripheral workers	<b>2000 aprox.</b>
	Adverse Effects	
<b>a.</b>	Loss of income from other allied activities dependent on river	-
<b>2. Life Health and Safety</b>		
<b>a.</b>	Possible health impacts due to mining activity	<b>fugitive dust and noise</b>
<b>3. Educational, cultural and recreational</b>		
<b>a.</b>	Possible detriment to recreational interests.	-
<b>4. Emergency Preparedness</b>		
<b>a.</b>	Total independence of sand supplies route	New road construction and maintainace is envisaged by local administration.

**Table No. 9.4. Total benefits from the implementation of proposed plans in study area**

<b>Regional Economic Development</b>	
Environmental Quality	Data for future regulation formulation.

Regional Income from sand	<b>It may vary from place to place</b>
Regional Employment	<b>Almost 8200</b>
Population Distribution	None
Economic Base and stability	Economic diversification, sand extraction capacity of area
Environmental concerns	Real impact, visual impact change in sand budget
<b>Social well being</b>	
Real Income Distribution	Reduced cost of sand, Creation of new jobs (direct and indirect employment),
Life Health Safety	Possible health impacts due to mining activity
Educational, cultural and recreational opportunities	Possible detriment to recreational interests.
Emergency Preparedness	Total independence of sand supplies route

**Table No. 9.5 Benefits-Adverse effects for Proposed Plan Implementation**

<i>Regional Economic Development</i>	<i>Environmental Quality</i>	<i>Regional Consideration</i>	
		<i>Development</i>	<i>Social well being</i>
Value of increased outputs	Areas of natural beauty	Income	Real Income Distribution
	Natural resources and ecological systems	Employment	Life, health, safety
Values of output results	The quality of air, water and land resources	Population Distribution	Education, culture, recreation
	Deterioation of Environment	Economic base and stability	Emergency preparedness

		Environmental concerns	
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## CHAPTER-IX

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# REGIONAL ENVIRONMENTAL MANAGEMENT PLAN

## 10.1.INTRODUCTION

On 1st July 2016 wide S.O. 2269 (E), directions have been given on environmental clearance for minor minerals and environment clearance for leases in group of leases and concept of Regional Environment Management Plan (REMP) has been introduced. Generic guidance on Regional Environment Impact Assessment (REIA)/ Regional Environment Assessment (REA) was introduced in the World Bank in 1989 with the adoption of an Operational Directive on environmental assessment (amended in 1996 as OP/BP/GP 4.01). The emerging experiences of regional pollution has revealed that this tool can improve regional development planning by helping to formulate more sustainable investment strategies and to build environmental management capacity at the regional level.

**10.2. REGIONAL ENVIRONMENT MANAGEMENT PLAN (REMP)** EMP is one of the crucial parts of any EIA study wherein detail description is needed for proper implementation of the same. However, for large projects, it is often difficult to provide a detailed description. For example, the greenbelt development is one of the mitigation measures to reduce the adverse impact of pollution on the environment but it is often quite challenging to mention in the EIA report the type of plants to be planted

considering the type of soil, agro climatic region and the type of pollutant emitted by the industry. Also, the total cost for implementing the mitigation plan is often hard to work out.

Causes of environmental change also include natural variability and anthropogenic climate change. Four types of impact of mining are identified which compined to create regional impact.

1. **Space Crowding**-occurs when a system is disturbed by several similar activities, or by different activities producing a similar effect, in an area small to assimilate the combined impacts. (Rees 1995)
2. **Time Crowding**-occurs when impacts are so close in time that the impact of one action are not dissipated before the next occurs.(CEARC 1986)
3. **Interactive effects**- can be additive or compounding, reflecting the interactive nature of ecosystems. Additive is the simple linear addition of one impact on another, whereas compounding is when two or more agents combine to cause an impact. Antagonistic effects can also occur, where the combined impact of more than one agent is less than the sum of the individual impacts. (Canter and Kamanth 1995)
4. **Indirect effects**- are secondary impacts arising as a result of the direct effect, and include the impacts of activities facilitated by a project, including reasonably foreseeable impacts from downstream users.
5. **Regional issues** When preparing the Regional Envieonmental management plan the first step is the identification of regional issues. Some of them are given below:

#### ***Water abstraction***

Direct abstraction from within the specified river/river reach as well as upstream (including tributaries) must be considered. This excludes indirect abstraction, for example by exotic vegetation. The presence of any of the following can be used as an indication of abstraction: cultivated lands, water pumps, canals, pipelines, cities, towns, settlements, mines, impoundments, weirs and industries. Water abstraction has a direct impact on habitat type, abundance and size; is implicated in flow, bed, channel and water quality characteristics; and riparian vegetation may be influenced by a decrease in water quantity.

### ***Inundation***

Destruction of instream habitat (*e.g.* riffle, rapid) and riparian zone habitat through submerging with water by, for example, construction of an on-channel impoundment such as a dam or weir. This leads to a reduction in habitat available to aquatic fauna and may obstruct movement of aquatic fauna; in addition it influences water quality and sediment transport.

### ***Water quality***

The following aspects should be considered: untreated sewage, urban and industrial runoff, agricultural runoff, mining effluent and effects of impoundments. Ranking may be based on direct measurements or indirectly via observation of agricultural activities, human settlements and industrial activities in the area. Water quality is aggravated by a decrease in the volume of water during low or no flow conditions.

### ***Flow modification***

This relates to the consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow such as an increase in duration of low flow season can have an impact on habitat attributes. This results in low availability of certain habitat types or water at the start of the breeding, flowering or growing season. Effects of flow regulation of floods and low flows are assessed separately.

### ***Bed modifications***

This is regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, *e.g.* the removal of rapids for navigation is also included.

### ***Channel modifications***

This may be the result of a change in flow, which alters channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.

### ***Presence of exotic aquatic fauna (e.g. fish)***

The disturbance of the stream bottom during feeding may influence, for example, the water quality and lead to an increase in turbidity. Predation on indigenous fish is also a factor. The extent of the effect is dependant upon the species involved and their abundance.

### ***Presence of exotic macrophytes***

Exotic macrophytes may alter habitat by obstruction of flow and may influence water quality. The extent of infestation over instream area by exotic macrophytes, the species involved, and its invasive abilities should be considered.

### ***Solid waste disposal***

The amount and type of waste present in and on the banks of a river, *e.g.* litter and building rubble is an obvious indicator of external influences on stream and a general indication of the misuse and mismanagement of the river.

