A

REPORT ON

BASELINE ENVIRONMENT DATA

&

ENVIRONMENT MANAGEMENT PLAN

FOR

M/s TRAVANCORE READYMIX PVT. LTD.

QUARRY PROJECT AT

VELLARADA, THIRUVANANTHAPURAM, KERALA

1. INTRODUCTION

The Building Stone Mining project (Minor Mineral) of M/s Travancore Readymix Pvt. Ltd. is situated at Survey Nos. 11/2, 11/2-1, 11/4, 11/5, 11/5-1, 11/6, 11/7, 11/8, 11/9, 11/12-1-1, 11/13, 11/14, 11/15-1, 10/2-1, 10/2-2, 10/3, 10/3-1, 10/13, 10/14, 10/15 & 10/16 of Vellarada Village, Neyyatinkara Taluk, Thiruvananthapuram District, Kerala for an area of 3.2658 hectares.

The first step in the identification of impact assessment of a development project is the assessment of existing environment. The Environment Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmentally sustainable manner and to understand the potential environmental risks arising from the proposed project and take appropriate actions to minimize those risks. EMP also ensures that the project implementation is carried out in accordance with the planned design and by taking appropriate mitigative actions to reduce adverse environmental impacts during the project's life cycle.

2. AREAS FOR IDENTIFICATION OF ENVIRONMENTAL ASPECTS AND IMPACTS

The environmental parameters likely to be affected by mining are related to many factors, i.e. physical, social, economic, agriculture. Opencast mining involves drilling, blasting, loading and transport of the mineral, stacking of topsoil & overburden. The excavated mineral will be crushed in a crusher and the final product from the crusher will be transported via trucks to the end user. The operations may disturb environment of the area in various ways, such as removal of mass, change of landscape, flora and fauna of the area, surface drainage, and change in air, water and soil quality. While for the purpose of development and economic up-liftment of people, there is need for establishment of mining industries, but these should be environment friendly. Therefore, it is essential to assess the impacts of mining on different environmental parameters, before starting the mining operations, so that abatement measures could be planned in advance for eco-friendly mining in the area.

BASELINE ENVIRONMENT DATA

The areas of environmental concerns for which the impacts and their predictions are taken into consideration are :-

- Air Environment
- Water Environment
- Noise Environment
- Land Environment
- Biological Environment
- Socio-Economic Environment

The baseline environmental status of the different environments mentioned above is assessed through primary data collection, field monitoring through NABL accredited laboratory and from secondary sources. The baseline environment status for different environments is given below:

✓ **AIR ENVIRONMENT**

The prime objective of the baseline ambient air monitoring was to evaluate the existing air quality of the area. This will also be useful for assessing the conformity the standards of the ambient air quality during the operation of the proposed mine.

METEOROLOGICAL PARAMETERS

The ambient air quality of an area has bearing on meteorological parameters of the area. Based on the Climate Zone Map of India by Bureau of Energy Efficiency (BEE), The district experiences warm humid type of climate. Further, climatological data was referred from nearest IMD Station & from CGWB district information booklet.

The city has a climate that borders between a tropical savanna climate and a tropical monsoon climate. As a result it does not experience distinct seasons. The mean maximum temperature 34°C and the mean minimum temperature is 21°C. The humidity is high and rises to about 90% during the monsoon season. Thiruvananthapuram is the first city along the path of the south-west monsoons and gets its first showers in early June. The city gets heavy rainfall of around 1700 mm per year. The city also gets rain from the receding north-east monsoons which hit the city by October. The dry season sets in by December. December, January and February are the coldest months while March, April and May are the hottest. The lowest temperature recorded during winter was 16.4°C on, and the highest temperature recorded in summer is 38.0°C.

(Source: Central Ground Water Information Booklet)

AMBIENT AIR MONITORING

Field monitoring studies for 24 hourly frequencies was carried out to evaluate the base line status of the project site in compliance with MoEF guidelines.

Ambient Air Quality Field Monitoring Values

PARAMETERS	Near South-West side boundary (µg/m^3)	LIMITS (µg/m^3)
PM_{10}	57.6	100
$PM_{2.5}$	33.2	60
Sulphur dioxide	<2	80
Nitrogen dioxide	<2	80

From the field measurement results of the ambient air, it is observed from the report that the ambient air quality at site within the prescribed standards (NAAQS) with respect to PM_{10}, $PM_{2.5}$, NOx and SO_2.

✓ **WATER ENVIRONMENT**

The purpose of this study is to:-

- Assess the water quality characteristics for critical parameters;
- Predict the likely impacts on water quality due to the project and related activities.

WATER MONITORING

To analyze the suitability of water for mining purpose, water sample from storm water pond and to analyze the suitability of water for domestic purpose, sample from bore well near to the project site were collected by NABL accredited laboratory and samples were analyzed for physical, chemical and biological parameters.

The sample was collected by grab sampling technique. The sample was analyzed as per the procedures specified in *'Standard Methods for the Examination of Water & Wastewater' published by American Public Health Association (APHA).*

Water Quality Monitoring Values

PARAMETERS & UNITS	RESULT Open Well – Near North-West boundary	LIMITS As per IS-10500
Colour (Hazen unit)	5	5
Odour	Unobjectionable	Unobjectionable
Turbidity (NTU)	19.6	5
pH	5.45	6.5-8.5

Total Dissolved solid (mg/l)	36.0	500
Total Hardness (mg/l)	14.4	300
Calcium as Ca (mg/l)	3.30	75
Magnesium as Mg (mg/l)	1.50	30
Chloride as Cl (mg/l)	10.6	250
Total Alkalinity (mg/l)	10.6	200
Iron as Fe (mg/l)	2.36	0.3
Sulphate (mg/l)	1.98	200
MICROBIOLOGICAL TEST		
Coliform bacteria (/100 ml)	Present	Absent
E coli (/100 ml)	Absent	Absent

Results & Conclusion: - The water samples collected and analyzed from the locations discussed above it is observed that the water quality of pond water and bore well water is fit after filtration, disinfection & treatment for domestic consumption and for activities attached with the mining operations except pH value, Turbidity, Iron & Coliform bacteria.

HYDROGEOLOGY

Ground water occurs under phreatic, semi-confined and confined conditions in the above formations. The weathered Charnockites, Granite gneiss, schists and laterites form the major phreatic aquifers, whereas the deep fractures in the Charnockites, Granite gneiss & schists and the granular zones in the Tertiary sedimentary formations form the potential confined to semi confined aquifers.

The Archaean rocks: - The shallow aquifers of the archaean rocks are made up of the highly decomposed weathered zone or partly weathered and fractured rock. Thick weathered zone is seen along the midland area either beneath the laterites or exposed. In the hill ranges, thin weathered zone is seen along topographic lows, area with lesser elevation and gentle slope. In areas along the hill ranges generally rock exposures are seen. The depth to water level in this aquifer varies from 2 to 16 mbgl and the yield of the well ranges between 2 to 10 cu.m. per day.

