7.1 HAZARD IDENTIFICATION AND RISK ASSESSMENT

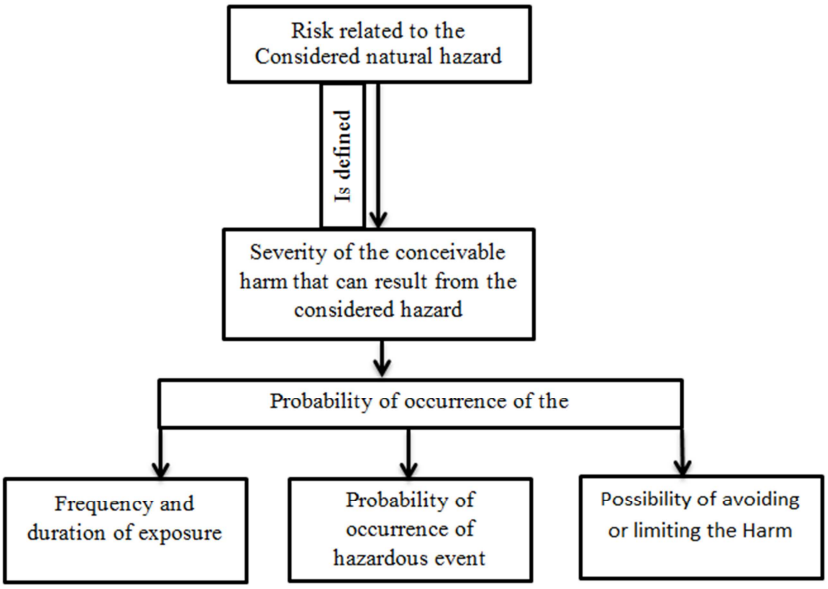

Figure 7.3: Outline representation of Hazard and Risk identification

The river bed mines also have risks which need to be addressed for which a disaster management plan has been formulated with an aim of taking precautionary steps to avert disasters and also take such action after disaster which limits the damage to minimum. In the sections below, the identification of various hazards, probable risks during the operational phase of the mining, maximum credible accident analysis and consequences analysis are addressed either qualitatively or quantitatively.

Risk assessments will help mine operators to identify high, medium and low risk levels. This is a requirement of the Occupational Health and Safety Act 2000. Risk assessments will help to priorities the risks and provide information on the need to safely control the risks. In this way, mine owners and operators will be able to implement safety improvements. The following natural/industrial problem may be encountered during the mining operation.

- Inundation: Filling of the mine pit due to excessive rains
- Quick sand condition
- Drowning
- Accidents due to vehicular moments
- Accidents due to material handling
- Slope failures at the mine faces or stacks
- Fugitive Emission
- Diesel fumes from diesel operated mechanization.
- Soil Erosion

As per proposal made under the mining plan the area will be developed by means of opencast mining method. Extraction of minerals is to be carried out by semi-mechanized. Water table will not be touched during the mining process. No high risk accidents like landslides, subsidence flood etc. have been apprehended.