### ***Bank erosion***

A decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or encroachment of exotic vegetation. Siltation is the process whereby fine solid particles build up on the bed of a river or lake and is the

result of an excessive load of suspended solids in a river or rivers. Mining operations produce large quantities of dust and finely powdered rock, with much rock having been ground to particle sizes below 0.2 mm. Though the materials that are dumped after removal of the commodity being mined have fine particle size and reasonable physical characteristics that could permit plant growth and retain adequate amounts of water, these materials have been formed from hard unweathered material and so may not contain much of the finest clay material and lack organic or microbial activity. The result is that mine dumps may be very unstable, easily blown by wind when they are dry and eroded by heavy rain when wet. The action of rain and wind thus removes fine particles into nearby water systems, leading to a build up of suspended solids and ultimately siltation.

### ***Ground water movement***

Many so-called sandstone aquifers are actually multiple-aquifer systems consisting of discontinuous sand bodies distributed complexly in a matrix of lower-permeability silts and clays. The arrangement and Interconnectedness of these various lithofacies strongly influence spatial patterns of hydraulic conductivity (K) and, in turn, groundwater flow and mass transport. The aquifer system, which consists of multiple, elongate sand bodies and silts and clays deposited in a fluvial environment and is similar to many other systems found in the sedimentary basins. The resulting deterministic-conceptual flow model demonstrates the importance and methods of incorporating geologic information in groundwater models. Flow in the aquifer is controlled not so much by hydraulic conductivity of the sands as by their continuity and Interconnectedness. Much of the aquifer system consists of large zones in which the fluvial channel-fill sands are sparse and apparently disconnected, resulting in groundwater flow rates lower by a factor of 10<sup>1</sup> to 10<sup>3</sup> than in adjacent, well-interconnected belts of fluvial channel-fill sand belts. Though sand body Interconnectedness is critically important, it is also very difficult to estimate. One or two well-connected sands among a

system of otherwise disconnected sands can completely alter a velocity field. This is particularly true if the sands are connected vertically and nonzero vertical hydraulic gradients exist, which yield reasonably accurate hydraulic heads (Fogg, 1986).

***Change in particle size:*** It appears that due to the mixing of different soil horizons during mining, the soil profile changed to a great extent (Ghosh, 2002). The particle size analysis reveals that sand particles increased, and silt and clay decreased with respect to unmined soil. This trend may be due to increased erosion of aggregates and consequently a high rate of infiltration. Studies reveal that indiscriminate and continued mining of sand from the alluvial reaches of river systems could impose marked changes in the grain size characteristics of river beds, in the long run (Scott, 1973; Sandecki, 1989; Stevens et al., 1990). It is now understood that the physical composition and stability of substrate are changed significantly as a result of instream sand mining. And, most of these physical effects exacerbate sediment entrainment in the channel. The deep pits created in the channel as a result of pit excavation method of sand mining act as sediment traps and the hungry water leaving the pits could selectively entrain sand particles in the finer entities and deposit further downstream. Continuation of this process, in the long run could result in bed coarsening with high percent content of coarser particles in the upstream. Indiscriminate extraction of sand from the lower reaches could impose marked changes in the sediment distribution pattern in this fluvial environment. The sand mining activates the selective removal of medium to very fine sands from the upstream and their deposition in the subsequent downstream stations. This process of selective sorting based on grain size aggravated many folds by indiscriminate sand mining, is responsible for bed coarsening in the upstream reaches of the rivers.

***Lowering of ground water:*** Due to the connectivity of aquifer with the river channel. The aquifer lithology of alluvial sand and alluvial clay consists of thick ferruginous fine sand, underlain successively by fine sand, 2-3 m of unconsolidated clay

and the weathered zone with open fractures and boulders of basement. This unique lithological assemblage has some advantages to areas with thick vermicular laterite upslope. When the river is in flood, the water level rises above the sand-clay interface. A major part of the sand thickness gets saturated. When the water saturated sand is in contact with vermicular laterite upslope, the water potential of the latter increases. However, when the floodwaters recede and reach its level of January to May virtually the entire sand is drained of its water and escapes as baseflow to the river leaving the wells along the river bank virtually dry. However, the water table in the vermicular laterite does not get lowered correspondingly. Continuous removal of sand from river bed increases velocity of flowing water which erodes beds and banks. Kondolf (2007) noted that as the velocity increases, the river bed can propagate both upstream and downstream for many kilometres. This can lower alluvial water tables. Stebbins (2006) added that in stream sand mining causes destruction of aquatic and riparian habitat through large changes in channel morphology, lowered water table, instability and sedimentation at mining sites due to stock piling and dumping of excess mining materials. There is environmental degradation on open land and rivers as well as high evaporation from exposed river beds leading to dry rivers and shortage of water for domestic purposes and animals. Sand act as a reservoir to charge ground water wells, so when removed, wells have to be dug deeper which increases water costs (Pereira, 2012). Generally, there is loss of employment to farm workers as agricultural land is destroyed to pave way for mining while there is human rights violation to farmers. When sand bed water is exposed by mining to dry atmosphere, there is a lot of evaporation. This leads to a micro disturbance of ground water. Continuous movement of heavy machines on rivers weaken riverbeds, causing water table to be nearer the surface where water is forming a pool from underground. Raised water table and formation of pools on riverbeds increases evaporation rate in summer such that exposed water is lost to atmosphere, and will not be useful to livestock and crops. (MADYISE, 2013) The water table along the

river bank plunges steeply to the riverbed. Channel incision due to sand mining, typically lowers the alluvial water table as the channel itself determines the level down to which the alluvial groundwater drains (Galay, 1983; Creuz des Chatelliers and Reygrobelle, 1990; Mas-Pla et al., 1999). This results in loss of groundwater storage and influences alluvial groundwater-surface water exchanges along the river system. Typical mining impact management and mitigation measures include the adherence to the Best Practice Guidelines that have been developed for a range of mining activities (for example, water quality management), investigating alternative locations for infrastructure and waste disposal sites, the adoption of different mining and beneficiation technologies, the use of cleaner production technologies, recycling of water and specific materials, pollution control measures, rehabilitation and landscaping, and the acquisition of additional property to compensate for habitat loss.

***10.2.1. The area was divided into three zones as per the sensitivity of the area on the basis of different environmental issues.***

1. Area of high sensitivity  
Area of high sensitivity is near the project site where impact is highest.
2. Area of medium sensitivity  
Area of medium sensitivity is near the project site where impact is lesser.
3. Area of Low sensitivity  
Area of low sensitivity is farthest from the project site where impact is least.