Laterites: - The depth to water level in the formation ranges from less than a meter to 25 mbgl. Laterite forms potential aquifers along valleys and can sustain medium duty irrigation wells with the yields in the range of 0.5 - 6 cu.m. per day. The occurrence and movement of ground water in the laterites are mainly controlled by the topography.

Laterite is a highly porous rock formation, which can form potential aquifers along topographic lows. However, due to this same porous nature, groundwater is drained from elevated places and slopes at shortest duration after monsoon due to which scarcity is experienced in the elevated places and slopes.

(Source: District Ground Water Information Booklet, Kerala State)

✓ **NOISE ENVIRONMENT**

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise expected to be generated during the mining operations in the project site.

Instant sound level meter is used for the collection of data related to noise at an interval of one hour per reading. Noise level for 24 hours was conducted in a day within the site. The details of the instrument used for the noise level sampling are as given below:-

Noise (Sound) Measuring Instrument

Instrument	Make	Model No.	Instrument Identification	Detection Limit
Integrated Sound Level Measurement Instrument Standard Accessories	Lutron	SL-4001	SAL/NOISE/INT/01	Lo 30-80dB Hi 80-130dB

Testing Method to be followed

Particular		Testing Method to be Followed
Noise Level Measurement		
A	Noise Level in dB (A) for continuous 24 hours at 1 hour interval	Operational Manual of Noise level Meter, Model No. DT - 805 issued by Mextech

AMBIENT NOISE MONITORING RESULTS IN dB (A)	
TIME (Hrs.)	RESULTS
	Near North-West boundary
06.00	37.1
07.00	39.4
08.00	41.3
09.00	43.6
10.00	45.7
11.00	49.2
12.00	47.6

13.00	48.1
14.00	45.9
15.00	46.3
16.00	48.2
17.00	46.1
18.00	43.8
19.00	41.5
20.00	40.7
21.00	38.1
22.00	36.9
23.00	34.7
00.00	35.1
01.00	34.6
02.00	35.9
03.00	37.0
04..00	36.1
05.00	34.8
Leq (day)	**45.0**
Leq (Night)	**35.5**

Results and Conclusion:- It is seen from the monitoring results that the Noise levels at monitoring station are within the prescribed national standards.

✓ **LAND ENVIRONMENT**

A. REGIONAL GEOLOGY

The area is formed of the Archaean metamorphics comprising charnockites, garnet-sillimanite gneiss (Khondalite), quartzo-felspathic gneiss, quartzite, Calc-granulite, garnetiferous-quartzo-felspathic granulose gneiss (leptynite), garnet-biotite gneiss with its associated migmatites, and pyroxene granulite. These gneissic rocks are traversed by quartz and pegmatite veins and by later dolerite dykes. The major rock units in the area, namely charnockite, khondalite and garnetbiotite gneisses, occur as structurally conformable alternating lenticular bands. The contact of the garnet-biogneiss, with charnockite and Khondalite appear to be gradational; and the contact between charnockite and Khondalite is obscured by thick soil cover. Garnetiferous

quartzo felspathic granulose gneiss occur as intimately admixtured layers as well as irregular patches within the gneissic rocks. Pyroxene granulite occurs as thin impersistent and concordant bands and their contacts with the country rock appear to be distinct. In view of thick forest and highly rugged terrain only geological traverses were made in the made in the high ranges and the geological boundaries of the formations drawn here are mostly inferential. The tentative succession of geological formation is given below opposite to the hitherto accepted geological succession.

Age	**Older Succession**	**Tentative Succession**
Sub-Recent to Recent	Alluvium	Loamy and Lateritic soils and Alluvium
Tertiary	Warkalai & Quilon Beds.	Clay and Sandstone.
	----------Unconformity----------	
	Basic dykes	Dolerites.
	Pink granite	Pegmatites and quartz veins.
		Pyroxene granulites.
Archaean	Cordierite gneiss	Garnet-biotite gneiss and Associated migmatites.
		Garnetiferous quartzo Felspathic granulose gneisses. (Leptynite).
	Charnockites, Khondalites & Leptynites.	Garnet-sillimanite gneiss Quartzo-felspathic gneiss Calc-granulites, quartzite
	Peninsular gneiss Dharwar system.	Charnockite

In the field the charnockite does not how any intrusive relationship with the Khondalites. On the other hand they occur as structurally conformable lenticular bands. It appears that garnet-biotite gneiss and associated migmatites have been derived from charnockite and Khondalite groups of rocks, as the result of incorporation of felspathic material. Evidence for such relationship is seen in the nature of the irregular patches of charnockite within garnet-biotite gneiss. Moreover garnet-biotite gneiss is having merging contact with both charnockite and Khondalites. The garnetiferous quartzo felspathic granulose gneiss (Leptynite) occurs as intimately admixtured layers and lenticles within the gneissic rock, indicating that the former may be the product of reconstitution of the host rocks. In the light of the above observations the authors are of the opinion that the charnockite may be older than the Khondalite suite of rocks.

(*Secondary Source : Geological Survey of India-www.gsi.gov.in)

B. LOCAL GEOLOGY

The local geology belongs to the regional geology. Main rock type in the study area is charnockite. At places where they are exposed, the charnockite is medium to coarse grained with dark grey quartz. The soil & over burden thickness is varies from average 0.10 m to 0.90 m. Topographically, the area is undulating with slope towards NE to SW.

✓ BIOLOGICAL ENVIRONMENT

Study of biological environment is one of the important aspects in Environmental Impact Assessment in view of the need for conservation of Environmental quality. A detailed enumeration of species was carried out. Occurrences of flora at various locations were observed and typical plant species were collected. The visual observations of plants were recorded with a view to obtain some idea about the relative density of certain species and their predominance.

FLORAL ASPECTS

The proposed quarry site is located in a hilly terrain with an altitude of about 160 m (msl). The general landuse consists of rubber plantation, open rocky outcrops and mixed natural vegetation. There are no houses adjacent to the proposed quarry.