7.2 IDENTIFICATION OF HAZARDS

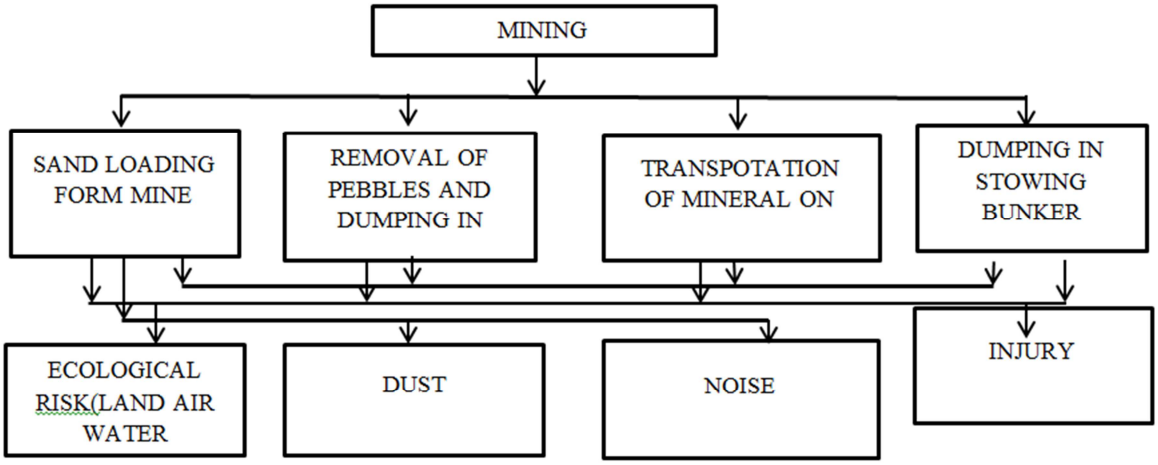

Figure 7.4: Identification of Hazard in Mine

7.2.1 Types of Hazard Identified: There are various factors, which can create disaster in sand mine. The main hazards identified are as follows:

- Inundation / Flooding.
- Quick Sand Condition.
- Drowning.
- Accident due to vehicular movement.
- Accident during sand loading, transporting and dumping.

7.3 RISK ANALYSIS: In order to assess the risk, identifying its assets, threat and vulnerability is important and also calculating its level by evaluating its consequences & likelihood is highly significant.

7.3.1 Purpose of the risk analysis:

- Forecasting any unwanted situation
- Estimating damage potential of such situation
- Decision making to control such situation
- Evaluating effectiveness of control measures

7.3.2 Approach: A logical systematic process is usually followed during a qualitative risk assessment to identify the key risk events and to assess the consequences of the events occurring and the likelihood of their occurrence. Further scaling is done to determine the level of Risk assessment.

Table 7.1: Risk likelihood and Consequences

	Step 1: Assess the Likelihood				Step 2: Assess the consequences	
L1	Happens every time we operate	Almost certain	Common or repeating occurrence	C1	Fatality	Catastrophic
L2	Happens regularly (often)	Likely	Known to have occurred “has	C2	Permanent disability	Major

			happened"			
L3	Has happened (occasionally)	Possible	Could occur or heard of it happening	C3	Medical/ hospital or lost time	Moderate
L4	Happens irregularly (almost never)	Unlikely	Not likely to occur	C4	First aid or no lost time	Minor
L5	Improbable (never)	Rare	Practically impossible	C5	No injury	Insignificant

7.3.3 Assessment methodology: A simple risk assessment way is adopted to calculate the risk level and the matrix is determined through multiplication and risk rating Index is identified.

Simple Risk Assessment: Consequences (C1-C5) X Likelihood (L1-L5)

Table 7.2: Qualitative Risk Assessment

Risk Rating Index			Likelihood ← High to low →				
High 1-4	Medium 4-9	Low 10-25	L1	L2	L3	L4	L5
Consequences			1	2	3	4	5
High ↑ To low ↓	C1	1	1	2	3	4	5
	C2	2	2	4	6	8	10
	C3	3	3	6	9	12	15
	C4	4	4	8	12	16	20
	C5	5	5	10	15	20	25

7.3.4 Risk Assessment Analysis:

On the basis of above rating index following level of risk for hazards identified are determined as shown in figure given below:

