# EXECUTIVE SUMMERY

## 1.0 INTRODUCTION AND BACKGROUND

### Scope of Report

The report covers an area of 4.9 ha. Pertaining to shale mine in Shella, East Khasi Hills District, Meghalaya. It is aimed at presenting reclamation principles, approach and limitations and also focusing on the legislative requirements, policies, guidelines and environment and social management. The ultimate objective of preparation of a 'Mine Reclamation and Closer Plan' is to provide a design for management of each of the problem areas and also a schedule of work programmes including estimated cost involved thereof.

### Reclamation Principles

The areas of resources affected by mining should be returned to a safe and productive condition through rehabilitation. The process of reclamation should be an ongoing activity through out the life of the mine operation. The reclamation principle can only be translated into action by appropriate technology, which may include re-contouring, and re-vegetation of degraded land surfaces. Containment of toxic waste and prevention of soil erosion and acid drainage, are other components.

### Care and Maintenance and Closure Rehabilitation Options

On the cessation of mining, a process of decommissioning with a follow up programme of reclamation / rehabilitation should start. This should include adoption of preventive measures against slope failure, managing toxicity of tailings or waste rock which may limit re-vegetation and preventing acid drainage from abundant pits, tailings etc.

A participatory management for care and maintenance of the reclaimed area may ensure a process of benefit sharing specially from the forest, that are to be grown, as a major work component of reclamation plan.

### Approach, Limitation

Rehabilitation techniques should include re-contouring and re-vegetation of degraded land surface, containment of wastes through vegetative barriers there by preventing erosion or acid drainage. The approach will also include water management measures through re-contouring. The limitation for such a programme may be due to inherent characteristics of local geomorphology and prohibitive cost of ongoing and post decommissioning rehabilitation. However, such limiting factors should not hinder the process and it has to be ensured through the aims of rehabilitation programme, that social impact study is carried out.

### Project Description

The project proposed by M/S Lum Mawshum Minerals Pvt. Ltd. (LMMPL) is basically targeted to establish a 1.2 MTPA Cement Plant in Bangladesh. To achieve

this target a 4.9 ha Shale mine area has been identified, located between the latitudes $25^0 11' 25''$N and $25^0 12' 00''$N and longitudes $91^0 37' 28''$E and $91^0 38' 01''$E. The mine area falls in the hamlet Phlangkaruh, village Nongtrai and lies on the western side of the Umium River, about 2 Km. NW of village Shella Bazar.

**Mining Reserve**

The minerable mining reserve has been calculated at 72,35,374.03 M.T. up to 40 m datum as against proven reserve of 88,61,849.04 M.T under Proven, Probable and Possible reserve. The average rated capacity of the mine is 3,70,721.53 M.T. per annum on first 5 years plant production and the life of the mine is expected to be 5-6 years with a lease right extending over 30 years.

The method of mining would be open cast and it is to be carried out from the top most benches gradually moving downwards; each bench will be 3.0 m. high and about 15.0m wide. The mining equipment to be used include two 0.9 $m^3$ shovels and 10 ton dumpers would be used for transportation.

The entire mining operation involving top slicing and partial mechanization of the query through deployment of light tippers, would be a completely dry operation, as such no water would be required and consequently no waste water is likely to be generated.

About 60 skilled/unskilled workers would be deployed for the proposed mine in two working shifts of 8 hours.

## 2.0 LEGISLATIVE REQUIREMENT

The mining project during pre-operational phase, operational phase and post-operational phase is to be governed by the following legal instruments, *viz.*

1. The Water (Prevention and Control of Pollution) Act, 1974 and Rules, 1975.
2. The Forest (Conservation) Act, 1980 and Rules, 1981.
3. The Air (Prevention and Control of Pollution) Act, 1981 and Rules, 1982.
4. The Environment (Protection) Act and Rules, 1986.
5. The Environment Impact Assessment Notification, 1994 amended till date under EPA, 1986.
6. The Factories Act and amendments, 1948, 1987.
7. The Public Liability Insurance Act, 1991.
8. The National Environment Tribunal Act, 1995.
9. The Environmental Standard Notification, 1993, 1996.
10. The Hazardous Waste (Management and Handling) Rules, 1989 amended 2000.

Besides the environment related laws, mines and minerals legislations pertaining into environment may also be considered for the present purpose. These include:

1. Mines and Minerals (Regulation and Development) Act, 1957.
2. Mine Acct, 1952 and Rules, 1953.
3. Mineral Concession Rules, 1960.