**10.2.1.1. Future scenario**

The economic activities which are expected to grow in the future are sand extraction. Because of the increasing population for permanent and satellite occupation and increased transportation will enhance. The strategy for the future scenario will include

1. Identification of present scenario.
2. Need for additional control measures for air quality deterioration because of the upcoming project.
3. Need for planning for additional solid waste due to increasing population.

### **10.2.1.2. Cost estimation for the different strategies.**

Identification of the problems because of the upcoming projects include the fugitive dust control measures will entail the cost of dust suppression by water spraying, improvement of PWD roads , paving of unpaved road. This will constitute bulk of investment.

### **10.2.1.3. Study area**

Out of total 31 sand/moram mine leases, 07 leases are granted by District Magistrate, Jalaun while 24 leases are granted by District Magistrate Hamirpur through e-tendering for excavation of Sand / Moram from River bed of Betwa River. The total area of mining lease is **619.41 ha** and the annual production will be **1,00,56,018 cum/annum**. These lease are situated on the river Betwa in two districts namely Hamirpur and Jalaun between - **25°54'25.56"N & 79°39'42.55"E to 25°55'34.68"N & 80°16'12.74"E** in the river bed of Betwa The plan period of the entire lease is 05 years. Area wise only eight projects "M/s Rama Traders, M/s Kanhaiya Lal & Sons, M/s Kamtanath Enterprises Pvt. Ltd\*, M/s Shri Rahul Kumar Gupta\*, M/s Unnao Infradevelopers\*, M/s Kuber Kamna Marbles Pvt. Ltd.\* and M/s Shri Shailendra Yadav\* (\*for which PH is awaited)" are falling under category B1 having area of more than 25 ha. All other projects are below 25 ha but some of them are being treated as B1 category because of group of leases situation. The spirit of EIA notification is the cumulative impact assessment of two small mines which individually are believed to cause less impact. The buffer zones of various mines on the stretch of river Betwa are overlapping each other, that is the need for impact assessment on the large scale and REIA is undertaken.

## **10.3. PRESENT ENVIRONMENTAL CONDITION**

pH of the ground water samples ranges from 7.12 to 7.84. The ground water sample from Kudra village shows lowest pH i.e. 7.15 whereas from Sidra danda village shows the

highest pH 7.84, which is in permissible limit of standards given by CPCB (Fig 3.14). Fluoride and Iron both are lowest in concentration in Beri Village but highest fluoride concentration is in Baragaon but the Iron concentration is highest in Sidra Danda (Fig 3.15). The concentration of iron and fluoride is far below the standards specified by CPCB for drinking water. Total hardness of ground water samples are well within the limits. For Fugitive dust emission at any site, the most prevalent particulate sources, such as unpaved roads, bare ground, and loading. The upwind and downwind concentrations of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> were measured. Emission of fugitive dust are influenced by moisture content, silt content, wind speed, and vehicle activity on unpaved roads, which includes vehicle speed and vehicle counts. The value of PM<sub>2.5</sub> is higher on all the monitoring locations than the NAAQS, 2009 (Attached as annexure-) standards with exception of AQ 30 and AQ 32 i.e. Ramedi and Bhilawa dariya. Higher PM<sub>2.5</sub> levels may be contributed due to traditional ways of cooking along with vehicular emission. PM<sub>10</sub> in the area may be formed by physical processes of abrasion of surfaces and agricultural activities. The anthropogenic source are coarse particles are produced by the mechanical break-up of larger solid particles, wind blown dust such as road dust, soot, agricultural processes, combustion of fossil fuel. It also causes visibility reduction. Almost all the monitoring locations are having higher PM<sub>10</sub>. SO<sub>2</sub> and NO<sub>2</sub> are far below standards.

#### **10.4. FUTURE SCENARIO**

It is expected that the economic growth in the study area would continue to be dominated by mining and associated activities. So environmental quality will be affected the environmental so there are number of strategies are in pipeline.

##### **10.4.1. Management Strategies**

This strategy confirms the need for additional abatement.

- Improvement of roads
- Improvement of quality of life.

##### **10.4.2. Combined Planning**

A combined strategy incorporating elements from all the components will be used for integrated environmental management plan. It will imply the integrated approach from the point of entry to closure of mines.

#### **10.4.3. Cost estimates**

The cost estimation of all the components of environmental protection will be account for all the projects proposed in the area.

### **10.5 REGIONAL ENVIRONMENTAL MANANGEMENT PLAN**

#### ***10.5.1. Aims and objectives***

The general aims and objectives of this plan are as follows:

- (a) to maintain and improve the water quality and river flows and its tributaries and ensure that development is managed in a manner that is in keeping with the national, state, regional and local significance of the Catchment,
- (b) to protect and enhance the environmental quality of the Catchment for the benefit of all users through the management and use of the resources in the Catchment in an ecologically sustainable manner,
- (c) to ensure consistency with local environmental plans and also in the delivery of the principles of ecologically sustainable development in the assessment of development within the Catchment where there is potential to impact adversely on ground water and on the water quality and river flows
- (d) to establish a consistent and coordinated approach to environmental planning and assessment for land along the river to promote integrated catchment management policies and programs in the planning and management of the Catchment,
- (e) to encourage more effective consultation between local government and State Government agencies in executing the responsibility for environmental planning within the Catchment,

#### **10.5.2. REMP application**

General principles when this Plan applies the following must be taken into account:

- (a) the aims, objectives and planning principles of this plan,
- (b) the likely effect of the proposed plan, development or activity on adjacent or downstream local government areas

, (c) the cumulative impact of the proposed development or activity on the River or its tributaries,

(d) any relevant plans of management including any River and Water Management Plans approved by the Minister for Environment and the Minister for Land and Water Conservation and best practice guidelines approved by MoEF&CC

(e) all relevant State Government policies, manuals and guidelines of which the council, consent authority, public authority or person has notice,

(f) whether there are any feasible alternatives to the development or other proposal concerned.

