

**** Just to reduce the size , all the figures are removed**
**** Annexures are appended already along with Form-01**

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

**Located at Khand No (s). K-2, Gata No.- 389Mi, 390Mi,
Village- Kharka,
Tehsil- Bhognipur, District – Kanpur Dehat
Sanctioned Area – 18.33 ha.
Proposed Production of Morrum – 274950.0 m³/year**

Prepared on the basis of TOR issued by SEAC, UP

File No. 4160

Submitted by:

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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 murram 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 purpose of Environmental Impact Assessment (EIA) is to identify and evaluate the potential environmental, social and economic impacts (beneficial and adverse) of development and projects on the environmental system. It is a decision making tool, which guides the decision makers in taking appropriate decisions for proposed projects. It aims predicting environmental impacts at an early stage of project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision makers. By using EIA, both environmental and economic benefits can be achieved. EIA systematically examines both beneficial and adverse consequences of the proposed project and ensures that these impacts are taken into account during the project design. By considering environmental effects and mitigation early in the project planning cycle, there are many benefits, such as protection of the environment, optimum utilization of resources and saving overall time and cost of the project. Properly conducted EIA also lessens conflicts by promoting community participation, informs decision-makers, and helps lay the base for environmentally sound projects.

Table 1.2 Various stages of Mining activities.

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

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

From a very long time MoEF, GOI, Delhi is undertaking a lot of project for Environmental studies of a group of activities in place of single project.

- 1. During June 1983 to October 1987-** Kailash Paliwal, School. of Biological Sciences . Madurai Kamaraj" University Madurai has taken up a study titled as "**An environmental impact assessment of human activities and cosnservation action models on natural andsemi natural-ecosystems in Western Ghats region in Tamil Nadu.**"
- 2. During April 1983 to April 1986-**S.M.Shetty, Department of Biology', Dhempe College of Arts & Science Panaji, Goa-403001 has taken up a study titled as" **Effect**

of mining on the ecosystems of sanguem ,Bichollm, Sattari and Quepem taluka, Goa.”

3. **During 1994 to 1998-** Dr. R.M. Lodha, Associate Professor, Department of Geography, M.L. Sukhadia University, Udaipur-313001 has taken up a study titles as **“Environmental impact of mining activity on land use : a case study of Udaipur Mineral Basin.”**
4. **“Remote sensing application in monitoring environmental impact of mines in jharia raniganj coal belt, India”** 2.2 in EIA summaries published by MoEF, GOI, Delhi by V. K. Srivastava Indian School of Mines Dhanbad-826 004, Jharkhand Email: ismkvinay@hotmail.com.
5. **“Environmental impact of iron ore mining in Goa through remote sensing”** 2.5 in EIA summaries published by MoEF, GOI, Delhi by G. Venkataraman Centre of Studies in Resources Engineering Indian Institute of Technology (IIT) Powai, Mumbai – 400 076, Maharashtra Email: gv@disha.csre.iitb.ac.in.
6. **“Remote sensing studies on environmental impact of mining bauxite & chromite in east coast area”** 2.6 in EIA summaries published by MoEF, GOI, Delhi by R. N. Rath & S. K. Mishra Directorate of Mining & Geology Government of Orissa Bhubaneshwar-751 001, Orissa.
7. **“Study on environmental impact of iron ore mining in Bailadilla, Bastar district, Madhya Pradesh through remote sensing”** 2.8 in EIA summaries published by MoEF, GOI, Delhi by G. Venkataraman Centre of Studies in Resources Engineering Indian Institute of Technology (IIT), Powai Mumbai – 400 076, Maharashtra Email: gv@disha.csre.iitb.ac.in.
8. **“Environmental impact of coastal wetlands of Vedaranyam”** 2.9 in EIA summaries published by MoEF, GOI, Delhi by T. Natarajan Institute of Remote Sensing (IRS) College of Engineering, Anna University, Guindy Chennai –600 025, Tamil Nadu.

9. **“Environmental impact assessment of Dhanbad district with particular reference to forest and soil cover through remote sensing image”** 2.10 in EIA summaries published by MoEF, GOI, Delhi by V. K. Srivastava Indian School of Mines (ISM), Dhanbad - 826 004, Jharkhand Email: ismkvinay@hotmail.com.
10. **“Environmental impact assessment of zaawar group of mines using multi-date satellite imagery”** 2.12 in EIA summaries published by MoEF, GOI, Delhi by M. L. Jhanwar Institute of Environment Education and Sustainable Development 5-A, Indira Nagar, Jaipur-302 018, Rajasthan Email: ieesd_jp@hotmail.com.
11. **“Impact assessment of sugar industries on water quality of eastern Uttar Pradesh”** 2.19 in EIA summaries published by MoEF, GOI, Delhi by J. B. Srivastava Remote Sensing Application Centre, Sector G, Janakipuram Lucknow- 226 001, Uttar Pradesh.

Details of the above all are attached as **Annexure-XXII**

- a. **Challenges Being Faced during the Study:** The designated area includes not only the functional sand mining leases but some proposed non functional sand mining projects. An EIA study being carried out for such area development projects comprises of both situations (existing and proposed) within the area. The baseline data collection is generated from primary survey as well as secondary sources.
- b. **Baseline Data Collection conforms to the BIS guidelines.**
EIA practice in India still considers impacts of individual activity/projects and the cumulative impact of the individual activity on the whole region is a major challenge before consultant as it requires comprehensive baseline data collection. The strategic locations of sampling station as per IS 5182 (Part 14) : 2000 (Reaffirmed in 2005 & 2010).
- c. **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.

1.2.2. Recommendation for The Group of River Bed Mining Projects

The following recommendations are therefore been made for river bed mining:

- i. In the case of mining leases for river bed morrum mining, specific river stretches should be identified and mining permits/lease should be granted stretch wise, so that the requisite safeguard measures are duly implemented and effectively monitored by the respective Regulatory Authorities.
- ii. The depth of mining may be restricted to 3m from surface /1 m above water level, whichever is less.
- iii. For carrying out mining in proximity to any bridge and or/embankment, appropriate safety zone should be worked out on case to case basis, taking into account the structural parameters, spatial aspects, flow rate etc. and no mining should be carried out in the safety zone so worked out.

1.3 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**

1.3.1 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 14th 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 10th 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;

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 generated

between March to May 2018 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.

The details of mining project in the area are presented in the following table:

Table 1.5: Details of Mining Lease

S.N	Name Of Mine	Area in Ha	Village	Tehsil/ District	Owner	Status
B1 category						
1.	Sand/Moram mining at Khand No. K-2, Gata No. 389Mi, 390Mi	18.33	Kharka	Bhognipur/ Kanpur Dehat	M/s Harihar Minerals LLP located at 405 Kha, New Patel Nagar, Near Kalidas School, Orai, Jalaun Proprietor Shri Ram Autar Singh S/o Shri Tejram Singh R/o New Patel Nagar, Orai, Jalaun (U.P.)	TOR issued on 25/04/18

1.5_PROJECT / PROPONENT DETAILS

1.5.1 Details of Project and Project Proponents in the study area

Given in Subchapter 2a: Lease wise description

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 project is new mining lease where the PP is 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, Kanpur Nagar, Knapur Dehat and DM, Hamirpur 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 of TOR for B1 projects are attached 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 5.0 km radius from proposed project site showing surrounding features is given below:

b. Brief History of Projects in the study area

Given in Subchapter2a: Lease wise description

c. Size

Proposed mine lease has been sanctioned over for period of five years. Only morrum will be excavated. It has been proposed that 274950.0 cum/ year of morrum will be excavated.

d. Area and categorization of Projects in the study area

Given in Subchapter 2a: Lease wise description

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

The LOI for M/s Harihar Minerals LLP is granted by District Magistrate, Kanpur Dehat through e-tendering for excavation of Sand/Moram from Riverbed of Yamuna River. LOI of is annexed as **Annexure-II**. The Mining Plan has been approved by Directorate of Geology & Mining and Terms of Reference has been issued. The copy of TOR is annexed as **Annexure-III** and **Annexure-IV**. Toposheet of the study area is attached as Fig.1.4

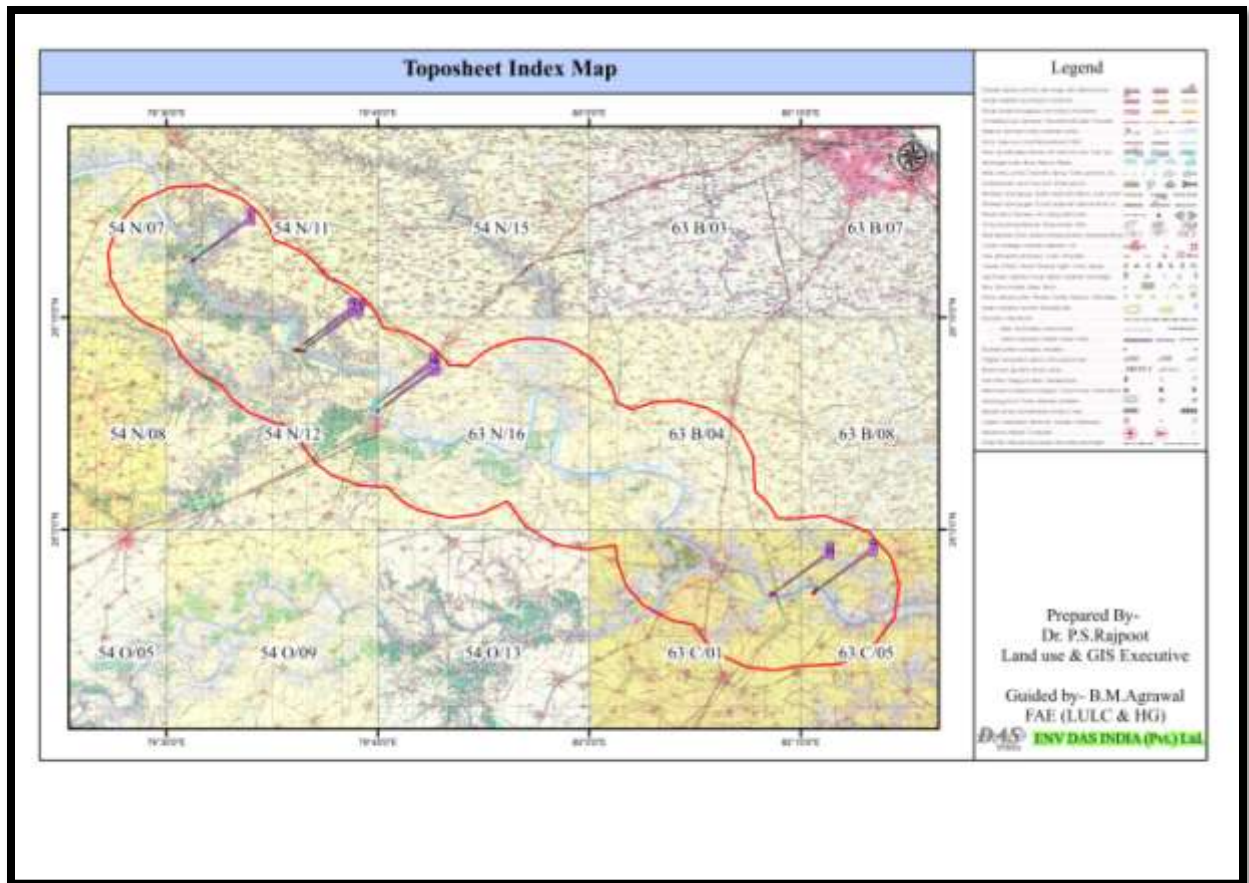


Fig 1.6 Toposheet of the stretch of Yamuna covered in EIA study

e. Location of Lease Area.

Given in Subchapter2a: Lease wise description

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 EIA report of the study area is prepared as per requirement of the TORs issued by State Level Expert Appraisal Committee, Uttar Pradesh/ 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**.

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 river's 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 riverbed leads to the destruction of the entire river system. If sand and gravel are extracted in quantities exceeding the capacity of the river 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. 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 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, 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 Yamuna River Bed in Kanpur Nagar, Kanpur Dehat & Hamirpur District inclusive of 05 B₁ category mines and 03 B₂ Category mines for morrum excavation (inclusive of upcoming projects of B₁-sub-category for which Public Hearing is awaited and B₂- sub-category projects for which EC is awaited).

1.8.1 Environmental rationale considered for group of leases 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, Kanpur Dehat.

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 Responsibility; 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 10th 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

PROJECT DESCRIPTION

S. NO.	CONTENTS
2.1	DESCRIPTION OF THE PROJECT
2.2	LEGISLATIONS APPLICABLE TO MINING OF MINOR MINERALS
2.3	CONNECTIVITY
2.4	TOPOGRAPHY & PHYSIOGRAPHY
2.5	RIVER PROFILE
2.6	DRAINAGE
2.7	TYPE OF PROJECTS
2.8	LIMITATIONS AND RESTRICTIONS OF MINING
2.9	CLOSURE OF MINES
2.10	TECHNOLOGY AND PROCESS DESCRIPTION
2.11	MINING TECHNOLOGY
2.12	LAND USE PATTERN
2.13	LIFE OF MINE
2.14	INFRASTRUCTURE FACILITIES
2.15	COST OF INDIVIDUAL MINE & WHOLE GROUP OF LEASES
2.16	OTHERS
2.17	FACILITIES TO LABOURS

2.1 DESCRIPTION OF THE PROJECT

- 3 The proposed morrum mining project is new mining lease where the PP is 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, Hamirpur 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.
- 4 The proposed project is 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. There are total 08 sand/moram mining sites at Yamuna River

Bed in the study area for Regional EMP. The spirits of EIA notification is the cumulative impact assessment of two small mines which individually are believed to cause least impact and create a larger picture. The total area of mining lease for M/s Harihar minerals LLP is 18.33 Ha and the total annual production will be 274950.0 cum/annum. The plan period of the entire group of lease is 05 years.

2.2 CONNECTIVITY

NH-25,NH-2A, and NH-86 are passing through the buffer zone of study area. Four state highways SH-91, SH-42, SH-46 and SH-17 passes through the vicinity of the projects along with other metalled road.

Table.2.3 Major roads of Study area

S.No.	Sub Category Name	Name Of Road	Road Number	Length (in km.)
Kanpur Dehat				
1	National Highway	Delhi Kolkata Road	NH0002	61.000
	National Highway	Sikandra Bhognipur Road	NH002A	27.000
	National Highway	Lucknow Kanpur Jhansi Shivpuri Road	NH0025	39.370
2	State Highway	Lucknow Mohan Bangarmau Nanamau Bilhaur Bela Etawah Marg	SH0040	31.000
	State Highway	Bhognipur Ghatampur Choudgara Marg	SH0046	21.000
	State Highway	Chaubepur Bela Marg	SH0068	33.500

3.	Major District Road	Sikandara Rasulabad Marg	MD047C	41.972
	Major District Road	Billhaur Makanpur Bighasan Rasoolabad	MD085C	20.000
	Major District Road	Kalyanpur Shivali	MD078C	18.000
Kanpur Nagar				
1.	National Highway	Delhi Kolkata Road	NH0002	56.966
2.	National Highway	Lucknow Kanpur Jhansi Shivpuri Road	NH0025	2.908
3.	National Highway	Kanpur Saagar Road	NH0086	32.074
4.	National Highway	Delhi Kanpur Road (Urban Area Of Ghaziabad	NH0091	74.057
5.	State Highway	Lucknow Mohan Bangarmau Nanamau Billhaur Bela Etawah Marg	SH0040	21.240
6.	State Highway	Bhognipur Ghatampur Choudgara Marg	SH0046	32.340
7.	State Highway	Chaubepur Bela Marg	SH0068	14.000
8.	Major District Road	Ramaipur Sath Jahanabad Marg	MD082C	26.540
9.	Major District	Billhaur Makanpur Bighasan Rasoolabad Marg	MD085C	22.600

	Road			
10.	Major District Road	Kalyanpur Shivali Marg	MD078C	21.000
Hamirpur				
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 Banda 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 Sadar 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 Sadar Kapsa Banda Marg	MD510B	10.050
	Major District Road	Muskara Sadar Kapsa Banda Marg	MD610B	29.700

The study area comprises of 06 districts namely, Kanpur Dehat, Kanpur nagar and Hamirpur where mining lease exist along the stretch of Yamuna River and Auraiya, jalaun and Fatehpur which are the part of Buffer zone, The road network of Kanpur Dehat, Kanpur Nagar and Hamirpur given below:

2.4 TOPOGRAPHY & PHYSIOGRAPHY

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 Kailanhigh 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.

Yamuna River is following from North West to South East from Etawah district to Kanpur and forming a large meanders. The deposition of sediments occur in channel and terrace form.

Betwa river, a tributary of river Yamuna flowing from SW to NE meets with Yamuna river on the right bank in Hamirpur District.

Geologically Etawah District occupies a part of Indogangetic plain and is underlain by quaternary sediments consisting of clay silt Kankar and sands of different grades. The thickness of these quaternary sediments increases gradually towards north. The general geological succession of the formations is given below.

Lithologic Composition	Group	Age
Fine Sand, Silt and Clay	Newer Alluvium	Upper Pleistocene to Recent

Clay with Kankar and sands of different grade	Older Alluvium	Lower Pleistocene to Upper Pleistocene
Unconformity		
Sand Stone Shales and Lime stone	Vindhya	Proterozoic
Granite and gneiss and outcrops of granitoid, meta sedimentaries and basites, dolerite and quartz reef.	Bundelkhand Granitic complex	Archean to Proterozoic

In Etawah District the sediments of newer alluvium are mainly arenaceous in nature and are found in topographically low region. These sediments are loose, unconsolidated flood plain deposits and are confined in narrow strips all along the present drainage system. The newer alluvium material along the river Yamuna comprises mainly micaceous mineral. While in the northern parts along the bed of the river Sonar the younger alluvium material resembles mineralogically to older alluvium material as it is formed by the reworking of older alluvium through alluvial action. The younger alluvial material occupying extreme southern part of the district differs in composition as the river Chambal originating from plateau region, south of Etawah district comprising mainly sandstones. The older alluvium material generally occupies the region of higher elevation. These sediments are argillaceous in nature and relatively compact. The clays predominate over sandy horizon in older alluvium.

There are only sands in Etawah district which are extracted from river Yamuna for purpose of the building materials.

2.5 RIVER PROFILE

The Yamuna is the longest and the second largest tributary river of the Ganga in northern India. It originates from Yamunotri glacier at a height of 6,387 metres on the south western slopes of Bandarpooh peaks in the uppermost region of the Lower Himalaya in Uttarakhand. The catchment of the Yamuna River system covers

parts of Uttar Pradesh, Uttarakhand, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh & Delhi states. The area of the Yamuna catchment lying in different states is shown below:

Table. 2.6. Catchment of River Yamuna in various states:

Name of State	Catchment area in the state (sq.km)
Uttar Pradesh (Including Uttarakhand)	74,208
Himachal Pradesh	5,799
Haryana	21,265
Rajasthan	102,883
Delhi	1,485

Table 2.7. Statewise Allocation of Utilizable flows of Yamuna River

State	Allocation in MCM
Uttar Pradesh	4,032
Himachal Pradesh	378
Haryana	5,730
Rajasthan	1,119
Delhi	724
Total	11,983

The Yamuna River can be segmented in five distinguished independent segments due to characteristic hydrological and ecological conditions as shown below:

Table. 2.8 . Different Segments of Yamuna River

Name of Segment	Location	Length
Himalayan Segment	From origin to Tajewala Barrage	172 km
Upper Segment	Tajewala Barrage to wazirabad Barrage	224 km
Delhi Segment	Wazirabad Barrage to Okhla Barrage	22 km

Eutrophicated Segment	Okhla Barrage to Chambal Confluence	490 km
Diluted Segment	Chambal Confluence to Ganga Confluence	468 km

Tributaries of Yamuna River

The Yamuna is a mighty river in itself and has a number of tributaries. In its first 170 km stretch, the tributaries Rishi Ganga Kunta, Hanuman Ganga, Tons and Giri join the main river. Later, big rivers, such as the Chambal, the Sind, the Betwa, and the Ken, join it. The tributaries of Yamuna account for 70.9% of the catchment area; the balance of 29.1% area directly drains into the Yamuna River or is occupied by smaller streams. Further, the catchment area of Yamuna amounts to 40.2% of the area of Ganga Basin and 10.7% of the land area of India.

Drainage Pattern

Yamuna river travels a total length of 1,376 kilometres (855 mi). The drainage area of the Yamuna basin is 366,220 sq km (141,399 sq mi), 40.2% of the entire Ganges Basin, which comprises part of seven states, viz. Uttarakhand, Himachal Pradesh, Uttar Pradesh, Haryana, Delhi, Rajasthan and Madhya Pradesh. Most importantly it creates the highly fertile alluvial, Yamuna-Ganges Doab region between itself and the Ganges in the Indo-Gangetic plain. Nearly 57 million people depend on the Yamuna waters.

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 (Vindhyan). 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.

Table. 2.9. The generalized stratigraphical sequence of Yamuna Basin

Era/Period	Age/ Group	Formation	Lithology
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

The southern hilly tract of Uttar Pradesh known as Bundelkhand is roughly parallel to the North Ganga Yamuna Lineament. It is underlain 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. 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 study area of this mining activity lies between the coordinates 25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"E and comprises of districts Kanpur Dehat, Kanpur Nagar, Hamirpur, Auraiya, Jalaun and Fatehpur. The average slope of the stretch is 1.0% with maximum slope of 2.8%.

The study area is underlain by alluvial deposits mainly which is of Pleistocene to Recent age. The alluvial deposits found within the study area are both Older alluvium and Newer Alluvium. Older Alluvium categorized into Banda and Varanasi Alluvium of Middle to Upper Pleistocene age. Newer Alluvium belongs to upper Pleistocene to Recent age. Within the study area, the major portion is overlain by Varanasi Alluvium in the districts Auraiya. Kanpur Dehat, Kanpur Nagar and Fatehpur and Banda alluvium found towards the districts Jalaun and Hamirpur and also a palaeochannel(25°53'23.88"N 80° 9'43.06"E) is found around the area where river Betwa joins the Yamuna river.

Along the water channel of Yamuna river flowing from North-west to South-east direction, newer alluvium is found viz. Terrace and Channel alluvium are found. Channel alluvium is mostly concentrated in the upper reaches of the river within the 10km radius buffer zone lying in districts Jalaun(26°20'25.40"N 79°32'39.93"E), Kanpur Dehat(26°16'47.91"N 79°33'15.89"E) and Kanpur Nagar(25°56'16.70"N 80°13'24.52"E) which indicates the presence of Channel, point and lateral bars within the active water channel and river bed of these formerly mentioned districts are partially or wholly submerged during the monsoon season.

Terrace alluvium which is found on the older flood plain of river Yamuna. These flood plains are low lying and preserved from the incision of rivers, hence the sediment keeps on getting deposited on these flood plains forming a terrace like formation. The deposition of alluvium is mainly coarse to very coarse in nature in texture. Within our study area, at many places the major deposition of terrace alluvium can be observed on river Yamuna in districts Kanpur

Dehat (26°22'32.08"N 79°31'6.90"E), Kanpur Nagar (26° 5'58.57"N 79°59'39.41"E), Hamirpur (26° 7'37.26"N 79°56'40.23"E & 25°54'20.59"N 80°19'4.11"E) and also on Betwa river which joins the Yamuna river in Hamirpur(25°54'25.89"N 80° 8'53.47"E) district has deposition of Terrace alluvium.

River Yamuna flowing within the Kanpur Dehat and Jalaun districts upto Behmai the average water level of the river is approximately 102m and the sand deposition within the stretch is of average thickness 39m-11m. In the next stretch upto Kalpi, the average water level of Yamuna river is approx. 1000m and the average thickness of sediments varies from 33m-13m. In the next stretch just before it enters Kanpur Nagar district, the average level of water in Yamuna river is 95m and the average thickness of sediment deposition is 28m-8m. Further down the stream within the Kanpur Nagar upto the point where Betwa river joins the Yamuna River in Hamirpur district the average water level of the river is approx. 94m and the average thickness of sediment deposition varies between 25m-10m. In the last stretch of Yamuna river flowing within the study area, the level of water in the river is approximately 92m and the average thickness of sediment deposition is 20m-8m

Characteristic of Yamuna Sands

In Yamuna River, medium to coarse sand is mainly constituted of quartz and feldspar minerals with little micaceous. Presence of quartz varies from 2 to 5% and heavies 2 to 5%. It contains very little amount of Clay minerals.

b. Soil

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 it 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 **Kanpur Nagar district**, soil exhibits a great variety of composition and appearance. The major part of the district consists of ordinary soils known locally as Bhur and Sand on ridges, Matiyar or clay in depressions and Domat or Loam in the Plains. The 'Reh' prevails in the clay dominant areas.

ALLUVIAL PLAIN (0-1 % SLOPE)

1. Deep, loamy soils and slightly eroded.
2. Deep, loamy soils and slightly eroded associated with silty soils.
3. Deep, fine soils moderately saline and sodic associated with loamy soils, slightly eroded.
4. Deep, fine soils and slightly eroded associated with loamy soils slightly saline and moderately sodic.
5. Deep, fine soils and slightly eroded associated with loamy soils.
6. Deep, silty soils associated with loamy soils slightly eroded.
7. Deep, silty soils with moderate salinity/sodicity associated with loamy soils slightly eroded. ,"
8. Deep, loamy soils and slightly eroded associated with silty soils slightly saline/sodic and moderately sodic.
9. Deep, silty soils and slightly eroded associated with fine soils.

OLD ALLUVIAL PLAIN WITH RIVER [LEFT OUT CHANNELS/OXBOWSIPOINT BARS (1-3%SLOPE)]

10. Deep, loamy soils and slightly eroded associated with stratified loamy soils slightly eroded

RECENT ALLUVIAL PLAIN 0-3% SLOPE]

11. Deep, loamy soils with moderate water logging and slight salinity associated with fine soils, slightly water logging.
12. Deep, silty soils and slight flooding associated with loamy soils and slight flooding.
13. Deep, loamy soils slightly eroded associated with sandy soils with slight flooding.
14. Deep, silty soils, moderately saline and sodic associated with loam soils and slightly eroded.

ACTIVE FLOOD PLAIN (1-3% SLOPE)

15. Deep, sandy soils with moderate flooding associated with stratified loamy soils and slight flooding.
16. Deep, stratified loamy soils, with moderate flooding associated with sandy soils with moderate flooding.
17. Deep, stratified loamy soils, with severe flooding associated with loamy soils with moderate flooding.

VERY GENTLY SLOPING UPLANDS WITH HUMMOCKS (1-3% SLOPE)

18. Deep, fine soils, slightly eroded associated with fine semiotic soils and slightly eroded.

Kanpur Dehat: The major area (about 90%) falls under Yamuna sub basin is covered by older alluvial soils consisting broadly of 'Bhur' or sandy soil occupying high mounds, Matiyar or clay rich soil in depressions and 'Domat' or loam in the plains.

In **Auraiya** district, broadly four types of soils found in the area are those generally occur in Ganga alluvial plain. These are briefly described as follows;

Bhur: Youngest soil occurs along river beds and contain large portion of sand.

Matiyar: Occur in low lying areas and contain large portion of clay.

Dumat: It is a loamy soil with dark colour, having clay and sand in equal proportion and can be categorized as intermediate type of bhur and matiyar. Such soil generally occurs in the upland areas.

Pilia: A lighter soil than Dumat and is an intermediate type of Dumat and Bhur.