4. Mineral Conservation and Development Rules, 1958.
5. Prohibition of Mining Operations in Ecologically Fragile Areas.

**World Bank Policies and Guidelines**

A list of most important policies and guidelines are given below (Environment Department, The World Bank, update no. 22, March 1998):

**OD 4.01 Environmental Assessment:** Policy and procedures for EA., whereby potential impacts are taken into account in selecting, siting, planning, and designing projects.
**OP/BP/GP 4.02 Environmental Action Plans:** Policy to encourage and support borrowers to prepare, implement, and maintain environmental action plans, which should be reflected in Bank operations.
**OP/BP 4.04 Natural Habitats:** Policy to support the protection, maintenance, and rehabilitation of natural habitats. The Bank does not finance projects that involve the conversion of designated critical natural habitats.
**OP 4.07 Water Resource Management:** Policy to promote economically viable, environmentally sustainable, and socially equitable water management.
**GP 4.11 Cultural Property:** The Bank's general policy regarding cultural properties is to assist in their preservation and avoid significant damage or elimination of irreplaceable cultural property.
**4.20 Indigenous Peoples:** Policy to ensure that indigenous peoples benefit from development project, and their projects' potentially adverse effects are avoided or mitigated.
**OD 4.30 Involuntary Resettlement:** Policy and procedure on Bank staff and borrower responsibilities towards displaced persons in operations involving involuntary resettlement.

In addition, a number of World Bank guidelines outlined in the 'Pollution Prevention and Amendment Handbook' are also relevance, including the following:

Guidelines on Mining and Milling (Open Pit and Underground), Coal Mining Processing, Coal washing, etc.,: Guidelines relating to, inter alia, liquid effluents, air emissions, management of tailings, erosion and reclamation, and occupational health and safety.

**Corporate Statements**

The corporate environmental policy of Lafarge is based on concept of sustainable development and revolves around the following main themes (Lafarge and the Environment, March 2000):

***Regulation*:** Lafarge will respect local laws, standard and regulation. Lafarge pledges to work with government authorities to evaluate the benefits and costs of environmental legislation and discuss the priorities and schedules for effective implementation.
***Environmental Technologies*:** Lafarge is committed to reduce the emission and impact of operation upon the environment and the communities in the areas of

operation. It pledges to devote a significant part of technical resources to develop clean technologies, better pollution control and for efficient reduction.
***Sparing use of Natural Resource*:** This objective is a major thrust of Lafarge's efforts. Actions include a policy of reuse of by-products and residual wastes as substitute for natural raw materials and fossil fuels, as well as energy efficient production processes.
***Research and Innovation*:** The Group's efforts in the area of research and innovation are directed at every phase of the product life cycle (extraction, processing, distribution, use and disposal or reuse).
***Demanding "Lafarge Standards"*:** Intent on staying ahead of local regulations on the five continents on which it operates, Lafarge defines its own environmental standards, which it applies to all new units and major plant upgrades.
***Risk Reduction*:** Lafarge takes special care to ensure that its facilities and sites blend smoothly into their natural or urban environment. Moreover, potential hazard and the risk of accidental pollution are systematically assessed at every installation on order to effective preventive measures to be designed.
***Training and Evaluation*:** In addition to training and awareness programmes directed at its employees, Lafarge defines special action plans to conduct regular reviews of environmental performance and measure the progress achieved.
*Communication*: Lafarge will establish communication strategy to provide clear information to all stakeholders including stuffs, local authorities, local interest groups, media and general public.
***Assessment of Results*:** Environmental protection goals and objectives will be established for all units, plants and managers and would be assessed at least annually.

**Best Practice Standards**

According to GSR 801 (E), EPA, 1986, dated Dec. 31, 1993 the State Boards follow the following guidelines for enforcing the standards specified under Schedule IV:

1. In case of lime kilns of capacity more than 5 tpd and up to 40 tpd, the particulate matter emission shall be within 500 mg/$Nm^3$.

2. In case of stone crushing units, the suspended particulate matter contribution value at a distance of 40 m from a controlled, isolated as well as from a unit located in a cluster should be less than 600 μg/$Nm^3$.

These units must also adopt the following pollution control measures:

- Dust contaminant cum suspension system for the equipment.
- Construction of wind breaking walls.
- Construction of the metalled roads within the premises.
- Regular clearing and wetting of the ground within the premises.