### 10.5.3. Specific issues

- River quality and river flows
- On-site sewage management
- River-related uses.
- Bank disturbance
- Flooding
- Land degradation

## 10.6 ENVIRONMENTAL MANAGEMENT ACTIVITIES.

**Table No. 10.1 Environmental management activities**

Activity	Issue	Action with Key Riders	Responsibility
Labourers activity	Consumption of water and discharge of sewage	Workers are proposed for operation of scrappers and loaders) labours will be required, which will be hired locally. Drinking Water supply will be provided by way of Private tankers and earthen pots at site. A portable treatment plant is proposed at site and and water from that will be used for plantation.	Project Proponent
	Generation of solid waste	It is a sand mining project, no waste generation is anticipated. Workers will also be hired locally to avoid permanent housing at site.	Project Proponent

Activity	Issue	Action with Key Riders	Responsibility
		Uncontrolled dumping will be discouraged. Dustbins shall be provided onsite to collect domestic waste generated.	
	Risks to occupational health and safety	<p>Mining activities will be open cast and semi-mechanized/OTFM (Other Than Fully Mechanized) i.e. using light earth Movers eg. Bar scraper and Loaders to avoid accidental hazards.</p> <p>Onsite first-aid and primary medical facilities will be provided during operation period.</p> <p>Protective equipments will be used. Training and awareness programs related to significance and use of protective gear will be imparted to the workers.</p>	Project Proponent
	Possible transmigration	The contractor will be encouraged to give preference to local labour in the region.	Project Proponent
<b>Earth Movement</b>	Induced soil erosion, loosing of productive top soil.	<p>Mining will be done as per the mining plan in the designated lease area from government for a period of five years up to the required depth only and will be confined along the river bed only.</p> <p>No impact is anticipated however replenishment activity is under process for actual volume estimation.as the mined area gets replenished every year during monsoon season.</p> <p>Top soil either absent or find in pockets and removal of Top soil is not required.</p>	

Activity	Issue	Action with Key Riders	Responsibility
		<p>Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. The unpaved surfaces used for the haulage of borrow materials will be maintained properly. The haul roads and borrow areas will be managed and maintained by the contractor.</p> <p>Since dust is the only impact along the haul roads, sprinkling of water will be carried at least twice a day</p>	
<b>Onsite activity</b>	Extraction of natural resources such as sand, morrum	No impact as the mined area gets replenished every year during monsoon season however replenishment activity is under process for actual volume estimation.as the mined area gets replenished every year during monsoon season.	Project Proponent
	Noise generation due to the movement of Vehicles	<p>No heavy machinery is proposed for the extraction of sand, operational is semi-mechnaized/OTFM (Other Than Fully Mechanized) using LEMM eg. Bar scrapper and loaders</p> <p>Noise generated due to movement of transportation vehicles will be managed by the use of vehicles which are less than 15 years old and after obtaining the pollution under control certificate. Also silence zones will be demarcated and noise barriers will be put accordingly.</p> <p>Labourers should be provided with personal hearing protection device (if required).</p>	Project Proponent

Activity	Issue	Action with Key Riders	Responsibility
	Air emissions	<p>The dust emissions will be minimized by following the good practices, for example, water sprinkling, provision of noise barriers, etc.</p> <p>Overloading of the trucks/trolleys should not be done.</p> <p>Suitable dust barriers shall be proposed.</p>	Project Proponent

### 10.7 ENVIRONMENTAL MANAGEMENT PLAN

Proper environmental management plan are proposed for “River Bed Material” mining project to mitigate the impact during the mining operation.

- Mining operation will be suspended during monsoon season.
- Mining operation will be carried out during day time only.
- Prior to mining, short awareness program will be conducted for labours to make them aware about the finer nuances related to mining.
- If some casualty or injury to animal or human being occurs, proper treatment should be given.
- No tree cutting, chopping, lumbering, uprooting of shrubs and herbs should be allowed.
- Corridor movement of wild mammals (If exists) should be avoided
- Care should be taken that noise produced during vehicles movement for carrying mine materials are within the permissible noise level.
- No piling of mine material should be done in agricultural areas.
- Care should be taken that no hunting of animals or collections of medicinal plant are carried out by labours.
- If wild animals are noticed crossing the river bed, it should not be disturbed or chased away, instead the labours should move away from their path.

**Table no. 10.2 Yearly plan for Environmental management Plan**

<b>S.No</b>	<b>Name of the project</b>	<b>Water requirement for plantation (KLD)</b>	<b>Air pollution control (Sprinkling) (KLD)</b>	<b>Environmental Monitoring Cost</b>	<b>No. of plants</b>
<b>B1 category</b>					
1.	Smt. Kaushilya Chobey Contractor	0.030	20.64	1350000	61
2.	M/s Pehalwan Traders	0.030	33.24	1350000	61
3.	M/s Bindu and Ram Construction Company	0.051	24.00	1350000	101
4.	M/s Indus Mines and Minerals	0.044	27.36	1350000	87
5.	M/s Balaji Enterprises	0.030	17.52	1350000	61
6.	M/s D. V. Construction	0.061	14.72	1350000	121
7.	M/s Ghanaram Infra Engineers Pvt Ltd	0.040	5.44	1350000	81

8.	Shri Kanha Construction Company	0.030	32.04	1350000	61
9.	M/s Rama Traders	0.077	95.84	1350000	154
10.	M/s Baba Bholenath Traders	0.030	3.60	1350000	61
11.	M/s Eureka Mines and Minerals LLP	0.040	10.88	1350000	81
12.	M/s Harihar Minerals LLP	0.030	21.12	1350000	61
13.	M/s Kanhaiya Lal & Sons	0.074	33.28	1350000	148
14.	M/s Kamtanath Enterprises Pvt. Ltd.	0.091	17.10	1350000	182
15.	M/s New Praveera Infraheight Pvt. Ltd.	0.051	30.60	1350000	101
16.	Shri Rahul Kumar Gupta	0.091	89.28	1350000	182

17.	M/s Shri Construction	0.091	29.44	1350000	182
18.	M/s Yadav & Sons	0.030	45.28	1350000	61
19.	M/s Unnao Infra developers Pvt. Ltd.			1350000	
20.	M/s Kuber Kamna Marbles Pvt. Ltd.	Projects Still under process			
21.	Shri Shailendra Yadav				
22.	M/s APM Mining & Infra Pvt. Ltd.				
	B2 category				
23.	Shri Suresh Chand Gupta.	0.040	25.60	1350000	81
24.	M/s Rishab Herbal Pvt. Ltd.	0.030	29.28	1350000	61
25.	M/s Indus Mines And Minerals	0.030	1.96	1350000	61

26.	M/s Maa Raktdantika Contractors and Suppliers Pvt Ltd.	0.051	29.82	1350000	101
27.	M/s Silver Mist Retail Private Limited	0.030	56.88	1350000	61
28.	M/s Silver Mist Retail Private Limited	0.030	12.42	1350000	61
29.	M/s Sharad Enterprises	0.051	3.92	1350000	101
30.	M/s Chaudhary Traders	0.061	47.04	1350000	121
31.	M/s Associated Commerce	0.022	10	1350000	45

### 10.7.1. Progressive Green Belt Development Plan

- 🌳 The lease area is designated as wasteland. Plantation will be carried out on:
- 🌳 Riparian fringe-All along the river bank
- 🌳 Sapling shall be planted along the approach roads and in the nearby villages i.e. all along the way from mine to nearest village in consultation with the Gram Panchayats
- 🌳 Trees growing up to 5m.or more in height will be planted within the riparian fringe, such that there is no impediment to movement of water and general

hydrodynamics.