Table 1. Plants recorded from the proposed quarry site

Table 1.1. List of Trees

Sl. No.	Scientific Name	Vernacular / English Name	Family	Habitat	Distribution	Number	Status
1.	*Artocarpus hirsutus Lam.*	Anjili	Moraceae	Semi-evergreen and moist deciduous forests, also in the plains	Southern Western Ghats	31	Endemic to W. Ghats
2.	*Mangifera indica* L.	Mavu	Anacardiaceae	Evergreen and semi-evergreen forests and also widely cultivated	Indo-Malaysia	8	
3.	*Phyllanthus emblica* L.	Nelli	Phyllanthaceae		Throughout the tropics	1	
4.	*Wrightia tinctoria* R.Br.	Dandappala	Apocynaceae	Moist and dry deciduous forests, also in the plains	India, Myanmar and Timor	10	
5.	*Tabernaemontana alternifolia L.*	Kunnanpala	Apocynaceae	Along margin of the evergreen forests and common in moist deciduous forest, up to 850 m.	Western Ghats	10	Endemic to the Western Ghats
6.	*Macaranga peltata* (Roxb.) Müll.Arg.	Vatta	Euphorbiaceae	Moist deciduous and secondary forests, also in the plains	India, Sri Lanka and Andamans	10	
7.	*Caryota urens* L.	Choonda/ Choondappana	Arecaceae	Evergreen forests, also in the plains	Indo-Malaysia	6	
8	*Olea dioica* Roxb.	Irippa	Oleaceae	Semi-evergreen and moist deciduous forests, also in the plains	India	5	
9.	*Cinnamomum malabatrum* (Burm.f.) J.Presl.	Idana	Lauraceae	Evergreen and semi-evergreen forests, also in the plains	Southern Western Ghats	1	Endemic to Western Ghats
10.	*Alstonia scholaris (*L.*)* R. Br.	Ezhilamppala	Apocynaceae	Moist deciduous forests and sacred groves, also in the plains	South and South East Asia to Australia	5	

11.	*Ailanthus excelsa* Roxb.	Pongaliam	Simaroubaceae	Planted in the plains	Indo-Malesia	5	
12	*Calophyllum inophyllum* L.	Punna	Clusiaceae	In plains along the banks of rivers and mangrove forests, also planted in the parks and roadsides	Paleotropics	5	
13	*Tectona grandis* L.f.	Thekku	Verbenaceae	Moist deciduous forests, also raised in plantations	South and South East Asia	5	
14.	*Bridelia stipularis* (L.) Blume.	Cherupanachi	Euphorbiaceae	Deciduous Forests	Indo-Malesia	5	
15.	*Mallotus philippensis (*Lam.*)* Muell.-Arg.	Kapila	Euphorbiaceae	Semi-evergreen, moist deciduous, evergreen and dry deciduous forests, also in the plains	Indo-Malesia and Australia	5	
16.	*Swietenia macrophylla*	Mahagony	Meliaceae	Grown as avenue tree	Native of Central America	5	Exotic
17.	*Dillenia pentagyna* Roxb..	Pattipunna	Dilleniaceae	Along the margin of evergreen to semi-evergreen forest, upto 1400 m	Indo-Malesia	5	
18.	*Areca catechu* L.	Arecanut	Arecaceae	Cultivated	Cultivated from India to the Solomon Islands and commonly in Africa and Tropical America	7	
19.	*Ficus tsjahela* Burm.f.	Karal / Kara / Chela	Moraceae	Moist deciduous forests, also in the plains; often epiphytic and later becoming independent	Peninsular India and Sri Lanka	1	
20.	*Dalbergia latifolia*	Iitti	Fabaceae	Dry and moist deciduous forests, also in the plains	Indo-Malesia	5	Vulnerable
21.	*Coccos nucifera L.*	Thengu / Coconut	Arecaceae	Cultivated	Cultivated throughout the tropics	6	

22.	*Hevea brasiliensis* (Willd. ex Juss.) Muell.-Arg.	Rubber	Euphorbiaceae	Cultivated	Native of Tropical America	10	Exotic
23.	*Acacia auriculiformis* Benth.	Acacia	Leguminosae	Cultivated	Native of Tropical Australia	60	Exotic
24.	*Albizia saman (Jacq.) Merr.*	*Mazha maram/rain tree*	Leguminosae	*Cultivated as avenue tree*	*Native of Central and South America*	4	Exotic
25.	*Tamarindus indica L.*	Valampuli	Leguminosae	Cultivated	Native of Tropical Africa; introduced and widely grown in India and parts of tropics	1	Exotic
26.	*Morinda coreia Buch.-Ham.*	Manjanathi	Rubiaceae	Moist and dry deciduous forests, also in the plains	Indo-Malesia	4	
27.	*Mallotus tetracoccus* (Roxb.) Kurz	Porivatta	Euphorbiaceae	Evergreen, semi-evergreen and shola forests, also in the plains	India, Sri Lanka and China	2	

Table 1.2.List of Tree saplings

Sl. No.	Scientific Name	Vernacular / English Name	Family	Habitat	Distribution	Status
1.	*Holarrhena pubescens (Buch. - Ham) Wall.*	Kudagapala	Apocynaceae	Moist deciduous and dry deciduous forests, also in the plains	Indo-Malesia	
2.	*Acacia auriculiformis* Benth.	Acacia	Leguminosae	Cultivated	Native of Tropical Australia	
3.	*Pterocarpus marsupium*		Fabaceae		Native to India, Nepal, and Sri Lanka	
4.	*Ficus exasperata Vahl.*	Parakam	Moraceae	Moist deciduous forests, also in the plains	East Africa, Arabia, India and Sri Lanka	

5.	*Helicteres isora* L.	East Indian Screw Tree	Malvaceae	Deciduous forests also in plantations and plains	Indo-Malesia, China and Australia	
6.	*Bridelia retusa (*L.*)* Spreng.	Mulluvenga	Euphorbiaceae	Evergreen to Deciduous Forests	Indo-Malaya	
7.	*Ficus arnottiana* (Miq.)	Kallai	Moraceae	Semi-evergreen, moist deciduous	India, Sri Lanka	
8.	*Tamarindus indica L*	Valampuli	Leguminosae	Cultivated	Native of Tropical Africa; introduced and widely grown in India and parts of tropics	Exotic

Table 1.3.List of Shrubs

Sl. No.	Scientific Name	Vernacular / English Name	Family	Habitat	Distribution	Status
1.	*Phyllanthus reticulatus Poir.*	Nirnelli	Phyllanthaceae	Stream banks, lake shores and also in moist deciduous and semi-evergreen forests	Paleotropics	
2.	*Ixora coccinea* L.	Thechi/ Chethi	Rubiaceae	In the plains, also grown in homesteads	Peninsular India and Sri Lanka	
3.	*Leea indica (Burm.f.) Merr.*	Erattayani	Leeaceae	Degraded semi-evergreen and evergreen forests, also in the plains	Indo-Malesia, China and Australia	
4.	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Communist-pacha	Compositae	A weed in all terrestrial habitats	Native of America; naturalised in Tropical Asia	Exotic/ Invasive Species
5.	*Hyptis suaveolens* (L.)	Nattapoochedi	Lamiaceae	Degraded moist and dry deciduous forests and wastelands	Originally from America now Pantropical	Invasive Species
6.	*Hibiscus hispidissimus* Griff.	Matthippuli	Malvaceae	Dry and moist deciduous forests, also in the plains	Paleotropics	
7.	*Justicia gendarussa*	Karunochchi	Acanthaceae	Moist deciduous forests, also in the	Tropical Africa and Asia	Exotic