**Environmental and Social Management**

The potential social and environmental issues associated with mining and mineral processing operations are highly significant and complex to manage, as the extent of impact due to mining activities may continue up to post-closer of the operation, varying throughout the stages of project implementation.

Most of the mining operations share a number of common stages or activities, each of which have potentially adverse impacts on the natural environment, social and cultural conditions, on the health and safety of mine workers, or communities in the environs of the mine. These adverse impacts may be largely on the indigenous peoples.

The potential adverse impact of each of the mining activities include impacts on air quality, hydrology and water quality, ecology and biodiversity, social and cultural conditions, human health, natural resources and infrastructure.

In principle the areas or resources affected by mining should be returned to a safe and productive condition through rehabilitation, which may or may not involve a return to pre-mining conditions and reclamation should be an ongoing activity through out the life of the operation as well as after decommissioning.

Rehabilitation techniques include: re-contouring and re-vegetation of degraded land surfaces; containment of toxic or acid generating wastes through the use of physical or vegetative barriers to prevent erosion or acid drainage; and long term water management measures through re-contouring or by physical barriers to help contain wastes. Issues in developing a reclamation plan should include:

- Long term stability of slopes and surface materials
- Safety issues relating to open pits, shafts, subsidence, toxic or radiological hazards
- Physical characteristics, nutrient status and inherent toxicity of tailings or waste rock which may constrain revegetation.
- Potential for acid drainage from abandoned pits and shafts, tailings and waste rock dumps (as a consequence of oxidation of sulphides contained in the ore or wastes)
- Costs of ongoing and post decommissioning rehabilitation

The socio-economic aspects of decommissioning are also important , particularly where the existence and economic survival of large communities may depend on a mine. Aside from loss of incomes, the provision of services such as water , sewerage, electricity and health care may be directly linked to the mine. All these issues should be featured in the post-closure plan, which should be adequately funded.

**Air Quality Management**

For maintenance of an acceptable ambient air quality in the mining area plans have been made for:

(i) Controlling Dust Levels, in the Mine, Stock-piles, Haulage, Crusher, Belt Conveyor,
(ii) Controlling CO Levels,
(iii) Controlling NOx Levels,
(iv) Occupational Health & Safety Measure to Control Dust Inhalation.

**Noise Pollution Control**

The present ambient noise level recorded in and around the proposed mining area shows that the ambient noise level are well within the permissible limit prescribed by Central Pollution Control Board. The major noise sources within the operational area of the mine *viz.* mining machinaries and equipment, crushing units and belt conveyer will be controlled through application of clean technology including sound proof system as also by regular monitoring and maintenance of the equipment. Thick green belt to be provided at the mine periphery, within the mine area and along the roads to screen the noise level. Further, occupational health and safety measures to control exposure to noise will be ensured by providing protective devices, isolating source of noise and reducing the exposure time of workers to the higher noise level.
As no blasting will be involved there should be no major ground vibration that would need to be controlled.

**Land Management**

The MMIRD Act, 1957 of India as amended stipulates simultaneous reclamation of land area along with the mining operation. Keeping the above in view, a land reclamation plan has been prepared with emphasis on plantation of selected local species in a planned manner; at any point of time the area under disturbance shall be kept at minimum. In general one year of grading and topsoil spreading will be followed by four years of landscaping and stabilisation of plantation. Thus every mined out area should be fully reclaimed within five years of completion of mining operation in a phased manner.

To prevent soil erosion and wash-off of dump-fines from freshly excavated benches and dumps, a series of measures would be adopted. These include:

- Construction of garland drains
- Construction of toe drains with suitable baffles

- Provision of local stone paved chutes and channels
- Designing proper bench level
- Preventing gully formation with check dams
- Providing retention wall around stockpile.

**Water Quality**

Surface water will be pump from the Phlangkaruh River to meet the requirement for the mine and its infrastructure. LLMPL proposes to install a pump for meeting the water requirement, both for industrial and domestic usage. No ground water extraction will be needed for the mining operation. So the possibility of lowering ground water table is nil.

The potential impact on the surface water quality is likely to be due to:

i. Higher load of suspended solids from shale dumps
ii. Oil spillage from maintenance workshops
iii. Effluent from mine infrastructure.

Plans have been made for effective management for prevention and control of pollution and degradation of water quality at each of the above-identified sources.