The Soil found in the district **Fatehpur** exhibit a great variety of composition and appearance. The soil types are sandy loamy and sandy soil, loam clayey, fine texture soil. The diversity of soil is mainly due to the influence of the various river and partly due to presence of peculiar soil Bundelkhand along the course of the Yamuna river. The major part of district consist of the ordinary soil locally known as Bhur or sand which is found on the ridge, Matiar or clay in the depression and Dumat or loan in the plains, Reh prevails in the clay dominant area. Prominent patches have been observed in part of eastern part of Teleyami block, Bhitaura, Hathgaon, and northern part of Haswa Khayua blocks. Purely alluvial soil of the river valley are present notably in the Kachhar of the Ganga and Yamuna rivers formed by repeated deposit of silt, brought down by river during floods.

c. Hydrology

The Yamuna together with the rivers Tons and Belan from the main drainage system of the area. 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.

(Pre-monsoon Depth to water level during May' 2012): 9.00 to 23.80 mbgl

(Post-monsoon Depth to water level during Nov' 2012): 5.04 to 19.05 mbgl

Long term of water level trend in 10 years (2003-2012) in m/year:

Rise = Nil, fall= 0.0545 to 1.1609

Groundwater Exploration by CGWB (As on 2012):

Depth Range (m): 10166-282.60 mbgl

Discharge (litres per minute): 1000-4000

Transmissivity (m^2/day): 2935 to 3660

2.6 DRAINAGE

The Yamuna is the longest and the second largest tributary river of the Ganga in northern India. It originates from Yamunotri glacier at a height of 6,387 metres on the south western slopes of Banderpooch peaks in the uppermost region of the Lower Himalaya in Uttarakhand. The catchment of the Yamuna River system covers parts of Uttar Pradesh, Uttarakhand, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh & Delhi states.

Tributaries of Yamuna River

The Yamuna is a mighty river in itself and has a number of tributaries. In its first 170 km stretch, the tributaries Rishi Ganga Kunta, Hanuman Ganga, Tons and Giri join the main river. Later, big rivers, such as the Chambal, the Sind, the Betwa, and the Ken, join it. The tributaries of Yamuna account for 70.9% of the catchment area; the balance of 29.1% area directly drains into the Yamuna River or is occupied by smaller streams. Further, the catchment area of Yamuna amounts to 40.2% of the area of Ganga Basin and 10.7% of the land area of India.

Drainage Pattern

It travels a total length of 1,376 kilometres (855 mi). The drainage area of the Yamuna basin is 366,220 sq km (141,399 sq mi), 40.2% of the entire Ganges Basin, which comprises part of seven states, viz. Uttarakhand, Himachal Pradesh, Uttar Pradesh, Haryana, Delhi, Rajasthan and Madhya Pradesh. Most importantly it creates the highly fertile alluvial, Yamuna-Ganges Doab region between itself and the Ganges in the Indo-Gangetic plain. Nearly 57 million people depend on the Yamuna waters.

A) Drainage Pattern & Groundwater Trend in Hamirpur: Ground water is mainly controlled by drainage, topography and lithological behaviour, it occurs underground water condition at shallow depths and under confined condition at deeper depths.

Drainage system & Ground water trend in district Hamirpur: Drainage of Hamirpur district is quite unique in characteristics because of diversifies 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.2.10. Rivers in Study area-3

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%

Yamuna: River Yamuna enters in Hamirpur district near Misripur reserved forest then passes through Haraulipur village. Subsequently, river passes through

several villages and Bhaura is the last census village through which Yamuna river passes in district.

Betwa: River Betwa enters in Hamirpur in Chandawari Danda reserved forest and subsequently passes through Ghurauli and Mngrauth villages. In Chandawari Danda, river Dhasan meets with river Betwa. In between village Baragaon and Sultanpur, Betwa joins river Yamuna.

Dhasan: River Dhasan enters in Hamirpur district near Jhinna Bira Reserved forest then passes through Kuchhechha R.F. Subsequently, river passes through Derra Khurd and Ramgarh R.F. and Chandawari Danda is the last village after which Dhasan river meet Betwa river.

Ken: River Ken enters in Hamirpur district near reserved forest before Khair then passes through various villages and exit after Garha village of Hamirpur.

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 seasoned 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 irrigation in the district (2009) was 20612.16 ha-m whereas the ground water draft

for the domestic and industrial was 2225.61 ha-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 23393.51 ha-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.

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: The major parts of the area are almost a flat plain with some minor undulations. The river Ganga and Yamuna with their tributaries form the drainage system (Dendritic type). The prevailing hydrogeological conditions and geomorphology controls the water table configuration. 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 becomes 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.

The long term water level trend for last 10 years shows annual declining trend and varies from 10cm/year to 88cm/year. In the district shallow aquifer in the depth range of 20-96 mbgl has been 'tapped' or utilized through cavity and strainer wells. The specific yield of unconfined aquifer is 12 %. The Net Annual Ground Water Availability of the district is 926.61 MCM. The existing Gross Ground Water Draft is 623.93 MCM. The stage of ground water development is 67.33%.

Groundwater trend in district Kanpur Dehat: The drainage system of the district is controlled by Ganga – Yamuna and tributaries like Pandu, Rind and Sengar. The unconsolidated alluvial sediments deposited over undulatory surface of the basement rock shows alternative beds of granular and clay horizons and the thickness of these sediments varies from 150 m (along Yamuna in south) to 565 m

(along Pandu in north). These granular zones form the multiple aquifer system and have been clubbed into four groups. The vertical and horizontal extents of different aquifer groups and cumulative thickness of granular zones in each group are as follows:

Table 2.11 Aquifers in Kanpur Dehat

Aquifer Groups	Occurrences		Ariel Extent	Potential	Quality
	Depth Range (mbgl)	Cummulative (Thickness of granular zone) (m)			
I Aquifer Group	GL-150	40-65	In entire district	Low to moderate	Good
II Aquifer Group	150-250	30-50	North& central part of district	Moderate	Poor (Saline)
III Aquifer Group	200-250	70-120	In entire district	High	Good Potable
IV Aquifer Group	Below 250	30-70	Encountered in western parts only	Moderate	Poor (Saline)

The ground water occurs under unconfined condition in phreatic aquifer and in confined condition in deeper aquifer. In year 2012, depth to water level in pre – monsoon period varies from 3.64 mbgl to 16.70 mbgl and during post monsoon from 1.30 mbgl to 15.42 mbgl. The fluctuation in ground water level varies from 0.20 to 2.34 m. The premonsoon water level trend for last 10 years (2003-2012) shows fall from 4 to 69 cm/year whereas rise is 8 cm/year. In pre-monsoon period decline in water level trend varies from 1.8 to 71 cm/year. In post-monsoon period, long term level trend show a fall from 8 to 82 cm/year.

The annual ground water recharge for the district (as on 31.03.2009) has been estimated as to 80952 ham. The net ground water availability of the district is

80951.80 ham. The gross ground water draft for all uses is 55274.91 ham. The net ground water availability for future irrigation development is 24598.16 ham. The stage of ground water development is 68.28 %.

Groundwater trend in district Auraiya: The area is drained by the tributaries of river Yamuna viz., Sengar, and Rind which generally flow from NW to SE direction. River Yamuna and its major tributary Chambal drain through southern most bordering parts of the district and flow in SE direction. The rivers and tributaries are perennial and follow a meandering course in narrow flood plains.

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.

Fig 2.7. Yamuna Lower Sub-basin and Watersheds

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. 2.12 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
2.	Yamuna Middle	34586.39	19	01	22	3576	7
3.	Yamuna Upper	35798.19	06	12	14	2842	23

Table No. 2.13 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
2.	Yamuna Middle	43	410.43	1232.25	804.33
3.	Yamuna Upper	47	321.77	1241.11	761.66

Fig 2.8 Yamuna Lower Sub-basin- Water Resource Assets

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 Yamuna namely Kanpur Dehat, Kanpur Nagar, Hamirpur, Jalaun, fatehpur and Auraiya.. 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.

Fig.2.9. Seismicity map of U.P.

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.

2.7 TYPE OF THE PROJECT

The proposed project is to mine sand/morrum 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 Ken 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 **274950.0 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. 2.9: Characteristics of minerals (Minor)

S.No.	Ore Type	Chemical Constituent in percentage (%)				
		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	Mn ₂ O ₃ + TiO ₂	Na ₂ O +K ₂ 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.

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 2.9.Google Map showing general location of Study Area

2.7.2.1. Co-ordinates of Leasehold area of lease areas in riverbed of Yamuna Given in Subchapter2a: Lease wise description

2.7.2.2. Production details of individual mines

Given in Subchapter 2a: Lease wise description

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

The total mine lease area of M/s Harihar minerals LLP is 18.33 Ha and the annual production is 274950.0 cum

2.7.4. 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 Mines. The total area of mining lease is **18.33 Ha** and **274950.0 cum/annum** is 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 within 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.

2.7.5. Proposed schedule for approval and implementation

Mining plans are approved by DGM for river bed mining of Morrum 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 Morrum 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

- Morrum 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
Which ever 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.

(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 18.33 ha, the proposed project is to extract morrum from the river bed of Yamuna River.

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 project is confined to the extraction of morrum up to **274950.0** m³/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.

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

Given in Subchapter 2a: Lease wise description

2.9 CLOSURE OF MINES

The proposed project is opencast riverbed mining of morrum for 5 years, where the extraction of morrum is only 274950.0 cum/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.
-  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, day time, dry season.

Mining activity in river bed of Yamuna River will be open cast and semi mechanized (OTFM). The mining method will be bar scalping/scraping (OTFM) using bar scraper for Morrum scraping form 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 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.

Fig. 2.12. Bar excavation Mechanism

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

Bar scrapper	
	The Bar scrapper is a PTO driven rear mounted attachment of tractor which collects sand from the surface through the scrapper blade and fills it in the tractor's trailer through a conveyor arrangement.. Sand is accumulated by the scrapper blade from the ground and collected by angles which are placed on the belt of conveyor This sand is conveyed along the chain of conveyor which drops it from a height of eight feet in the trailer of the tractor moving parallely. The conveyor comprises a set of chains.
<u>Loader</u>	
	A loader is a type of tractor, usually wheeled, sometimes on tracks, that has a front-mounted square wide bucket connected to the end of two booms (arms) to scoop up loose material from the ground, such as dirt, sand or gravel, and move it from one place to another without pushing the material across the ground. A loader is commonly used to move a stockpiled material from ground level and deposit it into an

	awaiting dump truck or into an open trench excavation.
<u>Dumper</u>	
	A dumper is a vehicle designed for carrying bulk material, often on building sites. Dumpers are distinguished from dump trucks by configuration: a dumper is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a dump truck has its cab in front of the load. The skip can tip to dump the load; this is where the name "dumper" comes from. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor. Dumpers with rubber tracks are used in special circumstances and provide a more even distribution of weight compared to tires. Continuous tracks allow the operator to carry heavier payload on slick, snowy, or muddy surfaces, and are popular in some countries.
<u>Trucks</u>	
	A truck or lorry is a motor vehicle designed to transport cargo. Trucks vary greatly in size, power, and configuration; smaller varieties may be mechanically similar to some automobiles. Commercial trucks

	can be very large and powerful, and may be configured to mount specialized equipment, such as in the case of fire trucks and concrete mixers and suction excavators
<u>Sprinkler</u>	
	These systems use spray nozzles to apply water and/or chemicals such as wetting, foaming and binding agents to dust particles. However, the system configuration varies depending on the goal – dust prevention or airborne dust suppression. Most operations require both prevention and suppression to effectively control dust.
<u>Bulldozer (optional) for rescue and salvage</u>	
	Typically, bulldozers are large and powerful tracked heavy equipment. The tracks give them excellent ground holding capability and mobility through very rough terrain. Wide tracks help distribute the bulldozer's weight over a large area (decreasing ground pressure), thus preventing it from sinking in sandy or muddy ground. Extra wide tracks are known as swamp tracks or LGP (low ground pressure) tracks. Bulldozers have transmission

	systems designed to take advantage of the track system and provide excellent tractive force.

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

2.12. LAND USE PATTERN

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

Given in Subchapter 2a: Lease wise description

2.13 LIFE OF MINE

The total production of Morrum is 274950.0 cum / annum for plan period of 5.0 years.

2.14 INFRASTRUCTURE 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 leasewise details of Project cost, Manpower and water requirement of leases in the riverbed of Yamuna River in District Banda & Hamirpur included in Study Area are discussed in detail.

Given in Subchapter 2a: Lease wise description

2.16 OTHER FEATURE

WATER

Given in Subchapter 2a: Lease wise description

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.

Given in Subchapter 2a: Lease wise description

COST

Given in Subchapter 2a: Lease wise description

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

The water requirement is anticipated to carry out the semi mechanized/OTFM (Other Than Fully Mechanized) excavation 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.

As per The National Action Plan for Municipal Solid Waste Management, CPCB, 100 litres capacity bin per 20-30 (Approx. 150 person) household is required. Also Shops/ offices/ institutions/ workshops/ hotels/ restaurants/ meat shops/ fish shops etc. should be directed to store their waste on-site in sturdy containers of about 100 litres capacity. So it is suggested to keep 02 dustbins of approx 50.0 litres per site.

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.

Table.2.11. 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 of mine work 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	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)	The Mine workers will be trained by Environment officer for – • Working conditions are hazardous details • Site specification • Emergency response • Providing first aid • Evacuation Plan • Report of Incidence • Emergency contact numbers The Mine Manager will be responsible for Training of Mine Workers.

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

2.11. 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.**

2.11.1. 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.

Lease wise Lease wise Project Description

S.No.	Content
2a.1	GENERAL
2a.2	M/s harihar Mineral LLP
2a.3	Other projects in the cluster

Chapter-2a: Lease wise description

Cosidering the large amount of informantion to be included in the EIA, we have compile lease wise information here.

2a.1 GENERAL

The proposed projects are to mine morrum from dry river bed sustainably and scientifically. The total area of mining lease is 18.33 Ha and the total annual production will be 274950.0 cum/annum. The plan period of the entire group of lease is 05 years.

2a.2 M/s Harihar Minerals LLP, Bhognipur/Kanpur Dehat

2a.2.1. History

Project Proponent(s) & Name of Company (if any) & Residential Address	M/s Harihar Minerals LLP located at 405 Kha, New Patel Nagar, Near Kalidas School, Orai, Jalaun Proprietor Shri Ram Autar Singh S/o Shri Tejram Singh R/o New Patel Nagar, Orai, Jalaun (U.P.)
Gata No (s)/ Arajai No (s)/ Khand No (s)	Khand No. K- 2, Gata No. 389 Mi, 390 Mi
Village	Kharka

Tehsil/ District	Bhognipur/ Kanpur Dehat		
Area (ha)	18.33		
Date of issue of Letter of Intent (LOI)	18.01.2018		
MP approved on	Yes on 15.02.2018		
Date of submission of EC application to MoEF's Portal with acknowledgement number & File No.	26/03/2018 , SIA/UP/MIN/22656/2018 File No. 4160		
Report Submission date	28.03.2018		
Date of presentation/ Agenda No. /Sl. No.	TOR- 04.04.2018, 328, 11		
Date of submission of draft EIA for Public Hearing	27.07.2018		
Date of grant of TOR/EC	TOR- 25.04.2018		
Public hearing conductance	PH conducted on 19.09.2018		
Co-ordinates	PILLAR	LATTITUDE	LONGITUDE
	A	26°12'45.72"N	79°39'25.31"E
	B	26°12'39.29"N	79°39'52.99"E
	C	26°12'33.10"N	79°39'50.34"E
	D	26°12'38.00"N	79°39'22.06"E
Annual Production	274950 .0 m ³ /annum		

2a.2.2. Project Detail and Surrounding features

Sl. No.	Item	Details
1.	Name of the Applicant	Shri Ram Autar Singh
2.	Mining Lease Area	Sanctioned Lease Area- 18.33 ha Effective working Area- 18.33 ha
3.	Land Use	River Bed of Yamuna 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	Yamuna River
7.	Name of RF, PF, Wildlife Sanctuary, Eco-sensitive area	No, RF, PF, Wildlife Sanctuary, Eco-sensitive area is located within core and 500 m radius of the proposed project site.

9.	Location	Khand No. K- 2, Gata No. 389 Mi, 390 Mi, Village- Kharka, Tehsil- Bhognipur, District- Kanpur Dehat														
10.	Topography	Plain River bed of Yamuna 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><tr><th>Year</th><th>Production in cum</th></tr><tr><td>Ist</td><td>274950.0</td></tr><tr><td>IIInd</td><td>274950.0</td></tr><tr><td>IIIrd</td><td>274950.0</td></tr><tr><td>IVth</td><td>274950.0</td></tr><tr><td>Vth</td><td>274950.0</td></tr><tr><td>Total</td><td>1374750.0</td></tr></table>	Year	Production in cum	Ist	274950.0	IIInd	274950.0	IIIrd	274950.0	IVth	274950.0	Vth	274950.0	Total	1374750.0
Year	Production in cum															
Ist	274950.0															
IIInd	274950.0															
IIIrd	274950.0															
IVth	274950.0															
Vth	274950.0															
Total	1374750.0															
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. 12 Crore 78 Lacs (excluding royalty)														
16.	Water demand	15.12 KLD (Drinking, Plantation and Sprinkling)														
17.	Sources of water	Existing dugwells/borewells in nearby village(for drinking)														
18.	Ultimate depth of Mining	3 m from the surface or 1 m above the water level of the river whichever is less														
19.	Man power	Approximately 66 workers including site and supervisory staff (unskilled and semi-skilled)														
20.	Solid Waste	Negligible solid waste will be generated and dustbin will be provided along with the mobile toilets to the worker.														
21.	Nearest railway station	Chunrah Railway Station- 12.80 km* (SE)														
22.	Nearest state highway	NH2A (Sikandra - Bhognipur)- 9.5 km* (NE)														
23.	Nearest Airport	Kanpur Airport- 77.60 km* (NE)														
24.	Nearest city	Nearest City/Town: Kalpi: 13.0 km*(SE)														

Cost of Project

TOTAL COST OF MACHINE (Rs.)	TOTAL LABOUR COST (Rs.)	EMP COST (Rs.)	TOTAL PERATIONAL COST (Rs.)
82500000.0	37874506.0	3426499.0	127845565.0

Manpower requirement

UNSKILLED LABOUR	SKILLED LABOUR	OTHERS	FLOATING POPULATION
46	09	12	153

Reserve estimation

MINE LEASE AREA (Ha)	WORK ABLE AREA (Ha)	GEOLOGICAL RESERVE (m ³)	PROPOSED PRODUCTION AS PER LOI (m ³ /annum)
18.33	18.33	916500.0	274950.0

Project Location

Water requirement

Water Demand (KLD) for Sprinkling on Unpaved haulage road	Water Requirement for plantation (KLD)	Drinkin g water -Day worker (KLD)	Drinking water - Floting populatio n(KLD)	Drinking water - Fixed populatio n(KLD)	Stored water (KLD)	Total Water
11.80	0.069	0.60	0.44	0.61	0.10	13.62

Layout Plan

Land Use

TOTAL MINE LEASE AREA (ha)	WORK ABLE AREA	NON- WORKABLE AREA	UNUSED AREA (ha)	AREA USED FOR AMENITIES	AREA LEFT AS SAFETY ZONE	MINEABLE AREA (ha)

	(ha)	(ha)		(ha)	(ha)	
18.33	17.6003	0.0	0.5792	0.1505	0.7297	16.8706

Waste generation

MSW FOR FLOATING POPULATION (kg)	MSW FOR FIXED POPULATION (kg)	MSW FOR MANPOWER (Approx 8.0 HRS) (kg)	TOTAL MSW GENERATION (kg)
23.1	6.0	13.5	42.6

Water budgeting

TOTAL WATER (KLD)	DRINKING WATER (KLD)	FRESH WATER (KLD)	WASTE WATER (KLD)	LOSS OF WATER(KLD)
9.30	1.36	2.79	6.51	1.86

Haulage route

Google Map showing Haulage Route- M/s Harihar Minerals LLP.

Above Figure represents the Haulage route which will be used by **M/s Harihar Minerals LLP**. The path shown in **Blue colour** represents the unpaved road and **Yellow colour** represents the paved road. The unpaved road is >10m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)

CHAPTER-III

DESCRIPTION OF ENVIRONMENT

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

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 regional study on the stretch of River Yamuna covers six districts namely Kanpur Nagar, Kanpur Dehat, Hamirpur, Jalaun, Auraiya and Fatehpur. Total 08 Sand Mining projects comprising 05 of Sub-category B1 and 03 of Sub-category of B2 are situated between 25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"E in the river bed of Yamuna.

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 three 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 regional 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.

c. Assessments of the Present state of the Environment for the specified area under study based on following factors:

- Bedrock, soils and landforms
- Surface water bodies and groundwater bodies, e.g. lakes and watercourses, flow rates and directions in water courses, water levels, water quality, soil and bedrock hydrogeology, and particularly any important reserves of groundwater used for the local water supply
- Any protected areas
- Natural habitats and any plant and animal species of conservation interest
- Local climate and air quality
- Land use, e.g. regional and local land use patterns and structures
- Current regional land use plans, local detailed plans
- Landscapes and landforms
- Cultural heritage and the built environment (including any significant built cultural environments and archaeological sites)
- The usage of local natural resources
- Settlements, demographic structure

Profile of the overall study area is presented in the following sections. The scope of the baseline studies includes detailed characterization of various Environmental & Social components, which are most likely to be influenced by the mining activity.

1. Land Environment:

- Land use/Land Cover
- Topography & Terrain
- Drainage Pattern & Ground water Trend
- Geology and Physical Features
- Soil

2. Physical Environment:

- Meteorological conditions
- Climate
- Rainfall & Relative Humidity
- Windspeed & Wind direction

3. Water Environment

4. Air Environment
5. Noise Environment
6. Soil Environment
7. Biological Environment
8. Socio-Economic Environment
9. Occupational Health Status
10. Public Utilities (Traffic Analyses)
11. Site-specific features

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 regional study includes part of six districts i.e Hamirpur, Jalaun, Kanpur Nagar, Kanpur Dehat and Fatehpur along the river Yamuna. Hence, the regional geology given here is of six 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 thin 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:

- **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.

District Kanpur Nagar: The Kanpur Nagar district lies in middle part of Uttar Pradesh, It lies between Latitude 25°26' to 26°58' North and Longitude 79°43' to 80°34' East in Survey of India Toposheet No. 54N and 63B. The total geographical area of the district is 3155 sq.km. The major parts of the area are almost a flat plain with some minor undulations. The river Ganga and Yamuna with their tributaries form the drainage system (Dendritic type).

Kanpur Nagar plain is situated in the central part of the district covering parts of all six tahsils of the district with a little variation in relative relief. It is also formed of Alluvium and Dun-gravels of Recent age. A continuous belt of eroded surface may be seen along the Surayana, Gond and Puras streams in their lower courses. This region covers an area of 2,828.55 sq. km.

The Kanpur Nagar district is a part of Indo-Gangetic Plain. The clay, silt, gravel and sands of different grades are main sedimentary constituents. The generalized geological succession is as follows:

The older alluvium, alluvial deposit mostly occurring in the central part was deposited during lower to Upper Pleistocene period. The newer alluvium was deposited during Upper Pleistocene to recent period mostly occurring along the course of rivers.

- **District Kanpur Dehat:** The Kanpur Dehat district occupies the central part of Uttar Pradesh on eastern bank of Yamuna river and encompasses a total geographical area of 3021 sq. km., lying between latitude 26° 06'30" – 26° 50'15" N and longitude 79° 30'00" – 81° 10'15" E. The river Yamuna forms the south-western boundary of the district while northwestern side is bounded by Etawah and Kannauj district. The rest of its periphery is contiguous with the Kanpur Nagar district.
 - **District Auraiya:** The Auraiya district falls in Ganga basin and forms a part of Ganga-Yamuna Doab, covering the parts of Rind and Sengar river water sheds. A minor stretch along its southern border is however forms the part of Chambal water shed. The district forms a part of the Central Ganga Alluvial Plain which can be divided in to Upland areas (Banda Alluvium & Varanasi Alluvium) and Low land areas (Older flood plain & Younger flood plain). Generally the area forms an extensively level tract which is intercepted at places by sand ridges particularly in northern parts of the district whereas in the southern parts ravine land developed extensively in the vicinity of river Yamuna and Chambal. The terrain has gentle slope from north-west to south-east with a gradient of 0.2 m/km.
 - **District Fatehpur:** The area is underlain by the unconsolidated sediments of Quaternary to recent period which comprises of silt, clay, sand of various grades or gravel and Kankar in varying proportions. The unconsolidated sediment deposited over the undulating surface of the basement granite Vindhyan sand stone rocks. It exhibits the existence of thick succession of granular and clastic formations. The depth of basement varies between 100 to 200 mbgl along southern boundary of district along river Yamuna 200 to 350 mbgl in the central part of district and 300 to 450 mbgl along Ganga river boarding the northern part of district.
- a. 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 regional study includes part of six districts i.e Kanpur Nagar, Kanpur Dehat, Hamirpur, Jalaun, Auraiya and Fatehpur along the river Betwa. Hence, the topography and terrain given here is of six 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 area forms part of the Gangetic alluvial plains which is bounded on the south by Bundelkhand rocky terrain of Jhansi. It is roughly demarcated by rivers Betwa, Pahuj and Yamuna in the South, west and North and North-east respectively. A few outliers of Bundelkhand granite forming low hillocks are met with in southern parts of the area protruding from 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 extensively 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.

- **District Kanpur Nagar:** The district of Kanpur Nagar occupies the north-western part of the Kanpur division and belongs to the tract known as the lower Doab (which comprises the eastern extremity of the strip of country lying between the Ganga and the Yamuna rivers). The district is a part of Indo-Gangetic plain. The silt, gravel and sands of different grades are main water bearing formations. The ground water occurs under unconfined condition in phreatic zones and under confined condition in deeper zones. The sediment constitution of the subsurface granular zones shows remarkable variation in the depth and the nature of occurrence in north and southern part of the district. In southern part especially along the Yamuna, feldspar-quartz, Jasper sand and gravel (Morrum) are the main

constituents of the granular zones that occurs comparatively at shallow levels i.e. 24 to 57 mbgl whereas in the northern parts along the Ganga river, these reworked sedimentary formations are existing at deeper levels i.e. 265 to 310 mbgl. The provenance of these sedimentary formations is mainly Bundelkhand Granite Complex of Archean age and Vindhyan Sandstone of Puranas. In the northern part the silt and clay sediments forming thin lensoid beds are frequently occurring in depth.

- **Distict Kanpur Dehat:** The Kanpur Dehat district occupies a part of the Ganga-Yamuna doab in the Indo-Gangetic Plain. More than 90% of the district area exhibits more or less a flat topography with a gentle slope towards south-west. The elevation of the land surface varies from 117 m to 139 m.a.m.s.l. Geomorphologically, the area can be classified into three broad geomorphic units viz. Older Alluvial Plain, Older Flood Plain of rivers Yamuna, Sengar, Rind and Pandu and Active Flood Plain of these rivers.
 - (a) Older Alluvial Plain:** It is the oldest geomorphic unit which covers about 80% of the district area with many Paleo-channels, Tals, meander cutoff's and ox-bow lakes occur in this plain. Bad land and ravines are developed along the bank of Yamuna and Sengar rivers. The major parts of the area between Sengar and Pandu rivers are affected with salt encrustations.
 - (b) Older Flood Plain:** The Older Flood Plains of Yamuna, Sengar and Pandu rivers are limited to their higher zones and occur as narrow, curvilinear lenticular patches along course of these rivers. These are represented by either one or two terraces. The higher (T2) being erosional and lower (T1) depositional terrace which are characterised by fluvial landforms like abandoned channels and meanders cutoff's.
 - (c) Active Flood Plain:** It is restricted to the present day active channel regimes of Yamuna, Sengar and Rind rivers. The associated landform includes point, channel and lateral bars.