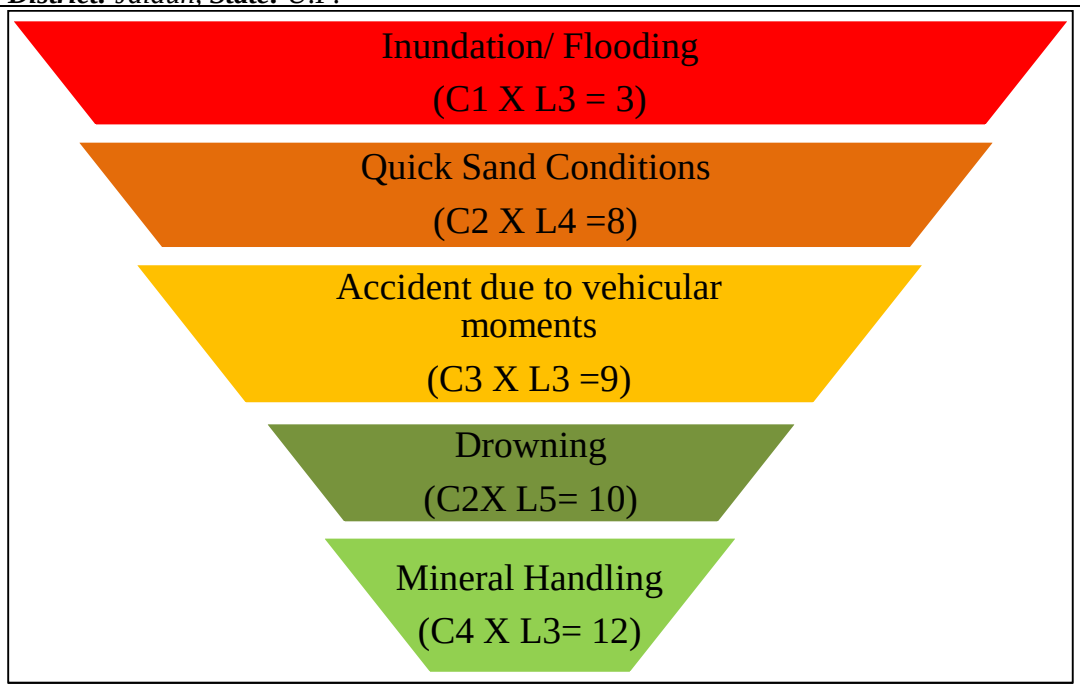

Figure 7.5: Identification of Risk Assessment

7.3.5 Risk Level Identified:
Following interpretation can be drawn from the above analysis (Table 7.3).

Table 7.3: List Occupational Risk in Minerals Mines

S. No.	Hazards	Human Risk		
		Probability of Occurrence	Consequence	Risk Level
1	Inundation/Flooding	Possible	Catastrophic	High
2	Quick sand condition	Unlikely	Major	Medium
3	Minerals Transport /Vehicular Movement	Possible	Moderate	Medium
4	Drowning	Rare	Major	Medium
5	Minerals Loading Dumping and Storage	Possible	Minor	Low

7.3.5.1 Inundation / Flooding
The risk rating depicted for it is 3 which reveal that it is possible and will have catastrophic with major consequences, if work started without assessment of the river bed condition especially during monsoon season.

- The possibility of inundation/flooding of the sand mines are very high during monsoon or during heavy rains in lean season as the mine area lies over the sand dunes of a riverbed.
- There are dangers to the trucks and other machineries due to flooding.

- There are dangers to the workers working in the sand dunes.

Inundation or flooding is expected but also is beneficial for these sand mines as during this time only the sand reserve get replenished.

7.3.1.2 Quick Sand Condition

The risk rating depicted for it is 8 which reveal that it is an unlikely event with major consequences as frequency of this risk is less likely to occur.

- This condition occurs when the working crosses the water table at a certain depth and the Permeability of the strata is very high.
- This condition occurs when the effective stress in the sand becomes zero due to influx of water i.e., i = icr = ϒ'/ϒw; where i = Hydraulic gradient, icr = Critical Hydraulic gradient, ϒ = submerged unit weight, ϒw = unit weight of water.
- This creates danger condition to the trucks and other machineries plying over the sand dunes

7.3.1.3 Drowning

The risk rating depicted for it is 10 which reveal that it is a rare accident but will have major consequences, if occurred.

- This may occur due to flash floods etc due to which the workers at the site may get seriously injured or drowned.
- There are possibilities of drowning in the deeper part of the river. However safety jackets, floating tube will be kept at the site office to prevent any mishap.

7.3.1.4 Accident due to vehicular moments:

The risk rating depicted for it is 9 which reveal that it is possible event with moderate consequences as frequency of this operation is more but the predicted/assumed intensity is less like minor cuts, bodily injury.

- The possibilities of road accidents are due to reckless or untrained driver or overloading of trucks or in case pathway is not compacted suitably, etc.

7.3.1.5. Accident during Sand Handling: Loading/ Transportation and Dumping:

The risk rating depicted for it is 12 which reveal that it is possible event with minor consequences", as frequency of this operation is more but the predicted/assumed intensity is less like minor cuts, abrasion, etc. may be due to river bank collapse, over thrown boulders/pebbles, injuries due to carelessness use of hand tools, etc.

a. Sand Loading

The sand is loaded in the trucks using hand shovels and back-hoe. There are possibilities of injury in the hands during loading with shovels and staying under bucket movement.