	Burm. f.			plains		
8.	*Grewia nervosa* (Lour.) Panigrahi.	Cherikkotta	Malvaceae	Semi-evergreen forests, sacred groves and scrub jungles	Tropical Asia	
9.	*Clerodendrum infortunatum L.*	Perivelam	Verbenaceae	Degraded forest areas and also in the plains	Indo-Malesia	
10.	*Canthium rheedei* DC.	Edalimaram	Rubiaceae	Evergreen forests and sacred groves	Peninsular India	
11.	*Sauropus andogynus (*L.) Merr.	Velicheera	Euphorbiaceae	Evergreen and semievergreen forest and also grown in homesteads	Indo-Malesia	
12.	*Canthium angustifolium Roxb.*	Kattakara	Rubiaceae	Moist deciduous, semi-evergreen and evergreen forests	Indo-Malaya	
13.	*Acacia caesia* (L.) Willd.	Incha	Leguminosae	Evergreen semi evergreen forest	Indo Malasia	

Table 1.4.List of Herbs

Sl. No	Scientific Name	Vernacular / English Name	Family	Habitat	Distribution	Status
1.	*Sebastiania chamaelea*	Kodiyavannakku	Euphorbiaceae	Grasslands and moist deciduous forests, also in plains	Indo-Malesia and Australia	
2.	*Oplismenus compositus* (L.) P.Beauv.		Poaceae	Degraded deciduous forests and shady places, also in the plains	Pantropical	
3.	*Osbeckia truncata* D. Don ex Wt. & Arn.		Melastomataceae	Moist deciduous forests and grasslands	Western Ghats	Endemic to Western Ghats
4.	*Phyllanthus niruri* L.	Keezharnelli	Euphorbiaceae	Degraded moist deciduous, forest plantations and also in plains	Tropics	
5.	*Achyranthes aspera* L.	Katalaati	Amaranthaceae	Abundant in plantation of the hills	Tropics.	

6.	*Coleus forskohlii*	Panikoorka	Lamiaceae	Plains, Cultivated, Grasslands and dry deciduous forests	India, Sri Lanka and Tropical East Africa	
7.	*Pennisetum polystachyon (L) Schult.*		Poaceae	Degraded moist deciduous forests and waste places	Paleotropics	
8.	*Mimosa pudica* L.	Thottavadi	Leguminosae	Common on moist and ungrazed places.	Native of South America, now pantropical.	Exotic
9.	*Triumfetta rhomboidea* Jacq.	Ottukayal/ Oorpam	Malvaceae	Degraded deciduous forests, also in the plains	Pantropical	
10.	*Costus speciosus (J.Koenig) Sm.*	Malavayambu	Costaceae	Moist deciduous and semi-evergreen forests, also in the plains	Indo-Malesia	
11.	*Kyllinga sp.*	Whitehead spikesedge	Cyperaceae	Waste places, degraded forest areas and grasslands	Pantropical	
12.	*Phyllanthus urinaria* L.	Chirukizhukanelli	Phyllanthaceae	In the plains, also in degraded deciduous forests	Native of Tropical East Asia; Circumtropical weed	
13.	*Spermacoce latifolia Aubl.*	Vellatharavu/ Tharavu/ Pachhapalla	Rubiaceae	Moist and dry deciduous forests and waste places	Native of Tropical America; Tropical Africa and Asia	Exotic
14.	*Elephantopus scaber* L.	Aanachuvadi	Compositae	Moist deciduous forests, also in plain	Pantropical	
15.	*Naregamia alata Wight & Arn.*	Nilanaragam	Meliaceae	Moist deciduous forests, also in the plains	Peninsular India	Endemic Peninsular India
16.	*Curculigo orchioides* Gaertn.	Nilappana/Black musale	Hypoxidaceae	Moist deciduous forests and grasslands, also in the plains	Indo-Malesha	
17.	*Desmodium sp*		Leguminosae	Grasslands and moist deciduous forests, also in plains	Indo-Malesia and Australia	
18.	*Colocasia esculenta* (L.) Schott	Chembu	Araceae	Waterlogged ditches and streamside	Pantropical	Exotic

19.	*Axonopus compressus* (Sw.) P.Beauv.	Kaalappullu/ Carpet Grass	Poaceae	Dry and moist deciduous forests, waste lands	Tropics and subtropics	
20.	*Synedrella nodiflora* (L.) Gaertn.	Mudianpacha	Compositae	Deciduous forests, also in the plains	Native of West Indies; naturalised in India, China, Malesia and Polynesia	Invasive Species
21.	*Cyanotis sp.*		Commelinaceae	Grasslands, degraded forest areas.	Western Ghats	
22.	*Biophytum sensitivum* (L.) DC.	Theendavadi/Mukkutti	Oxalidaceae	Moist shady places	Indo-Malesia	
23.	*Justicia japonica*Thunb.		Acanthaceae	Grasslands and waste places	Indo-Malesia, East Africa	
24.	*Commelina clavata* C.B.Clarke		Commelinaceae	Moist deciduous forests	India, Sri Lanka and Java	
25.	*Alternanthera brasiliana* (L.) Kuntze		Amaranthaceae		Mexico, Central America and Columbia to the Guianas, Brazil and Peru	
26.	*Ananas comosus* (L.) Merr.	Kaithachakka	Bromeliaceae	Cultivated	Tropical America, widely cultivated in Paleotropics	Exotic
27.	*Kalanchoe pinnata* (Lam.) Pers.	Elamulachi	Crassulaceae	Rocky areas in moist deciduous forests	Native of Madagascar	

Table 1.5.List of Climbers

Sl No	Scientific Name	Common Name	Family	Habitat	Distribution	Status
1.	*Ziziphus oenoplia* (L.) Mill.	Thodalli	Rhamnaceae	More common on the lower slopes. Plains from the coast to 1200m.	Tropical Asia and Australia.	
2.	*Mukia maderaspatana* (L.) M.Roem.	Kasappuchedi	Cucurbitaceae	Deciduous forests, also in the plains	Paleotropics	Climber