- 🌳 Plantations of adequate density serve as vertical screen of Biomass, screening the dispersion of air borne pollutants and attenuating noise as well.
- 🌳 Local species will be planted as per the CPCB guidelines and in consultation with local forest office. Species to be planted will be the trees like Arjuna, Akashmoni, Kachnar, Jamun, Kaner, Bahera, Neem, Amaltas , GulMohar, etc.
- 🌳 Fast growing trees with thick perennial foliage will be grown, as otherwise it may take many years for trees to grow to their full height.
- 🌳 Planting should be done in large sized 90cm x 90cm.due in advance and filled about 50 days before planting. The plantation raised earlier should be carefully maintained. Mortalities should be replaced by fresh planting.

#### **10.7.2. Green Belt Development in the study area.**

Same has been given in Chapter-07 under section 7.10.

#### **10.7.3. Environmental Monitoring Plan**

An Environmental monitoring programme has been prepared for the proposed project for periodical assessment of effectiveness of implementation of Environment Management Plan and to take corrective measures in case of any degradation in the surrounding environment. For assessing the prevailing quality of air, water, noise, land etc., regular monitoring of parameters are necessary. The data assessed will be helpful in predicting the impact and planning suitable measures to improve / protect the environment. In the study area, the lessee will carry out monitoring studies for ambient air quality, fugitive dust, water quality, noise levels and soil quality as per the standard procedures and schedules. The monitoring system will include:

1. Monitoring stations in the buffer zone remain the same as selected in this study for Air, water, Soil, Noise etc.
2. Implementation of the planned mitigating measures.
3. Monitoring the programme of implementation.

The Environmental parameters will be monitored & samples will be analyzed as per the stipulations of Indian Bureau of Mines & UP Pollution Control Board and as per MOEF Guidelines. The above monitoring proposals shall be adhered to and the results shall be

intimated to the appropriate authorities for their perusal and records. A typical environmental monitoring plan is given below in Chapter-06

**Table No. 10.3 : Frequency of Monitoring**

<b>S.No.</b>	<b>Monitoring parameters</b>	<b>Frequency of Monitoring</b>
<b>1</b>	<b>Ambient Air Quality</b> Ambient air monitoring at appropriate location for Particulate matter (PM <sub>10</sub> , PM <sub>2.5</sub> ), SO <sub>2</sub> ,NO <sub>2</sub>	<b>Half-yearly</b>
<b>2</b>	<b>Water</b> Surface and Ground Water	<b>Yearly</b>
<b>3</b>	<b>Noise</b> Day and night level of noise	<b>Half-yearly</b>
<b>4</b>	<b>Soil</b> Soil sampling	<b>Yearly</b>

#### **10.7.4 . Organizational setup for Environmental Monitoring**

Major attributes of environment are not confined to the mining site alone. Implementation of proposed control measures and monitoring programme has an implication on the surrounding area as well as for the region. Therefore, mine management should strengthen the existing control measures as elaborated earlier in this report and monitor the efficacy of the control measures implemented within the mining area relating to the following specific areas for eco-friendly mining:

1. Collection of air and water samples at strategic locations with frequency suggested and by analyzing thereof. If the parameters exceed the permissible tolerance limits, corrective regulation measure will be taken.
2. Collection of soil samples at strategic locations once in every year and analysis thereof with regard to deleterious constituents, if any.
3. The effectiveness of drainage system depends upon proper cleaning of all drains provided in the surrounding of mine area. Any blockage due to siltation or loose material will be checked at least once in a month.
4. Measurement of water level fluctuations in the nearby ponds dug wells and bore wells.
5. Regular visual examination will be carried out to look for erosion of river banks. Any abnormal condition, if observed will be taken care of.

6. Measurement of noise levels at mine site, stationary and mobile sources, and adjacent villages will be done in every quarter of the year.

7. Monitoring Ground Vibrations: Ground vibrations studies or monitoring is not required as there is no proposal of drilling / blasting for scooping operations.

#### **10.7.5. Implementation Of EMP**

As the major environment attributes will continue to be around the project area alone, Implementation of the proposed control measures and monitoring thereof will be undertaken on a regional basis. The project proponent will ensure the implementation of the measures within the mine area and carryout efficient monitoring through outsourcing to competent certified consultants and laboratories. In order to implement the measures suggested for mitigating the adverse impacts on the environment, it is suggested to monitor the environmental parameters regularly.

#### **10. 7.6. Environment Management Mechanism**

No cell is proposed to form; the plan will be implemented through outsourcing suitable and accredited consultants and experts. Environmental Monitoring will be directly coordinated by the Supervisor / Owner. Competent outsourced certified organization/lab personnel will conduct the monitoring operations. A full-fledged laboratory is not essential; part of the work will be given to competent consultants to undertake these jobs. Regular semi skilled manpower will be required for supervision, assistance in reclamation works followed by trained unskilled labourers to carry out other necessary operations.

#### **10.7.7 . Functions of the EMP Implementation Team**

1. Implementation of the mitigation measures.
2. Maintain Records of the operation.
3. Monitoring the programme of implementation.
4. To estimate the efficiency of measures taken.
5. To bring out any other unforeseen effect on environment not covered under the report.
6. Inspection and regular maintenance of mining equipments and transport vehicles.