- **District Auraiya:** The district forms a part of the Central Ganga Alluvial Plain which can be divided into Upland areas (Banda Alluvium & Varanasi Alluvium) and Low land areas (Older flood plain & Younger flood plain). In the area, approximately 250 to 300 m thick Quaternary alluvium is deposited directly over Vindhyan formation of Pre-Cambrian age.

There is a wide variation in sediments assemblages which is in variant with different depositional environment from north to Southern parts of the district. A thick sequence of gravel bed admixed with ferruginous material and clay encountered at 190 mbgl at Laharpur. This is inferred that the sediments derived from southern provenances are widely spread northwardly below the sediments brought from Himalayan provenances.

- **District Fatehpur:** The district form a part of central Ganga plain and exhibits fluvial feature typical of the flood plain Fatehpur district can be categorized as the composite flood plain and the meander flood plain. The meander flood plain occurs in northern part of district along river Ganga covering in the northern part of Malwar, Teliyam, Bhitura, hathgon and Airwan blocks and southern part of district along river Yamuna covering of south part of Amamli, Khayua, Asother, Bijaipur and Dhata block. These plains are low lying, the river meander are found within the area and form Ox-bow Lake due to abandoning channel. The composite flood plain occupy, entire central part of district extending from NE to SW. these flood plain bear feature of more than one phase of flood plain formation.

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 area under study is 210934 ha out of which total mine lease area is 172.193 ha. The core zone of the study area is taken as 500m all along the 156 km stretch of river Yamuna and similarly the buffer zone as 10.0 km from the river bank all along the stretch of river Yamuna of

the area under study. Other rivers which flow in the buffer zone are Betwa river and Sengar River.

A) Land use Pattern regional: Land use pattern of the three district falling within the area under study of this particular Regional Environmental Impact Assessment study on the stretch of River Yamuna is as follows:

Table No.3.1 Regional 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.)	Kanpur Dehat (in,000 ha.)	Auraiya (in,000 ha.)
1.	Geographical Area	390.90	454.40	301.30	422.126	315.0	206.126
2.	Cultivable area	325.80	377.30	234.80	351.863	262.80	172.596
3.	Forest Area	24.50	28.20	5.60	7.615	5.8	4.321
4.	Land under non-agricultural use	32.90	39.0	42.40	49.707	29.8	20.902
5.	Permanent pastures	0.50	0.20	3.70	2.791	0.4	1.292
6.	Cultivable wasteland	8.60	1.50	8.90	10.186	4.3	7.087
7.	Land under Miscellaneous tree, crops and groves	0.70	1.60	3.10	5.461	2.7	1.521
8.	Barren and uncultivable land	7.10	9.80	14.80	10.150	16.2	7.015
9.	Current Fallows	16.90	20.70	25.0	32.819	21.5	11.090
10.	Other Fallows	5.30	6.80	8.70	14.426	12.40	7.577

Description of Land use/land cover

The buffer zone of study area-2 is almost 51 % crop land and 24 % of land area is scrub land or with no scrub. The total builtup area in 10 km radius is 1.8 % and waste land is 8.6% 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	3343.89	19
Land with or without scrub	2473.9	14
Crop land (Horticulture)	2143.77	12
Sand	9704.07	55

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 55% lies within the impact zone is of **Sand** as the area is mainly the river bed of the river Yamuna which is covered by the alluvial deposits brought by the river from all along its course. The next category which has 14% 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 19%. The major river which flows within the study area and along which all the mine lease are located is river Yamuna, there is River Betwa which is also present within the Study area. The **Crop** land has the least percentage which is 12% within the impact zone as the major portion of it is river bed of River Yamuna 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

Land use types	Area ha	% Area
River and water bodies	4571.93	2.2
Forest	19200.5	9.1
Land with or without scrub	51564.4	24.5
Crop land	109112	51.8
Fallow land	1364.61	0.6

Built-up land	3695.97	1.8
Waste land	18161.5	8.6
Sand	2883.83	1.4

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 51.8 % 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 24.5 % & 9.1% 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 14 RFs and 07 PFs are found . The percentage of **River and water bodies** within the impact zone is 2.2 %. The major river which flows within the study area and along which all the mine lease are located is river Yamuna, there is River Betwa which is also present within the Study area. The **Waste land** has the percentage which is 8.6 %, **Built-up land** has 1.8% and **Fallow land** has 0.6 % 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 is of **Sand** i.e. 1.4% within the buffer zone as it is majorly present within the impact zone comprising of River bed of Yamuna 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 regional study includes part of six districts i.e Kanpur Dehat, Kanpur Nagar, Hamirpur, Jalaun, Fatehpur and Auraiya along the river Yamuna. Hence, the climate given here is of three districts:

A) Climate of the region/ area under study: the study area includes the major part of Kanpur Dehat, Kanpur Nagar, Hamirpur along with Jalaun, Fatehpur and Auraiya districts.

Fatehpur

The climate is typically sub-humid punctuated by long and intense summer and mild winters. The average rainfall in the district is 932 mm and about 90% of which is received from south-west monsoon. May is the hottest month with temperature shooting up to 46.5°C. January is generally the coldest month and temperature drops generally 8°C but occasionally even upto 4°C. The highest relative humidity in the morning during the month of August is 86% and the lowest is 25% during the month of May.

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.

Kanpur Nagar

Climate is sub humid and is characterized by hot summer and general dryness except in the south west monsoon. About 90% of rainfall takes place from third week of June to September. During monsoon surplus water is available for deep percolation to ground water. May and early part of June constitute the hottest part of the year. The mean daily maximum temperature in May is 41.7°C. The mean daily minimum temperature is 27.2°C and maximum temperature rises up to 45°C or over. With the onset of the monsoon in June the day temperature drops down appreciably. The January is the coldest month with mean daily maximum temperature at 22.8°C and mean daily minimum temperature at 8.6°C. The mean monthly maximum temperature is 32.2°C and means monthly minimum temperature is 19.5° C. During monsoon season the relative humidity is high and in summer season, humidity is less. The mean monthly morning relative humidity is 69% and mean monthly relative humidity is 50%. The winds are generally light with some strength in force during summer and early monsoon season. The mean wind velocity is 9.6 kmph. The potential evapotranspiration is 1660.9 mm.

Kanpur Dehat: The climate is sub-humid and it is characterized by a hot summer and general dryness except during the southwest monsoon. About 90% of rainfall takes place from June to September. During monsoon surplus water is available for percolation to ground water. The average annual rainfall of the district is 782.8 mm. May is the hottest month of the year. The mean daily maximum temperature in May is 41.70C. The mean daily minimum temperature is 8.60C and maximum temperature varies upto 450C.

With the onset of the monsoon in third week of June the day temperature drops down appreciably. The January is the coldest month with mean daily maximum temperature 22.80C and mean daily minimum temperature at 8.60C. The mean monthly maximum temperature is 32.20C and mean monthly minimum temperature is 19.50C. During monsoon season, the relative humidity is high and in summer season, relative humidity is less. The mean monthly morning relative humidity is 69% and mean

monthly evening relative humidity is 50%. The mean wind velocity is 9.6Km/hr. The potential evapotranspiration is 1660 mm.

Auraiya: The climate of the district is sub-humid and characterized by hot summer and bracing cold season. After February there is continuous increase in temperature till May which is generally the hottest month. The mean daily maximum temperature in May is 41.8°C and the mean daily minimum is 7.4°C in the month of January. During the southwest monsoon season the relative humidity is high and after the withdrawal of the monsoon humidity decreases. The mean monthly morning relative humidity is 60%, and means monthly evening relative humidity is 41 %. Winds are generally very light. During the period May to September winds often blow between northeast & southeast directions. The mean of wind velocity is 4.5 km /h. The potential evapotranspiration is 121.5 mm.

a. Study Area:

The climatic condition of the study area ranges from sub-tropical to sub-humid and the average rainfall ranges from 782 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

Temperature: The temperature during the months in which environmental monitoring has been done is shown below in Figure No 3.8. 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.

A) **Rainfall:** The variation in rainfall during the duration of environmental monitoring is shown below in Figure No 3.9. 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 3.22. Mean monthly Rainfall variation in the study area

B) 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-east 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.

C) Ground water: Seasonal fluctuation in water levels in the study area indicated minimal change in groundwater storage. Water table fluctuates in response to

Recharge takes 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. 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 mine lease sites is approx. 15.12 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.

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 (KLD)	Stored water (KLD)	Total Water
13.6	0.046	0.54	0.31	0.52	0.10	15.12

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, ground water & 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 regional 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 HNO₃. 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:

The ground water sampling locations are listed below in Table No3.4 and represented in Google Map in Fig No.3.26.

Table No.3.4 Description of Ground water Monitoring Locations

Sl. Nos.	Station Code	Location	Status	Coordinates

1.	GW 4	Pichaura	Buffer Zone	26°14'1.85"N 79°40'12.58"E
2.	GW 5	Kharka	Buffer Zone	26°13'13.80"N 79°39'32.40"E
3.	GW 6	Urkahara Kalan	Buffer Zone	26°11'17.27"N 79°39'0.92"E

Table No 3.5 Analysis of Ground water Samples

SN	PARAMETERS	UNIT	GW ₄	GW ₅	GW ₆	Acceptable Limit	Permissible Limit
1	Colour	Hazen	< 1	< 1	< 1	5	15
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	pH Value at 25°C	-	7.25	7.39	7.77	6.5	8.5
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity	NTU	0.4	0.8	0.3	1	5
6	Total Dissolve Solids	mg/L	480	387	464	500	2000
7	Chloride (as Cl)	mg/L	68.7	58.4	50.6	250	1000
8	Fluoride (as F)	mg/L	0.17	0.19	0.14	1	1.5
9	Free Residual Chlorine	mg/L	BDL	BDL	BDL	0.2	1
10	Iron (as Fe)	mg/L	0.11	0.14	0.16	0.3	0.3
11	Total Hardness (as CaCO ₃)	mg/L	146	158	166	200	600
12	<i>E.coli</i>	MPN/100ml	<2	<2	<2	Shall not be detected in 100ml sample	
13	Total Coliform	MPN/100ml	<2	<2	<2	Shall not be 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 7.65 to 7.84 which is within acceptable limit of 6.5 to 8.5.

2. Taste & Odour

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 Kanpur Dehat & Hamirpur districts are within acceptable limit, i.e. below 2000.0 mg/l of permissible limit.

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 samples were below 1.0 NTU which is the Acceptable limit in case of ground water.

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, land fills leachates, septic tank effluent and industrial and irrigation drainage.

The highest value of chloride is 64.1 mg/L and lowest is 62.1 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 highest value of chloride is 64.1 mg/L and lowest is 62.1 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.

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. The permissible Iron concentration in ground water is less than 1.0 mg/litre as per the BIS Standard for drinking water

Districts Having Localized Occurrence of Iron (>1.0 mg/litre) in Ground Water in U.P.

(Source: <http://cgwb.gov.in>)

STATE	PARTS OF DISTRICTS HAVING FE> 1.0 MG/LITRE
Uttar Pradesh	Azamgarh, Balia, Balrampur, Etawah, Fatehpur, Gazipur, Gonda, Hardoi, Kanpur Dehat, Kanpur Nagar, Lakhimpur, Lalitpur, Mau, Siddharthnagar, Unnao

As per our analysis, the concentration of iron is below acceptable limit of 0.3 mg/l. The minimum and maximum concentration are 0.22 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 ₃
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 112.0 & 132.0 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.

Table No 3.6.Description of surface water sampling sites

S. No.	Station Code	Location	Status	Coordinates

1.	SW 4	Nibarri Kachhar	Impact Zone	26°13'43.15"N 79°38'53.17"E
2.	SW 5	Kharka	Core zone	26°12'37.32"N 79°39'21.81"E
3.	SW 6	Khartala Katari	Impact Zone	26°11'53.59"N 79°40'56.22"E

Table No 3.7. Analysis of Surface water Samples

SN	Parameters	Unit	SW ₄	SW ₅	SW ₆
1.	Colour	Hazen	<1	<1	<1
2.	Odour	-	Agree able	Agree able	Agree able
3.	pH Value at 25°C	-	7.64	7.46	7.81
4.	Total Dissolve Solids	mg/L	496	398	518
5.	Total Suspended Solids	mg/L	26	34	28
6.	Total Solids	mg/L	522	432	546
7.	Temperature	°C	28.4	29.5	29.7
8.	Conductivity at 25°C	µmhos/cm	760	620	795
9.	Calcium (as Ca)	mg/L	56.2	52.1	64.1
10.	Ammonical Nitrogen	mg/L	1.56	2.45	1.52
11.	Chloride (as Cl)	mg/L	48.2	47.6	56.8
12.	Iron (as Fe)	mg/L	0.14	0.2	0.13
13.	Magnesium (as Mg)	mg/L	37.5	32.3	41.2
14.	Nitrate (as NO ₃)	mg/L	34.5	34.6	42.5
15.	Potassium (as K)	mg/L	60	46.1	23.7
16.	Phosphate (as PO ₄)	mg/L	0.62	0.64	0.83
17.	Sodium (as Na)	mg/L	110	88	130
18.	Sulphate (as SO ₄)	mg/L	42.1	43.5	52.2
19.	Total Alkalinity (as CaCO ₃)	mg/L	128	152	155
20.	Total Hardness (as CaCO ₃)	mg/L	322	348	296
21.	Dissolved Oxygen	mg/L	5.2	5.4	4.7
22.	Biochemical Oxygen Demand	mg/L	10	12	14
23.	Chemical Oxygen Demand	mg/L	24	28	32
24.	Faecal Coliform	MPN/100mL	54	43	63

Result of Primary Data

pH of the surface water samples ranges from 7.74 to 7.96 , which is in permissible limit of standards given by CPCB. Ammonical Nitrogen concentration is lowest in Bakchha Khadar from all other locations, however lowest Iron concentration is found in Ujrehta Village and highest iron concentration is found in Bhulsi village .The concentration of iron and Ammonical Nitrogen is below the standards specified by CPCB for drinking water. Total hardness of ground water samples are well within the limits. The critical parameters such as pH, COD, BOD, Total Coliform, EC, were used for Primary Water Quality Criteria. The average pH in water quality of entire stretch of river Beeting is meeting the drinking water quality class 'A' and Class 'B' of primary water quality criteria (6.5-8.5) for drinking

water without conventional treatment but after disinfection, and Outdoor bathing, Organized. The issues related with water quality of River Yamuna due to regulated flow which has transformed the river into various segments in dry seasons. Intermittent release of water from barrages due to unpredictable rainfall cause significant change in the water quality at downstream reaches. In the summer season water in the active channel reduced upto a stream and concentration of pollutants increased because of less dilution.

SURFACE WATER ANALYSES

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 7.74 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 520 mg/L to a maximum of 574 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 B Category of Surface Water as per CPCB Standards.

4. Total Suspended Solid

The minimum and maximum TSS are 26.0 mg/L & 34.0 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 794.0 $\mu\text{mhos/cm}$ and Maximum 900.0 $\mu\text{mhos/cm}$ 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 52.1 mg/L & 64.1 mg/L and that of Magnesium are 37.9 mg/L & 46.5 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 47.6 & 56.8 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 0.2 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 large amounts of nitrate from 34.5 to 42.5 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.*** Also as per CGWB report, the values of Nitrate in this region is generally higher.

10. 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 292 – 342 mg/L. Using Durfer and Backer classification, the surface water bodies in the study area are Very Hard.

11. Biological Oxygen Demand

The average BOD levels in water quality of River Yamuna 11.0 mg/l. The average BOD levels in water quality of River Yamuna from is higher than the desired levels of 3.0 mg/l and matches to ***Category D & E for Propagation of wildlife, fisheries and irrigation, Industrial cooling etc purposes.***

12. 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 27.0 – 48.0 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.

13. Total Alkalinity

The minimum and maximum values of total Alkalinity in the study area are 128.0 – 159.0 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 Regional 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 Yamuna 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 km². In cities with large number of population with complex topography or with an unusually large number of pollution sources one station per 5 to 10 km² is suggested.

Table No 3.8 Recommended Minimum Number of Stations, Population-Wise (Clause 10.7.2.2)

Pollutant	Population of Evaluation Area	Minimum No. of AAQ Monitoring Station
SPM (Hi-Vol)	< 100 000 100 000 - 1 000 000 1 000 000 - 5 000 000 >5 000 000	4 3+ 0.6 per 100-000 population 7.5 + 0.25 per 100 000 population 12 + 0.16 per 100 000 population
SO ₂	< 100 000 100 000 - 1 000 000 1 000 000 - 10 000 000 >10 000 000	3 2.5+0.5 per 100 000 population 6 + 0.15 per 100 000 population 20
NO ₂	< 100 000 100 000 - 5 000 000 >5 000 000	4 2 + 0.6 per 100 000 population 3 10
CO	< 100 000 100 000 - 10 000 000 >10 000 000	1 1 + 0.15. per 100 000 population 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_{2.5} & PM₁₀ have been estimated by Gravimetric method IS: 5182. Modified West and Gaeke method (IS-5182 part-II, 1969) has been adopted for estimation of SO₂ and Jacobs-Hochheiser method (IS-5182 part-VI, 1975) has been adopted for the estimation of NO_x. Description of sampling locations along with the Map is shown below:

Table No 3.9.Description of Ambient air Quality Sampling Locations

S. No.	Station Code	Location	Status	Coordinates
1.	AQ 5	Kharka	On site/ Downwind within 500m	26°12'39.36"N 79°39'37.64"E
2.	AQ 9	Dahelkhand Mustaqil	Upwind	26°12'37.86"N 79°38'15.52"E
3.	AQ 8	Kharka	Crosswind	26°13'3.57"N 79°39'17.95"E
4.	AQ 6	Khartala Bangar	Downwind	26°12'56.97"N 79°41'29.10"E

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 (SiO₂, NO_x, SO₂, PM₁₀ and 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:

- PM₁₀
- PM_{2.5}
- Sulphur dioxide (SO₂)
- Oxides of Nitrogen (NO_x)
- Carbon Monoxide (CO)
- Free Silica (SiO₂)

For gaseous samples, 8 hourly samples were collected, while 24 hourly sampling was conducted for PM₁₀ and PM_{2.5}. NAAQ standards are attached as Annexure.

Table No. 3.10. Sampling and Testing Methodology

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

Table No.3.11. Analysis of Ambient Air Quality

Sr. No.	Test Parameters	Unit	Location	Min	Max	CPCB Standards
	Particulate Matter (PM _{2.5})	µg/m ³	AQ 5	46	55	60
			AQ 9	42	69	
			AQ 8	42	63	
			AQ 6	44	65	
2	Particulate Matter (PM ₁₀)	µg/m ³	AQ 5	74	96	100
			AQ 9	82	115	

			AQ 8	74	106	
			AQ 6	80	114	
3	Sulphur Dioxide (as SO ₂)	µg/m ³	AQ 5	6.5	8.3	80
			AQ 9	7.2	11.2	
			AQ 8	7.2	11.1	
			AQ 6	6.5	11.9	
4	Oxide of Nitrogen (as NO ₂)	µg/m ³	AQ 5	8.2	11.9	80
			AQ 9	8.8	12.8	
			AQ 8	8.8	14.2	
			AQ 6	8.6	14.6	
5	Carbon Monoxide (as CO)	µg/m ³	AQ 5	BDL	BDL	
			AQ 9	BDL	BDL	
			AQ 8	BDL	BDL	
			AQ 6	BDL	BDL	
6	Silica	µg/m ³	AQ 5	BDL	BDL	
			AQ 9	BDL	BDL	
			AQ 8	BDL	BDL	
			AQ 6	BDL	BDL	

3.4.2. 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 PM₁₀, standards for which are prescribed under the NAAQ. Crystalline silica is composed of SiO₂ whereas SiO₂ 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 (PM₄). There are no generally accepted methods of monitoring in ambient PM₄ air.

PM₁₀ emissions as observed in the baseline study ranged from 74.0 to 115.0 µg/m³, inclusive of free silica, which was well within the standards specified for PM₁₀ (100 µg/m³). U.S.E.P.A has assumed that 10% of total PM₁₀ in ambient air was crystalline silica.

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/m³. It has been assumed in studies that 85% of the TSPM is composed of PM₁₀. Under these circumstances, the maximum incremental PM₁₀ is not likely to be beyond 1.06µg/m³. 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 SiO₂ in sand/morrum is about 90%. Assuming this, the incremental concentration of free silica is expected to be 0.954µg/m³ (90% of 1.06µg/m³). No standards are prescribed but the PM₁₀ 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/m³ (10µg/m³) 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.

Fig .3.35.Study area for 10 km buffer zone of sand/morrum mine project, Yamuna River in Districts Kanpur Nagar, Kanpur Dehat & Hamirpur

Fig: 3.36 Baseline mean concentration of PM_{2.5}

Overall PM₁₀ concentration (predicted incremental and baseline air pollutants concentration) were observed above permissible limit of NAAQS 2009 at some monitoring stations such as Example: AQ5, and AQ19. Overall PM_{2.5} concentration (predicted incremental and baseline air pollutants concentration) was observed above permissible limit of NAAQS 2009 at AQ5. PM₁₀ and PM_{2.5} at other monitoring stations were below the permissible limit due to more distance from sources. Overall SO₂ and NO₂ concentration were observed below the permissible of NAAQS 2009 at all monitoring stations. Overall carbon monoxide (CO) was observed below 1mg/m³ at all monitoring stations and also below permissible limit (2 mg/m³) of NAAQS 2009

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 **04 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_{min}** - Minimum Noise Level Recorded
- **L_{max}** - Maximum Noise Level Recorded
- **L_d** - Day Equivalent (6 AM to 10 PM)
- **L_n** - 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. Nos.	Station Code	Location	Status	Coordinates
1.	NQ 5	Kharka	Impact Zone	26°12'39.36"N 79°39'37.64"E
2.	NQ 9	Dahelkhand Mustaqil	Impact Zone	26°12'37.86"N 79°38'15.52"E
3.	NQ 8	Kharka	Buffer Zone	26°13'3.57"N 79°39'17.95"E
4.	NQ 6	Khartala Bangar	Buffer Zone	26°12'56.97"N 79°41'29.10"E

Fig.3.40. Google Map of Ambient Noise Quality Monitoring Stations

Table No3.12. Noise Quality Monitoring Data

Location Code	NQ5	NQ9	NQ8	NQ6
Maximum	57.1	57.4	59.4	57.4
Minimum	39.5	37.6	40.1	39
L_d	52.3	52.1	53.6	52.3
L_n	41.1	40.6	41.7	40.8
L_{dn}	52	51.7	53.1	51.9

Fig: 3.41 Noise Levels

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, **03** 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.

12 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.

The list of all sampling location is given in Table No3.15 and are depicted in Figure No.3.41 and the results for the same are discussed below.

Table No. 3.13.Description of Soil Quality Sampling Locations

Sl. Nos.	Station Code	Location	Project Area	Coordinates
1.	SQ 4	Pichaura	Buffer Zone	26°14'1.85"N 79°40'12.58"E
2.	SQ 5	Kharka	Buffer Zone	26°13'13.80"N 79°39'32.40"E
3.	SQ 6	Urkahara Kalan	Buffer Zone	26°11'17.27"N 79°39'0.92"E

Fig.3.41. Location of Soil Quality sampling sites

Table No 3.14. Result of Soil Analysis

SN	Parameters			
		SQ4	SQ5	SQ6
1	pH Value at 25°C	8.14	7.7	7.82
2	Conductivity at 25°C	752	832	870
3	Moisture	8.8	10.5	11.2
4	Sodium (as Na)	290	324	272
5	Potassium (as K)	140	131	128
6	Total Kjeldhal Nitrogen	640	714	520
7	Phosphorus	74	82	67.8
8	Organic Matter	1.29	1.2	1.11
9	Magnesium (as Mg)	145	165	132
10	Cation Exchange Capacity	20.9	17.8	15.5
11	Water Holding Capacity	23.5	22.7	21.8
12	Bulk Density	1.35	1.29	1.23
13	Porosity	16.8	14.8	13.1
		SQ4	SQ5	SQ6
1	Sand	54.2	55.1	53.3
2	Silt	24.5	23.9	21.8
3	Clay	21.3	21	24.9

Fig .3.42.Percentage of Sand, silt & Clay in Soil at Sampling Sites

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 26th 2009. Out of these, none of them is located within the study area of this regional 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 3.15.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/Barrage s	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

Fig3.43.Wetland Map of Hamirpur

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 No3.24.

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 3.16.Area estimates of Wetlands in 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

Kanpur Nagar: The city's coordinates are 26.47° N latitude and 80.35° E longitude. Kanpur is situated on the banks of the river Ganga. The districts surrounding Kanpur are Hamirpur in the south and Unnao in the north-east.

The total wetland area in the district is 14770 ha. Major wetland types of the district are river/stream with 75.0 per cent share. The other major types are man-made wetlands viz. Tanks/pond and waterlogged. There are 129 Tanks with 853 ha area (5.78%). There are 1189 small wetlands (<2.25 ha) identified. Detailed estimates of wetlands in Allahabad are given in Table No 3.25.

Area under aquatic vegetation in pre-monsoon season is 1191 ha during post-monsoon season while in pre- monsoon season 472 ha. Water spread area in post-monsoon season is 7069 ha. Where as in pre-monsoon season the water spread area is 6061 ha. Moderate turbidity is observed in many wetlands during post- monsoon season (6162 ha). Most of the tanks have shown low turbidity, High turbidity is associated with riverine wetlands and accounted an area of 1176 ha during pre-monsoon season.

Table No3.17. Area estimates of Wetlands in Kanpur Nagar (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	17	124	0.84	27	19
2	1102	Ox-bow lakes/cut-off meanders	5	94	0.64	65	58
3	1103	High altitude wetlands	--	--	---	--	--
4	1104	Riverine wetlands	11	120	0.81	40	52
5	1105	Waterlogged	19	264	1.79	180	35
6	1106	River/Stream	87	11152	75.50	5899	5371
	1200	Inland Wetlands- Man-Made					
7	1201	Reservoirs/Barrages	--	--	--	--	--

8	1202	Tanks/Ponds	129	853	5.78	281	366
9	1203	Waterlogged	70	974	6.59	577	160
10	1204	Salt Pans	--	--	--	--	--
		Sub-Total	338	13581	91.95	7069	6061
		Wetlands(<2.25 ha), mainly Tanks	1189	1189	8.05	--	--
		Total	1527	14770	100.0	7069	6061

Area under Aquatic Vegetation	1191	472

Area under turbidity levels		
Low	808	739
Moderate	6162	4146
High	99	1176

Kanpur Dehat: The district is surrounded by Kanpur-Nagar, Hamirpur, Jalaun, Etawah, Kannauj on different sides. River Yamuna divides Kanpur-Dehat from district Jalaun. The district headquarter is Akbarpur, located at 26°22' to 26.38°N latitude and 79°57' to 79.95°E longitude.

The total wetland area in the district is 11603 ha. Major wetland types of the district are River/Stream, Lakes/ponds and waterlogged areas. There are 36 Lakes/ponds with 883 ha area (7.6%). There are 96 natural waterlogged areas and 93 man-made waterlogged areas accounting for 9.3 and 12.2 per cent area respectively. In addition, 1852 small wetlands (<2.25 ha) identified and demarcated as point feature. Area estimates of the district are summarized in table given below.