- There are possibilities that the workers standing on the other side of loading may get injury due to over thrown sands with pebbles.
- There are possibilities of workers getting injured during opening of side covers of the trucks to facilitate sand loading.
- Chance of workers getting injured due to improper balancing of truck while loading.

b. Sand Transport

The sands loaded in 10 Tons trucks are being sent to the collieries through public roads.

- All likelihoods of road accidents are possible.
- Accident may also occur during movement in the mine (sand dunes).
- There are possibilities that due to overloading, some pebbles or big boulder may injure the passerby public

c. Sand Dumping and Storage

- There are possibilities of the trucks rolling/ sliding down the sand bunker during dumping operation.
- The dumper /trucks may cause injury to the workers working near the stowing plant.
- Dumping the sand in an empty sand bunker may cause injury to the stowing operator if the bunker chute is in open condition.
- Dumping the sand in an empty sand bunker may cause burying the stowing machineries if the bunker chute is in open condition.

OTHER RISKS ENVOLVE AND ITS CONTROL/ PREVENTION MEASURES

7.2.2 Risks Due to Failure of Pit Slope

In order to allay dangers due to open cast slope failure, final pit, slope stability estimations will be made for the existing mines. Determining the factor of safety, the slopes should be monitored at regular intervals to check for any possible failure.

7.2.3 Risks due to Failure of Waste Dumps

Also during extraction of sand there is no over burden or soil cover. All the ROM produce will be used as raw material source for aggregate. Therefore there is no risk associated with failure of waste dumps.

7.2.5 Risk due to Fugitive Emission

Due to loading /unloading operation of sand/ moram Fugitive Emissions create, due to loading causes impact on health of mine workers. Water sprinkling will be provided for dust settlement.

7.2.6 Risk due to diesel fumes from diesel operated mechanization

Health impact due to diesel particulates from emission of diesel operated vehicles which are used for transportation and loading /unloading purposes of sand. Regular check and proper maintenance of vehicles should be done To avoid such instances we will talk to the workers and their representatives and will involve them in the risk assessment process and tell them what to do, to reduce risk. All transportation within the mine lease area should be carried out directly under the supervision and control of management.

- The vehicles will be maintained in good working 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 vehicles especially at working place/loading points, stopper should be posted to properly guide reversing/spotting operating.
- Only trained drivers will be hired.

7.2.7 Soil Erosion

No mining will be done within 10 m from the either side of river banks to maintain its protection. Mining will proceed along the river in the direction from downstream to upstream in each block .No mining will be done across the river.

7.3.2 Mitigation of Hazards

7.3.9.6 Measures to Prevent Dangerous Incidents during Inundation/Flooding

- Inundation or flooding is expected and beneficial for these sand mines as during this time monsoon only the sand reserve gets replenished.
- During monsoon months and heavy rains the sand mining operations are ceased.
- The Trucks and other vehicle plying over the dunes will be kept on the river banks beyond HFL.
- The workers are not allowed to go over the dunes during heavy rains.
- There will be mechanism/warning system of heavy rains and discharges from the upstream dams

7.3.9.7 Measures to Prevent Quick Sand Condition

- The only way to avoid quick sand condition is by avoiding sand lifting below water table.
- The critical hydraulic gradient (icr) will be maintained at less than 1 to prevent high artesian pressure in a coarse sand area.
- At least 0.5m sand bed will be left in-situ while harvesting sand from riverbed.

7.3.9.8 Measures to Prevent Drowning

- The sand mining will be done under strict supervision.
- The workers are not allowed to go to the deeper areas of the rivers.
- The workers are not allowed to fish in the river during working hours.
- In case it is required to cross the river, it is done under strict supervision and over the shallow area using life lines.
- Few life jackets, inflated tubes will be kept near the mine site.

7.3.9.5 Measures to Prevent Accidents due to Transportation.

- All transportation within applied mining lease working will 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 at haul road up to the main road (wherever required).
- To avoid danger while reversing the equipment's/ vehicles especially at the working place / loading points, stopper will be posted to properly guide reversing/ spotting operating.
- A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.
- Regular training will be provided to the operators by the Company or the Contractors.
- Overloading will not be permitted and will be covered with tarpaulin.
- The maximum permissible speed limit will be ensured. The truck drivers will have valid driving license.