**Ecology and Biodiversity**

Ecological surveys in the core zone and buffer zone reveal no exceptional features of wild life interest. There is no endemic, rare or threatened species in the proposed mining area. There are no reserve forest, wildlife sanctuary or biosphere reserve within the core or buffer zone. As such the proposed management of the land area is expected to increase the habitat for the biological species through intensive afforestation programme.

**Social Issues and Management**

Impacts of social related issues and proposed management are planned in the following manner.

- Resettlement issues – No eviction required and no resettlement planned.
- Effects on indigenous people – With small work force, the effects would be minimum and manageable.
- Loss of livelihood – Not significant due to lack of productive agriculture or other practices in the proposed mine area. On the other hand, the project will create job opportunity and income generation activity.
- Induced development issues – Isolated location of the colony will reduce the potential conflict.
- Effects on aesthetics and landform – The proposed afforestation programme along with landscaping will improve the aesthetic and landforms.

# 3.0 MINE RECLAMATION AND CLOSURE PLAN

**Reclamation Objective and Land Use**

The present land use of the core zone of the proposed mining area shows forestland without any human population while the buffer zones has village, plantation and agricultural land. No adverse impact is foreseen in the buffer zone due to proposed shale-mining operation, as all the mining activities will be confined to the core zone of 4.9 ha.

The ongoing reclamation with the projected 3 phase work plan is likely to ensure stabilization of the mine area through a process of afforestation. The plant species have been carefully selected for soil binding and prevention of erosion. Additional benefit of afforestation besides reclaiming the land to the erstwhile use as forest land, are expected from non-wood forest produces which are deemed useful for the local community.

**Socio Economic Consideration**

The mine being opened in a predominantly forest land with no settlements or habitation would not result in the generation of any oustees or displaced population, who would otherwise have been required to be rehabilitated and provided with adequate compensation.

**Socio Economic Welfare Assistance**

The proposed project shall enhance the prospects of employment of unskilled and semi-skilled workforce from the local area. The development of basic amenity viz. Roads, transportation, electricity, drinking water, proper sanitation, educational institutions, medical facilities, entertainment, etc., will be enhancing the quality of life.

**Tailing dam, Open pits, Dumps and Stock piles**

***Tailing Dams & Dumps:***

No wet processing is envisaged and therefore no tailings dam is envisaged throughout the life of the mine.

It may be noted that there is no overburden and the entire mining will comprise shale/ silt stone that will be consumed. As the area has mixed flora, whatever topsoil is available within the area will be removed and stored separately. The topsoil dump of 0.38 ha will be a temporary storage. Some quantities of topsoil will be used for green belt development (a width of 7.5m within the lease boundary). The rest will be stored for reclamation at the end of the life of mine that is expected to be about 5 to 6 years.

***Stockpiles:***

Whatever shale / siltstone that will be mined will be despatched on a day to day basis to the adjacent Nongtrai Limestone Mine ROM stockpile area from where it will be transported to the crusher and onto belt conveyor to cement plant. Thus, no temporary storage (except for the topsoil dump which has been discussed earlier) or stockpile is envisaged here.

**Accommodation, Roads, Processing Plant and Ancillary Facilities**

The workers in the quarry will either come from nearby towns or will be accommodated in the proposed Nongtrai Limestone mines colony. Thus, even after the Shella Shale Quarry is closed, the colony will continue to cater to Nongtrai Limestone Mines. Similarly, the crushing plant installed for Nongtrai Limestone Mine will be used for shale crushing and therefore, the crushing plant will continue to cater the Nongtrai Limestone Mines.

Two areas of about 40mx30m and 100mx40m have been earmarked outside the mining lease boundary for servicing the mining equipment and providing rest shelter. Except for these, the administrative, diesel, etc. services will be catered from Lafarge's adjacent Nongtrai Limestone Mine. The entire area available within the lease area of 4.9 ha will be utilised for mining after leaving the statutory 7.5m width along the lease boundary. The pit area will be separated by a suitable vegetative belt, to reduce the migration of pollutants. Afforestation would also be done along out-of-pit service roads and around the service areas with planting started at the beginning of mine operation in a planned way.

In order to minimise the effect of run-off from the disturbed mining areas, drainage channels will be constructed around the pit limits. To prevent erosion of fines from freshly excavated areas, gully formations on sides of benches shall be provided and the water will then be guided to a sump at the bottom most bench, where the fines will be settled. Pumps of adequate capacity will be provided for draining the water from the sump.