Area under aquatic vegetation in pre-monsoon season is 2554 ha during post-monsoon season while in pre-monsoon season 892 ha. Water spread area in post-monsoon season is 5336 ha and in pre-monsoon it is reduced to 4367 ha. Moderate to low turbidity of open water prevailed in both the seasons.

Table No3.18. Area estimates of Wetlands in Kanpur Dehat (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	36	883	7.61	278	256
2	1102	Ox-bow lakes/cut-	7	180	1.55	11	2

		off meanders					
3	1103	High altitude wetlands	--	--	--	--	--
4	1104	Riverine wetlands	9	19	0.16	6	6
5	1105	Waterlogged	96	1082	9.33	87	187
6	1106	River/Stream	58	5380	46.37	3712	3545
	1200	Inland Wetlands- Man-Made					
7	1201	Reservoirs/Barrages	2	6	0.05	3	2
8	1202	Tanks/Ponds	160	781	6.73	225	221
9	1203	Waterlogged	93	1420	12.24	1014	148
10	1204	Salt Pans	--	--	--	--	--
		Sub-Total	461	9751	84.04	5336	4367
		Wetlands(<2.25 ha), mainly Tanks	1852	1852	15.96	--	--
		Total	2313	11603	100.0	5336	4367

Area under Aquatic Vegetation	2554	892
Area under turbidity levels		
Low	1460	2052
Moderate	3821	750
High	55	1565

Fig.3.45.Wetland Map of Kanpur Dehat

Auraiya: The Auraiya district is situated in southwestern part of U.P., between 26° 21' and 27° 01' N latitude and 78°45' and 79° 45' E longitude. It is bounded on the north by the districts of Kannauj, western border adjoins tehsil Bharthana of the Etawah district and the district of Gwalior. The eastern frontier marches with the district of Kanpur Dehat, and along the south lies Jalaun.

The total wetland area in the district is 7148 ha. Rivers/streams occupy 41.23 per cent share. Other major wetland types of the district are waterlogged areas. There are 252 sites of natural waterlogged with 1203 ha area accounting for 16.83 per cent of total wetlands and 48 man-made waterlogged areas with 1050 ha area accounting 14.69 per cent. There are 1506 small wetlands (<2.25 ha) identified and delineated as point feature. Wetland area estimates of the district are summarized in table below.

Area under aquatic vegetation in pre-monsoon season is 200 ha and covered an area of 3067 ha in post - monsoon season. Water spread area in post-monsoon season is

4059 ha and in pre-monsoon it is 3015 ha. Moderate turbidity and low turbidity of open water prevailed during post and pre monsoon season respectively.

Table No3.19. Area estimates of Wetlands in Auraiya (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	8	155	2.17	102	32
2	1102	Ox-bow lakes/cut-off meanders	--	--	--	--	--
3	1103	High altitude wetlands	--	--	--	--	--
4	1104	Riverine wetlands	10	79	1.11	53	0
5	1105	Waterlogged	252	1203	16.83	652	61
6	1106	River/Stream	35	2947	41.23	2423	2596
	1200	Inland Wetlands- Man-Made					
7	1201	Reservoirs/Barrages	--	--	--	--	--
8	1202	Tanks/Ponds	35	208	2.91	117	291
9	1203	Waterlogged	48	1050	14.69	712	35
10	1204	Salt Pans	--	--	--	--	--
		Sub-Total	388	5642	78.93	4059	3015
		Wetlands(<2.25 ha), mainly Tanks	1506	1506	21.07	--	--
		Total	1894	7148	100.0	4059	3015

Area under Aquatic Vegetation	939	200

Area under turbidity levels		
Low	1091	1681

Moderate	2930	55
High	38	1279

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 km² constituting 7.33% of geographical area of the country. The recorded Forest area of the state is 16,580 km² which is 6.88 % of its geographical area. The Reserved Forests constitute (12,126 km²) 72.79%, Protected Forests (1,223 km²) 6.98% and Unclassed Forests (3,228 km²) 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 km² has been used and the analysis of forest covers within and outside this area.

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
	Total	65,318	14,679	100.00

(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
Kanpur Nagar & Dehat	6176	00	12	97	109	1.76	00	37

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 Yamuna 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 Kanpur Dehat & Nagar and Hamirpur 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 monosperma*), 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 (*Emblica 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
Akol	<i>Alangium salvifolium</i>	Roots and the fruits are used for the treatment of rheumatism and haemorrhoid. Externally, it is used for the treatment of bites by rabbits, rats, and dog
Agast	<i>Sesbania grandiflora</i>	The flowers of <i>S. grandiflora</i> are eaten as a vegetable in South Asia and Southeast Asia,

Aamrood	<i>Psidium guavava</i>	Used for inflammation, diabetes, hypertension, caries, wounds, pain relief, fever, diarrhea, rheumatism, lung diseases, and ulcers
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
Ased	<i>Solanum verbascifolium</i>	A root decoction is used to treat dysentery, fever, diarrhea, digestive problems, and violent body pains. The root bark is used as an anti-inflammatory and to treat arthritis.

Aak	<i>Calotropis procera</i>	Plant extract is used as bronchodilator
Chinari	Grewia tenax	The fruits consumed by man and animals contain a large amount of iron and can be made into a refreshing drink
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 as per Forest data

Botanical name	Local name	Botanical name	Local name
<i>Cassia fistula</i>	Amaltas	<i>Azadirachta indica</i>	Neem

<i>Madhuca longifolia</i>	Mahua	<i>Albizia lebbbeck</i>	Kala siris
<i>Bombax ceiba</i>	Semal	<i>Puyranjiva roxburghii</i>	Putranjiwa
Syzygium cumini	Jamun	Trewia nudiflora	Gutel
Santalum album	Chandan	Atrocarpus lakoocha	Badhal
Erythrina subarosa	Pharai	Ehretia lavis	Chamror
<i>Bridelia retusa</i>	Kaja	<i>Ficus carica</i>	Aal
Cajenus cajan	Arhar	Urginia indica	Jangali piyaj

Grewia helictrifolia	Gudsakari	Indigofera hirsuta	Neel
Cuscuta reflexa	Amarbel	Smilax prolifera	Ramdatoon
Trichosanthes dioica	Parwal	Chloris dolichostachya	Santoor
Apluda mutica	Bhujri	Cocculus hirsutus	Charendi

Among the flora given in the table above, some of the species are found at the Study area 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>Acacia nilotica</i>	Fabaceae	Babool
<i>Terminalia arjuna</i>	Combrataceae	Arjuna/ koha
<i>Ficus religiosa</i>	Moraceae	Pipal

<i>Terminalia bellirica</i>	Combretaceae	Bahera
<i>Ficus glomerata</i>	Moraceae	Goolar
<i>Diospyros melanoxylon</i>	Ebenaceae	Tendu
<i>Cassia fistula</i>	Caesalpiniaceae	Amaltas

<i>Hardwickia binata</i>	Fabaceae	Hardwickia
<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>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 antidysenteric a</i>	Apocyanaceae	Doogi
<i>Gardenia latifolia</i>	Rubiaceae	Papada
<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>	Rhaminaceae	Ber
<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>Ocimum sanctum</i>	Lamiaceae	Tulsi
<i>Cassia tora</i>	Caesalpiniaceae	Puvar
<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 neriifolia</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. 3.26 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

Desmostachya bipinnata	Poaceae	Khus
Vetiveria zizanioides	Poaceae	Khas
Aristida setacea	Poaceae	Jhani
Cynodon dactylon	Poaceae	Dhoob grass
Dichanthium annulatum	Poaceae	Bhuravel

Eragrostis interrupta	Poaceae	Bhurabhusi choti

Medicinal plants

Lists of the medicinal plants found at Study area-1 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
1	<i>Vitis quadrangularis</i>	Harjor/Haddij or	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>	Drond 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>Aristolochia indica</i>	Near Threatened
2	<i>Asparagus racemosus</i>	Near Threatened
3	<i>Bacopa monnieri</i>	Vulnerable

4	<i>Butea monosperma var.lutea</i>	Endangered
5	<i>Caesalpinia bonduc</i>	Vulnerable
6	<i>Chlorophytum tuberosum</i>	Vulnerable
7	<i>Commiphora wightii</i>	Rare
8	<i>Costus speciosus</i>	Vulnerable
9	<i>Curculigo orchioides</i>	Endangered
10	<i>Curcuma amada</i>	Endangered
11	<i>Curcuma angustifolia</i>	Vulnerable
12	<i>Dioscorea bulbifera</i>	Vulnerable
13	<i>Gloriosa superba</i>	Vulnerable
14	<i>Gymnema sylvestre</i>	Under Threat
15	<i>Manilkara hexandra</i>	Near Threatened
16	<i>Mucuna pruriens</i>	Near Threatened
17	<i>Operculina petaloidea</i>	Endangered
18	<i>Oroxylum indicum</i>	Vulnerable
19	<i>Rauvolfia serpentina</i>	Endangered
20	<i>Saraca asoca</i>	Endangered
21	<i>Spilanthes calva</i>	Vulnerable
22	<i>Tinospora cordifolia</i>	Vulnerable
23	<i>Tylophora 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>Terminalia arjuna</i>	1	1	0	0	1	0	3	0	0	0	6	4	10	0.4	1.5	0.6	2.5
2	<i>Ficus hispida</i>	2	0	0	0	0	1	3	1	1	0	8	5	10	0.5	1.6	0.8	2.9
3	<i>Mitragyna parvifolia</i>	0	1	1	0	2	1	0	0	1	2	8	6	10	0.6	1.3	0.8	2.7
4	<i>Acacia leucophloea</i>	2	0	0	1	2	0	1	3	0	1	10	6	10	0.6	1.7	1	3.3
5	<i>Haloptelea intergrifolia</i>	0	1	0	0	3	2	2	1	1	0	10	6	10	0.6	1.7	1	3.3
6	<i>Moringa pterygosperma</i>	1	0	1	0	2	1	1	1	3	3	13	8	10	0.8	1.6	1.3	3.7
7	<i>Cochlospermum</i>	2	0	1	1	0	0	0	0	1	1	6	5	10	0.5	1.2	0.6	2.3
8	<i>Lannea grandis</i>	2	1	0	1	0	1	1	1	1	0	8	7	10	0.7	1.1	0.8	2.6
9	<i>Ficus religiosa</i>	1	0	3	0	1	1	2	0	0	0	8	5	10	0.5	1.6	0.8	2.9
10	<i>Garuga pinnata</i>	3	2	0	1	1	0	1	2	0	0	10	6	10	0.6	1.7	1	3.3
11	<i>Sterculia urens</i>	1	0	1	2	2	0	1	1	0	1	9	7	10	0.7	1.3	0.9	2.9
12	<i>Ficus glomerata</i>	1	2	0	2	0	2	1	0	0	0	8	5	10	0.5	1.6	0.8	2.9
13	<i>Azadirachta indica</i>	0	1	0	3	1	0	2	3	1	2	13	7	10	0.7	1.9	1.3	3.9
14	<i>Madhuca indica</i>	2	1	0	0	1	1	0	0	0	0	5	4	10	0.4	1.3	0.5	2.2
15	<i>Tamarindus indica</i>	0	2	1	0	0	0	1	0	1	1	6	5	10	0.5	1.2	0.6	2.3
16	<i>Cassia fistula</i>	2	0	1	2	0	1	0	1	0	0	7	5	10	0.5	1.4	0.7	2.6
17	<i>Bauhinia racemosa</i>	1	0	2	1	0	1	2	3	0	1	11	7	10	0.7	1.6	1.1	3.4

18	<i>Bauhinia purpurea</i>	1	0	2	2	0	1	0	0	2	0	8	5	10	0.5	1.6	0.8	2.9
19	<i>Crataeva religiosa</i>	1	0	0	0	2	0	1	0	1	0	5	4	10	0.4	1.3	0.5	2.2
20	<i>Randia duemetorum</i>	0	1	1	2	1	0	0	1	1	1	8	7	10	0.7	1.1	0.8	2.6
21	<i>Ziziphus xylopyrus</i>	2	1	1	0	1	1	2	0	1	0	9	7	10	0.7	1.3	0.9	2.9
22	<i>Gardenia pianta</i>	1	0	1	2	1	0	2	0	1	3	11	7	10	0.7	1.6	1.1	3.4
23	<i>Gardenia turgida</i>	4	0	0	0	0	1	1	2	0	2	10	5	10	0.5	2.0	1	3.5
24	<i>Ziziphus jujuba</i>	1	0	2	2	3	0	1	0	0	1	10	6	10	0.6	1.7	1	3.3
25	<i>Semecarpus anacardium</i>	2	3	0	1	0	2	0	3	1	0	12	6	10	0.6	2.0	1.2	3.8
26	<i>Alangium salvifolium</i>	0	0	1	0	1	0	1	2	1	0	6	5	10	0.5	1.2	0.6	2.3
27	<i>Achyranthes aspera</i>	1	0	2	0	1	2	1	1	0	2	10	7	10	0.7	1.4	1	3.1
28	<i>Dodonaea viscosa</i>	2	1	0	0	0	0	2	1	0	2	8	5	10	0.5	1.6	0.8	2.9
29	<i>Tribulus terrestris</i>	1	0	0	2	1	0	3	0	1	0	8	5	10	0.5	1.6	0.8	2.9
30	<i>Andrographis paniculata</i>	0	1	0	0	2	3	1	0	0	1	8	5	10	0.5	1.6	0.8	2.9
31	<i>Ziziphus nummularia</i>	1	0	2	1	0	0	0	2	2	0	8	5	10	0.5	1.6	0.8	2.9
32	<i>Ocimum sanctum</i>	2	1	0	0	2	3	0	0	0	3	11	5	10	0.5	2.2	1.1	3.8
33	<i>Vitex negundo</i>	1	0	2	3	1	0	2	1	1	0	11	7	10	0.7	1.6	1.1	3.4
34	<i>Cassia tora</i>	1	0	2	1	0	0	0	2	2	1	9	6	10	0.6	1.5	0.9	3.0
35	<i>Thespesia lampas</i>	2	1	0	0	1	0	1	0	1	0	6	5	10	0.5	1.2	0.6	2.3
36	<i>Embelia robusta</i>	2	0	1	0	0	2	2	0	1	2	10	7	10	0.7	1.4	1	3.1
37	<i>Solanum nigrum</i>	3	0	1	0	2	1	1	0	0	1	9	6	10	0.6	1.5	0.9	3.0
38	<i>Eclipta prostrata</i>	2	1	0	1	1	1	0	2	1	0	9	7	10	0.7	1.3	0.9	2.9
39	<i>Vernonia divergens</i>	1	2	2	0	1	0	1	1	0	1	9	7	10	0.7	1.3	0.9	2.9

40	<i>Adhatoda vasica</i>	0	1	0	2	1	2	0	1	0	0	7	5	10	0.5	1.4	0.7	2.6
41	<i>Ricinus communis</i>	0	1	0	2	1	0	0	0	1	0	5	4	10	0.4	1.3	0.5	2.2
42	<i>Grewia hirsuta</i>	1	0	2	1	2	0	1	0	0	0	7	5	10	0.5	1.4	0.7	2.6
43	<i>Lantana camara</i>	1	0	3	0	0	0	1	2	1	1	9	6	10	0.6	1.5	0.9	3.0
44	<i>Ziziphus oenoplia</i>	0	3	2	0	1	0	2	2	0	0	10	5	10	0.5	2.0	1	3.5
45	<i>Jatropha curcas</i>	3	1	0	2	0	2	1	2	0	1	12	7	10	0.7	1.7	1.2	3.6
46	<i>Annona squamosa</i>	1	0	0	2	0	2	0	2	1	1	9	6	10	0.6	1.5	0.9	3.0
	Total											400			26.5	69.4	40	135.9

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 *Salmlia 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 include Common Langur, Fishing Cat, Ratel, Striped Hyaena, Blue Bull, Common House Rat, Ground Shrews etc. 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)

Table No. 3.30.Fauna at the Study area

Zoological	Family	Common name	Schedule
Animals			
<i>Macaca mulatta</i>	Cercopithecidae	Bandar	IV
<i>Felis chaus</i>	Felidae	Jungli billi	II

<i>Sus scrofa</i> <i>Linnaeus</i>	Suidae	Indian Wild Boar	III
<i>Bandicota bengalensis</i>	Muridae	Field rat	V
<i>Golunda ellioti</i>	Muridae	The Indian bush rat	IV
<i>Cervus unicolor</i>	Cervidae	Sambhar	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
Reptiles			
<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
Fishes			
<i>Labeo rohita</i>	Cyprinidae	Rohu	IV
<i>Catla catla ham</i>	Cyprinidae	Catla	IV
<i>Cirrhinus cirrhosus</i>	Cyprinidae	Mrigal	IV
Amphibians			
<i>Bufo melanostictus</i>	Bufonidae	Common toad	IV

<i>Rana tigrina</i>	Ranidae	Indian bull frog	IV

Table No. 3.31. Fauna around the Study area

Zoological name	Family	Common	Schedule
Animals			
<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>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
Reptiles			
<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
Fishes			

<i>Labeo rohita</i>	Cyprinidae	Rohu	IV
<i>Catla catla</i>	Cyprinidae	Bhakar	IV
<i>Cirrhinus cirrhosus</i>	Cyprinidae	Mrigal	IV
Amphibians			
<i>Bufo melanostictus</i>	Bufoidea	Common toad	IV
<i>Rana tigerina</i>	Ranidae	Indian bull frog	IV

Birds:

About 100 species of birds are permanent resident of area under study. Rain Quail (*Coturnix coromendelica*), Rock Pigeon (*Columbia livia*), Laughing Dove (*Streptopelia*

senegalensis), Cattle Egret (*Bubulcus ibis*), Brahminy Kite (*Haliastur indus*), Jungle Owlet (*Glaucidium rad radiatum*) 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. 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

Zoological name	Family	Common name	Schedule
BIRDS			
<i>Pavo cristatus</i>	Phasianidae	Indian Pea Fowl	I
<i>Columba livia</i>	Columbidae	Rock Pigeon	IV
<i>Psittacula krameri</i>	Psittacidae	Parrot	IV
<i>Passer domesticus</i>	Ploidae	House sparrow	IV

<i>Spilopelia senegalensis</i>	Columbidae	Laughing Dove	IV
<i>Ardeola grayii</i>	Phalacrocoracidae	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>Eudynamys scolopaceus</i>	Cuculidae	Cukoo	IV
<i>Halcyon smyrnensis</i>	Halcyonidae	White brested 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>Corvus splendens</i>	Corvidae	House crow	IV
<i>Corvus macrorhynchos</i>	Corvidae	Jungle crow	IV
<i>Tachybaptus ruficollis</i>	Podicipedidae	Little Greb	IV

Table No3.33. Avifauna around the Study area

Zoological	Family	Common	Schedule
BIRDS			
<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>Eudynamys scolopaceus</i>	Cuculidae	Cuckoo	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>Eudynamis scolopacea</i>	Cuculidae	Cuckoo	
<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>	Columbidae	Blue rock pigeon	IV
<i>Streptopelia chinensis</i>	Columbidae	Spotted dove	IV
<i>Coracias benghalensis</i>	Coraciidae	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 Russelli's Vipera (*Vipera russellii*) The crocodile of both varieties, gharial and magar are found in the Yamuna 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.

3.AQUATIC ECOLOGY

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:

No. of individuals per cm³ = A/B

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

B – Volume of water taken in cm³.

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

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

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

P_i = importance probability for each species = n_i/N

Table No.3.34 Study of Phyto and Zooplankton's – Shannon Wiener Index

Phytoplankton				
Sp. Name	Sp.	Ind.	(n_i/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
Total	6	13	0.97	2.31

Zooplankton				
Sp. Name	Sp.	Ind.	(n_i/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
Total	5	10	1.00	2.14

Table No. 3.35. Aquatic plants at the Study site

S.N	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 Yamuna 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 Yamuna 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.

Fig.3.49.: Important fishes of the Yamuna River

3.9 SOCIO-ECONOMIC ENVIRONMENT

The study area comprises of six districts i.e. Kanpur Nagar, Kanpur Dehat, Hamirpur, Jalaun, Auraiya and Fatehpur. It includes three sub-districts of Hamirpur namely Hamirpur, Rath and Maudaha, similarly three sub-districts of Kanpur Nagar district Ghatampur, Kanpur and Bilhaur, and two sub-districts of Fatehpur namely Fatehpur and Bindki, three sub-districts of Jalaun district Kalpi, Madhogarh and Jalaun, in district Kanpur Dehat five sub-districts namely Sikandra, Akbarpur, Derapur, Bhognipur and Rasulabad and two sub-districts of Auraiya district namely Auraiya and Bidhuna. Total 523 villages fall under the area under study covering 6 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
Hamirpur	Hamirpur	88

	Rath	2
	Maudaha	2
Jalaun	Kalpi	117
	Madhogarh	1
	Jalaun	14
Kanpur Nagar	Ghatampur	90
	Kanpur	02
	Bilhaur	01
Fatehpur	Bindki	31
	Fatehpur	02
Auraiya	Auraiya	3
	Bidhuna	2
Kanpur Dehat	Sikandra	63
	Akbarpur	7
	Derapur	3
	Rasulabad	2
	Bhognipur	93
Total		523

3.9.1. Population Profile:

The study area has a total population of 826346, out of which major percent which is 32% from district Kanpur Dehat, and other districts viz. Hamirpur, Jalaun, Kanpur Nagar,

Fatehpur and Auraiya have percentages 20%, 21%, 19%, 7.25% and 0.75% respectively. The percentage of population share among the districts is shown in Fig3.27.

Fig3.50.Perecntage of population in the study area

The total number of households within the study area are 149435 out of which Kanpur Dehat district contributes the major portion (32%), percent share of other districts is represented in Fig.3.28.

LITERACY PROFILE:

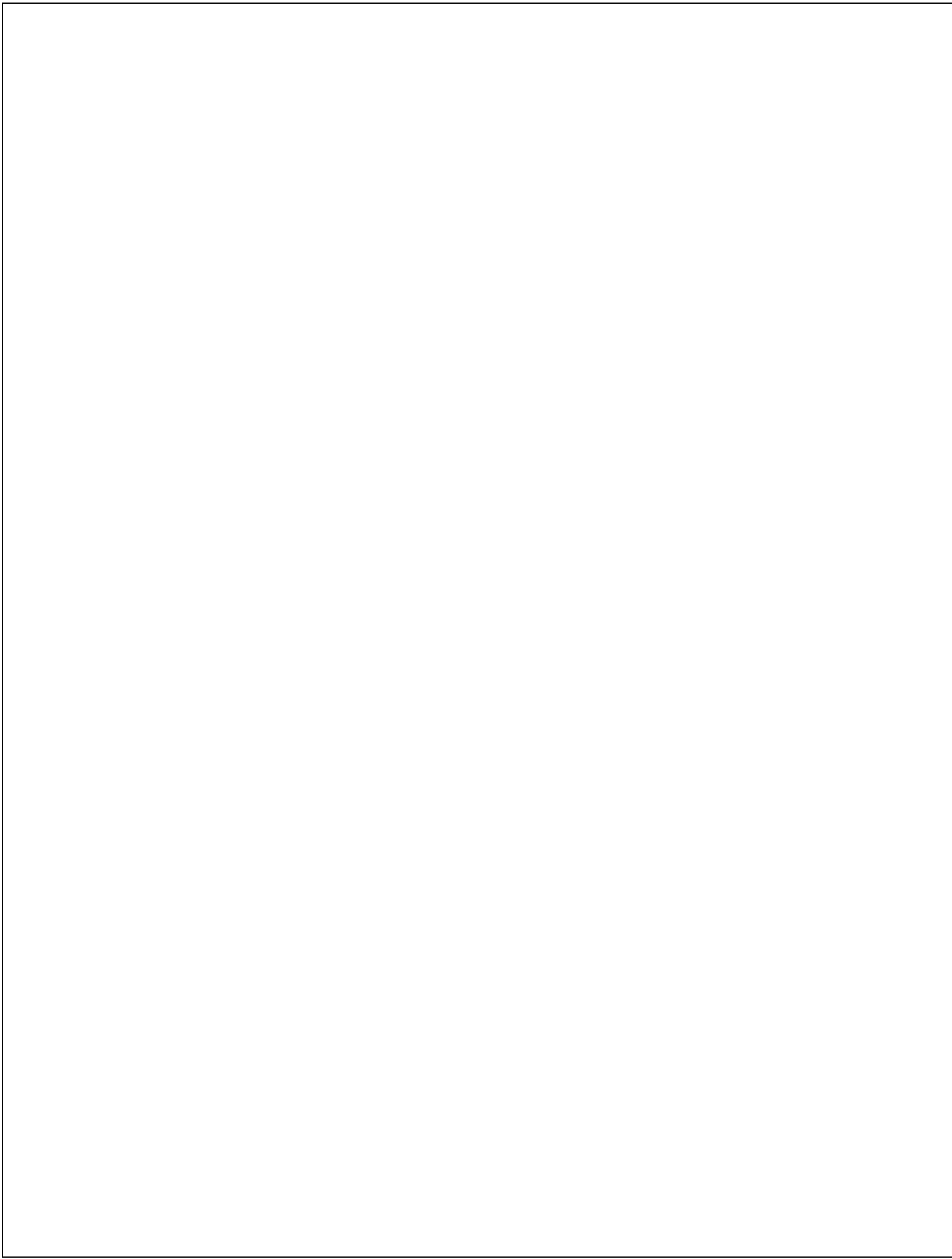
There are parts of six districts which are falling under this Regional EIA study namely Kanpur Nagar, Kanpur Dehat, Hamirpur, Jalaun, Auraiya and Fatehpur. Literacy profile of the study area is given below in Fig.3.29.

OCCUPATIONAL PROFILE:

The percentage of Worker and Non-Worker population out of the total population constituting the study area is given in Fig3.29. 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. Category wise percentage of Main and Marginal workers is given in Fig3.30.



CHAPTER- IV

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION METHODS

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4.0	GENERAL
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4.2	FOLCHI METHOD FOR IMPACT ASSESSMENT

4.0 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

S. Nos.	District	Village	Number of mine leases
1.	Kanpur Nagar & Dehat	Katari, Kanpur Nagar	01
2.		Katri Khera, Ludhwa Kanpur Nagar	01

Given above are the numbers of leases (02 leases) which are falling within the Study Area-3, other than the existing leases for which Regional EIA study has been done in this report. These leases (02-projected + 08-existing leases) would be included in the impact prediction of Study Area-3, as these projected 02 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 addressed 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 Regional 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 Regional Environment Impact Assessment (REIA) (due to numbers of leases (08) on Yamuna river in district Kanpur

Dehat, Kanpur Nagar & 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 REIA considering all vital parameters of the physical & biological parameters if 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.

	Main Impact	Consequences
Air	Increase level of air pollutants concentration	Human health risks
Flora and fauna	Habitat loss	Alteration on fish population
		Increasing level of weed infestation

	Main Impact	Consequences
Water	Physical disturbance of the habitat	Degradation of aquatic biota
		Alter number of animal species
	Vegetation is destroyed	Reduction of farmlands and grazing lands
	Increase water turbidity	Decrease plants photosynthetic activity
		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

	Main Impact	Consequences
	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.)