7.3.2.1 Measures to Prevent Accidents during Sand Loading/ Transportation and Dumping.

a. Sand Loading

- The trucks will be brought to a level so that the sand loading operation suits to the ergonomic condition of the workers.
- The loading will be done from one side of the truck only.
- The workers will be provided with gloves and safety shoes during loading.
- Opening of the side covers (pattas) will be done carefully and with warning to prevent injury to the loaders.
- No sand will be collected within 7.5m from bank, especially from outer bank of the meandering river. Safe clearance will be mainly determined by the height of the river bank and thickness of sand to be extracted from the close vicinity of that bank.
- Ponding in the river bed shall not be allowed.
- Operations during daylight only.
- No foreign material (garbage's) will be allowed to remain/spill in river bed and catchment area, or no pits/pockets are allowed to be filled with such material.
- Stockpiling of harvested sand on the river bank will be avoided.
- For particular operations, approaching river bed from both the banks will be avoided.

b. Sand Transportation.

- All transportation within the main working will be carried out directly under the supervision and control of the management.
- The Vehicles must be maintained in good repairs and checked thoroughly at least once a week by the competent person authorized for the purpose by the Management.
- Road signs will be provided at each and every turning point especially for the guidance of the drivers at the evening/night.
- To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all workers will be removed from all areas for reversing of lorries, and the vehicle will have audio-visual alarm during reversing.
- A statutory provision of the fences, constant education, training etc. will go along way in reducing the incidents of such accidents.
- Generally, overloading will not be permitted. Big boulders will not be loaded. This is unsafe and may damage equipment and stowing bunker.
- The truck will be covered and maintained to prevent any spillage.
- The maximum permissible speed limit will be ensured.
- The truck drivers will have proper driving license.

c. Measures to Prevent Accidents during Sand Dumping and Storage

- The Stowing Sand bunkers will be covered by steel grizzly (netting) to prevent inadvertent fall of human being or the vehicles during dumping operation.
- The dumping will be done only when the chute of the sand bunker is in closed condition or partially filled.
- The vehicles/trucks will not be brought over the grizzly.
- There will be a duly constructed berm made up of concrete or other material to prevent the rear wheels come/roll over the grizzly of sand bunker.
- Dozers are used near the sand bunkers to maintain the safety berm and to push material over the edge as required.

- The dumping operation will be done under strict supervision.

7.3.11 Disposal of Mining Machinery

Machinery is proposed on hire basis. Hence no de-commissioning of mining machinery is proposed.

7.4 OCCUPATIONAL HEALTH HAZARDS

Dry-pit mining by open cast method involves dust generation by excavation, loading and transportation of mineral. At site, during excavation and loading activity, dust is main pollutant which affects the health of workers whereas environmental and climatic conditions also generate the health problems. Addressing the occupational health hazard means gaining an understanding of the source (its location and magnitude or concentration), identifying an exposure pathway (*e.g.* a means to get it in contact with someone), and determination of likely a receptor (someone receiving the stuff that is migrating).

7.4.1 Aim of the Occupational Health and Safety program: The goal of all occupational health and safety programs is to foster a safe work environment. Excessive dust, noise and vibration are the chief health hazards for the miners. Possible physical hazards are as below mention:

- Physical Hazards (Occupational hazard due to sand mining mainly comes under the physical hazards).
- Exposure to dust
- Noise exposure

Table 7.4: The Project related health issues and its protective measures

Sr. No.	Particulars	Impact	Personal Protective Equipments
1.	Sun Light & Fugitive dust	Eye Strain, Headache, Eye Pain, Watering of Eyes, Itching	Protective Goggles will be provided for direct sunlight and fugitive dust
2.	Heat & Head Injury	Heat Exhaustion, Heat Stroke, Brain stroke.	Helmets will be provided.
3.	Exposure to Dust	Respiratory problem	Mask Respirators will be provided.
4.	Noise Exposure	Hearing problems due to the operation machineries.	Earplugs or Earmuffs
5.	Foot injury	Foot burn in sand, bite of insects etc.	Safety foot wears

7.4.2 Physical Hazards Due To Mining Operations

Following health related hazards were identified due to riverbed sand mining operations to the workers:

7.4.2.1 Light: The workers may be exposed to the risk of poor illumination or excessive brightness. The effects are eye strain, headache, eye pain and lachrymation, congestion around the cornea and eye fatigue.