3.	*Hemidesmus indicus* R.Br.	Nannaari/Naruneendi	Asclepiadaceae	Plains from the coast, in scrub jungles and upto 1000m on slopes.	India and Sri Lanka.	
4.	*Mimosa diplotricha* var. *diplotricha*	Aanathottavadi	Leguminosae	Weed in degraded forests, also in the plains	Native of Tropical America; a weed in India	Exotic/ Invasive species
5.	*Ichnocarpus frutescens (L.) R.Br.*	Palvalli	Apocynaceae	Moist and dry deciduous forests, also in the plains	Indo-Malesia and Australia	
6.	*Cyclea peltata (Lam.) Hook. f. & Thoms.*	Padathali	Menispermaceae	Semi-evergreen and evergreen forests, also in the plains	India and Sri Lanka	
7.	*Wattakaka volubilis (*L.f.*)* Stapf.	Vattakakkakkoti	Asclepiadaceae	Moist deciduous forests and scrub jungles	Indo-Malesia and China	
8.	*Piper nigrum L. var. nigrum*	Kurumulaku	Piperaceae	Evergreen and semi-evergreen forests, also cultivated	Peninsular India and Sri Lanka, cultivated elsewhere	
9.	*Abrus precatorius* L.	Kunnikuru	Leguminosae	Deciduous forests, also in the plains	Pantropical	
10.	*Dioscorea sp.*		Dioscoreaceae			
11.	*Passiflora foetid*a L.	Poochapazham	Passifloraceae	Very common along roadsides, thickets and water courses from plains	Native of tropical America, widely naturalized tropics	Exotic
12.	*Vigna umbellata (Thunb.) Ohwi & H.Ohashi*	Kattuzhunnu	Leguminosae	Semi-evergreen and moist deciduous forests	Indo-Malesia	
13.	*Piper longum* L.	Thippali	Piperaceae	Semi-evergreen, evergreen, moist deciduous forests and wastelands	Indo-Malesia	
14.	*Anamirta cocculus* (L.) Wight & Arn.	Nanchuvalli	Menispermaceae	Moist deciduous and evergreen forests, also sacred groves in plains	Indo-Malesia	

15.	*Cardiospermum halicacabum* L.	Uzhinja	Sapindaceae	Moist deciduous forests, also in scrub jungles	Pantropical	
16.	*Pueraria phaseoloides*	Thotta-payar	Fabaceae	Along margins of cultivated lands	Tropical Asia	Exotic
17.	*Mussaenda frondosa* L.	Vellila	Rubiaceae	Moist deciduous and semi-evergreen forests, also in the plains	Peninsular India	Endemic to Peninsular India
18.	*Centrosema molle* Benth.	Kattupayar	Fabaceae	Forest plantations and deciduous forests, also in the plains	Native of America; introduced in India	Exotic

Table 1.5.List of Ferns

Sl No	Scientific Name	Common Name	Family	Habitat	Distribution	Status
1.	*Selaginella tenera* Spring.	Sanjeevani	Selaginellaceae	Found commonly on the forest floor and at road side rocks.		
2.	*Adiantum latifolium* Lam.		Adiantaceae	Disturbed open areas.	Native to tropical America	Exotic
3.	*Hemionitis arifolia* (Burm. fil.) Moore		Hemionitidaceae		Tropics	

FAUNAL ASPECTS

The following lists of faunal elements were observed from the site:

Birds : 17 species
Mammals : 8 species
Butterflies : 18 species
Odonates : 7 species
Amphibians : 5 species
Reptiles : 6 species
Spiders : 5 species
Ants : 4 species

List of Mammals (In and around the project site)

Sl No.	Common Name	Scientific Name	IUCN Status	IW(P)A (Schedule)
1	Jungle Cat	*Felis chaus*	Least Concern	II
2	Palm civet/Toddy Cat	*Paradoxurus hermaphroditus*	Least Concern	II
3	Black-naped Hare	*Lepus nigricollis*	Least Concern	IV
4	Indian grey mongoose	*Herpestes edwardsii*	Least Concern	III
5	Jungle striped squirrel	*Funambulus tristriatus*	Least Concern	-
6	Indian Flying Fox	*Pteropus giganteus*	Least Concern	V
7	Greater Short-nosed Fruit Bat	*Cynopterus sphinx*	Least Concern	V
8	Pig Rat	*Bandicota indica*	Least Concern	V

* IW(P)A -The Indian Wildlife (Protection) Act, 1972.

List of Reptiles

Sl No.	Scientific Name	Common Name	IUCN Status
1	*Hypnale hypnale*	Hump-nosed Pit Viper	Not assessed
2	*Bungarus caeruleus*	Common Krait	Least Concern
3	*Ptyas mucosa*	Oriental Rat Snake	Least Concern
4	*Calotes versicolor*	Oriental Garden Lizard	Least Concern
5	*Eutropis carinata*	Keeled Indian Mabuya	Least Concern
6	*Cnemaspis sp.*	Day gecko	Least Concern

List of Amphibians

Sl No.	Scientific Name	Common Name	IUCN Status
1	*Duttaphrynus melanostictus*	Indian common toad	Least Concern
2	*Pseudophilautus kani*	Kani Bush Frog	Least Concern
3	*Hoplobatrachus tigerinus*	Indian bullfrog	Least Concern
4	*Polypedates sp.*	Tree Frog	
5	*Zakerana keralensis*	Kerala Warty Frog	Least Concern

List of Odonates

Sl No.	Scientific Name	Common Name
1	*Tholymis tillarga*	Coral-Tailed Cloudwing
2	*Neurothemis fulvia*	Fulvous Forest Skimmer
3	*Rhyothemis variegata*	Common Picture Wing
4	*Orthetrum sabina*	Green Marsh Hawk
5	*Pantala flavescens*	Wandering Glider
6	*Ceriagrion cerinorubellum*	Orange-Tailed Marsh Dart
7	*Vestalis gracilis*	Clear-winged forest Glory

List of Birds

Sl No.	Scientific Name	Common Name	IUCN Status
1	*Ninox scutulata*	Brown Hawk Owl	Least Concern
2	*Oriolus xanthornus*	Black headed oriole	Least Concern
3	*Corvus culminatus*	Indian Jungle Crow	Least Concern
4	*Dicaeum erythrorhynchos*	Pale billed Flowerpecker	Least Concern
5	*Megalaima viridis*	White cheeked barbet	Least Concern
6	*Chalcophaps indica*	Common Emerald Dove	Least Concern
7	*Dendrocitta vagabunda*	Indian Treepie	Least Concern
8	*Glaucidium radiatum*	Jungle Owlet	Least Concern
9	*Pycnonotus jocosus*	Red Whiskered Bulbul	Least Concern
10	*Dicrurus paradiseus*	Racket tailed Drongo	Least Concern
11	*Turdoides striatus*	Jungle Babbler	Least Concern
12	*Loriculus vernalis*	**VERNAL HANGING PARROT**	Least Concern
13	*Aegithia tiphia*	Common Iora	Least Concern
14	*Acritillas indica*	Yellow-browed Bulbul	Least Concern
15	*Centropus sinensis*	Greater coucal	Least Concern
16	*Dicrurus leucophaeus*	Ashy Drongo	Least Concern
17	*Hypothymis azurea*	Black-naped Monarch	Least Concern