	Main Impact	Consequences
	Soil erosion	Watercourses, wetlands and lakes pollution
Land	Landscape disturbance	Dramatically change of the landscape
		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 a EIA 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, Kanpur Dehat, Kanpur Nagar 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 land form or physiography 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 year 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 impact on flora and fauna due to land degradation, deforestation, etc. However, as the mining is restricted to 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 waste land, 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 REIA identifies the impact of 08 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 Yamuna between 25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"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 to 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.

f. Impact on riverine ecology

In the current EIA, dredging or instream mining is not proposed in any of the 11 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.

g. 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, PM₁₀ and PM_{2.5}. 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/ m³

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 $\mu\text{g}/\text{m}^3$. 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

Fig. 4.1 Concentration of Fugitive Dust vs Distance

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 Yamuna is one of the major flowing rivers of the district. Yamuna 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. Excessive mining 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. Excess esive dewatering in mines

Fig. 4.2 Water Surface due to dewatering

Source : Green *et al.*, 2005

as shown in figure create the cone of depression surrounding the pit and the merging of Aquifer 1 and Aquifer 2 water surfaces due to dewatering. 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 arial 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 hori zontal 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

4.1.5.4. 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 (Wass *et 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 beyond the 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 to move 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, *et al*, 2002) . Other impact of turbidity is discoloration of water which more than anything renders good water 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-4 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-4, 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.

4.1.6.4.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.

4.1.6.5.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
M/s Ghanaram Infra Engineers Pvt. Ltd.	Khand No. 1/Gata No. 364 मि०ए 365 मि०ए 366 मि०ए 367 मि०ए 390 मि०	958	64	>10m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)	0.39	11.1	11.49

M/s Harihar Minerals LLP	Khand No. के० 2, Gata No. 389 मि०ए 390 मि०	1000	67	>10m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)	0.68	10.29	10.97
M/s Eureka Mines & Minerals LLP	Gata No. 1598 Cha	2000	133	>6m wide road connected to Metaled road which is further connected to NH 86 (From Kanpur to Dewas)	0.78	3.55	4.04
M/s Vikas Enterprises	Khand No. 31/5	2650	177	>10m wide road connected to NH 86 through village chak road & Metaled road (From Kanpur to Dewas)	1.98	11.4	13.38
M/s Bundelkhand Industries	Gata No.- 826 Mi/01	1309	87	>8m wide road connected to NH 2A village chak road & Metaled road (From Sikandara to Bhognipur)	0.65	10.7	11.35
M/s Ghanaram Infra Engineers Pvt. Ltd.	Gata No. 138	881	59	>6m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)	0.52	14	14.52
M/s Maa Raktdantika Contractors And Suppliers Pvt. Ltd.	Khand No. 05	195	13	>8m wide road connected to NH 25 (Jhansi – Kanpur Highway)	1.44	0.48	1.92
M/s Maa Raktdantika Contractors And Suppliers Pvt. Ltd.	Khand No. 02	707	47	>8m wide road connected to NH 25 (Jhansi – Kanpur Highway)	0.44	0.28	0.72
Grand Total	08 Leases- (B1+B2)**	7,959	647		6.88	61.32	68.39

Table 4.3(a) : Existing Traffic Scenario & LOS

Road	V	C	Existing V/C Ratio	LOS
Near project site	60*	500	0.12	A
SH	306*	1500	0.20	B
NH	364*	2400	0.15	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 is “A” i.e. Excellent and for National Highway- is “B” i.e. Very Good.

Table 4.3(b) : Existing Traffic Scenario & LOS

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.

4.1.6.6.During mine operation

Total extraction of morrum : 2667547 cum (as estimated in LOI)*

No. of working days in a year	: 275
Total extraction/day	: 7959 cum
Truck Capacity	: 15 cum
No. of trucks deployed/day	: 647 trucks
Working Hours per day	: 12 hours
No. of trucks deployed/hr	: 53.9 say 54 trucks
Increase in PCU/ hr	: 108 (to and fro)

Table 4.4: Modified Traffic Scenario & LOS

Road	V	C	Existing V/C Ratio	LOS
Near project site	168	500	0.33	B
SH	414	1500	0.27	B
NH	472	2400	0.19	A

4.1.6.7. Results

From the above analysis it can be seen that the V/C ratio will be modified to 0.33 on roads nearby project sites/ village roads with LOS being “C” which is good. While for National Highway V/C ratio and State Highways will slightly be modified to 0.19 and 0.27, respectively with unchanged LOS being “B” & “A” which is Very Good. 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 Yamuna 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

4.1.7.2. Increased Habitat Loss and Disturbance of Wildlife

The proposed projects are in the river bed of River Yamuna. 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 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.

4.1.7.3. 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.

4.1.7.4. 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.

4.1.7.5. 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 there will be approximately 621 labours for all the mining leases in the riverbed of Yamuna river in District Kanpur Nagar , Kanpur Dehat 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 heavy vehicle movements per day related to Yara Dallol 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 residents of study area. If the ground water is being withdrawn, 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 Yamuna. 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	
OPERATIONAL PHASE									
LAND ENVIRONMENT									
1.	Impact on existing land use	+ve	Direct	High	Short term/temporary	Significant	Reversible	Long Term	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. Thus, there will be no impact on existing land use as the mined area gets replenished every year during monsoon season
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	There will be no pits.Sand will be scrapped. The mine section will be backfilled on arrival of Monsoon every year itself.
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.
2.	Impact on surface water source	+ve	direct	high	Long term/temporary	Significant	reversible	Positive Direct Impact	The main stream will not be diverted to form inactive channels from mining. Mining will remove excess deposits and deepen river bed which will prevent flooding and related problems.

3.	Impact on ground water source	Nil	Nil	Nil	Nil	Nil	Nil	No Impact; ground water extraction is not proposed	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. Mining will be restricted to max.depth of 3 m from the ground level or/ 1m above water level whichever is less.
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	Newer vehicles less than 15 year old will be used for transportation. PUC certificates shall be obtained. Labourers will be provided with personal hearing protection device. Noise & dust barriers among areas of heavy vehicular movement and excavation site.

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.

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	labourers will be required, which will be hired locally, rest shelters and portacabins are proposed.. Drinking Water supply will be provided by way of Private tankers and earthen pots at site.	Contractor
	Generation of solid waste	Temporary	Low	It is a morrum mining project, no mine waste generation is anticipated. 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.	Contractor
	Risks to occupational health and safety	Temporary	Moderate	Mining activities will be carried out semi-mechanized/ OTFM using bar scraper and loader only. Onsite first-aid and primary medical facilities will be provided during operation period. Personal protective equipments will be used. Training and awareness programs related to significance and use of protective gear will be imparted to the workers.	Contractor
	Possible transmigration	Temporary	Moderate	The contractor will be encouraged to give preference to local labour in the region.	Contractor
Earth Movement	Induced soil erosion, loosening of productive top soil.	Nil	Nil	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	

Activity	Issue	Duration / Extent	Magnitude	Action with Key Riders	Responsibility
				confined along the river bed only. No impact as the mined area gets replenished every year during monsoon season. Since it is a RBM project, availability of top soil is very rare. 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. 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.	
Onsite activity	Extraction of natural resources such as morrum	5 years	Negligible	No impact as the mined area gets replenished every year during monsoon season.	Contractor
	Noise generation due to the movement of Vehicles	Temporary	Moderate	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. 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.	Contractor

Activity	Issue	Duration / Extent	Magnitude	Action with Key Riders	Responsibility
				Labourers should be provided with personal hearing protection device (if required).	
	Air emissions	Temporary/ Short Term	Moderate	The dust emissions will be minimized by following the good practices, for example, water sprinkling, provision of noise barriers, etc. Overloading of the trucks/trolleys should not be done. Suitable dust barriers shall be proposed.	Contractor

4.2 FOLCHI METHOD FOR IMPACT ASSESSMENT

The method used to quantify the Environmental Impact for the open pit mining. The affected environment was broken down into a number of components, such as public health and safety, social relationship, air and water quality, flora and fauna. The effect of the various impacting factors from the mining activities, both directly and indirectly, was then calculated for each environmental component. To do this, each impacting factor was first given a magnitude, a number based solely on the range of scenarios possible for the impacting factor. A matrix of weighting factors was then derived to systematically quantify, and normalise, the effects of each impacting factor on each environmental component. The overall impact upon each individual environmental component was then calculated by summing the weighted magnitudes for all the impacting factors. The method, which is outlined here in a schematic form, was originally developed for a mining operation in Sardinia, Italy. It has subsequently been successfully used for trough and other mining ventures and more general industrial activities, such as waste dumping, recycling and, energy production. As with any evaluation, the method requires an element of subjective assessment but it does at least give transparency to the process used to assess environmental impact. The method can be used to ensure the consistency of approach required to allow realistic comparisons to be made between various design

solutions, mitigation measures. In a wider sphere, for instance a provincial mining district, it could be used to ensure a consistent means of comparison between the environmental impacts due to different mining sites. The Regional Environmental Impact Statement had only to consider the mining activity itself and the study was conducted in the following manner:

1. Characterising the pre-existing environmental context in terms of geology, geotechnics, hydrology, weather, economy, etc.
2. Identifying the IMPACTING FACTORS, namely those factors, that during mining, could modify the pre-existing environmental conditions
3. Defining the possible ranges for the MAGNITUDE of the variation caused by each IMPACTING FACTOR
4. Singling out the ENVIRONMENTAL COMPONENTS whose pre-existing condition could be modified as a result of the mining
5. Correlating each IMPACTING FACTOR and each ENVIRONMENTAL COMPONENT
6. Estimating the specific MAGNITUDE for each IMPACT FACTOR, using the already defined ranges
7. Calculating the weighted sum of the environmental impact induced from the IMPACTING FACTORS on each ENVIRONMENTAL COMPONENT.

4.2.1. Pre-existing environmental context

The present mining geological study area lies between the coordinates 25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"E in which River Yamuna. The study area is underlain by alluvial deposits mainly which is of Pleistocene to Recent age. The alluvial deposits found within the study area are both Older alluvium and Newer Alluvium. Older Alluvium categorized into Banda and Varanasi Alluvium of Middle to Upper Pleistocene age. Newer Alluvium belongs to upper Pleistocene to Recent age. Within the study area, the major

portion is overlain by Varanasi Alluvium in the districts Auraiya. Kanpur Dehat, Kanpur Nagar and Fatehpur and Banda alluvium found towards the districts Jalaun and Hamirpur and also a palaeochannel(25°53'23.88"N 80° 9'43.06"E) is found around the area where river Betwa joins the Yamuna river.

Along the water channel of Yamuna river flowing from North-west to South-east direction, newer alluvium is found viz. Terrace and Channel alluvium are found. Channel alluvium is mostly concentrated in the upper reaches of the river within the 10km radius buffer zone lying in districts Jalaun(26°20'25.40"N 79°32'39.93"E), Kanpur Dehat(26°16'47.91"N 79°33'15.89"E) and Kanpur Nagar(25°56'16.70"N 80°13'24.52"E) which indicates the presence of Channel, point and lateral bars within the active water channel and river bed of these formerly mentioned districts are partially or wholly submerged during the monsoon season.

Terrace alluvium which is found on the older flood plain of river Yamuna. These flood plains are low lying and preserved from the incision of rivers, hence the sediment keeps on getting deposited on these flood plains forming a terrace like formation. The deposition of alluvium is mainly coarse to very coarse in nature in texture. Within our study area, at many places the major deposition of terrace alluvium can be observed on river Yamuna in districts Kanpur Dehat (26°22'32.08"N 79°31'6.90"E), Kanpur Nagar (26° 5'58.57"N 79°59'39.41"E), Hamirpur (26° 7'37.26"N 79°56'40.23"E & 25°54'20.59"N 80°19'4.11"E) and also on Betwa river which joins the Yamuna river in Hamirpur(25°54'25.89"N 80° 8'53.47"E) district has deposition of Terrace alluvium.

River Yamuna flowing within the Kanpur Dehat and Jalaun districts upto Behmai the average water level of the river is approximately 102m and the sand deposition within the stretch is of average thickness 39m-11m.

In the next stretch upto Kalpi, the average water level of Yamuna river is approx. 1000m and the average thickness of sediments varies from 33m-13m. In the next stretch just before it enters Kanpur Nagar district, the average level of water in Yamuna river is 95m and the average thickness of sediment deposition is 28m-8m. Further down the stream within the Kanpur Nagar upto the point where Betwa river joins the Yamuna River in Hamirpur district

the average water level of the river is approx. 94m and the average thickness of sediment deposition varies between 25m-10m. In the last stretch of Yamuna river flowing within the study area, the level of water in the river is approximately 92m and the average thickness of sediment deposition is 20m-8m.

4.2.2 Impacting factors The following ten IMPACTING FACTORS were taken into account:

i. Alteration of the area's potential resources

The area is government waste land and not being used for any purposes.

ii. Exposition, visibility of the pit

The mined out leases will be visible from the nearby town and from local roads up to 5 km away. However, all the roads in the area were little more than tracks, with no asphalt covering, and consequently, traffic volume was low, approximately 60 vehicle passages per day. But with the start of operations the traffic volume will be enhanced multiple fold. As estimation 1140 trucks /day will be transporting the sand through the study area and coming back.

iii. Interference with the above-ground water system

The mining would take place in a dry riverbed. The surrounding terrain was impermeable and trough valleys conveyed water directly to the river. The location of the pit and its supporting infrastructure, such as ramps, paths and yards, were all designed to minimize any interference with the above-ground water courses. The presence of the pit was minimal, compared to the existing river basin, and would not cause any significant perturbations in the above-ground water system.

iv. Interference with the underground water system

Sand will be mined out from the dry river bed and above the ground water table.

v. Increase in vehicular traffic

Access to the pit area, for personnel, supply of materials, spare parts and explosives, would take place via the existing public roads. Transportation of the sand along with transportation and essential services will add in to the existing scenario of trafficular vvehicle.

vi. *Atmospheric release of gas and dust*

Emissions into the atmosphere, together with acoustic emissions and ground vibration, can be one of the most significant IMPACTING FACTORS for open pit mining with explosives. Drilling and blasting both produce a fine dust that contains silica. Due to a strong, year long round wind, and the dust could be distributed over a wide area and at some considerable distance from the pit. A similar fine dust is also produced from haulage and provisions are made for paths and yards would be kept wet, to dampen down the dust. All these precautions, taken to provide an effective means of reducing the risk of silicosis, also significantly reduce any spread of the dust outside of the working area. Gases such as CO, CO₂ and NO_x would be produced by vehicles, compressors and detonation of the explosives.

vii. *Fly-rock*

It is not applicable as it is a sand mining project.

viii. *Noise*

Trucks, scrapers and loaders produce low amplitude, low frequency, persistent acoustical impact. Past experience suggests that, following the initial desertion from the affected area, a tolerance is acquired and the abandoned territories are gradually re-inhabited. The time needed for these re-occupation ranges from weeks to months. The impacted area was expected to be extended by about 2 km (1.2 miles). Conversely, the effects of acoustical impact on humans are well known. However, experience has shown that not exceeding “nuisance” threshold values is not a guarantee of freedom from complaints and law suits.

ix. *Ground vibration*

No rock blasting is involved.

x. *Employment of local work force*

The study area is a region with high unemployment and the new mining activities across the stretch itself would bring new job opportunities to the nearby town and also increased trade for the service industries, hotels and restaurants.

1.0 *Magnitude of the impacting factors*

The possible scenarios for each IMPACTING FACTOR were then considered and a numerical value, or MAGNITUDE, was given to each scenario. For simplicity, the value

chosen for each scenario was between 1 and 10, the number chosen being indicative of the severity of the environmental impact, with 10 being the most severe. The various scenarios and their related MAGNITUDE are shown for each IMPACTING FACTOR in Table (1).

2.0 Environmental components involved

The environment surrounding the pit was broken down into the following eleven components:

- a. Human health and safety
- b. Social relationship and quality of life
- c. Water quality
- d. Air quality
- e. Use of territory, as naturalistic resources, socio-cultural and economical
- f. Flora and fauna
- g. Aboveground
- h. Underground
- i. Landscape
- j. Noise
- k. Economy

4.2.3. Weighted influence of each impacting factor on environmental component

An IMPACTING FACTOR will modify the pre-existing state of equilibrium of an ENVIRONMENTAL COMPONENT in a way that can vary from having no effect at all through to a severe impact. Four levels of perturbation, namely nil, minimum, medium and maximum, were chosen to describe the effect that an IMPACTING FACTOR has on an ENVIRONMENTAL COMPONENT. The maximum perturbation level was numerically defined as double the medium perturbation level and similarly, the medium perturbation level was defined as double the value of the minimum level. The sum of all the perturbation levels for each ENVIRONMENTAL COMPONENT was normalized by imposing the sum equal to 10. Table (2) shows the perturbation level of the IMPACTING

FACTORS for each ENVIRONMENTAL COMPONENT and the related numeric weighting factors calculated as described above.

4.2.4. Calculation of the impact on each environmental component Firstly, using the MAGNITUDE ranges defined in Table (1), each IMPACTING FACTOR for the proposed mining activity was assessed and its MAGNITUDE chosen, as shown in Table (3). A matrix of the IMPACTING FACTORS against the ENVIRONMENTAL COMPONENTS was then drawn up, with the chosen MAGNITUDE weighted using the numeric values given in Table (2). Table (4) shows the resultant matrix. Then the overall effect on each ENVIRONMENTAL COMPONENT was calculated by summing the weighted magnitudes of all the IMPACTING FACTORS. It was then possible to summarise the Environmental Impact Statement for the proposed mining activity as a simple graphical representation as shown in Figure (2).

Table No. 4.6. Ranges of MAGNITUDE for IMPACTING FACTORS

IMPACTING FACTORS	SCENARIO	MAGNITUDE
ALTERATION OF AREA'S POTENTIAL RESOURCES	Parks, protected areas	8 – 10
	Urban area	6 – 8
	Agricultural area, wood	3 – 6
	Industrial area	1 - 3
EXPOSITION, VISIBILITY OF THE PIT	Can be seen from inhabited areas	6 - 10
	Can be seen from main roads	2 - 6
	Not visible	1 - 2
INTERFERENCE WITH ABOVE-GROUND WATER	Interference with lakes and rivers	6 – 10
	Interferences with non relevant water system	3 – 6
	No interference	1 - 3
INTERFERENCE WITH UNDERGROUND WATER	Water table superficial and permeable grounds	5 – 10
	Water table deep and permeable grounds	2 - 5

	Water table deep and un-permeable grounds	1 - 2
INCREASE IN VEHICULAR TRAFFIC	Increase of 200%	6 - 10
	Increase of 100%	3 - 6
	No interference	1 - 3
ATMOSPHERIC RELEASE OF GAS and DUST	Free emissions in the atmosphere	7 - 10
	Emission around the given reference values	2 - 7
	Emission well below the given reference values	1 - 2
FLY-ROCK	No blast design and no clearance procedures	9 - 10
	Blast design and no clearance procedures	4 - 9
	Blast design and clearance procedures	1 - 4
NOISE	Peak air overpressure at 1 km distance	
	< 141db	8 - 10
	< 131 db	4 - 8
	< 121db	1 - 4
GROUND VIBRATION	Cosmetic damage, above threshold	7 - 10
	Tolerability threshold	3 - 7
	Values under tolerability threshold	1 - 3
EMPLOYMENT OF LOCAL WORK FORCE	Job opportunities :	
	High	7 - 10
	medium	3 - 6
	low	1 - 2

Table No. 4.7. Correlation matrix with values of the weighted influence of each IMPACTING FACTOR on each ENVIRONMENTAL COMPONENT

IMPACTING FACTORS	Environmental Components											
	Human health and society	Social relationship	Water Quality	Air Quality	Use of territory	Flora and fauna	Above ground	Underground	Landscape	Noise	Economy	
ALTERATION OF AREA'S POTENTIAL RESOURCES	Med 0.80	Min 0.77	Nil 0	Nil 0	Max 5.71	Min 0.63	Nil 0	Nil 0	Max 2.86	Nil 0	Nil 0	
EXPOSITION, VISIBILITY OF THE PIT	Nil 1.60	Min 0.77	Nil 0	Nil 0	Med 2.86	Nil 0	Nil 0	Nil 0	Max 2.86	Min 2.0	Nil 0	
INTERFERENCE WITH ABOVE-GROUND WATER	Max 0.40	Nil 0	Max 4.44	Nil 0	Nil 0	Max 2.50	Med 6.67	Nil 0	Max 2.86	Nil 0	Nil 0	
INTERFERENCE WITH UNDERGROUND WATER	Min 1.60	Nil 0	Max 4.44	Nil 0	Nil 0	Nil 0	Nil 0	Med 6.67	Nil 0	Nil 0	Nil 0	
INCREASE IN VEHICULAR TRAFFIC	Max 1.60	Max 3.08	Nil 0	Nil 0	Min 1.43	Max 2.50	Nil 0	Nil 0	Min 0.71	Nil 0	Nil 0	
ATMOSPHERIC RELEASE OF GAS and DUST	Max 1.60	Min0.77	Min 1.11	Max 10.0	Nil 0	Max 2.50	Min 3.33	Nil 0	Min 0.71	Nil 0	Nil 0	
FLY-ROCK	Max 1.60	Nil 0	Nil 0	Nil 0	Nil 0	Med1.25	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	
NOISE	Med 0.80	Nil 0	Nil 0	Nil 0	Nil 0	Min 0.63	Nil 0	Nil 0	Nil 0	Max 8.0	Nil 0	
GROUND VIBRATION	Max	Med	Nil	Nil	Nil	Nil	Nil	Min	Nil	Nil	Nil	

	1.60	1.54	0	0	0	0	0	3.33	0	0	0
EMPLOYMENT OF LOCAL WORK FORCE	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	Nil 0	Ma x 10. 0
Total=	10	10	10	10	10	10	10	10	10	10	10

Table No. 4.8. MAGNITUDE of IMPACTING FACTORS for the sand mining in Standard Conditions

IMPACTING FACTORS	Details of Magnitude	Magnitude
ALTERATION OF AREA'S POTENTIAL RESOURCES	The mining of the pit would have temporary modified the potential resources of the area. Although this aspect would not be relevant after the mining phase after the flooding of the river, it had to be taken into account during mining activity	5
EXPOSITION, VISIBILITY OF THE PIT	The mining area would have modified a landscape Plantation on the banks will help to adsorb visual impact.	4
INTERFERENCE WITH ABOVE- GROUND WATER	The mining activity in dry river bed will minimize alteration of the hydraulic basin.	2
INTERFERENCE WITH UNDERGROUND WATER	As mining will be carried out above the water table, there is no impact on the mining area.	1
INCREASE IN VEHICULAR TRAFFIC	Increase of 200 %	6
ATMOSPHERIC RELEASE OF GAS and DUST	Dust and gas emissions would be kept below given threshold values, paths and yards kept wet. Negligible gas pollution from machinery and blast.	2

FLY-ROCK	The blast would be planed to keep rock throw distance within the quarry area. Haulage at the bench toe, without push and stocking in a dejection cone, reduces the quantity of fines and minimize the quantity of dust.	0
NOISE	Noise of trucks	4
GROUND VIBRATION	To maximize fragmentation, the total explosive charge would be detonated in a high number delay sequence, thus reducing induced vibrations. Also the low productivity required, 150,000 m ³ /y, would mean low levels of vibration.	0
EMPLOYMENT OF LOCAL WORK FORCE	For the mining of the pit, it would be necessary to hire non qualified local workforce and some truck drivers. Also related economical activities, gas stations, small hardware stores, hotel, restaurants, etc. would benefit.	3

Table No. 4.9. Matrix of weighted MAGNITUDES for each IMPACTING FACTOR on each ENVIRONMENTAL COMPONENT

IMPACTING FACTORS	Environmental Components										
	Human health and society	Social relationship	Water Quality	Air Quality	Use of territory	Flora and fauna	Above ground	Underground	Landscape	Noise	Economy
ALTERATION OF AREA'S POTENTIAL	4	3.85	0	0	28.55	3.15	0	0	14.3	0	0

RESOURCES											
EXPOSITION, VISIBILITY OF THE PIT	6.4	3.08	0	0	11.44	0	0	0	11.44	8	0
INTERFERENCE WITH ABOVE- GROUND WATER	0.8	0	8.88	0	0	5	13.34	0	5.72	0	0
INTERFERENCE WITH UNDERGROUND WATER	1.6	0	4.44	0	0	0	0	6.67	0	0	0
INCREASE IN VEHICULAR TRAFFIC	9.6	18.48	0	0	8.58	15	0	0	4.26	0	0
ATMOSPHERIC RELEASE OF GAS and DUST	3.2	1.54	2.22	20	0	5	6.66	0	1.42	0	0
FLY-ROCK	0	0	0	0	0	0	0	0	0	0	0
NOISE	3.2	0	0	0	0	2.52	0	0	0	32	0
GROUND VIBRATION	0	0	0	0	0	0	0	0	0	0	0
EMPLOYMENT OF LOCAL WORK FORCE	0	0	0	0	0	0	0	0	0	0	30
Overall impact=	28.8	26.95	15.54	20	48.57	30.67	20	6.67	37.14	40	30

Fig.4.3. Combined impact of all the projects in the study area-4

4.2.5. Conclusion As can be seen from Figure (2), the most significant impacts were on three ENVIRONMENTAL COMPONENTS, namely “Use of Territory”, “Noise” and “Economy”. However, a major impact would have an Overall Impact value of 100 on any of the ENVIRONMENTAL COMPONENTS and therefore, the actual impacts on these three

ENVIRONMENTAL COMPONENTS are low. The Overall Impacts on the other ENVIRONMENTAL COMPONENTS, "Public Safety", "Social Relationships", "Water Quality", "Air Quality", "Flora and Fauna", "Above Ground" and "Underground" were considered to be insignificant. This quantitative analysis provided a neat method for demonstrating that the proposed mining activity would not cause any relevant alteration to the surrounding environment. Something that was to be expected since the activity would only last five years and take place in a confined area, which would subsequently be replenished.

CHAPTER- V

ANALYSIS OF ALTERNATIVES

S. NO.	CONTENTS
5.1	EXCAVATION METHODS AS PER SUSTAINABLE SAND MINING GUIDELINES 2016
5.2	OTHER POPULAR METHODS
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5.4	WHY BAR SKIMMING/SCALPING
5.5	ANALYSIS OF ALTERNATIVE SITE

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).

Excavating Sand and Gravel from stream Channels using LEMM (Langer, 2003).

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
Trenching			• Potential introduction of fines. • Potential low flow channel diversion. • Potential fish stranding. • Poor fish habitat value.

			• Potential bed load sink. • In non-aggraded channels, can result in head cutting, bank erosion, turbidity.
Bar skimming		Ideally, self-replenishing If within replenishment capacity following impacts can be negate 1. Channel Confinement 2. Channel widening and swallowing 3. Potential braiding 5. Potential channel Degradation 6. Increased bank heights. 7. Lowering of groundwater table. 8. Loss of riparian vegetation.	
Pit mining			• Stream capture. • Fish stranding.
Extraction from meander scars, high terraces		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.

Fig 5.1(b) Dry Pit Channel Mining. (Source: <https://sandrp.in> SOUTH ASIAN NETWORK ON DAMS, RIVERS & PEOPLE)

c) Wet-Pit Channel Mining

Wet-pit mining involves excavation of a pit in the active channel below the surface water in a perennial stream or below the alluvial groundwater table.

Fig 5.2 Wet Pit Mining.

{Source: **River Sand Mining Management Guideline (2009)**. Published by Department of Irrigation and Drainage (DID) Jalan Sultan Salahuddin 50626 Kuala Lumpur, MALAYSIA}

d) 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.

e) 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

METHODS	Acceptibility of method
Bar Skimming	√
Dry Pit Channel Mining	X
Wet Pit Channel Mining	X
Bucket Plow method	X
Trenching Method	X
Pitting Method	X

Fig 5.5 Diagram of sand-and-gravel stream bed showing (A) the nick point that develops with a pit excavation, and (B) the upstream head cutting and downstream bed degradation that develop during high flows.