7.4.2.2 Heat and Humidity: The most common physical hazard is heat. The direct effects of heat exposure are burns, heat exhaustion, heat stroke and heat cramps; the indirect effects are decreased efficiency, increased fatigue and enhanced accident rates. Heat and humidity are encountered in hot

and humid condition when temperatures and air temperatures increase in summer time up to 48^0C or above in the river bed mining area.

7.4.2.3 Exposure to Dust: exposure to fine particulates is associated with work in most of the dust-generating stages notably from sand handling, and transportation**.** It may cause a) Eye Irritation as during the high windy days in summer the sand could be the problems for eyes like itching and watering of eyes. b) Respiratory Problems**:** Large amounts of dust in air can be a health hazard, exacerbating respiratory disorders such as asthma and irritating the lungs and bronchial passages.

7.4.2.4 Noise exposure: Long time exposure of Noise from machinery may induced hearing Loss: Machinery is the main source of noise pollution at the mine site.

7.4.3 Medical Examination Schedule: To minimize the health impacts PPE like dust masks, ear plugs/ muffs and other equipments will be provided for use by the work personnel. All workers will be subjected to Pre-Placement Medical Examination as per Mines Rule 1955 at the time of appointment. Periodical Medical Examination will be conducted at least once in five years. Medical camps will be organized. The detail of health checkup and periodical medical examination schedule is given below:

7.4.3.1 Pre- placement medical examination: All the mine workers will be subjected to health checkup before placing them in the job

7.4.3.2 Initial medical examinations of mine worker are:

- Physical Check-up
- Psychological test
- Audiometric test
- Respiratory test

7.4.3.3 Periodical Medical examination (PME): The health of the workers will be regularly checked and suitable medical facilitates will be created by the lessees. By periodical medical checkup & treatment and job rotation of employees, the impact would be minimized. PME As per Mine Rule, 1955 the workers should be least examine once in three years and special examination should be given in case of emergency.

7.5 DISASTER MANAGEMENT PLAN

Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine will be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions also will not impair his working efficiency. This is possible only when there is adequate safety in mines. Hence mine safety is essential aspects of any working mine. The safety of the mine and the employees is taken care of by the Mines Act 1952, which is well defined with laid down procedure to ensure safety and constantly monitored and supervised by Directorate General of Mines Safety and Department of Mines, State Government.

The main objectives of the Disaster Management Plan would be:-

- Ensure that loss of life and injuries to persons are minimized.
- Damage to environment is minimized.
- Property loss is minimized.

- Relief and rehabilitation measures are effective and prompt.
- Preplanning a proper sequence of response actions.
- To incorporate the disaster resistant features of national building code and earthquake Resistant codes of Bureau of Indian Standards.
- Identify casualties.
- First aid and medical facilities
- System of communication

The general order of priority for involving measures during the course of emergency would be follows:

- Safeguard Life
- Safeguard Environment
- Safeguard Property

Emergency plan which may affect surrounding areas of the project has to prepare after due final discussion with local Panchayat & revenue officials. As per this plan, actions have to be promptly initiated to deal with any disastrous situation, with help collector and other offices.

7.5.1 ANTICIPATED DISASTERS: The study area mainly prone to two types of disasters flood & earth quakes.

7.5.1.1. Floods: The area is prone to floods. However bank protection has been taken care by the govt. by constructing of flood embankments/retaining walls/check dams, etc. Precautionary measures will be taken to avoid the effects on the workers at the site if the disaster occurs.

7.5.1.2. Earth Quake: The lease area falls in between seismic zone II which is prone to earthquakes.

7.5.2 EMERGENCY PLAN & REPONSIBILITIES:-

In case of an emergency at Mine site, the On-site Emergency Plan will come into action. Effective emergency plan requires that, in the event of an accident, nominated functionaries to be given specific responsibilities, often separate from their day-to-day activities. Emergency control cell has been designed by identifying the safe transition from normal condition to emergency condition. For this purpose an emergency response organization with appropriate lines of authority with succession planning and actuating the response management has been formed. The organization Chart for Disaster Management Plan is shown in Figure 7.6.