List of Spiders

Sl No.	Family	Scientific Name
1	Tetragnathidae	*Tetragnatha sp.*
2	Oxyopidae	*Oxyopes sp.*
3	Hersilidae	*Hersilia savignyi*
4	Tetragnathidae	*Nephila maculata*
5	Araneidae	*Argiope sp.*

List of Butterflies

Sl. No.	Common Name	Scientific Name	Status
	Papilionidae		
1	Malabar Raven	*Papilio dravidarum* Wood-Mason	Endemic to W.Ghats
2	Common Mormon	*Papilio polytes* Linnaeus	
3	Malabar Rose	*Pachliopta pandiyana* Moore	Endemic to W.Ghats
	Pieridae		
4	Psyche	*Leptosia nina* Fabricius	
5	Three-spot Grass Yellow	*Eurema blanda* Boisduval	
6	Common Emigrant	*Catopsilia* Fabricius	
	Nymphalidae		
7	Chocolate Pansy	*Junonia iphita* Cramer	
8	Bush- brown	*Mycalesis* sp.	
9	Common Four-ring	*Ypthima huebneri* Kirby	
10	Dark Blue Tiger	*Tirumala septentrionis* Butler	
11	Common Crow	*Euploea core* Stoll	
12	Dark Evening Brown	*Melanitis phedima*	
	Lycaenidae		
13	Common Line-blue	*Prosotas nora* C. Felder	
14	Common Cerulean	*Jamides celeno* Cramer	
15	Western Centaur Oakblue	*Arhopala pseudocentaurus* Doubleday	
	Hesperidae		
16	Chestnut Bob	*Iambrix salsala* Moore	
17	Pygmy Grass Hopper	*Aeromachus pygmaeus* Fabricius	
18	Grass Demon	*Udaspes folus* Cramer	

List of Ants

Sl No.	Common Name	Scientific Name
1	Yellow crazy Ant	*Anoplolepis gracilipes*
2	Hunchback Ant	*Myrmicaria sp.*
3	Black Crazy Ant	*Paratrechina sp.*
4	Spiny Ant	*Polyrhachis sp.*

Other Insects

1	House fly	*Musca domestica*
2	Flower Wasp	*Scolia sp.*
3	True honey bee	*Apis dorsata*
4	Grass hopper	*Mecopoda elongata*
5	Mole Cricket	*Meconema sp.*

Results & Conclusion:

Floral Aspects:

Most of the floral species identified are common and widely distributed and the range of occurrence extended to wide geographical area. Analysis of the flora revealed that there are 94 plant species falling under 42 plant families distributed in the project area. Angiosperms forms 91 species with 33 species of trees and its saplings, 13 species of shrubs, 27 species of herbs and 18 species of climbers. There are 3 Pteridophytes (ferns) falling under 3 families. The most dominant plant family is Leguminosae followed by Euphorbiaceae, Rubiaceae, and Apocynaceae. The plant species *Artocarpus hirsutus, Tabernaemontana alternifolia, Cinnamomum malabatrum, Osbeckia truncata, Naregamia alata* and *Cyanotis burmanniana* are endemic to Western Ghats / Peninsular India.

Faunal Aspects:

Regarding the conservation status of the fauna, none of the animal species identified from the site belonged to the threatened categories identified by the International Union for Conservation of the Nature and Natural Resources (IUCN). Most of them are common and widely distributed and the range of occurrence extended to wide geographical area. However, two species of butterflies namely *ie*. Malabar Raven (*Papilio dravidarum*) And Malabar Rose (*Pachliopta pandiyana*) reported from the site are endemic to W.Ghats.

✓ SOCIO ECONOMIC ENVIRONMENT

Vellarada Gram Panchayat

Vellarada is the southernmost part of Kerala state, sharing its border with Tamil Nadu. Vellarada is said to be the threshold to the high range areas of eastern part of Thiruvananthapuram district. Vellarada is also known for its hilltop shrine "*Kurisumala* Pilgrim Centre" (called *Thekkan kurisumala*) which is located at a height of 3,000 feet. Thousands of devotees from various parts of Tamil Nadu, Kerala, Andhra Pradesh and Karnataka visit the shrine during the time of Lent in every year. The hilly areas of the panchayat are facing drinking water scarcity during summer season. The infrastructure facilities of aided schools are pathetic.

Panchayat at a glance

Name of the Panchayat	Vellarada Gram Panchayat
Geographical area	31.06 Sq. KM
Total ward	23
Village	Vellarada
Block	Perunkadavilla
District	Thiruvannathapuram
Boundary	North – Amboori Gram Panchayat South – Kunathukal Gram Panchayat West – Kunnathukal and Aryankode Gram Panchayat East - Tamilnadu

Demography

Total Population	37,092
Total Male Population	18,699
Total Female Population	18,393
Density of population	1,174
Ratio	984
Literacy	82.94

ENVIRONMENT MANAGEMENT PLAN (EMP)

The Environment Management Plan (EMP) for a development project prescribes the mitigation measures to be adopted to nullify or to minimize various anticipated environment impacts so as to ensure nill / low impact due to the project to the surrounding environment. This will ensure sustainable development and environment friendly mining operations. The Environment Management Plan for various facets of environment are given below : -

✓ **AIR ENVIRONMENT**

ANTICIPATED POTENTIAL IMPACTS

Drilling, Blasting & Transportation

Apart from the mining operations of drilling & blasting, movement of vehicles like dumpers, trucks, tankers etc. will generate dust. The transportation activities on unpaved area will results in fugitive emissions to the tune of 1.261 kg/VkmT for PM_{10} and 0.126 kg/VkmT for $PM_{2.5}$. (***Calculation based on USEPA- AP 42 series.***).

Gaseous Emission rate due to transportation

CO	5.45 g/kWh
HC	0.78 g/kWh
NOx	5.0 g/kWh

MITIGATION MEASURES:

Mining activities will generate certain quantities of dust during drilling, blasting, loading and transportation operations. The following measures will be taken to mitigate the fugitive dust from these operations.

- Laying of haul road as per the standards, black topping of permanent haul road and service road to avoid or eliminate air – borne dust.
- To avoid the dust generation from the drilling operations, wet drilling method will be adopted.
- Drill machines will be equipped with dust collectors.
- Use of appropriate explosives for blasting and avoiding overcharging of blast holes.
- Controlled blasting techniques will be adopted.
- Watering of haul road and other road at regular intervals.
- Provision of dust filters/ mask to workers for highly dust prone and affected areas.
- Provision of green belt all along the periphery of the lease area.
- Periodical monitoring of ambient air quality in and around the lease area.

The extracted mineral will be transported from the quarry to the end user by adopting following measures so as to minimize dust emissions.

- In case of long transportation the trucks after loading will be covered with tarpaulin sheets.
- Speed of the vehicles will be maintained within the prescribed limits.
- Trucks will not be over loaded and will be maintained to the body level.