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

Fig 5.6 Excavating Sand and Gravel from Stream Channels Using Conventional Earth Moving Equipment (Langer, 2003)

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.

Identification of sand mining blocks:-

Identification of sand block 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.

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.

CHAPTER- VI

ENVIRONMENTAL MONITORING PROGRAMME

S. NO.	CONTENTS
6.1	INTRODUCTION
6.2	MONITORING SCHEDULE & PARAMETERS
6.3	MEASUREMENT METHODOLOGY
6.4	IMPLEMENTATION OF ENVIRONMENT MONITORING PLAN
6.5	ENVIRONMENTAL POLICY
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.

6.1 INTRODUCTION

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 programme 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	PM10, PM2.5, SOx, NOx, CO & SIO2	As per CPCB/MoEF&CC requirements i.e. 24 hourly monitoring for one month in each season except monsoon.	Total 26 Monitoring Stations in and around Core Zone.
2.	Noise	Spot Noise level recording Leq	periodic/As per CPCB norms i.e. quarterly	Total 26 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 10 GW & 10 SW (Upstream & Downstream)
4.	Soil Quality	Physical & Chemical Parameters	once in each season except monsoon	Total 10 Sampling Sites in and around Core Zone.
5.	Traffic	No. of vehicles	For all 11 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	04
2.	Noise	04
3.	Water Quality Surface Ground	03 03
4.	Soil Quality	03
Total Monitoring Stations		17

TOTAL MONITORING STATIONS = 17

Fig 6.1 Distribution of Monitoring locations.

LEASE WISE 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 (surafce+ ground) according to any point sources of effluents/discharges into the river and aquifers, if any.

Fig 6.2. Monitoring Stations for Study Area

A) Project Name: M/s Vikas Enterprises , Hamirpur

(AIR & NOISE MONITORING STATIONS)

S. No.	Station Code	Location	Status	Co-ordinates
1.	AQ 5	Kharka	On site/ Downwind within 500m	26°12'39.36"N 79°39'37.64"E
2.	AQ 9	Dahelkhand Mustaqil	Upwind	26°12'37.86"N 79°38'15.52"E
3.	AQ 8	Kharka	Crosswind	26°13'3.57"N 79°39'17.95"E
4.	AQ 6	Khartala Bangar	Downwind	26°12'56.97"N 79°41'29.10"E

(GROUNDWATER SAMPLING STATIONS)

S. No.	Station Code	Location	Status	Co-ordinates
1.	GW 4	Pichaura	Buffer Zone	26°14'1.85"N 79°40'12.58"E
2.	GW 5	Kharka	Buffer Zone	26°13'13.80"N 79°39'32.40"E
3.	GW 6	Urkahara Kalan	Buffer Zone	26°11'17.27"N 79°39'0.92"E

(SURFACE WATER SAMPLING STATIONS)

S. No.	Station Code	Location	Status	Co-ordinates
1.	SW 4	Nibarri Kachhar	Impact Zone	26°13'43.15"N 79°38'53.17"E
2.	SW 5	Kharka	Core zone	26°12'37.32"N 79°39'21.81"E
3.	SW 6	Khartala Katari	Impact Zone	26°11'53.59"N 79°40'56.22"E

(SOIL SAMPLING STATIONS)

S. No.	Station Code	Location	Status	Co-ordinates
1.	SQ 4	Pichaura	Buffer Zone	26°14'1.85"N 79°40'12.58"E
2.	SQ 5	Kharka	Buffer Zone	26°13'13.80"N 79°39'32.40"E
3.	SQ 6	Urkahara Kalan	Buffer Zone	26°11'17.27"N 79°39'0.92"E

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 ₁₀ (PM₁₀), Particulate matter _{2.5} (PM_{2.5}), Sulphur dioxide (SO₂), Oxides of Nitrogen (NO_x), 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 ₁₀	IS: 5182 Part 23:2006	RDS Sampler	Balance, Desicator
2.	PM _{2.5}	NAAQS Monitoring & Analysis Guidelines volume- 1, 2011 CPCB	Fine Dust Sampler	Balance, Desicator
3.	SO ₂	IS: 5182 (Part-V)	RDS Sampler	Spectrophotometer
4.	NO ₂	IS: 5182 (Part-IV)	RDS Sampler	Spectrophotometer
5.	SiO ₂	NIOSH Molebdsilicate Method	RDS Sampler	Spectrophotometer
6.	CO	EPA Method 13	CO Analyzer	CO Analyzer

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 ₃)	IS 3025 Part 34:1988

15	Potassium (as K)	IS 3025 Part 45: 1993
16	Phosphate (as PO ₄)	IS 3025 Part 31:1988
17	Sodium (as Na)	IS 3025 Part 45:1993
18	Sulphate (as SO ₄)	IS 3025 Part 24:1986
19	Total Alkalinity (as CaCO ₃)	IS 3025 Part 23:1986
20	Total Hardness (as CaCO ₃)	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

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

6.3.5

Traffic

Given in chapter 7.0 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 & Aquatic Ecology	Primary Data Collection	By field survey	Floral & Faunal diversity
	Secondary Data Collection	From authentic sources like Forest Department of U.P., District Forest Officer, Kanpur Dehat, Kanpur Nagar, Hamirpur and other	Floral & Faunal diversity and study of vegetation, forest type, importance etc.

		Literatures	

6.3.8. Biodiversity Study

Given in chapter 3.0 in baseline data generation

6.4 Implementation of Environment Monitoring Plan

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 project proponent will be responsible for authorizing a person for:

- 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.

NAME OF RESPOSIBLE PERSON	
POST	
SIGN	
PHONE NUMBER	

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. Copy of letter is annexed as **ANNEXURE-VI**. However the schedule of compliance monitoring will be sent to RO, UPPCB in advance and results will be submitted as annexure of six monthly compliance report.

ADDITIONAL STUDIES

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 IMPCT ASSESSMENT
7.7	RESSETLEMENT & REHABILITATION PLAN
7.8	DISASTER MANAGEMENT
7.9	TRANSPORTATIONAL ROUTE ANALYSIS
7.10	INCREAMENTAL NOISE IN THE STUDY AREA
7.11	GREEN BELT DEVELOPMENT

7.1 PUBLIC CONSULTATION

The public hearing process is an important part of the EC process. Public hearings mandate the EAC and MoEF to consider recorded public concerns. As a component of public consultation, a public hearing provides a “decentralised democratic space” (Utkarsh Mandal v Union of India 2009) in the clearance process where members of the public are given an opportunity to participate in the regulatory process. It is meant to give assurance to people by the government, through face-to-face interactions, to raise their concerns and provide them with all the information regarding the project, while seeking their opinions and hearing their grievances. At the same time, the opinions of the project proponents are also considered before a final decision is made. These face-to-face interactions fulfil the government’s commitment towards “sustainable development,” “environmental justice” (Bowen 2001 and US EPA), “empowered participatory governance” (Fung and Erik 2003) and “principles of natural justice” (S Nandkumar v State of Tamil Nadu 2010). The addressing of these issues by proponents ensures that authorities are aware of ground realities and the pros and cons of the project, which would contribute to effective decision-making (M P Patil v Union of India 2012).

7.1.1 Procedural Guidelines

- Online submission of project proposal.
- Preparation of draft report on the basis of TOR issued/standard TOR.
- The draft REIA is prepared by TOR issued by SEAC or on the basis of standard TOR issued by MoEF as prescribed in EIA notification 2006 amended on 10th April 2015, is submitted to SPCB.
- After submission of draft REIA State Pollution Control Board gave the advertisement for public hearing, which will be conducted between 30-45 days.
- At the day of the public hearing Regional office made all the arrangements for public hearing.
- The presentation based on the draft REIA was presented in the presence of all the people assembled for the public hearing, item-wise.
- No person was allowed to enter the pandal/hall where the public hearing is being conducted holding party flags and they shall not be allowed to raise party slogans.

- No irrelevant issues were discussed and the public hearing was strictly confined to the issues that arise from the draft REIA report and ancillary there to, and nothing more.
- The persons who wanted to speak in the public hearing were asked to give their names in a prescribed form indicating details such as name, father/husband's name, name of the village, taluk/tehsil, and the subject on which he or she wants to speak, etc. Those people were periodically given the mike
- Consultants were present with the proponent in the presence of the public and submit views, on the subject.
- At the end, all the views, whether for or against the project, were addressed subject-wise/issue-wise and be responded to by the project proponent or consultants.
- The authority conducting the public hearing took an active part in following each and every minute procedure required for conducting the public hearing. Regional Office prepared minutes of the proceedings in accordance with the EIA notification, 2006 and show it to the public.
- All the concerned issues are mentioned and incorporated in Regional Environmental Impact Assessment.

Point wise public hearing compliances were given in PH compliances.

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 600) 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 colloid hydrogel 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. 1/3rd 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 10^0 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 m³ (1000 yd³) 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

Yamuna: : This river forms north boundry of the district. The river first touches the district at the vilage Haraulipur in tehsil Hamirpur, where it forms a sudden loop. Flowing then east to

Jamrehi Tir, it curves abruptly south to Sikrohi and then continues south-east part Hamirpur to Baragaon where the Betwa joins it. Its length in Hamirpur district is approximately 56 km.

Betwa : This river flows along the north-western border of the District from the point where the Dhasan joins it to the village of Kuprat separating tehsil Rath from district Jalaun. It enters the district near the village of Beri and flows separating tehsils Rath and Moudaha from tehsil Hamirpur. Its length in Hamirpur district is approximately 65 km.

Other rivers lying in the district are Dhasaan, Barma, Ken, Chndrahal and Pandwaha. These rivers are used for irrigation purpose. A dam named Swami Bramhananad Dam (Moudaha Dam) has been constructed on the river Barma.

7.5.2. Geology

Yamuna River is following from North West to South East from Etawah district to Kanpur and forming a large meanders. The deposition of sediments occur in channel and terrace form.

Betwa river, a tributary of river Yamuna flowing from SW to NE meets with Yamuna river on the right bank in Hamirpur District.

Geologically Etawah District occupies a part of Indogangetic plain and is underlain by quaternary sediments consisting of clay silt Kankar and sands of different grades. The thickness of these quaternary sediments increases gradually towards north. The general geological succession of the formations is given below.

Lithologic Composition	Group	Age
Fine Sand, Silt and Clay	Newer Alluvium	Upper Pleistocene to Recent
Clay with Kankar and sands of different grade	Older Alluvium	Lower Pleistocene to Upper Pleistocene
_____Unconformity_____		
Sand Stone Shales and Lime stone	Vindhyan	Proterozoic
Granite and gneissess and outcross of granitoid, meta sedimentaries and basites,	Bundelkhand Granitic complex	Archean to Proterozoic

dolerite and quartz reef.		

In Kanpur Dehat District the banks of Yamuna are potential areas for fine quality sand and morrum for which mining lease granted.

7.5.3 Local Geology

The morrum occur all along with the Yamuna River in Kanpur Dehat, Kanpur Nagar & 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

The study area of this mining activity lies between the coordinates 25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"E and comprises of districts Kanpur Dehat, Kanpur Nagar, Hamirpur, Auraiya, Jalaun and Fatehpur. The average slope of the stretch is 1.0% with maximum slope of 2.8%.

The study area is underlain by alluvial deposits mainly which is of Pleistocene to Recent age. The alluvial deposits found within the study area are both Older alluvium and Newer Alluvium. Older Alluvium categorized into Banda and Varanasi Alluvium of Middle to Upper Pleistocene age. Newer Alluvium belongs to upper Pleistocene to Recent age. Within the study area, the major portion is overlain by Varanasi Alluvium in the districts Auraiya. Kanpur Dehat, Kanpur Nagar and Fatehpur and Banda alluvium found towards the districts Jalaun and Hamirpur and also a palaeochannel(25°53'23.88"N 80° 9'43.06"E) is found around the area where river Betwa joins the Yamuna river.

Along the water channel of Yamuna river flowing from North-west to South-east direction, newer alluvium is found viz. Terrace and Channel alluvium are found. Channel alluvium is mostly concentrated in the upper reaches of the river within the 10km radius buffer zone lying in districts Jalaun(26°20'25.40"N 79°32'39.93"E), Kanpur Dehat(26°16'47.91"N 79°33'15.89"E) and Kanpur Nagar(25°56'16.70"N 80°13'24.52"E) which indicates the presence of Channel, point and lateral bars within the active water channel and river bed of these formerly mentioned districts are partially or wholly submerged during the monsoon season.

Terrace alluvium which is found on the older flood plain of river Yamuna. These flood plains are low lying and preserved from the incision of rivers, hence the sediment keeps on getting deposited on these flood plains forming a terrace like formation. The deposition of alluvium is mainly coarse to very coarse in nature in texture. Within our study area, at many places the major deposition of terrace alluvium can be observed on river Yamuna in districts Kanpur Dehat (26°22'32.08"N 79°31'6.90"E), Kanpur Nagar (26° 5'58.57"N 79°59'39.41"E), Hamirpur (26° 7'37.26"N 79°56'40.23"E & 25°54'20.59"N 80°19'4.11"E) and also on Betwa river which joins the Yamuna river in Hamirpur(25°54'25.89"N 80° 8'53.47"E) district has deposition of Terrace alluvium.

River Yamuna flowing within the Kanpur Dehat and Jalaun districts upto Behmai the average water level of the river is approximately 102m and the sand deposition within the stretch is of average thickness 39m-11m.

In the next stretch upto Kalpi, the average water level of Yamuna river is approx. 1000m and the average thickness of sediments varies from 33m-13m. In the next stretch just before it enters Kanpur Nagar district, the average level of water in Yamuna river is 95m and the average thickness of sediment deposition is 28m-8m. Further down the stream within the Kanpur Nagar upto the point where Betwa river joins the Yamuna River in Hamirpur district the average water level of the river is approx. 94m and the average thickness of sediment deposition varies between 25m-10m. In the last stretch of Yamuna river flowing within the study area, the level of water in the river is approximately 92m and the average thickness of sediment deposition is 20m-8m.

Fig.7.2.Drainage Map of the study area

Table No.7.1 Drainage status in study area

S.No.	Name of water body	Merges with
1.	Bhitan Nala	Yamuna River
2.	Sunao Nala	
3.	Katchha River	
4.	Jamuria River	
5.	Dabka Nala	
6.	Parmia Nala	

A) **7.5.5. Rainfall:** The variation in rainfall during the duration of environmental monitoring is shown below in Figure No 7.2. 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

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 it 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 **Kanpur Nagar district**, soil exhibits a great variety of composition and appearance. The major part of the district consists of ordinary soils known locally as Bhur and Sand on ridges, Matiyar or clay in depressions and Domat or Loam in the Plains. The 'Reh' prevails in the clay dominant areas.

ALLUVIAL PLAIN (0-1 % SLOPE)

1. Deep, loamy soils and slightly eroded.
2. Deep, loamy soils and slightly eroded associated with silty soils.
3. Deep, fine soils moderately saline and sodic associated with loamy soils, slightly eroded.
4. Deep, fine soils and slightly eroded associated with loamy soils slightly saline and moderately sodic.
5. Deep, fine soils and slightly eroded associated with loamy soils.
6. Deep, silty soils associated with loamy soils slightly eroded.
7. Deep, silty soils with moderate salinity/sodicity associated with loamy soils slightly eroded.,"
8. Deep, loamy soils and slightly eroded associated with silty soils slightly saline/sodic and moderately sodic.
9. Deep, silty soils and slightly eroded associated with fine soils.

OLD ALLUVIAL PLAIN WITH RIVER [LEFT OUT CHANNELS/OXBOWSIPOINT BARS (1-3%SLOPE)]

10. Deep, loamy soils and slightly eroded associated with stratified loamy soils slightly eroded

RECENT ALLUVIAL PLAIN 0-3% SLOPE)

11. Deep, loamy soils with moderate water logging and slight salinity associated with fine soils, slightly water logging.
12. Deep, silty soils and slight flooding associated with loamy soils and slight flooding.
13. Deep, loamy soils slightly eroded associated with sandy soils with slight flooding.
14. Deep, silty soils, moderately saline and sodic associated with loam soils and slightly eroded.

ACTIVE FLOOD PLAIN (1-3% SLOPE)

15. Deep, sandy soils with moderate flooding associated with stratified loamy soils and slight flooding.
16. Deep, stratified loamy soils, with moderate flooding associated with sandy soils with moderate flooding.
17. Deep, stratified loamy soils, with severe flooding associated with loamy soils with moderate flooding.

VERY GENTLY SLOPING UPLANDS WITH HUMMOCKS (1-3% SLOPE)

18. Deep, fine soils, slightly eroded associated with fine semiotic soils and slightly eroded.

Kanpur Dehat: The major area (about 90%) falls under Yamuna sub basin is covered by older alluvial soils consisting broadly of 'Bhur' or sandy soil occupying high mounds, Matiyar or clay rich soil in depressions and 'Domat' or loam in the plains.

In **Auraiya** district, broadly four types of soils found in the area are those generally occur in Ganga alluvial plain. These are briefly described as follows;

Bhur: Youngest soil occurs along river beds and contain large portion of sand.

Matiyar: Occur in low lying areas and contain large portion of clay.

Dumat: It is a loamy soil with dark colour, having clay and sand in equal proportion and can be categorized as intermediate type of bhur and matiyar. Such soil generally occurs in the upland areas.

Pilia: A lighter soil than Dumat and is an intermediate type of Dumat and Bhur.

The Soil found in the district **Fatehpur** exhibit a great variety of composition and appearance. The soil types are sandy loamy and sandy soil, loam clayey, fine texture soil. The diversity of soil is mainly due to the influence of the various river and partly due to presence of peculiar soil Bundelkhand along the course of the Yamuna river. The

major part of district consist of the ordinary soil locally known as Bhur or sand which is found on the ridge, Matiar or clay in the depression and Dumat or loan in the plains, Reh prevails in the clay dominant area. Prominent patches have been observed in part of eastern part of Teleyami block, Bhitaura, Hathgaon, and northern part of Haswa Khayua blocks. Purely alluvial soil of the river valley are present notably in the Kachhar of the Ganga and Yamuna rivers formed by repeated deposit of silt, brought down by river during floods.

Fig. 7.4 Soil map of Districts in study area

7.5.6. Land Use/Land cover

Fig 7.5 Land use map of study area

Table no.7.2. Land use of 500 m radius

Land use types	Area ha	% Area
River and water bodies	3343.89	19
Land with or without scrub	2473.9	14
Crop land (Horticulture)	2143.77	12
Sand	9704.07	55

Table 7.3.Land use of 10 km radius

Land use types	Area ha	% Area
River and water bodies	4571.93	2.2
Forest	19200.5	9.1
Land with or without scrub	51564.4	24.5
Crop land	109112	51.8
Fallow land	1364.61	0.6
Built-up land	3695.97	1.8

Waste land	18161.5	8.6
Sand	2883.83	1.4

Description of Land use/land cover

The buffer zone of study area is almost 52 % crop land and 24.5 % of land area is scrub land or with no scrub. The total builtup area in 10 km radius is 1.8 % and waste land is 8.6 % of the total area covered in the buffer zone of study area.

7.5.8. 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 (τ) 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.

Fig 7.8 : Sediment Transport in river

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

- 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 data provides an excellent resource for estimating sediment yield directly. 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 within 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 a 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: $E = 11.35 I^{0.35} R^{1.75} S^{0.591} p^{0.1}$ 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 one-third of the suspended-sediment load in the lower Rhine river. A large portion of the transported material comes to rest on flood plains [4], 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 [2, 5]: $\log cs = C \log Q + B$ (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 cross-section. 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. The study indicates that the bed load transport rate of mixtures should be based on the availability of the each size range in the surface layer. 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 No 7.4. Popular methods for Replenishment Study

Sediment Transport Equations	• Yang Equation • Engelund-Hansen Equation
River Modeling	• River Modelling Using HEC-RAS
Sediment Rating Curve Determination	• Flow Discharge based on Surveyed Cross Section • Sediment Distribution Curve • Total Bed Material Load Computation • Historical Flood Hydrograph • Extraction Volume Determination

Site Visits and Estimation of Actual Amount	• Visits to extraction site annually, reviews cross section survey data & estimates the actual amount of replenishment over the flood season.

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.**

Fig7.10. Installed marked observation rods on the sites in pre-monsoon season

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 at 10m below the bed level.

Hence, no dewatering is required.

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 from 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. 7.5 Transportational 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.	Khand No. 1/Gata No. 364 मि०ए 365 मि०ए 366 मि०ए 367 मि०ए 390 मि०	958	64	>10m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)	0.39	11.1	11.49
M/s Harihar Minerals LLP	Khand No. के० 2, Gata No. 389 मि०ए 390 मि०	1000	67	>10m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)	0.68	10.29	10.97
M/s Eureka Mines & Minerals LLP	Gata No. 1598 Cha	2000	133	>6m wide road connected to Metaled road which is further connected to NH 86 (From Kanpur to Dewas)	0.78	3.55	4.04
M/s Vikas Enterprises	Khand No. 31/5	2650	177	>10m wide road connected to NH 86 through village chak road & Metaled road (From Kanpur to Dewas)	1.98	11.4	13.38

M/s Bundelkhand Industries	Gata No.- 826 Mi/01	1309	87	>8m wide road connected to NH 2A village chak road & Metaled road (From Sikandara to Bhognipur)	0.65	10.7	11.35
M/s Ghanaram Infra Engineers Pvt. Ltd.	Gata No. 138	881	59	>6m wide road connected to NH 2A through village chak road & Metaled road (From Sikandara to Bhognipur)	0.52	14	14.52
M/s Maa Raktdantika Contractors And Suppliers Pvt. Ltd.	Khand No. 05	195	13	>8m wide road connected to NH 25 (Jhansi – Kanpur Highway)	1.44	0.48	1.92
M/s Maa Raktdantika Contractors And Suppliers Pvt. Ltd.	Khand No. 02	707	47	>8m wide road connected to NH 25 (Jhansi – Kanpur Highway)	0.44	0.28	0.72
08 Leases		7959	647		6.88	61.32	68.39

*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)

Fig 7.11. Google Map showing Transportation Route of Study Area

In the above figure, the transportation route of Study area -3 is represented, in which **Blue** path represents the unpaved road, **Yellow** path represents the paved road and brown path represents the main roads like SH and NHs.

Details of transportation routes are given in Chapter-2 under lease wise details.

7.9.1. Air pollutants level prediction using modeling for worst case scenario (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, Yamuna River District Kanpur Dehat/ Kanpur Nagar/ 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,

NO₂, and SO₂. 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, SO₂, NO₂, 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. 7.6. AQI category, ranges and their associated health impacts (Source: CPCB, 2014)

Analysis of emission load of air pollutants from heavy trucks.

Projects production: 7959.0 cum/day)

Table No. 7.7 Emission load of PM_{2.5} from heavy capacity truck employed at sand mining project sites on Yamuna River area

Monitoring stations	Baseline concentration of PM _{2.5}	Incremental value in concentration of PM _{2.5}	Total (Baseline +Incremental) concentration of PM _{2.5}	Increase in % of PM _{2.5}
AQ 1	54.7	1.5	56.2	2.7%
AQ 2	54.3	1.5	55.8	2.7%
AQ 3	52.4	3.0	55.4	5.4%
AQ 4	55.4	1.8	57.2	3.1%
AQ 5	52.3	9.5	61.8	15.4%
AQ 6	53.7	2.2	55.9	3.9%
AQ 7	52.9	1.5	54.4	2.8%
AQ 8	50.4	5.3	55.7	9.5%
AQ 9	51.8	1.3	53.1	2.4%
AQ 10	51.8	1.3	53.1	2.4%
AQ 11	52.7	2.1	54.8	3.8%
AQ 12	52.8	2.6	55.4	4.6%
AQ 13	52.7	1.5	54.2	2.8%
AQ 14	50.9	2.1	53.0	4.0%
AQ 15	52.5	3.2	55.7	5.7%
AQ 16	49.8	1.8	51.6	3.5%
AQ 17	55.3	1.5	56.8	2.6%
AQ 18	51.4	1.5	52.9	2.8%
AQ 19	53.8	5.6	59.4	9.4%

Overall PM_{2.5} concentration (predicted incremental and baseline air pollutants concentration) was observed above permissible limit of NAAQS 2009 at AQ5. Rest of monitoring station below the permissible limit for PM_{2.5}.

Table No. 7.8_Emission load of PM₁₀ from heavy capacity truck employed at sand mining project sites on Yamuna River area

Monitoring stations	Baseline concentration of PM ₁₀	Incremental value in concentration of PM ₁₀	Total (Baseline +Incremental) concentration of PM ₁₀	Increase in % of PM ₁₀
AQ 1	91.5	0.0	91.5	0.0
AQ 2	92.8	0.0	92.8	0.0
AQ 3	89.9	5.0	94.9	5.3
AQ 4	91.6	3.6	95.2	3.8
AQ 5	92	17.6	109.6	16.1
AQ 6	86.2	0.0	86.2	0.0
AQ 7	91.4	0.0	91.4	0.0
AQ 8	88.7	9.9	98.6	10.0
AQ 9	87.1	1.3	88.4	1.4
AQ 10	89.1	0.0	89.1	0.0
AQ 11	85.9	3.6	89.5	4.1
AQ 12	91.5	4.2	95.7	4.4
AQ 13	88.5	0.0	88.5	0.0
AQ 14	89	3.6	92.6	3.9
AQ 15	89.6	5.9	95.5	6.2
AQ16	88.3	2.8	91.1	3.1
AQ17	94.2	0.0	94.2	0.0
AQ18	86.8	0.0	86.8	0.0
AQ19	92	11.3	103.3	11.0

Overall PM₁₀ concentration (predicted incremental and baseline air pollutants concentration) were observed above permissible limit of NAAQS 2009 at some monitoring stations such as Example: AQ5, and AQ8

Table No. 7.9_Emission load of SO₂ from heavy capacity truck employed at sand mining project sites on Yamuna River area

Monitoring stations	Baseline concentration of SO ₂	Incremental value in concentration of SO ₂	Total (Baseline +Incremental) concentration of SO ₂	Increase in % of SO ₂
AQ 1	8.2	0.00	8.2	0.0
AQ 2	11.1	0.00	11.1	0.0
AQ 3	7.8	0.56	8.4	6.7
AQ 4	8.7	0.04	8.7	0.5
AQ 5	8.3	0.96	9.3	10.4
AQ 6	8.3	0.00	8.3	0.0
AQ 7	8.4	0.00	8.4	0.0

AQ 8	7.7	0.48	8.2	5.9
AQ 9	8.3	0.00	8.3	0.0
AQ 10	8.1	0.00	8.1	0.0
AQ 11	7.9	0.10	8.0	1.2
AQ 12	8	0.19	8.2	2.3
AQ 13	8.4	0.00	8.4	0.0
AQ 14	7.8	0.05	7.8	0.6
AQ 15	8.4	0.48	8.9	5.4
AQ16	7.4	0.05	7.4	0.6
AQ17	9.1	0.00	9.1	0.0
AQ18	8.1	0.00	8.1	0.0
AQ19	8.2	0.60	8.8	6.8

Ambient Air Quality Monitoring stations at Code AQ 1, AQ 2, AQ 6, AQ 7, AQ 9 , AQ 10 , AQ 13, AQ17, AQ18 shows negligible % increase in SO₂ because of the distance from the nearest mine site are situated at approximately more than 4.50 kms. Overall SO₂ concentration was observed below the permissible of NAAQS 2009 at all monitoring stations.