#### **10.7.8. Budget For Environmental Management**

Annual budget for EMP is very essential for successful implementation of EMP. The fund allocated will not be diverted for any other purposes and the top management will be

responsible for this. The budget will take into consideration of capital and recurring expenses:

**Table no. 10.4 Environmental Expenditure (Lease wise)**

S.No	Name of the project	Sprinkling+ Water demand for plantation EMP (Recurring Cost)	Cost (sapling + tree guards+monito ring) EMP (Capital Cost)	EMP (Recurring Cost) Per Year
<b>B1 category</b>				
1.	Smt. Kaushilya Chobey Contractor	1480505	1480505	568852
2.	M/s Pehalwan Traders	1480559	1480559	915352
3.	M/s Bindu and Ram Construction Company	1567602	1567602	662087
4.	M/s Indus Mines and Minerals	1537136	1537136	754195
5.	M/s Balaji Enterprises	1480559	1480559	483052
6.	M/s D. V. Construction	1611128	1611128	407305

7.	M/s Ghanaram Infra Engineers Pvt Ltd	1524086	1524086	151270
8.	Shri Kanha Construction Company	1480559	1480559	882352
9.	M/s Rama Traders	1680767	1680767	2638773
10.	M/s Baba Bholenath Traders	1480559	1480559	100252
11.	M/s Eureka Mines and Minerals LLP	1524086	1524086	300870
12.	M/s Harihar Minerals LLP	1480559	1480559	582052
13.	M/s Kanhaiya Lal & Sons	1667706	1667706	918248
14.	M/s Kamtanath Enterprises Pvt. Ltd.	1741698	1741698	474008
15.	M/s New Praveera Infraheight Pvt. Ltd.	1567580	1567580	843587

16.	Shri Rahul Kumar Gupta	1741698	1741698	2458958
17.	M/s Shri Construction	1741698	1741698	813358
18.	M/s Yadav & Sons	1480559	1480559	1246452
19.	M/s Unnao Infradevelopers Pvt. Ltd.	9456788	1741698	1891358
20.	M/s Kuber Kamna Marbles Pvt. Ltd.	Projects still under process		
21.	Shri Shailendra Yadav			
22.	M/s APM Mining & Infra Pvt. Ltd.			
	<b>B2 category</b>			
23.	Suresh Chand Gupta.	1524043	1524043	705670
24.	M/s Rishab Herbal Pvt. Ltd.	1480559	1480559	806452

25.	M/s Indus Mines And Minerals	1480559	1480559	55152
26.	M/s Maa Raktdantika Contractors and Suppliers Pvt Ltd.	1567602	1567602	822137
27.	M/s Silver Mist Retail Private Limited	1480559	1480559	1565452
28.	M/s Silver Mist Retail Private Limited	1480559	1480559	342802
29.	M/s Sharad Enterprises	1567580	1567580	109887
30.	M/s Chaudhary Traders	1611118	1611118	1296105
31.	M/s Associated Commerce	1379589	1445675	275918

## CHAPTER- XI

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# SUMMARY & CONCLUSION

## 11.1 SUMMARY OF EIA

In district Hamirpur and Jalaun, river Betwa covers a distance more than 160 m as stated in District survey report of Sand of District Hamirpur and Jalaun. Across the river Betwa in its river bed many minable areas are identified and leased for morrum scrapping from the area under the guidelines issued in SSMMG, 2016 by MoEF & CC, GOI. The contiguous leases on the river stretch make the area more susceptible to Environmental degradation. A project level impact assessment is limited to a specific area and it does not ask whether the proposed undertaking is the most appropriate form of development or whether the cumulative effects of such development are in conflict with broader environmental goals or desired future conditions. It disregards the cumulative impacts i.e. deforestation, depletion of the ozone layer, biodiversity decline etc. No single project can be considered responsible for the problems; however they do occur due to the combination of several impact sources. When projects are assessed individually, not much attention is paid to other developments (existing or planned) affecting the same area, consequently the decision makers are masked the true nature of the problem under analysis and are asked to assess the acceptability of individual impacts. Such impacts often appear negligible despite their potentially harmful cumulative effect

Thus, for such a large area containing different land uses Regional EIA is needed for assessing the cumulative impact of the proposed industries on the region as a whole. Regional EIA is more than expanding the boundaries of EIA “up” to a higher tier or “out” to encompass a broader geographic area, rather it represents a different way of approaching the relationship between environment and development decision making at a regional scale. These leases (B1-21 and B2-10)\* (inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited) have their individual buffer area but when plot together their buffer area is overlapping each other. This study shows how over some areas the environmental impact of projects is increased as those areas are having cumulative impact of both. To meet the objective of cumulative impacts on the environmental condition of the region containing multiple leases on the river stretch of Betwa in Hamirpur and Jalaun District, Environmental Impact Assessment (EIA) is being carried out. However the area of the project is only 16.194 ha and it is B2 category project, but according to the cluster certificate another mine in 500 m radius of the proposed project having an area of 8.9 ha form a cluster . So it also becomes a B1 category project. Proposed mine leases has been sanctioned over for period of five years. Only morrum will be excavated. It has been proposed that 3,23,880 cum/ year of morrum will be excavated. The proposed project is situated in Gata No-747, Khand No.-1, Pathreta, Kalpi, Jalaun.

## **11.2 PROJECTS**



**Fig 11.1 Google map of the project**

**11.2.1. Project Description**

**12. Table No.11.1 Details of the leases in the riverbed Betwa in District Jalaun**

<b>Project Proponent(s) &amp; Name of Company (if any) &amp; Residential Address</b>	M/s Eureka Mines and Minerals LLP Proprietor- Shri chandershekhar Chaurasia S/o Shri Deen Dayal Chaurasia H.No. 28, Brahmpuri Colony, Near Jugauli Crossing, Faizabad Road, District Lucknow, Uttar Pradesh.
<b>Gata No (s)/ Araj No (s)/ Khand No (s)</b>	Gata No. 747, Khand No. 01
<b>Village</b>	Pathreta
<b>Tehsil/ District</b>	Kalpi/Jalaun
<b>Area (ha)</b>	Sanctioned Lease Area – 16.194 ha
<b>Date of issue of Letter of Intent (LOI)</b>	27.01.2018
<b>MP approved on</b>	9/2/2018
<b>Date of submission of EC application to MoEF's Portal with</b>	10/07/2018, SIA/UP/MIN/28125/2018; File No. 4384