The pre-closure mine area reclamation plan (MRP) will cover the following areas during mining activity:

- Open pit areas
- Areas undisturbed within the lease (that will not be disturbed through out life of mine)
- Service Areas
- Top soil dump

The reclamation will involve:

- Storage of Topsoil generated from within the lease area and & Procurement of Topsoil from outside, as and when necessary.
- Preparing the areas planned for afforestation;

- Preparing the abandoned mining benches for afforestation;
- Re-carpeting, planting of vegetation and afforestation as required.

**Acid Rock Drainage Management**

As the water coming out at Phalangkaruh is alkaline, no separate provision for management of acid rock drainage is made. As such, no acidic run-off is envisaged on account of mining.

**Rehabilitation of Disturbed Areas**

The Restoration plan has been prepared keeping in view the land use changes that will occur due to mining operation in the area. The objectives of the restoration plan are:

- To reclaim the mined out areas by planting trees which are indigenous in nature;
- To provide a green belt around the periphery of the mine areas crushing, loading-unloading points and conveyor belt corridor to combat dispersal of dust in the adjoining areas;
- To protect the erosion of the soil;
- To conserve moisture for increasing ground water recharging;
- To restore the ecology of the area;
- To restore aesthetic beauty of the locality;
- To meet the requirement of fodder, fuel and timber of the local community;

**Selection of Appropriate Species**

Species have been selected and restoration programme developed in order to ensure a diverse and robust polyculture forest is developed after mining. Species that are native to the area have been given preference. At the same time the species which have dust tolerance have also been focused on; growth rates of the species have also been considered as the area needs to be covered very quickly. The area is also full of shale and will be uneven after completion of mining, and the base is likely to have residual shale and be devoid of any top- soil and nutrition. As such the species which can survive in such adverse conditions have been selected. All the species recommended are selected from indigenous flora.

**Availability of Area for Restoration**

A total area of 4.9 ha (or say 5 ha) from where the Shale Mining will be done, is available for afforestation. The entire area is proposed to be mined within 5 years at the initial phase. It is presumed that the area for restoration will be available in phased manner as soon as the mining process and the area available for afforestation 1.00 ha at 2$^{nd}$ year, 2.00 ha at 4th year and another 2.00 ha at the end of 5th year.

As the area is having sporadic stunted trees with considerable blanks in between, it is proposed in the Environmental Management Plan to provide a green belt along the periphery of the mining areas, crushing, loading and unloading points and also corridor of belt conveyor with suitable fast growing and dust tolerance species to

arrest the residual dust particles even after the various dust control measures proposed to be taken. An area of 3.00 ha may be accounted for green belt to be developed in the areas stated above.

**Nursery**

As there is no Forest Department nursery in the area, there is no possibility of obtaining the desired seedlings. As such, a nursery is proposed to be established by the Mining Company. Land for nursery to be procured nearest to the planting site. If possible the existing nursery proposed to be established for Limestone Project may be utilised.

***Seed***

For successful afforestation, good nursery stock is essential. For this purpose good matured seeds from genetically superior trees are required. Seeds will be collected mostly from the Forest Department and if some seeds are not available with them, then those are to be collected from the reputed seed suppliers. A time schedule is to be followed according to the availability of seeds, as per their maturity and viability.

***Seedlings***

Two years old tall seedlings are to be planted for afforestation. For the purpose polythene tube of size 22.5cm x 15cm with thick gauge is to be procured and the seedlings are to be raised in the polythene tubes after filling the same with imported good earth and cow-dung manure in 3:1 proportion.

***Small sized Seeds***

For small sized seeds (e.g. *Alstoria*, *chukrasia spp*), the seeds are to be sown in mother beds, after pretreatment and to be pricked out in polythene tubes, while the bigger seeds are to be dibbled in the polythene tubes directly.

***Weeding, Cleaning and Howing***

Weeding, cleaning, howing of seedlings and application of oil cake are to be done occasionally to boost up the growth of the seedlings. Sorting, shifting and culling of seedlings to be done to avoid penetrating the root in the nursery soil and to get genetically superior seedlings of uniform height.

At least one permanent staff (*Mali*) is to be recruited beside casual staff, and maintained for upkeepment of the nursery at the project cost.