Table No. 7.10 Emission load of NO₂ from heavy capacity truck employed at sand mining project sites on Yamuna River area

Monitoring stations	Baseline concentration of NO₂	Incremental value in concentration of NO₂	Total (Baseline +Incremental) concentration of NO₂	Increase in % of NO₂
AQ 1	10.2	0.0	10.2	0.0
AQ 2	11	0.0	11.0	0.0
AQ 3	10	2.0	12.0	16.8
AQ 4	10.3	1.1	11.4	9.5
AQ 5	10.7	5.0	15.7	32.0
AQ 6	10.5	0.0	10.5	0.0
AQ 7	10.3	0.0	10.3	0.0
AQ 8	10.1	3.0	13.1	23.0
AQ 9	10.9	0.0	10.9	0.0
AQ 10	10.4	0.0	10.4	0.0
AQ 11	10.4	1.3	11.7	11.0
AQ 12	10.3	2.6	12.9	20.0
AQ 13	11.3	0.0	11.3	0.0
AQ 14	10.1	1.3	11.4	11.2
AQ 15	10.5	3.5	14.0	25.1
AQ16	10	1.1	11.1	10.1

AQ17	11.2	0.0	11.2	0.0
AQ18	10.4	0.0	10.4	0.0
AQ19	10.8	3.8	14.6	26.2

Ambient Air Quality Monitoring stations at Code AQ 1, AQ 2, AQ 6, AQ 7, AQ 9 , AQ 10 , AQ 13, AQ17, AQ18 shows negligible % increase in NO₂ because of the distance from the nearest mine site. Overall NO₂ concentration was observed below the permissible of NAAQS 2009 at all monitoring stations.

Table No. 7.11 Emission load of CO from heavy capacity truck employed at sand mining project sites on Yamuna River area

Monitoring stations	Baseline Air pollutants concentration	Incremental value of Air pollutants concentration	Total Air pollutants concentration
AQ 1	BDL	0.00	0.00
AQ 2	BDL	0.00	0.00
AQ 3	BDL	0.08	0.08
AQ 4	BDL	0.02	0.02
AQ 5	BDL	0.15	0.15
AQ 6	BDL	0.00	0.00
AQ 7	BDL	0.00	0.00
AQ 8	BDL	0.08	0.08
AQ 9	BDL	0.00	0.00
AQ 10	BDL	0.00	0.00
AQ 11	BDL	0.02	0.02
AQ 12	BDL	0.04	0.04
AQ 13	BDL	0.00	0.00
AQ 14	BDL	0.02	0.02
AQ 15	BDL	0.10	0.10
AQ16	BDL	0.02	0.02
AQ17	BDL	0.00	0.00
AQ18	BDL	0.00	0.00
AQ19	BDL	0.14	0.14

Overall carbon monoxide (CO) was observed below 1mg/m³ at all monitoring stations and also below permissible limit (2 mg/m³) of NAAQS 2009.

Overall air quality status has been investigated using air quality index of CPCB 2014 in the study area of Yamuna River. Air quality was observed moderately polluted at two monitoring stations

(Example: AQ5, and AQ8) due to near haulage route, paved road and Sand/Morrum mine projects and also existing core zone in the Study Area of Yamuna River. Air quality at other stations (Example: AQ1 to AQ4, AQ6, AQ7, AQ9 to AQ19) were satisfactory condition due to higher distance from haulage road, upwind direction of wind and existing forest area

Table 7.12: Air quality index of AAQ monitoring locations.

Location/AQI	Air pollutant Sub-index					AQI	Health statements for AQI
	I _{PM10}	I _{PM2.5}	I _{SO2}	I _{NO2}	I _{CO}		
AQ 1	91.5	93.6	10.3	12.8	0.0	93.6	Satisfactory
AQ 2	92.8	92.9	13.9	13.8	0.0	92.9	Satisfactory
AQ 3	94.9	92.2	10.5	15.0	3.8	94.9	Satisfactory
AQ 4	95.2	95.3	10.9	14.2	1.0	95.3	Satisfactory
AQ 5	106.7	103.0	11.6	19.7	7.6	106.7	Moderately polluted
AQ 6	86.2	93.1	10.4	13.1	0.0	93.1	Satisfactory
AQ 7	91.4	90.5	10.5	12.9	0.0	91.4	Satisfactory
AQ 8	98.6	92.7	10.2	16.4	3.8	98.6	Satisfactory
AQ 9	88.4	88.3	10.4	13.6	0.0	88.4	Satisfactory
AQ 10	89.1	88.3	10.1	13.0	0.0	89.1	Satisfactory
AQ 11	89.5	91.2	10.0	14.6	1.0	91.2	Satisfactory
AQ 12	95.7	92.1	10.2	16.1	2.0	95.7	Satisfactory
AQ 13	88.5	90.2	10.5	14.1	0.0	90.2	Satisfactory
AQ 14	92.6	88.2	9.8	14.2	1.0	92.6	Satisfactory
AQ 15	95.5	92.7	11.1	17.5	5.0	95.5	Satisfactory
AQ 16	91.1	85.8	9.3	13.9	1.0	91.1	Satisfactory
AQ 17	94.2	94.6	11.4	14.0	0.0	94.6	Satisfactory

AQ 18	86.8	88.0	10.1	13.0	0.0	88.0	Satisfactory
AQ 19	102.6	99.0	11.0	18.3	7.0	102.6	Moderately polluted

Overall air quality status has been investigated using Air Quality Index (AQI) of CPCB 2014 in the study area of Yamuna River. AQI are presented in Table 7.13 and Figure 7.20 Air quality was observed moderately polluted at two monitoring stations (Example: AQ5, and AQ19) due to near haulage route, paved road and Sand/Morrum mine projects and also existing core zone in the Study Area of Yamuna River. Air quality at other stations (Example: AQ1 to AQ4, AQ6 to AQ18) were satisfactory condition due to higher distance from haulage road, upwind direction of wind and existing forest area.

Table 7.13: IND-AQI category, ranges and their associated health impacts (Source: 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

Yamuna River study area : Air quality status fall in Moderate and Satisfactory condition

7.10 INCREAMENTAL NOISE IN THE STUDY AREA

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. 7.14. Equipment Types, and Their Noise Levels.

EQUIPMENT TYPE	USAGE FACTOR	Lmax at 50 feet (dBA)	Leq at 50 feet (dBA)
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-

Fig 7.21: 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. 7.15. Noise emission(Baseline +Incremental) at different monitoring Locations

NQ Strn.	Baseline(dBA)	Final base+incremental(dBA)	% incremental
N1	53.9	53.9	0.0
N2	52.4	52.4	0.0

N3	53.9	54.0	0.2
N4	52.6	53.0	0.7
N5	53.5	62.5	14.4
N6	56.4	56.4	0.0
N7	52.1	52.1	0.0
N8	52.6	53.7	2.0
N9	54.7	54.7	0.0
N10	52.2	52.2	0.0
N11	52.8	52.8	0.1
N12	52.2	52.5	0.6
N13	53.7	53.7	0.0
N14	54.0	54.2	0.4
N15	57.2	58.0	1.4
N16	52.3	52.3	0.0
N17	52.1	52.1	0.0
N18	53.6	53.6	0.0
N19	52.3	53.8	2.8

Table No.- 16- Higher Percentage Noise Locations.

N5	core zone	station in MLA site
N8	core zone	near site and road within 100m
NQ15	core zone	near site and road within 500m
NQ19	core zone	near site and road within 100m

Noise levels were increased significantly at NQ5 (within MLA), and NQ8, NQ19 due to near more than one mine site and roads (100 m) and also existing core zone. Noise levels was also increased significantly at NQ15 due to near main roads (SH/NH) within 100 m.

7.11 GREEN BELT DEVELOPMENT

The proposed green belt for the cluster on river Yamuna extending between (25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"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.

Fig.7.24.Illustration of plantation on River Bank

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.7.17. Green belt development Plan for 5 years

Year	Saplings to be planted (Survival rate (@ 100 %))	Species	Place of Plantation
I	861	Local species found in the region after consultation with DFO Kanpur Dehat,	• Along the Haul routes which will be used by empty and loaded vehicles (especially bushes)
II	107*		• Plantation in nearby villages towards

III	107*	Kanpur Nagar & Hamirpur	Prominent downwind direction from the mine lease sites
IV	107*		• Plantation along the river bank for its protection
V	107*		• Plantation in the vacant places in the region (transition region between the Dariya and Danda regions)

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:

Total Mine leases	08*
Mine Area(in ha)	172.19 ha**
Total Number of plants/saplings(@ 5 sapling per hectare)	861
Total Lease Period	5 Years
Total length of haul road(in km)	68.39 km

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. 7.18. Details of row Plantation pattern

Table No.7.19.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, Tamarind, Ficus	Amla, Dhak, Subabool, Lantana camara	Beard Grass, Bluestem, Buffalo Grass, Anjan. Birdwood Grass, Durwa Grass(Bermuda Grass), 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. 7.20. Matrix for plant selection.

Table No.7.21 Suitability of plant species for plantation throughout the country.

Scientific name	Common name	Type	Stressed/ Tolerant	Growth rate	Evergreen/ Deciduous	Score
<i>Azadirachta indica</i>	Neem	Tree	Tolerant	Quick	Evergreen	5.71
<i>Tamarindus indica</i>	Tamarind	Tree	Tolerant	Quick	Evergreen	5.46
<i>Cocos nucifera</i>	Coconut	Tree	Tolerant	Slow	Evergreen	5.1
<i>Bombusa arundinacia</i>	Bamboos	Tree	Tolerant	Fast	Evergreen	4.92
<i>Ficus benghalensis</i>	Banyan	Tree	Tolerant	Quick	Evergreen	4.79
<i>Zizyphus marutiana</i>	Ber	Tree	Tolerant	Quick	Evergreen	4.71
<i>Caesalpinia pulcherrima</i>	White gold mahur	Tree	Tolerant	Quick	Evergreen	4.56
<i>Trema orientalis</i>	Charcoal	Tree	Tolerant	Quick	Evergreen	4.53
<i>Alstonia scholaris</i>	Devil tree	Tree	Tolerant	Quick	Evergreen	4.51
<i>Peitophorum pterocarpum</i>	Copper pod tree	Tree	Tolerant	Quick	Evergreen	4.45
<i>Samanea saman</i>	Rain tree	Tree	Tolerant	Quick	Evergreen	4.45
<i>Duranta repens</i>	Duranta	Tree	Tolerant	Quick	Evergreen	4.4
<i>Anona squamosa</i>	Custard Apple	Tree	Tolerant	Fast	Evergreen	4.4
<i>Dendrocalamus strictus</i>	Lathi bans	Shrubs	Tolerant	Fast	Evergreen	4.4
<i>Thespesia populnea</i>	Umbrella tree	Tree	Tolerant	Quick	Evergreen	4.39
<i>Cassia siamea</i>	Iron wood tree	Tree	Tolerant	Fast	Evergreen	4.37
<i>Anthocephalus chinensis</i>	Kadam	Tree	Tolerant	Fast	Deciduous	4.34
<i>Prosopis cineraris</i>	Khejari	Tree	Tolerant	Quick	Evergreen	4.32
<i>Acacia nilotica</i>	Babul	Tree	Tolerant	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.7.22 Suitable species for different soil types.

Soil Type	Suitable Species
Clay Soil	Azadirachata indica, Pongamia pinnata, Swietenia mahagoni, Pterocarpus marsupium, Terminalia tomentosa, Melia dubia, Delbergia latifolia, Delbergia sissoo
Red soil with 10 ft minimum soil depth	Swietenia mahagoni, Pterocarpus marsupium, Terminalia tomentosa, Melia dubia, Delbergia latifolia, Azadirachata indica, Pongamia pinnata, Ailanthus exceisa
Red soil with 5 ft minimum soil depth	Tectona grandis, Swietenia mahagoni, Santalum album, Pterocarpus marsupium, Delbergia latifolia, Azadirachata indica, Melia dubia, Ailanthus exceisa
Alluvial soil	Tectona grandis, Swietenia mahagoni, Pterocarpus marsupium, , Melia dubia, Delbergia latifolia, Neolamarckia cadamba, Pongamia pinnata
Uncultivable soil	Azadirachata indica, Albezia lebbeck, Delbergia sissoo, Ailanthus exceisa, Pterocarpus santanalius
	Terminalia arjuna, Casurina junghuniana, Pongamia pinnata

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. 7.23 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 lebbeck</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. 7.24 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. 7.25 APTI score of 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. 7.26 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-1)
1.	I	861	First year plantation for all leases included in Study Area-1
2.	II	107*	Recurring Plantation to maintain 100% survival rate
3.	III	107*	Recurring Plantation to maintain 100% survival rate
4.	IV	107*	Recurring Plantation to maintain 100% survival rate

5.	V	107*	Recurring Plantation to maintain 100% survival rate

Total Cost of projects included in Cluster = Rs. 1,12,74,42,947*

Cost for Green Belt Development for five year = Rs. 19,40,166

Other Maintenance Charges (Fencing/Tree guards) = Rs. 17,22,200

Annual Irrigation = Rs. 88,801

*(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. 7.27. List of plants, shrubs and herbs found in Study Region:

Comman name	Scientific Name	Comman name	Scientific Name
Akol	<i>Alangium salvifolium</i>	Godni	<i>Cordia rothi</i>
Agast	<i>Sesbania grandiflora</i>	Gular	<i>Ficus glomerata</i>
Arjun	<i>Terminalia arjuna</i>	Gulmohar	<i>Delonix regia</i>
Aamrood	<i>Psidium guavava</i>	Gorak	<i>Adansonia digitata</i>
Aaru	<i>Ailanthus excelsa</i>	Ghata	<i>Schrebera sweitenioides</i>
Amaltas	<i>Cassia fistula</i>	Chamror	<i>Ehretia lavis</i>
Asna	<i>Terminalia alata</i>	Pakad	<i>Ficus lacor</i>
Aam	<i>Magnifera indica</i>	Papita	<i>Carica papaya</i>
Aanjan	<i>Hardwickia binata</i>	Phalsa	<i>Grewia asiatica</i>
Aanwla	<i>Embelica officinalis</i>	Pilua	<i>Saladora persica</i>
Aadu	<i>Prunus persica</i>	Pindar	<i>Randia uliginosa uliginosa</i>
Imli	<i>Prunus communis</i>	Pipal	<i>Ficus religiosa</i>
Anjeer	<i>Tamarindus indica</i>	Pula	<i>Kydia calycina</i>
Aal	<i>Ficus carica</i>	Putranjiwa	<i>Puyranjiva roxburghii</i>
Kadam	<i>Mitrageya parvifolia</i>	Papadi	<i>Holopteria integrifolia</i>
Kadamb	<i>Anthocaphalus indicus</i>	Paper mulberry	<i>Broussonetia papyrifera</i>
Karghai	<i>Anogeissus pendula</i>	Pharai	<i>Erythrina subarosa</i>
Kanji	<i>Pogamia pinnata</i>	Babool	<i>Acacia nilotica</i>
Kathal	<i>Artocarpus heterophyllus</i>	Bargad	<i>Ficus bengalensis</i>
Kanakchampa	<i>Pterospermum accrifolium</i>	Baheda	<i>Terminalia bellerica</i>
Kaja	<i>Bridelia retusa</i>	Ber	<i>Pterocarpus marsupium</i>
Kataiya	<i>Flacourtia indica</i>	Bakain	<i>Melia azedarach</i>
Kamrakh	<i>Averrhoa carambola</i>	Bakar	<i>Premna latifolia</i>
Kumhar	<i>Callicarpa arborea</i>	Badhal	<i>Atrocarpus lakoocha</i>
Kairula	<i>Diospyrus cardifolia</i>	Barna	<i>Crataeva ododra</i>
Kaner	<i>Nerium indicum</i>	Bakail	<i>Gymnospora spinosa</i>
Kaner	<i>Thevetia nerifolia</i>	Bel	<i>Aegle marmelos</i>
Kagji nimbu	<i>Citrus aurantifolia</i>	Bansha	<i>Albizzia odoratissima</i>
Kathsagaun	<i>haplophragma adenophyllum</i>	Bhurkul	<i>Hymenodictyon excelsum</i>

Kari	<i>Miliusa tomentosa</i>	Mahua	<i>Madhuca indica</i>
Kala sirus	<i>Albizzia lebbak</i>	Mahuli	<i>Bauhinia racemosa</i>
Kusum	<i>Schliechera trijuga</i>	Malta	<i>Citrus sinensis</i>
Kumbhi	<i>Careya arborea</i>	Maulshri	<i>Mimusops elengii</i>
Kaisia	<i>Cassia siamea</i>	Vanber	<i>Zizyphus xylopxra</i>
Kaitha	<i>Limmonia acidissima</i>	Chakotra	<i>Citrus maxima</i>
Kharhar	<i>Gardenia turgida</i>	Chandan	<i>Santalum album</i>
Kharpat	<i>Garuga pinnata</i>	Chilla	<i>Casearia tomentosa</i>
Khair	<i>Acacia catechu</i>	Chekur	<i>Prosopis cinararia</i>
Khajur	<i>Phoenix sylvestris</i>	Jarul	<i>Alstonia scholaris</i>
Gajhar	<i>Ficus rumphii</i>	Jarkanda	<i>Lagarstroemia flosreginae</i>
Gutel	<i>Trewia nudiflora</i>	Jamrasi	<i>Eleodendron glaucum</i>
Gamhar	<i>Gmelina arborea Roxb.</i>	Jalmalha	<i>Salix tetrasperma</i>
Gawadi	<i>Cochlospermum religiosum</i>	Jamun	<i>Syzygium cumini</i>
Khair	<i>Acacia catechu</i>	Jangal Jalebi	<i>Pithecolobium dulec</i>
Jheengan	<i>Lannea coromandelica</i>	Dhak	<i>Butea monosperma</i>
Tarcharvi	<i>Sapium sebiferum</i>	Wakli	<i>Anogeissus latifolia</i>
Tad	<i>Borassus flabellifer</i>	Neem	<i>Azadirachta indica</i>
Tun	<i>Toona ciliata</i>	Naspati	<i>Pyrus communis</i>
Tendu	<i>Diospyros melanoxylon</i>	Nimbu	<i>Citrus medica</i>
Dhudhi	<i>Holarrhena antidysentericawall</i>	Meetha nimbu	<i>Citrus limmettioides</i>
Dhamna	<i>Grewia tiliaefolia</i>	Chameli	<i>Millingtonia hurtensis</i>
Chapra	<i>Gardenia latifolia</i>	Parsidh	<i>Hardwickia binata</i>
Pile	<i>Sterespermum suaveolens</i>	Musammi	<i>Citrus aurantium</i>
Reetha	<i>Sapindus emarginatus</i>	Rijoj	<i>Acacia leucophloea</i>
Lsaoda	<i>Cordia dichotoma</i>	Leechi	<i>Litchi chinensis</i>
Lukat	<i>Eriobotrya japonica</i>	Vilayti babool	<i>Prosopis juliflora</i>
Sheesham	<i>Dalbergia sissoo</i>	Shareefa	<i>Anona squamosa</i>
Shahtoot	<i>Morus alba</i>	Safed siras	<i>Albizzia procera</i>
Sagaun	<i>Tectona grandis</i>	Sahjan	<i>Mosinga oleifera</i>
Sandan	<i>Ougenia oojenensis</i>	Sihor	<i>Streblus asperSemal</i>
Semal	<i>Bombax ceiba</i>	Silver oak	<i>Grevillea robusta</i>
Satpatia	<i>Hesperethusa crenulata</i>	Harad	<i>Terminalia chebula</i>
Saal	<i>Shorea robusta</i>	Haldu	<i>Adina cordifolia</i>
Sawani	<i>Langerstromia indica</i>		
Sirsa	<i>Dalbergia lanceolaria</i>		
Exotic species			
Khaya	<i>Khaya senegalensis</i>	Parkinsonia	<i>Parkinsonia aculata</i>
Balamkheera	<i>Kigellia pinnata</i>	Eucalyptus	<i>Eucalyptus hybrid</i>
Australian babool	<i>Acacia auriculiformis</i>	Su-babool	<i>Leucaena leucocephala</i>
Poplar	<i>Populus Spp</i>	Casia	<i>Cassia auriculata</i>
Beltoferum	<i>Peltophorum ferrugineum</i>		
Shrubs and herbs			

Ased	<i>Solanum verbascifolium</i>	Kairi	<i>Dichrostachys cinerea</i>
Aak	<i>Calotropis procera</i>	Kuri	<i>Lantan camara</i>
Arhar	<i>Cajenus cajan</i>	Kathmar	<i>Ficus cuneia</i>
Arusa	<i>Adhatoda vasica</i>	Kankohar	<i>Randia dumetorum</i>
Inni	<i>Clerodendron phlomidis</i>	Kankad	<i>Abutilon indicum</i>
Gokharu	<i>Echinopes echinatus</i>	Khadiyar	<i>Salvadora persica</i>
Kataiya	<i>Flacourtia indica</i>	Kathneem	<i>Carrisa spinarum</i>
Kareel	<i>Capparis decidua</i>	Gudsakari	<i>Grewia helictrifolia</i>
Chakunda	<i>Cassia occidentalis</i>	Jawasa	<i>Alhagi camelorum</i>
Chakbad	<i>Cassia tora</i>	Jhau	<i>Tamarix dioica</i>
Gurgawa	<i>Grewia flavesens</i>	Dhaei	<i>Woodfordia fruitsoca</i>
Chinari	<i>Grewia tenax</i>	Neel	<i>Indigofera hirsuta</i>
Jangali piyaj	<i>Urginia indica</i>	Petera	<i>Typha elephentia</i>
Jharbery	<i>Zizyphus nummularia</i>	Pransi	<i>Crotolaria medicagenia</i>
Bhang	<i>Cannabis sativa</i>	Bhant	<i>Clerodendron viscosum</i>
Bhatkataiya	<i>Solanum xanthocarpum</i>	Manju	<i>Vitex negundo</i>
Sarfok	<i>Tephrosia purpurea</i>	Harsingar	<i>Nyctanthes arbortristis</i>
Hingot	<i>balanites aegyptica</i>	Hauns	<i>Cappris zeylanica</i>
Climbers			
Amarbel	<i>Cuscuta reflexa</i>	Kaunch	<i>Mucuna pruriens</i>
Aal	<i>Mimosa himalyana</i>	Gurchi	<i>Tinospora malabarica</i>
Aadi	<i>Cappris sepiara</i>	Gauj	<i>Milletia auriculata</i>
Banda	<i>Dendropfthoe falcata</i>	Mulathi	<i>Abrus precarius</i>
Aaila	<i>Acacia pinnata</i>	Indrayan	<i>Combetum decandrum</i>
Bauri	<i>Ventilago calyculata</i>	Kundroo	<i>Coccinea indica</i>
Charendi	<i>Cocculus hirsutus</i>	Darain	<i>Butea superba</i>
Dhudhi	<i>Cryptolepsis buchanani</i>	Tamren	<i>Mearua arenaria</i>
Dhudhia	<i>Ichnocarpus frutescens</i>		
Pani bel	<i>Cissus repanda</i>	Parwal	<i>Trichosanthes dioica</i>
Mahurain	<i>Pilliosigma vahlii</i>	Harjuri	<i>Cissampelos pareira</i>
Malkangni	<i>Celastrus paniculatus</i>	Makoi	<i>Zizyphus oenoplia</i>
Ramdatoon	<i>Smilax prolifera</i>	Satawar	<i>Asparagus racemosus</i>
Baans			
baans	<i>Dendrocalamus strictus</i>	Kathbaans	<i>Bambusa arundinaceae</i>
Grass			
Anjana	<i>Cenchrus siliaris</i>	Gagerua	<i>Andropogon pumilus</i>
Kaans	<i>Saccharum spontaneum</i>	Guria	<i>Chrysopogon montanus</i>
Kush	<i>Chrysopogon montanus</i>	Kala lappa	<i>Heteropogon contortus</i>
Khas	<i>Vetveria zizanoides</i>	Jama	<i>Dicanthum annulatum</i>
Guner	<i>Themeda arundinaceae</i>	Vindra	<i>Setaria glauca</i>
Narsal	<i>Arando donex</i>	Bamai	<i>Eulaliopsis binata</i>
Bhujri	<i>Apluda mutica</i>	Musel	<i>Iselema laxum</i>
Roopa	<i>Cymbopogon martini</i>	Murjhaina	<i>Eremopogon fovelatus</i>
Moonj	<i>Saccharum munja</i>	Safed	<i>Aristida depressa</i>
Siroo	<i>Empreata cylindrica</i>	Santoor	<i>Chloris dolichostachya</i>
Sen	<i>Sehima nervosum</i>	Usari ghas	<i>Marginatus</i>
Chota jarwi	<i>Bothriochola pertusa</i>	Doob	<i>Cynodon dactylon</i>

Daab	<i>Desmostachya bipinnata</i>		

Fig:7.26 _Map showing Plantation Program in the cluster

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.7.28 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>	Leguminosae	Dhak	13.40
3.	<i>Phyllanthus emblica</i>	Phyllanthaceae	Amla	40.93
4.	<i>Lantana camara</i>	Verbenaceae	Raimuniya	10.95

Table No. 7.29. 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.Nos.	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>Pennistum purpureum</i>	Poaceae	Anjan
5.	<i>Cenchrus setiger</i>	Poaceae	Birdwood grass
6.	<i>Cynodon dactylon</i>	Poaceae	Durva(Bermuda grass)

Table No. 7.30. 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

PROJECT BENEFITS

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

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 21st 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.

Now the royalty received from mining activities are now used in Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) is a programme launched on 17 September 2015 to provide for the welfare of areas and people affected by mining related operations. PMKKKY is implemented by the District Mineral Foundations (DMFs) of the respective districts using the funds accruing to the DMF from miners. (Khanij means Mineral and

Kshetra means area or field in Hindi. Kalyan stands for welfare and Yojana stands for a Plan or project). District Mineral Foundation (DMF) is a trust set up under Mines and Minerals (Development & Regulation) Amendment Act, (MMDRA) 2015 as a non-profit body in those districts affected by the mining works to work for the interest and benefit of persons and areas affected by mining related operations, in such manner as prescribed by the relevant State Government. At least 60% of the funds under the PMKKKY has to be used for high priority areas such as drinking water supply, environment preservation and pollution control measures, primary / secondary health care, education, welfare of women, children, aged and disabled people, skill development & sanitation. Up to 40% of the funds can be used for infrastructure projects such as physical infrastructure, irrigation, energy and watershed development and any other measures for enhancing environmental quality in mining district. Not more than 5% of the funds can be used for administrative expenses. Save for the base minimum contractual posts, creation of posts, purchase of vehicles etc. would require prior permission. The DMFs have also been directed to take all major decision in a participatory mode, in consultation with the '*gram sabhas*' of the respective villages. They are expected to maintain utmost transparency in their functioning and provide periodic reports on the various projects and schemes taken up by them. Efforts are made to achieve convergence with the State and the District Plans so that the activities taken up by the DMF supplement/complement the development and welfare activities already being carried out. However, activities meant to be taken up under the 'polluter pays principle' cannot be taken up under the PMKKKY.

Of the total funds that DMF would receive in a year, no less than 20 per cent should be deposited in an account for future use (when mining operations are closed) as well as for emergency situations, such as natural calamities.