The proposed mining activity is attached with a crusher operation. The following measures are being taken to control the dust emissions:-

- The unit is based on latest green technology and the entire unit is closed loop with proper control strategies
- The unit is well equipped with dust extraction system like bag filters at all traverse points to control the dust emissions.
- Closed conveyor system with water sprinkling arrangements are adopted in this unit
- Sufficient water is used to maintain the moisture content to control the fugitive emissions throughout the system

✓ **WATER ENVIRONMENT**

A. Water for Domestic Consumption

ANTICIPATED POTENTIAL IMPACTS

From the analysis report of the water sample collected from the bore well, it is observed the water from the bore well is having Turbidity, Iron & Coliform bacteria which are in excess of the permissible standard. The consumption of non potable water can lead to water borne diseases and which will affect the health of workers attached to project.

MITIGATION MEASURES:

It is suggested to adopt appropriate treatment / filtration / disinfection of water before consumption.

B. Domestic Sewage

ANTICIPATED POTENTIAL IMPACTS

The domestic sewage generation, if discharged untreated, can contaminate the ground water and other ground & surface water sources.

MITIGATION MEASURES:

The sewage to the tune of 1.60 KLD will be generated from the site and the same will be diverted to the septic tank followed by soak pit.

C. Storm water contamination with silt

ANTICIPATED POTENTIAL IMPACTS

Mining activities may cause adverse impacts due to siltation due to runoff/ storm water. An impact due to soil erosion during monsoon period is also significant in nature. This also has the potential to clog the water channels and to spoil agriculture.

MITIGATION MEASURES:

Some of the control measures adopted for controlling water pollution due to the siltation of storm water by mining operations are as follows:-

- Storm water drains with silt traps will be suitably constructed all along the periphery of the pit area (Garland drains) to collect the run-off from the lease area and divert into the storm water pond/tanks proposed within the complex.
- Appropriate channelization of storm water with channels of sufficient width
- All measures will be taken not to disturb the existing drainage pattern adjacent to the other property.
- De-siltation traps and storm water collection pond proposed for silt removal.
- The storm water collected from the lease area will be utilized for dust suppression on haul roads, plantation within the premises, etc.
- The layout of channelization of storm water from the project site is shown in the environmental plan and in the storm water drainage plan which are attached at **Annexure No. A & B** respectively.
- Construction of check dams and collecting channel all around at the foot of the hill to prevent soil erosion during the monsoon season and also to collect the storm water for various use within the mine lease area.

D. Consumption of water – A Natural Resource

ANTICIPATED POTENTIAL IMPACTS

The mining operations require large quantity of water for dust suppression, wetting of roads etc. Therefore, if appropriate measures are not adopted, it will lead to withdrawal of large quantity of ground water and which will deplete the ground water table.

MITIGATION MEASURES – CONSERVATION OF WATER

- The quarry site has got potential to store large quantity of storm water. The storing of surface run-off can be done in a storm water collection pond. Stored storm water can be used for dust suppression & greenbelt development which will reduce / eliminate

the usage of fresh water. Therefore, the conservation of water is achieved. A storm water collection pond of capacity 20,000 KL is available at site which is outside the mine lease area. This will be fenced so as to avoid accidents. The settled dust particles within the storm water collection pond will be removed from the pond periodically.

- Further, in the mine closure phase of the mine, a large area is proposed to be used as surface run-off storage structure. The stored rain water will be used for maintenance of eco-restoration carried out in the mine lease area.

✓ **NOISE ENVIRONMENT**

ANTICIPATED POTENTIAL IMPACTS

Drilling, blasting, compressors, plying of vehicles and loading & unloading of materials are the main sources of noise in the project area. The expected noise level from the above mentioned operations are given below:

S. No.	List of equipments	Range dB (A)
1.	Excavator	95-100
2.	Hydraulic Jack Hammer	95 -100
3.	Compressor	92-95
4.	Trucks/ Tippers	84-86

The nearest house is about 107m in E direction from the project site and predicted noise levels at different distances from the source is given below:-

Distance from the source	Predicted noise levels without EMP, dB(A)
50	65
107	**60.5**
200	58
300	54.5
400	52
500	50

MITIGATION MEASURES

The following noise control measures are undertaken to bring down the noise levels:-

- Proper maintenance of machinery, equipments and improvement on design of machines.
- Use of personal protective devices i.e., earmuffs and earplugs by workers, who are working in high noise generating areas.

- Creation of wide green belt of dense foliage between mine areas and residential colonies.
- Regular medical check-up related health problems
- Proper training to personnel to create awareness about adverse noise level effects.
- Planned noise monitoring at suitable locations in the plant and outside location for proper effective remedial actions.

✓ **LAND ENVIRONMENT**

ANTICIPATED POTENTIAL IMPACTS

A. Land use change

Any mining activity may alter the land use pattern in the lease area

B. Loss of Top soil & overburden

C. Soil erosion due to storm water

MITIGATION MEASURES

In order to minimize the adverse affects, the following suggestions have been made.

- Concurrent eco restoration will be carried out.
- Construction of check dams and collecting channel all around at the foot of the hill to prevent soil erosion during the monsoon season and also to collect the storm water for various use within the mine lease area.
- Green belt development along the boundary of the lease area.
- It is proposed to reclaim the pit area and this area will be suitably planted with local species for eco-restoration in all possible means.
- Proper barricading and monitoring of the water stored area will be taken up to prevent accidents (if any)
- It is estimated that around 13,872 cu. m. of top soil will be generated from the proposed pit, which will be properly stacked and will be utilized for plantation over the reclaimed areas.
- It is also estimated that around 8,637 cu. m. of OB is generated which will be utilized in developing internal roads.

D. OTHER ANTICIPATED POTENTIAL IMPACTS IN LAND ENVIRONMENT

1. GROUND VIBRATIONS

The only source of ground vibrations is due to blasting operations. Based on the ground vibration studies made earlier proper care will be taken during blasting.

2. BLASTING HAZARDS

Blasting in mining areas may give rise to ground vibrations. Fly rock is another problem that deserves attention. Based on the ground vibration studies made earlier, proper precautions will be taken during blasting operations for controlling the ground vibrations.

MITIGATION MEASURES

The mitigation measures for addressing the various impacts due to blasting operation are presented below.

Controlled blasting technique will be adopted in this project in order to reduce blast vibrations. Further, charge per delay will be regulated to minimize blast vibrations. Proper hook-up will be adopted while firing the drill holes. Moreover the experience gained in other open cast mines would be gainfully utilized to limit the ground vibration levels within the prescribed limit of 15 mm/sec (as per DGMS). In practice, this is kept much less to about 10mm/sec.