**Planting Technique**

Planting techniques will include soil work, planting pattern, tending operation. A detail work plan has been drawn with regard to the planting pits, spacing, contour bund after terracing and application of fertilizer, weeding, cleaning and mulching. These have been drawn up in a phased manner with demarcated time schedule for

seasonal operation. Planting will be done after land terracing and contour bunding at 10 m interval; pits of 45 cm x 30 cm (at the top), 30 cm x 30 cm (at the bottom) are to be dug at 2 m apart lines. No pits would be dug on the contour bund which will be used for sowing seeds and planting broom stick, shrubs and bamboos. Cost norms for creation of plantation @ 1 ha = 1600 seedlings and cost norm for creation of nursery are given at the present price index (2002).

## WATER AND WASTE MANAGEMENT

### Natural Water Resources of the Area

The proposed project lies in sub-tropical region surrounded by natural watercourses, springs and waterfalls. The outflow water from the proposed mine area will fall into a drainage net of phlangkaruh river which culminates into Umium river. The main drainage system in the study area is governed by the Phlangkaruh River and Umium River along with its tributaries.

The proposed mine site comprises of Karst topography which can be characterized by presence of fissure, joints, cavities. Natural vertical movement of the water to greater depths occur through : shaft flow (where open shafts or funnels connect to caves or larger cavities at greater depths), vadose trickles (the water descend through solution widened joints and reach caves as fast drips of streamlets) and vadose seepage (that feed slow drips in caves below and that may take months to respond to rainfall events). There is also a set of three springs appearing at south at an elevation of 22mRL. These springs appear even during non-rainy season showing their link with some surface water drainage . It has been reported by folklore of Nongtrai village that water from Fotsgnet near their village links with water springs, which forms a rivulet called Phlangkaru stream.

Due to a long monsoon season and high amount of rainfall the area is prone to surface runoff and soil erosion that ultimately will lead to the river systems flowing along the gorges and the foothills.

### Wastewater from Mine

There is no perennial water stream within the mine area. The Phlangkaruh river originating in the foothills of the mine area is expected to be loaded with additional sediment due to surface runoff during rainy season. During the rains the storm water may carry solids and debris from the opencast mine area in the absence of any control measures. The rehabilitation of excavated land and final land restoration as per plan will also stabilize the drainage pattern.

### Impact & Management of Surface Water

The potential impact on the surface water quality is likely to be due to higher load of suspended solids. As shale mining project would not generate any waste water, there would be no impact on the surface water quality of the nearby streams. As such the inhabitants of the area depending on river water are expected to be unaffected due to mining operations.

**Ground Water Management**

The potential impacts of mining would have negligible effects on the ground water, as the site and its adjoining areas are located at an elevated topography. In general, the entire study area is devoid of bore wells for the water sources and as such, the likely chances of the contaminate reaching the groundwater are very rare.

**WASTE MANAGEMENT**

No overburden would be generated during mining that would require disposal. The entire material mined would be used in some form other. As a result, there would be no generation of solid waste in the mining process. Even the minimum amount of waste generated will be utilized for reclamation, restoration and rehabilitation of the terrain, without affecting the drainage and water regimes. Waste may be used as road material after crushing to proper size. Domestic solid waste would be converted in to compost and used for sanitary land filling. The plastic and other such material will be brunt off at pre-selected sites.

**MONITORING PROGRAMME**

Regular monitoring of the important environmental and socio-economic parameters, even after decommissioning of the mine is very much important to evaluate the effectiveness of the Environmental Management Programme (EMP). Socio-economic parameters can be monitored through physical survey.

In the present project regular monitoring stations will be set up to evaluate the effectiveness of environment management plan. The schedule, duration and the parameter for monitoring have been planned as follows.

Table: Monitoring Schedule and Parameters

| Sl. No. | Description of Parameters | Schedule of Monitoring |
|---|---|---|
| A. | Air Quality (SPM, RPM, CO, $SO_2$, NOx) | |
| 1. | In the vicinity of the mine | One sample over 24 hours continuous duration, once a week throughout the year. |
| 2. | Within the mine | One sample over 24 hours continuous duration, twice in a week throughout the year. |
| 3. | In the surrounding areas covering three locations $120^0$ apart, close to the nearest habitation. | One sample over 24 hours continuous duration, twice in a week throughout the year. |
| B. | Water Quality | |
| 1. | Water stored in the mine area | Twice a week for selected parameters like, pH, TSS, TDS, COD, BOD and oil and grease. The detailed analysis should be carried out once in three months. |

| Sl. No. | Description of Parameters | Schedule of Monitoring |
|---|---|---|
| 2. | Surface and ground water quality in the vicinity of the mine area for water potability conforming to drinking water standard IS: 10500:1991. | Once in three months. |
| C. | Ambient Noise Level | Quarterly |
| D. | Inventory of flora | Once in two years in the project monitoring area. |
| E. | Soil quality | Once in year on all reclaimed area and adjoining villages. |
| F. | Socioeconomic condition of local population – physical survey. | Once in two years. |