- ✓ Of the total funds that DMF would receive in a year, no more than 80 per. cent should be spent in the year.
- ✓ Of the total money that DMF has to spend in a year:
- ✓ No less than 65 per cent should be spent on directly affected areas.
- ✓ No less than 50 per cent should be used for the upliftment of directly affected persons.

- ✓ No more than 20 per cent should be spent on indirectly affected areas.
- ✓ No more than 10 per cent should be spent for the development of the district, excluding directly and indirectly affected areas.
- ✓ No more than 5 per cent should be used as administrative expenses of the DMF.

a. Benefit-sharing

- ✓ Every directly affected family should be entitled to equal monetary benefit, which could either be paid monthly or annually. The directly affected family could include widows, single mothers and old people without family support.
- ✓ The amount of monetary benefit should be decided by the Governing Council of the DMF at the beginning of each financial year. However, such amount of monetary benefit shall not be less than the amount a family may be entitled to under the provisions of the Mahatma Gandhi National Rural Employment Guarantee Act, 2005.
- ✓ In fact the need to provide at least the minimum wage has also been mentioned under the Mineral Concession Rules, 1960 (Rule 27p and q). It specifies that such monetary benefit must be given to tribals and persons displaced due to mining if they are employed by mining-lease holders.
- ✓ It is important that a part of the DMF money be used to secure livelihoods of directly affected persons. The second priority, therefore, should be given for education scholarships, health insurance, livelihood trainings, loans to establish small businesses, etc. Priority should be given to support businesses of women.
- ✓ The DMF funds can be used as an 'add-on' (to supplement the funds that district/blocks/ villages would receive normally) for developing local infrastructure, including healthcare facilities, schools, water supply, sanitation and sewerage, electricity, roads, etc. For such developmental purposes, there should be mechanisms in place to transfer DMF funds to other concerned government departments that can implement and maintain these assets. However, the DMF must have a system to verify and audit its contributions.

- ✓ A part of the DMF money used for administrative expenses must be used for capacity building of the affected communities to run the DMF, including fiscal training. Investing in the future
- ✓ A part of the money should be invested for the future. This money should be kept to revive the economy of the area when mining finishes to avoid the issue of 'ghost towns' as is commonly observed in mining areas. DMF funds to be used for the socio-economic upliftment of the community must not be compromised by its administrative expense requirements. Similarly, district entitlements from state coffers must not be affected.

However all the decisions regarding DMF are responsibility of district administration.

Activities that may be shared in the study area by administration and project proponent:

- Road strengthening.
- Road widening
- Road creation
- School building renovation.
- Medical assistance to the beneficiaries
- Educational assistance
- Plantation
- Creation of new drinking water facilities
- Repairing of existing drinking water facilities
- Creation of public toilets for public use
- Support to existing facilities in the area

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

Action both by public and private sector companies mainly spans a diverse set of thematic areas- health, education, livelihood, poverty alleviation, environment, housing, water, women empowerment, child development, infrastructure etc.

The CER activities, which are mandatory for execution of mining activities, are not merely compliance; it is a commitment to support initiatives that measurably improve the lives of underprivileged by one or more of the following focus areas as notified under Section 135 of the Companies Act 2013 and Companies (Corporate Social Responsibility Policy) Rules 2014:

- Eradicating hunger, poverty & malnutrition, promoting preventive health care & sanitation & making available safe drinking water;
- Promoting education, including special education & employment enhancing vocation skills especially among children, women, elderly & the differently unable & livelihood enhancement projects;
- Promoting gender equality, empowering women, setting up homes & hostels for women & orphans, setting up old age homes, day care centers & such other facilities for senior citizens & measures for reducing inequalities faced by socially & economically backward groups;
- Reducing child mortality and improving maternal health by providing good hospital facilities and low cost medicines;
- Providing with hospital and dispensary facilities with more focus on clean and good sanitation so as to combat human immunodeficiency virus, acquired immune deficiency syndrome, malaria and other diseases;
- Ensuring environmental sustainability, ecological balance, protection of flora & fauna, animal welfare, agro forestry, conservation of natural resources & maintaining quality of soil, air & water;
- Employment enhancing vocational skills
- Protection of national heritage, art & culture including restoration of buildings & sites of historical importance & works of art; setting up public libraries; promotion & development of traditional arts & handicrafts;
- Measures for the benefit of armed forces veterans, war widows & their dependents;

- Training to promote rural sports, nationally recognized sports, sports & Olympic sports;
- Contribution to the Prime Minister's National Relief Fund or any other fund set up by the Central Government for socio-economic development & relief & welfare of the Scheduled Castes, the Scheduled Tribes, other backward classes, minorities & women; xii. Contributions or funds provided to technology incubators located within academic institutions, which are approved by the Central Government;
- Rural development projects, etc
- Slum area development. Explanation for the purposes of this item, the term "slum area" shall mean any area declared as such by the Central Government or any State Government or any other competent authority under any law for the time being in force.

c. Education.

- i) Support to Technical /Vocational Institutions for their self-development.
- ii) Academic education by way of financial assistance to Primary, Middle and Higher Secondary Schools.
- iii) Adult literacy amongst those belonging to BPL.
- iv) Awareness Programmes on girl education.
- v) Counseling of parents
- vi) Special attention on education, training and rehabilitation of mentally & physically challenged children/persons.
- vii) Spreading legal awareness amongst people and disadvantageous sections of the society about their rights & remedies available.
- viii) Promotion of Professional Education by setting up educational Institutions offering courses in Engg, Nursing, Management,
- ix) Medicine and in Technical subjects etc.

- x) Provide fees for a period of one year or more to the poor and meritorious, preferably girl students of the school in the operational area of the Company to enable them to get uninterrupted education. B Water Supply including Drinking Water

d. Water Supply including Drinking Water:

- i) Installation/Repair of Hand Pumps/Tube Wells.
- ii) Digging/Renovation of Wells.
- iii) Gainful utilization of waste water from Under -ground Mines for Cultivation or any other purpose.
- iv) Development/construction of Water Tank/Ponds.
- v) Rain water-harvesting scheme.
- vi) Formation of a Task Force of Volunteers to educate people regarding
- vii) Proper use of drinking water.
- viii) Empowerment to the villagers for maintenance of the above facilities for availability of water:
 - Installation/Repair of Hand Pumps/Tube Wells.
 - Digging/Renovation of Wells.
 - Gainful utilization of waste water from Under -ground Mines for Cultivation or any other purpose
 - Development/construction of Water Tank/Ponds.
 - Rain water-harvesting scheme.
 - Formation of a Task Force of Volunteers to educate people regarding
 - Proper use of drinking water.
 - Empowerment to the villagers for maintenance of the above facilities for availability of water.

Health Care organizing, health awareness Camps on

- i) AIDS TB and Leprosy
- ii) Social evils like alcohol, smoking, drug abuse etc.
- iii) Child and Mother care
- iv) Diet and Nutrition.
- v) Blood donation camps.
- vi) Diabetics detection & Hypertension Camps
- vii) Family Welfare.
- viii) Senior Citizen Health Care Wellness Clinics.
- ix) Fully equipped Mobile Medical Vans.
- x) Tele medicine
- xi) To supplement the different programme of Local/State Authorities.
- xii) Along with De addiction centers

e. Environment

- i) Organizing sensitizing programmes on Environment Management and
- ii) Pollution Control.
- iii) Green belt Development
- iv) Afforestation, Social Forestry, Check Dams, Park.
- v) Restoration of mined out lands.
- vi) Development of jobs related to agro product i.e., Dairy/Poultry/farming and others.
- vii) Plantation of saplings producing fruit.
- viii) Animal care.

f. Social Empowerment.

- i) Self /Gainful Employment Opportunities – Training of Rural Youth for Self Employment (TRYSEM) on Welding, Fabrication, and other Electronic appliances.

- ii) To provide assistance to villagers having small patch of land to develop mushroom farming, medicinal plants, farming & other cash crops to make them economically dependent on their available land resources.
- iii) Training may be provided by agricultural experts for above farming.
- iv) Organizing training programmes for women on tailoring Embroidery designs,
- v) Home Foods/Fast Foods, Pickles, Painting and Interior Decoration and other
- vi) Vocational Courses.
- vii) Care for senior citizens.
- viii) Adoption/construction of Hostels (specially those for SC/ST & girls)
- ix) Village Electricity/Solar Light
- x) To develop infrastructural facilities for providing electricity through Solar Lights or alternative renewal energy to the nearby villages. Recurring expenditure should be borne by the beneficiaries.
- xi) Pawan Chakki as alternative for providing electricity in villages, etc.

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 ECONOMICAL 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.

Cost of Project

TOTAL COST OF MACHINE (Rs.)	TOTAL LABOUR COST (Rs.)	EMP COST (Rs.)	TOTAL OPERATIONAL COST (Rs.)
82500000.0	37874506.0	3426499.0	127845565.0

EMP Cost Details

1.	Environment Management Plan (EMP)		
	Items	Units	Cost in Rs.
a	No. of plants (@5 plants/ha)	92 saplings	13,748/-
b	Tree Guard (@2000/- per unit)	for 92 saplings	1,83,300/-

c	Water Demand for plantation (@ 0.5 litre/plant)	0.046 KLD	9,451/-
d	Sprinkling on haulage route for dust supression	11.80 KLD	18,70,000/-
e	Monitoring cost		13,50,000/-
Total			34,26,499/-
Cost of EMP is for 5 years (capital and recurring). We have also proposed the mobile STP.			

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.

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.

Table - Other projects in the vicinity, Project Cost & CER Cost

S.N.	PROJECT NAME	VILLAGE/ TEHSIL/ DISTRICT	TOTAL PROJECT COST	TOTAL CER COST
1.	M/s Eureka Mines & Minerals LLP	Samuhi/ Ghatampur/	190015346	3800306.927

		Kanpur Nagar		
2.	M/s Harihar Minerals LLP	Kharka/ Bhognipur/ Kanpur Dehat	127845565	2556911.291
3.	M/s Ghanaram Infra Engineers Pvt.	Kharka/ Bhognipur/ Kanpur Dehat	122621521	2452430.41
4.	M/s Vikas Enterprises	Patyaura/ Sadar/ Hamirpur	240310105	4806202.091
5.	M/s Bundelkhand Industries,	Behmai/ Sikandara/Kanpur Dehat	151201719	3024034.374
6.	M/s Maa Raktdantika Contractors	Daulatpur Kachhar/ Bhognipur/ Kanpur Dehat	73419778	1468395.563
7.	M/s Maa Raktdantika Contractors	Daulatpur Kachhar/ Bhognipur/ Kanpur Dehat	101147750	2022955.007
8.	M/s Ghanaram Infra Engineers Pvt. Ltd.	Bichhawli Kachhar/ Sikandara/ Kanpur Dehat	120881164	2417623.281

CHAPTER-IX

ENVIRONMENTAL COST BENEFIT ANALYSIS

S. NO.	CONTENTS
9.1	INTRODUCTION
9.2	ANALYSIS OF PROJECT COMPONENTS
9.3	QUANTITATIVE ANALYSIS
9.4	QUALITATIVE ANALYSIS
9.5	INFERENCE
9.6	COST BENEFIT ANALYSIS OF THE PROJECTS IN THE STUDY AREA:

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

Fig 9.1.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

(Source Bianchi,2013)

Fig 9.2 Sand Plume

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

Fig.9.3. 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 complex 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 take 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 population. 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 m³ of Extracted Sand – Total Costs of Extraction of 100 m³

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**
 - No of plants
 - a 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 removal etc.)
 - a
 - 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.

Cost of Project

TOTAL COST OF MACHINE (Rs.)	TOTAL LABOUR COST (Rs.)	EMP COST (Rs.)	TOTAL OPERATIONAL COST (Rs.)
82500000.0	37874506.0	3426499.0	127845565.0

NOTE: Quantitative dimension and time frame for implementation of CER will be finalized after consultation with local Administration and will be given with the first compliance report

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.

Table No- 9.1 EMP Cost

1.	Environment Management Plan (EMP)		
	Items	Units	Cost in Rs.
a	No. of plants (@5 plants/ha)	92 saplings	13,748/-
b	Tree Guard (@2000/- per unit)	for 92 saplings	1,83,300/-
c	Water Demand for plantation (@ 0.5 litre/plant)	0.046 KLD	9,451/-
d	Sprinkling on haulage route for dust suppression	11.80 KLD	18,70,000/-
e	Monitoring cost		13,50,000/-
Total			34,26,499/-
Cost of EMP is for 5 years (capital and recurring). We have also proposed the mobile STP.			

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 / Morrum mining projects the environmental benefits are:

The proposition is to mine morrum 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 turns 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
A	Social					
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	+	+	+	-	0

	water					
B	Economic					
7	Cost of repairing infrastructure	++	+++	+	-	0
8	Effect on crop production	+	++	0	-	++
9	Income of mine owners	---	--	-	++	0
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
C	Environmental					
17	Loss of biodiversity	++	++	+	--	0
18	Loss of riverine vegetation	++	++	+	--	0
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
D	Technical					
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, maintainance 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
1. Regional Income		
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	
2. Regional Employment		

Beneficial Effects		
a.	Increase in number of employed person (Direct and Indirect)	Almost 2200
Adverse Effects		
b.	None	-
Total Net benefit		
3. Population Distribution		
a.	Beneficial and adverse Effects	Incoming of people for satellite ioccupation can deplete the livelihood resources.
Total Net benefit		None
4. Reginal Economic Base and Stability		
Beneficial Effects		Yes
a.	Provide a source of Economic stability and economic diversification.	
b.	Provide for regional mining capability	Yes
Total Net benefit		
5. Regional Environmental Concerns		
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, Impaaact 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
1. Regional Income Distribution		
Beneficial Effects		
a.	Gross Earnings from Excavated sand	
b.	Beneficiaries	
	<u>Primary</u>	
	a.Project proponent	8
	b. Local people who are employed	500 aprox
	c. Government	-
	<u>Secondary</u>	
	Contractors and allied industries	1300aprox
	<u>Tertiary</u>	
	Consumers	
	Peripheral workers	400 aprox.
Adverse Effects		
a.	Loss of income from other allied activities dependent on river	-
2. Life Health and Safety		
a.	Possible health impacts due to mining activity	fugitive dust and noise
3. Educational, cultural and recreational		
a.	Possible detriment to recreational interests.	-
4. Emergency Preparedness		
a.	Total independence of sand supplies	New road construction and

	route	maintainance is envisaged by local administration.

Table No. 9.4. Total benefits from the implementation of proposed plans in study area

Regional Economic Development	
Environmental Quality	Data for future regulation formulation.
Regional Income from sand	It may vary from place to place
Regional Employment	Almost 2200
Population Distribution	None
Economic Base and stability	Economic diversification, sand extraction capacity of area
Environmental concerns	Real impact, visual impact change in sand budget
Social well being	
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 oportunities	Possible detriment to recreational interests.
Emergency Preparedness	Total independence of sand supplies route

Table No. 9.5 Benefits-Adverse effects for Proposed Plan Implementation

Regional Economic Development	Environmental Quality	Regional Consideration	
		Development	Social well being
Value of increased	Areas of natural	Income	Real Income

outputs	beauty		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	

CHAPTER-IX

REGIONAL ENVIRONMENTAL MANAGEMENT PLAN

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10.6	ENVIRONMENTAL MANAGEMENT ACTIVITIES.
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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 is 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 10¹ to 10³ 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 we 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 processes 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 Reygrobellet, 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 this 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 incoming 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 08 sand/moram mine leases, 06 leases are granted by District Magistrate, Kanpur Dehat while 01, 01 leases are granted by District Magistrate Hamirpur & Kanpur Dehat respectively through e-tendering for excavation of Sand / Moram from River bed of Yamuna River. The total area of mining lease is **172.193 ha** and the annual production will be **2667547.0 cum/annum**. These leases are situated on the river Yamuna in two districts namely Hamirpur and Jalaun between 25°54'28.55"N & 80°21'38.84"E to 26°23'47.50"N & 79°29'12.69"E in the river bed of Yamuna. The plan period of the entire lease is 05 years. Area wise only three projects "M/s Eureka Mines & Minerals LLP, M/s Vikas Enterprises , M/s Bundelkhand Industries" 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 Yamuna 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 7.25 to 7.71 . The ground water sample from Bewanpur village shows lowest pH i.e. 7.25 whereas from Lohai Diwara village shows the highest pH 7.71, which is in permissible limit of standards given by CPCB. Fluoride concentration is lowest in Baijamau Kachhar and highest in Bewanpur village, however lowest Iron concentration is found in Pichaura Village and highest iron concentration is found in Baijamau Kachhar village .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, PM₁₀, and PM_{2.5} 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_{2.5} and PM₁₀ is higher than the NAAQS, 2009 (Attached as annexure-) standards in almost all the places except at the monitoring locations AQ 11 and AQ 16 i.e. villages Bilhapur and Bhilawa Dariya. Higher PM_{2.5} levels may be contributed winter months as mixing height is lower in winter months resulting in less volume of troposphere for mixing and hence higher concentrations. PM₁₀ in the area may be formed by physical processes of abrasion of surfaces and agricultural activities. The anthropogenic source of coarse particles are produced by the mechanical break-up of larger solid particles, windblown 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 PM₁₀. SO₂ and NO₂ 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 environment 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 MANAGEMENT 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 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. Uncontrolled dumping will be discouraged. Dustbins shall be provided onsite to collect domestic waste generated.	Project Proponent
	Risks to occupational	Mining activities will be open cast and semi-mechanized/OTFM (Other	Project

Activity	Issue	Action with Key Riders	Responsibility
	health and safety	Than Fully Mechanized) i.e. using light earth Movers eg. Bar scraper and Loaders to avoid accidental hazards. Onsite first-aid and primary medical facilities will be provided during operation period. Protective equipments will be used. Training and awareness programs related to significance and use of protective gear will be imparted to the workers.	Proponent
	Possible transmigration	The contractor will be encouraged to give preference to local labour in the region.	Project Proponent
Earth Movement	Induced soil erosion, loosing of productive top soil.	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. 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. Top soil either absent or find in pockets and removal of Top soil is not required. 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	

Activity	Issue	Action with Key Riders	Responsibility
		maintained by the contractor. Since dust is the only impact along the haul roads, sprinkling of water will be carried at least twice a day	
Onsite activity	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	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 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. Labourers should be provided with personal hearing protection device (if required).	Project Proponent
	Air emissions	The dust emissions will be minimized by following the good practices, for example, water sprinkling, provision of noise barriers, etc. Overloading of the trucks/trolleys	Project Proponent

Activity	Issue	Action with Key Riders	Responsibility
		should not be done. Suitable dust barriers shall be proposed.	

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

S.N.	Name of the project	Water Requirement for plantation (KLD)	Air pollution control (Sprinkling) (KLD)	Environmental Monitoring Cost	No of plants
B1					

1	Sand/Moram mining at Gata No. 1598 Cha, Village-Samuhi, Tehsil-Ghatampur, District- Kanpur Nagar in an area of 27.50 Ha.	0.069	9.36	1350000	138
2	Sand/Moram mining at Khand No. K- 2, Gata No. 389 Mi, 390 Mi, Village-Kharka, Tehsil- Bhognipur, District – Kanpur Dehat in an area of 18.33 Ha.	0.046	13.6	1350000	92
3	Sand/Moram mining at Khand No. 1/Gata No. 364 Mi, 365 Mi, 366 Mi, 367 Mi, 390 Mi, Village- Kharka, Tehsil- Bhognipur, District – KanpurDehat in an area of 17.56 Ha.	0.044	7.8	1350000	88
4	Sand/Moram mining at Khand No. 31/5, Village-Patyaura, Tehsil-Sadar, District-Hamirpur in an area of 36.437 Ha.	0.091	39.6	1350000	182
5	Sand/Moram mining at Gata No. 826 Mi/01, Village-Behmai, Tehsil – Sikandra, District – Kanpur Dehat, U.P in an area of 30.0 Ha.	0.075	10.4	1350000	150
B2					

6	Sand/Moram mining at Khand No. 05, Village- Daulatpur Kachhar, Tehsil- Bhognipur, District – KanpurDehat in an area of 5.973 Ha.	0.015	23.04	1350000	30
7	Sand/Moram mining at Khand No. 02, Village- Daulatpur Kachhar, Tehsil- Bhognipur, District – KanpurDehat in an area of 12.15 Ha.	0.030	7.04	1350000	61
8	Sand/Moram mining at Gata No. 138, Village- Bichhawli Kachhar, Tehsil- Sikandara, District- Kanpur Dehat in an area of 24.24 Ha.	0.061	6.24	1350000	121

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

S.No.	Monitoring parameters	Frequency of Monitoring
1	Ambient Air Quality Ambient air monitoring at appropriate location for	Half-yearly

	Particulate matter (PM ₁₀ , PM _{2.5}), SO ₂ ,NO ₂	
2	Water Surface and Ground Water	Yearly
3	Noise Day and night level of noise	Half-yearly
4	Soil Soil sampling	Yearly

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)

Name of the project	Sprinkling+ Water demand for plantation EMP (Recurring Cost)	Cost (sapling + tree guards+ monitoring) EMP (Capital Cost)	EMP (Recurring Cost) Per Year
B1			
Sand/Moram mining at Gata No. 1598 Cha, Village- Samuhi, Tehsil- Ghatampur, District- Kanpur Nagar in an area of 27.50 Ha.	1301180	1645625	260236
Sand/Moram mining at Khand No. K- 2, Gata No. 389 Mi, 390 Mi, Village-Kharka, Tehsil- Bhognipur, District – Kanpur Dehat in an area of 18.33 Ha.	1879451	1547048	375890
Sand/Moram mining at Khand No. 1/Gata No. 364 Mi, 365 Mi, 366 Mi, 367 Mi, 390 Mi, Village- Kharka, Tehsil- Bhognipur, District – KanpurDehat in an area of 17.56 Ha.	1081554	1538770	216311
Sand/Moram mining at Khand No. 31/5, Village- Patyaura, Tehsil- Sadar, District- Hamirpur in an area of 36.437 Ha.	5463788	1741698	1092758
Sand/Moram mining at Gata No. 826 Mi/01, Village- Behmai, Tehsil	1445469	1672500	289094

-Sikandra, District – Kanpur Dehat, U.P in an area of 30.0 Ha.			
B2			
Sand/Moram mining at Khand No. 05, Village- Daulatpur Kachhar, Tehsil- Bhognipur, District – KanpurDehat in an area of 5.973 Ha.	3171080	1414210	634216
Sand/Moram mining at Khand No. 02, Village- Daulatpur Kachhar, Tehsil- Bhognipur, District – KanpurDehat in an area of 12.15 Ha.	974260	1480505	194852
Sand/Moram mining at Gata No. 138, Village- Bichhawli Kachhar, Tehsil- Sikandara, District- Kanpur Dehat in an area of 24.24 Ha.	870519	1611010	174104

CHAPTER- XI

SUMMARY & CONCLUSION

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11.1	SUMMARY OF EIA
11.2	PROJECTS
11.3	PROJECT DESCRIPTION
11.4	OVERALL JUSTIFICATION FOR THE IMPLEMENTATION OF THE PROJECT
11.5	RECOMMENDED MANAGEMENT PRACTICES
11.6	EXPLANATION OF HOW ADVERSE EFFECTS HAVE BEEN MITIGATED

11.1 SUMMARY OF EIA

In district Hamirpur and Kanpur Dehat, Kanpur Nagar, river Yamuna covers a distance more than 150 m as stated in District survey report of Sand of District Hamirpur and Banda. Across the river Ken 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 (B1-09 and B2-02) have their individual buffer area but when plot together their buffer area is overlapping each other. This study show 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 Ken in Hamirpur and Banda District, Regional Environmental Impact Assessment (EIA) is being carried out. The details of various mining leases in the study area are tabulated below:

11.2 PROJECTS

Table No.11.1 Details of the lease in the riverbed Ken in District Banda

S.No.	Cat.	Name Of Mine	Area in Ha	Village Tehsil/ District	Owner	Proposed production capacity (cum/annum)
1.	B1	Sand/Moram mining at Khand No. K-2, Gata No. 389Mi, 390Mi	18.33	Kharka / Bhognipur/ Kanpur Dehat	M/s Harihar Minerals LLP located at 405 Kha, New Patel Nagar, Near Kalidas School, Orai, Jalaun Proprietor Shri Ram Autar Singh S/o Shri Tejram Singh R/o New Patel Nagar, Orai, Jalaun (U.P.)	274950.0

11.2.1. Project Description:

M/s Harihar Minerals LLP is situated in the stretch of Yamuna river at Kharka, Tehsil-Bhognipur, District – Kanpur Dehat in an area of 18.33 ha.

11.2.2. Leasehold area

18.33 ha

11.2.3. Estimation of the reserve

Given in Table 11.1

11.3. 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 274950.0 cum/annum 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. It is projected that approx 75 workers will be required for the proposed project The water requirement will be 41.82 KLD (including drinking, plantation and misc.), which will be met by nearby existing dugwells/borewells or by private water tankers.

11.3.2.Man Power Requirement

Approximately 75 workers will be employed in the sand mines.

(Reference from socio-economic data also)

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 of Study Area 4.

- 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

Project	Environmental Impact Assessment of Moram mining for M/s Awasthi Traders at Village Bakchha khadar, Tehil-Maudaha, District- Hamirpur in an area of 12.15 ha.
Type	Mining of Minor Minerals
Environment Consultant with their Accreditation Status	ENV DAS India Pvt. Ltd., Lucknow (QCI Certificate No. NAMET/EIA/1720/RA 0078 Valid upto 2 nd April 2020)
Coordinator Name: Signature and date:	1. Mr. Ashok Jamkar (QCI approved EC for Category A Projects under Activity Schedule 1(a)) 2. Mr. B.M.S Negi (QCI approved EC for Category A Projects under Activity Schedule 1(a)) 3. Dr. Ritu Pandey (QCI approved EC for Category B Projects under Activity Schedule 1(a) for Opencast Mining only) 4. Dr. G.S.Jaiswal (QCI approved EC for Category B Projects under Activity Schedule 1(a)) 5. Mr.Atulesh Kumar (Proposed Associate EC) for Category A Projects under Activity Schedule 1(a))
Sectoral Experts • Air pollution • Air Quality • Socio-Economy • Ecology-Biodiversity • Hydrology & Ground water • Geology and soil • Noise and Vibration • Land use • Risk and Hazards • Soil Conservation	• Dr. S.P. Shukla/Dr. Ritu Pandey • Mr. Manoj Kumar Mishra/ Mr. Atulesh • Mr. Akhil Prasad/ Dr.Asha George • Dr. Bajrang Singh • Mr. B. M. Agrawal • Mr. Gautam Ghosh/ Dr. G.S.Jaiswal • Mr. Manoj Kumar Mishra • Mr. B. M. Agrawal • Mr. Manoj Kumar Mishra

• Water Pollution • Solid & Hazardous Waste	• Dr. Bajrang Singh • Ms. Tushali Jagwani • Dr.Ritu Pandey
Name of Associate FAEs	• Mr. Atulesh (AP,WP) • Mr. Devanshu (WP,SHW) • Mr.Mayank Pushkar(AP,WP)
Name of Team Members	• Ms. Surabhi Verma • Ms. Anjali Mishra • Dr. Pushpendra S. Rajpoot • Dr.S.K.Yadav • Ms. Anshika Yadav • Mr. Gulshan Gaur • Mr. D.P.Pathak
Name of Mentors	• Mr.P.P.Srivastava • Mr.Mohammad Ahsan • Mr. Gautam Ghosh • Mr.Deepak Saxena • Mr.Prakash Lal
Technical Assistance:	• Mr. Izhar Hussain • Mr. Hriday Kumar • Mr. Rishabh Verma