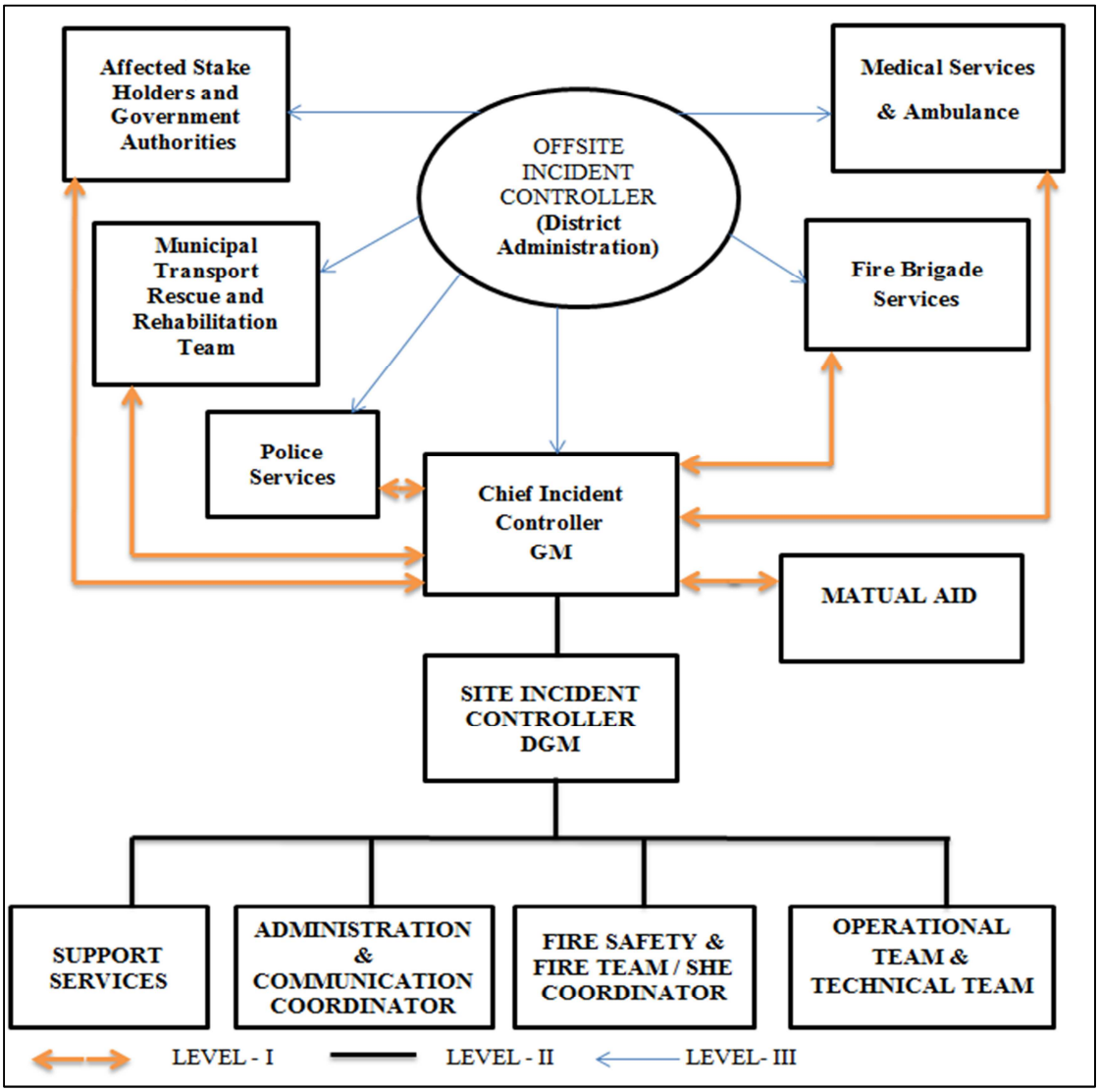

Figure 7.6: Organizational Chart for DMP

7.5.2.1 Emergency Control Cell

Overall objectives of the emergency control cell are as follows:

- To promptly control problems as they develop at the scene.
- To prevent or limit the impact on other areas and offsite.
- To provide emergency personnel, selecting them for duties compatible with their normal work functions wherever feasible.

7.5.2.2 Disaster awareness

a. Public Awareness System

The safety measures to be taken in the event of an emergency shall be made known to the general public who are likely to be affected.

For disclosure of information to the public of the mine site they are briefed about our preparedness and measures taken to face any disaster situation. They are also explained about the Disaster Warning Signals and measures to be taken in case of any disaster in the location and any possible emergency.