<b>acknowledgement number &amp; File No.</b>			
<b>Report Submission date</b>	27.08.2018		
<b>Date of presentation/ Agenda No. /Sl. No.</b>	29.08.2018, 353, 07		
<b>Date of submission of draft EIA for Public Hearing</b>	27.07.2018		
<b>Date of grant of TOR/EC</b>	TOR awaited		
<b>Public hearing conductance</b>	PH conducted on 19.09.2018		
<b>Co-ordinates</b>	<b>Points</b>	<b>Latitude</b>	<b>Langitude</b>
	<b>Coordinates Sanctioned MLA</b>		
	A	25°52'28.09" N	79°48'23.44 "E
	B	25°52'41.58" N	79°48'32.46 "E
	C	25°52'37.32" N	79°48'45.41 "E
D	25°52'24.27" N	79°48'33.20 "E	
<b>Annual Production</b>	3,23,880.00 m <sup>3</sup> /annum		

## 12.2. PROJECT DESCRIPTION (Technology & Process)

The proposed project is to mine morrum from river bed sustainably and scientifically. Mining will be opencast, semi- mechanized/ OTFM (Other Than Fully Mechanized) using scraper and loaders along the river bed keeping bank unaffected. Following geo-scientific methods are proposed to carry out the activity:

- Mining will be confined to extraction of Morrum from the river bed only.
- Mining of gravelly morrum from the river bed will be restricted to a maximum depth of 3m from the surface.
- No drilling, blasting and beneficiation is proposed.

- Approximately 3,23,880 cum/annum (production inclusive of upcoming projects of B1-sub-category for which Public Hearing is awaited and B2- sub-category projects for which EC is awaited) minor mineral will be extracted.
- No mining activity will be undertaken during the monsoon season. So the river bed material will be replenished during the monsoon season every year.
- The mining activity will be restricted to daytime only in order to avoid environmental pollution or any accidental hazards.
- The operation will be done using OTFM (Other Than Fully Mechanized) method using Bar scraper and Loaders.
- During the lease period, the deposit will be worked from the top surface of the river bed to 3 m bgl or 1 m above water level whichever is less.

### 11.3.1 Water Supply

There will be very little requirement of water is anticipated to carry out operations as it will be done in semi- mechanized manner. The water will be required either for drinking purposes or for dust suppression and in Plantation. The water requirement will be met by nearby existing dugwells/borewells or by private water tankers.

Water Demand (KLD) for Sprinkling on Unpaved haulage road	Water Requirement for plantation (KLD)	Drinking water -Day worker (KLD)	Drinking water - Floating population (KLD)	Drinking water -Fixed population (KLD)	Stored water (KLD)	Total Water
10.88	0.040	0.54	0.35	0.51	0.10	12.42

### 11.3.2. Man Power Requirement

UNSKILLED LABOUR	SKILLED LABOUR	OTHERS	FLOATING POPULATION
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45	9	11	177
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## **11.4 OVERALL JUSTIFICATION FOR THE IMPLEMENTATION OF THE PROJECT**

### **11.4.1. Sustainable Mining**

All the measures to make the mining activity sustainable will be taken in to the consideration. The masures will include OTFM method using Scrapers and loaders, no mining in the concave areas of the rivers, 7.5 m safety zones inside of the either banks inside the river bed in the lateral form. Ultimate working depth will be upto 3.0m from Riverbed level and not less than one meter from the water level of the River channel whichever is reached earlier and suitable slopes not more than a gradient of 30° will be maintained. No mining in Monsoon season and in night time.

No mining below the water table and no mining and within 200-500 meter of bridge, 200 meter upstream and downstream of water supply / irrigation scheme, 100 meters from the edge of National Highway and railway line, 50 meters from a reservoir, canal or building, 25 meter from the edge of State Highway and 10 meters from the edge of other roads. Use of PUC certified vehicles will be allowed for the transportation of minor mineral.

### **11.4.2. Environmental Benefits**

- This activity promotes a piscicultural operation extremely important for maintaining ecology and environment of the area.
- It controls river bank erosion by deepening of river channel, thus prevents flooding and other natural hazards.
- It helps in Regeneration & Establishment of Pioneer Species like Shisham & Khair on the banks of rivers besides saving agricultural land & land cutting.
- It regulates & maintains the existing course of the river, and improves the water holding capacity of channels.

### **11.4.3 Social Benefits**

- Generates employment to the locals engaged directly in extraction of morrum as well as indirectly transportation and sale of mineral.
- Leads to improvement in lifestyle and standard of living.
- Earns huge sum of revenue in the form of mineral royalty or dead rent for the State Exchequer.

### **11.5 RECOMMENDED MANAGEMENT PRACTICES**

It outlines best management practices and addresses good operational elements to minimise impacts for the following aspects in sand mining operations:

- ❖ Operational practices;
- ❖ Processing Site/Maintenance yards;
- ❖ Appropriate Transportation Methods;
- ❖ Fuel storage/solid waste; and
- ❖ Practical BMPs and their effective implementation.

#### **a. Operational practices**

- ❖ The use of river reserve as dumping area will be prohibited; the river itself will not be used as dumping area;
- ❖ Machinery and transportation vehicles used in the operations must be maintained well and be free of any leakages;
- ❖ Mining activities will be avoided at night times;
- ❖ Vehicles transporting sand will maintain speed to not more than 20km/hr, be covered to avoid spilling on public roads and should travel on non-peak hours;
- ❖ Site office and workers quarters will be equipped with proper sanitation facilities. No direct discharge of sewage or sullage will be allowed into the river course;
- ❖ Proper waste collection bins will be provided; and
- ❖ Working areas will be made good after operations.

#### **b. Processing site and maintenance yard**

- ❖ No discharge of oily wastewater directly into the river;

- ❖ Wherever skid tank is used for fuel storage, it should be surrounded by a bund and underlain with concrete flooring to prevent any spillages reaching the river;
- ❖ Equipment, machinery and transportation leaving the site should always be clean and if applicable, provision made for a wheel washing facility to clean tyre prior to entering public roads;
- ❖ A maintenance yard should be concreted with perimeter drainage to collect oily waste; and
- ❖ Overburden from mining activities is not allowed to be dumped on the riverbank or riverine reserve

### **c. Appropriate transportation methods**

Sand from the project site will be transported mainly via land and possibly by land transportation. Land transportation involves dumpers. Impact of this type of transportation will be fugitive dust from the sand itself and the gravel road on which the dumpers travel. Appropriate measures such as covering the dumpers with canvas or plastic sheets can prevent dust nuisance to road users and local residents.

### **d. Modifying operational practices working time**

Environmental impacts can be minimized by improvement and improvisation in the working time. By operating at certain particular times, impact on the environment can be minimized. The following can be used as guidelines for mining operations. There will not be any mining activities during breeding periods of fish and other aquatic inhabitants (the operator should verify with the Fisheries Department).