# 4.0 WORK PROGRAMME, BUDGET AND SCHEDULE

**Ongoing Reclamation**

Appropriate reclamation work will be taken up during operational period in the phased manner to reduce the impact of mining. These are: (i) Soil Conservation measure (ii) Affrostation programme in phased manner (iii) Reclamation of pile after flushing and/or neutralizing (iv) Solid waste management (v) Air and sound pollution control measure (vi) Management of water quality & Wastewater (viii) Social related issues.

**Site Configuration at Cessation of Mining**

At the cessation of mining, a furrow measuring 490m x 100m will be formed. At the end of mining the benches below 94m RL on western side and below 85m RL on the eastern side will be completely filled. The benches above 85m RL will be contoured by necessary back-filling. This material can be procured from the river beds.

**Decommissioning and Closure Facilities**

All the structures that include blasting shelter, rest shelter and workshop will be removed and the corresponding area graded, top soiled and seeded. That is there will be no structures abandoned and left as it is. All other infrastructural facilities including crushing and conveying, colony, etc. that are partly used for Shella Shale Quarry are located as a part of Nongtrai Limestone Mine Complex and these will continue to remain and cater for limestone mining activities. The proposed actions for the decommissioning and closure of facilities (Service area, Hard standing area, Connecting roads, excavators) are: the service area will be completely dismantled, the hard standing areas will be developed for reclamation by afforestation, and the connecting roads will be retained for public use.

Post mining land use will involve 3.57 ha for forest/plantation programme and 1.33 ha., will remain as undisturbed area within the mining lease area; service area (0.54

ha.) and top soil dump area (0.38 ha.) will also be used for plantation programme; the connecting roads (0.65 ha.) will be utilized for public use.

**Fall Back Strategies**

The specific infrastructure for the Shella Shale Quarry will be retained for further use if Lafarge decides to apply for larger lease area in the adjoining areas for continuing to extract shale. If the area of 4.9 Ha is also retained as part of the new larger lease area then instead of resorting to back-filling, mining can be continued at deeper levels by expanding the operational area. This alternative is possible if Lafarge decides to work in the same region for further shale sourcing and obtains necessary permissions from various government agencies as per applicable Acts.

**Schedule of Operation and Cost**

Estimating the costs of pre-abandonment reclamation plan: The mining costs will include procurement of boulders and sand for back-filling. Some amount of dozing will be required for contouring and battering of slopes by dozer. If dozing is preferred to be done by dozer, approximately Rs 800/hr can be taken as the expenses involved for dozing about 200 cum in one hour. As top soil will be generated during mining, this can be utilized for reclamation. Depending on the adequacy of topsoil, additional topsoil requirement, if any, can be sourced from nearby areas.

The schedule of operation for decommissioning and its related cost estimated has been provided.

**Management Supervision**

The Management Supervision plan includes:

- Monitoring objectives,
- Monitoring schedule, and
- Effective implementation.

***Monitoring objectives:*** The project authority will set up regular monitoring stations to assess the ambient levels of environmental parameters during on –going reclamation phase and after the cessation of mine. It provide useful information on the following aspects:

- It helps to verify the warnings on environment presented in the study
- It helps to indicate warnings of development of any alarming environmental situations and thus provide opportunities for adopting appropriate control measures. The post project monitoring will be conducted in various categories of environment is discussed in above section.

***Monitoring schedule:*** To evaluate the effectiveness of environmental programme, regular monitoring of the important environmental parameters will be taken up.

***Effective Implementation:*** For effective implementation and mid-term corrective measures, if required, monitoring and control of programme implementation will be taken up.

The Supervision will follow the guideline provided by OD 13.05 on project supervision issued from the World Bank. Supervision will based on project conditionality. Project legal documents will provide much of the framework to support and enforce supervision. The supervision plan also will ensure linkage with project implementation plan and environmental covenants agreed to by the project authorities as the condition for receiving any external financial support.