Or disclosure of the information, particularly during the disaster situation, the Public announcements are being done by Communication Department. To avoid any panic, it is been considered that the necessary announcement will be made for working personnel onsite/off-site of mine lease area and nearby villagers too.

7.5.2.2 The use of Electronic Media

For bringing the awareness among the external public at large, the use of electronic media like TV, Air & Press coverage is used. The Welfare & Media co-coordinator prepares the Press release to the issued for the local press & other important dailies

7.5.2 Safety Measures adopted:

7.5.2.1 Training and Human Resources Development

- Appointment and delegating qualified and experienced personnel in various disciplines.
- Adequate training/refresher training will be provided to the supervisors, workers keeping in view provisions of Mines Vocational Training Rules, 1966; Mine Rules, 1955, Mines Rescue Rules, 1985.
- Personnel who have to operate and maintain HEMM, Trucks etc are to be trained under the guidance of the manufacturers and as per provisions of DGMS Circular Technical 1/1989 regarding accidents in opencast mines. Recommendation of Seventh Conference on Safety in Mines on "Safety in Open Cast Mining", "Traffic Rules and Procedures", "Mobile equipments and Highway Delivery Vehicles", "Operations and Operator Training" and other related circulars.
- The training of mine personnel shall be provided regularly with respect to environmental protection.
- Special courses for employees will be arranged for afforestation, vegetation, reclamation, health hazards (identification), malaria eradication, and HIV prevention etc. in the training center of the company / contractor.

7.5.2.2 Safety Features Required in Tippers/Trucks

- Exhaust/ Retard Brake: Required as per DGMS circular 02 of 2004.
- Propeller shaft guard: Propeller shaft guard as per DGMS circular 10 of 1999.
- Tail gate protection: Protection of cabin against collision either by head to head or head to tail.
- Limiting speed device: To ensure speed limits as decided by management. The device may be Electronic or mechanical type speed governors.
- Reverse gear for audio-visual alarm: The audio-visual alarm provided for equipments will confirm to DGMS (Tech.) Tests to be carried out on the audio-visual alarm and certificates shall be issued to user industries.
- Provision of two brakes: One of brakes shall be fail safe and for details refer DGMS circular 09 of 1999.
- Body lifting position locking arrangement: A hooter along with an indication may be provided to show the body is lifted.
- Fire suppression System: Semi-automatic fire suppression system. For details refer DGMS circular 10 of 2004. The fire suppression system shall be a factory fitment.
- Blind spot mirror: Better view of front blind spot by operator.
- Retro reflective reflectors on all sides: For visibility of truck during night
- Seat belt reminder: To alert operator for using the seat belt

- Proximity warning device: To alert operator
- Rear Vision System: For assisting operator to have back view during reversing
- Auto dipping System: To reduce glaring of eyes of operator during night
- Load Indicator and Recorder: Enables management to detect and prevent over loading.
- Global Positioning system: To prevent illegal transport and selling of sand, restricting short-cut routes other than stipulated routes and computerized monitoring. It is the responsibility of the Project Proponent to mention these terms and conditions in the tender document.

7.5.2.3 Safety measures to be implemented to prevent access to excavations area by un-authorized persons as per Mines Act 1952, MMR, 1961.

i. Safety measures will be implemented as per Mines Act 1952, MMR, 1961, Mines Rules 1955.
ii. Provision of MMR, 1961 will be followed strictly and all roads will be 6m wide
iii. Excavation will not be more than 3 m in river bed
iv Width of bench will be kept around 20.0 m for ease of operations and provide sufficient room for the movement of equipments.
v. Protective equipment like dust masks, ear plugs / muffs and other equipments will be provided for use by the work persons.
vi. Notice giving warning to prevent inadvertent entry of persons will be displayed at all conspicuous places and in particular near mine entries.
vii. Danger signs will be displayed near the excavations.
viii. Security guards will be posted.
ix. In the event of temporary closer, approaches will be fenced off and notice displayed.

7.5.2.4 Time Scheduling for Abandonment

The mining area has enormous potential for continuance of operations even after the expiry of the awarded period. The details of time schedule of all abandonment will be given at the time of final closer plan. Mining activities are confined to river bed, up to 3.0 m. depth, relatively shallow depth of workings. Partial replenishment of the Sand being removed from the river bed is a natural process particularly during monsoon periods.