## **11.6 EXPLANATION OF HOW ADVERSE EFFECTS HAVE BEEN MITIGATED**

A brief description of mitigation of adverse effects is discussed as under, however, a detailed discussion on the same is done in Chapter 4 of EIA .

- The mining activity is restricted to the dry river bed only. Since the site is government owned waste land, no impact on existing land use is anticipated. Also the mined area would get replenished on arrival of monsoon every year.



- Mining will be done as per the mining plan in the designated lease area from government for a period of five years up to the required depth only (3m below river bed/ or 1 m above the water level/ water table whichever is less) and should be confined to the dry river bed only.
- The only air pollution sources are fugitive dust emission due to movement, loading, unloading and transportation of minor minerals, as drilling, blasting, crushing, DG Set/furnace or storage is not proposed at site.
- There are no wastewater discharges to water bodies from the mining operations. The only water contaminant is rainwater run-off during the monsoon season. There will be almost negligible impact due to the proposed mining on the water environment and the water flow pattern does not disturb the turbidity and velocity, hence no mitigation measures are suggested.
- There is no noticeable effect on surrounding ground water resource due to mining as the mining activity does not require ground water extraction.
- As there will be no heavy earth moving machinery involved in the mining operations, there will not be any major impact on noise level due to the mining and other association activities. A detailed noise survey has been carried out and results are discussed in Chapter 3.
- Blasting technique is not used for morrum lifting, hence no possibility of land vibration.
- The mining operation will have positive and long term impact on river environment as the operation will result in extraction of excessive morrum deposits from points where the maximum sedimentation occurs, in order to prevent flooding or related natural hazards, which in turn will save the existing agricultural practices of nearby areas.
- No mining will be carried out during monsoons. This will minimize impact on aquatic life.
- It is a river bed mineral mining project which has no vegetation, therefore clearance of vegetation is not required


- An inventory of the risks involved during the proposed project would be delineated with the measures to mitigate the same and the same would be ensured to the people by conducting an awareness program in the surrounding areas.


CHAPTER- XII

# DISCLOSURE OF CONSULTANT

Table. No.12.1. Disclosure of consultants

<b>Project</b>	<b>Environmental Impact Assessment of M/s Eureka Mines and Minerals LLP situated in Kalpi, Jalaun</b>	
<b>Type</b>	Mining of Minor Minerals	
<b>Environment Consultant with their Accreditation Status</b>	<b>ENV DAS India Pvt. Ltd., Lucknow</b> (QCI Certificate No. NABET/EIA/1720/RA 0078 Valid upto 2 <sup>nd</sup> April 2020)	
<b>Coordinator</b>  Name:     Signature and date:	<ol style="list-style-type: none"> <li>1. Mr. Ashok Jamkar (QCI approved EC for Category A Projects under Activity Schedule 1(a))</li> <li>2. Mr. B.M.S Negi (QCI approved EC for Category A Projects under Activity Schedule 1(a))</li> <li>3. Dr. Ritu Pandey (QCI approved EC for Category B Projects under Activity Schedule 1(a) for Opencast Mining only)</li> <li>4. Dr. G.S.Jaiswal (QCI approved EC for Category B Projects under Activity Schedule 1(a))</li> <li>5. Mr.Atulesh Kumar (Proposed Associate EC) for Category A Projects under Activity Schedule 1(a)</li> </ol>	          
<b>Sectoral Experts</b>		
<ul style="list-style-type: none"> <li>• Air pollution</li> <li>• Air Quality</li> <li>• Socio-Economy</li> </ul>	<ul style="list-style-type: none"> <li>• Dr. S.P. Shukla/Dr. Ritu Pandey</li> <li>• Mr.Manoj Kumar Mishra/Mr. Atulesh</li> <li>• Mr. Akhil Prasad/ Dr. Asha George</li> </ul>	

<ul style="list-style-type: none"> <li>• <b>Ecology-Biodiversity</b></li> <li>• <b>Hydrology &amp; Ground water</b></li> <li>• <b>Geology and soil</b></li> <li>• <b>Noise and Vibration</b></li> <li>• <b>Land use</b></li> <li>• <b>Risk and Hazards</b></li> <li>• <b>Soil Conservation</b></li> <li>• <b>Water Pollution</b></li> <li>• <b>Solid &amp; Hazardous Waste</b></li> </ul>	<ul style="list-style-type: none"> <li>• Dr. Bajrang Singh</li> <li>• Mr. B. M. Agrawal</li> <li>• Mr. Gautam Ghosh/ Dr. G.S.Jaiswal</li> <li>• Mr. Manoj Kumar Mishra</li> <li>• Mr. B. M. Agrawal</li> <li>• Mr. Manoj Kumar Mishra</li> <li>• Dr. Bajrang Singh</li> <li>• Ms. Tushali Jagwani</li> <li>• Dr. Ritu Pandey</li> </ul>	
<p><b>Name of Associate FAEs</b></p>	<ul style="list-style-type: none"> <li>• Mr. Atulesh (AP,WP)</li> <li>• Mr. Devanshu (WP,SHW)</li> <li>• Mr. Mayank Pushkar(AP,WP)</li> </ul>	
<p><b>Name of Team Members</b></p>	<ul style="list-style-type: none"> <li>• Ms. Surabhi Verma</li> <li>• Ms. Anjali Mishra</li> <li>• Dr. Pushpendra S. Rajpoot</li> <li>• Dr. S.K.Yadav</li> <li>• Ms. Anshika Yadav</li> </ul>	

	<ul style="list-style-type: none"> <li>• Mr. Gulshan Gaur</li> <li>• Mr. D.P.Pathak</li> </ul>
<b>Name of Mentors</b>	<ul style="list-style-type: none"> <li>• Mr. P. P. Srivastava (WP, SHW)</li> <li>• Mr. Mohammad Ahsan (EB)</li> </ul>
<b>Experts</b>	<ul style="list-style-type: none"> <li>• Mr. P. P. Srivastava (Advisor – Environmental Law)</li> <li>• Mr. Gautam Ghosh (GEO) </li> <li>• Mr. Deepak Saxena Pollution Control Laws including Corporate &amp; Commercial Law</li> <li>• Mr. Prakash Lal (GEO)</li> </ul>
<b>Technical Assistance:</b>	<p>Ñ Mr. Izhar Hussain</p> <ul style="list-style-type: none"> <li>• Mr. Hriday Kumar</li> <li>• Mr. Rishabh Verma</li> </ul>