In addition, the following guidelines will be adopted wherever required to check the ground vibrations:-

- The maximum charge per delay will not be more than 10 kg so as to limit the PPV values to 10mm/ sec. (As against the permissible 15 mm/ sec.).
- Optimum delay sequence and stem to column ratio will be maintained to minimize the fly rock distance and ground vibration intensity.
- Basing on the distance of the nearest sensitive areas from the epicenter of the blast, charge weight will be altered to meet the stipulated standards.
- Design of optimum blast hole geometry considering bench height, diameter of hole, type of explosive, nature of rock, level of fragmentation required etc.
- Divide total charge/ blast in several parts so as to keep minimum explosive per delay i.e. use of millisecond delay detonators & relays.
- Avoid concentration of explosive by using deck charging.
- Avoiding blasting in unfavorable weather conditions.

3. FLY ROCK CONTROL MEASURES

There are a large number of factors that influence fly rocks. Most important of these factors are long explosive columns with little stemming at the mouth of the hole,

irregular shape of face, long water column in holes, loose stones on face of the surface blasting area, and strong wind.

MITIGATION MEASURES

Certain preventive measures will be taken to minimize the risks arising from flying fragments. These are given below:-

- **Marking of danger zone: -** The area falling within 250 m of the blasting area will be marked off as danger zone with red flags, or other appropriate signs, and entry of any unauthorized person into this zone will be prohibited during blasting operation.
- **Warning signals: -** An audible warning signal will be given, fifteen minutes before actual firing of blast to enable persons to move out of danger zone. For this purpose, a set of sirens/ hooters will be provided at appropriate places.
- **Providing blasting shelters: -** In order to protect the personnel engaged in blasting operations, blasting shelters will be provided for taking shelter during blasting.

4. AIR BLAST CONTROL MEASURES

The release of explosive energy through air and movement of fragmented rocks are primary causes for noise and air over pressure during blasting.

MITIGATION MEASURES

Adoption of the following measures while carrying out blasting operation will help in reducing the intensity of air blasts and will also minimize the noise level associated with the air blasts. The measures suggested are given below:-

- Avoiding overcharging of blast holes
- Adequate stemming
- Maintaining proper inter-hole & inter-row delays.

✓ **BIOLOGICAL ENVIRONMENT**

ANTICIPATED POTENTIAL IMPACTS

Clearing and cutting of trees, shrubs & herbs during the mining operations will have impact on biological environment by way of loss of habitat, loss of biodiversity. In order to compensate the anticipated impacts due to the mining activity, the following measures are proposed:

MITIGATION MEASURES

1. COMPENSATORY MASS PLANTATION PROGRAMME

An area equivalent to about 10% of the area proposed for quarrying is reserved in the area owned by the project proponent outside the proposed quarry for compensatory

mass plantation. The area selected is such that there is enough depth of top soil and overburden and the quarrying in this area is not proposed in future. In the instant project site, about 0.6 hectare of land is dedicated to green belt / tree plantation so as to minimize the loss of biodiversity due to the mining activity.

2. GREEN BELT DEVELOPMENT/ ECO-RESTORATION

In the concurrent eco-restoration of mine, about 3,000 trees will be planted in an area of 3.0224 hectare.

3. RECOMMENDED SPECIES FOR ECO-RESTORATION PROGRAM

The following recommendations were made for the sustainable development of the project so as to protect the biodiversity of the area. The following species of native plants can be planted in the area earmarked for green zone and also during mine closure.

Sl No.	Trees	Shrubs
1	*Pterocarpus marsupium*	*Dendrocalamus strictus*
2	*Cinnamomum malabatrum*	*Bambusa bambos*
3	*Artocarpus heterophyllus*	*Helicteres isora*
4	*Wrightia tinctoria*	*Rauvolfia serpentina*
5	*Terminalia paniculata*	*Cycas circinalis*
6	*Holarrhena pubescens*	*Chassalia curviflora*
7	*Tectona grandis*	*Mussaenda frondosa*
8	*Syzygium cumini*	*Ochlandra travancorica*
9	*Olea dioica*	*Bambusa vulgaris*
10	*Artocarpus hirsutus*	*Ixora coccinea*
11	*Dalbergia latifolia*	*Pseudarthria viscida*
12	*Cassia fistula*	*Glycosmis pentaphylla*
13	*Grewia tiliifolia*	*Clerodendrum infortunatum*
14	*Terminalia bellirica*	

✓ SOCIO-ECONOMIC ENVIRONMENT

INTRODUCTION

To identify the needs of the nearby community to the project site, a community need assessment study was carried out in Vellarada Gram Panchayat during the last week of December 2015. The main purpose of the study was to assist the project proponent in delivering their Corporate Social Responsibility (CSR). As per the guidelines of *Company's Act (Amendment) 2013*, the study was mainly focused on the following areas.

1. **PROMOTION OF EDUCATION**
2. **ENVIRONMENTAL SUSTAINABILITY**
3. **HEALTH CARE**

Approach adopted

To conduct the study, primary and secondary data were used.

Primary Data: Stake holder interviews, unstructured interview, transect walk, field observation, and telephonic survey.

Secondary data: Yearly project document and Development Charter of the Panchayat.

Stake Holders

As part of study the socio economic expert conducted interviews with different stakeholders of the Panchayat. The list of stake holders are given below

Sl. No	Name	Designation	Ph. No
01	Jucy christabel	H M, Govt. L P School Koothali	9946386086
02	Manoj V K	H M, Iswaravilasam U P S, Koothali	7868860171
03	Ida M	Teacher, Day care center, Kurisumala	8943639766
04	Saseendrakumari	Angnawadi worker	9048560133
05	Sasi R G	Auto driver	9387165128

Identified Corporate Social Responsibility

The Socio - Economic expert conducted Need Assessment study in Vellarada Gram Panchayat and identified Corporate Social Responsibility (CSR) for the project proponent. The identified CSR activities are given below.

1. PROMOTION OF EDUCATION

A. There are 383 children studying in the Govt. L P School, Koothali. To improve the facilities, the project can support the school.

Particulars	Total (in Rs.)	Type of Expense
Smart class room	80,000	Non recurring
Water purifier	15,000	Non recurring

Computer maintenance	4,000	Recurring
Children's park	50,000	Non recurring
Total	**1,49,000**	

B. There are 250 children studying in Saraswathivilasam U P School, Koothali. The school does not get any aid form the local self government to improve the infrastructure, curricular and extracurricular facilities. The project can support the school to improve its facilities.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Girls friendly toilet		60,000	Non recurring
Maintenance urinal and toilet block		50,000	Non recurring
Maintenance of class rooms		1,00,000	Non recurring
Kitchen		1,00,000	Non recurring
Smart class room		80,000	Non recurring
Furniture	3,000 x 10	30,000	Non recurring
Total		**4,20,000**	

C. A day care center of CSI church is working in Kurisumala. The center is giving nutritious and educational support to the children of economically backward families. The center is facing financial crisis to run its activities. The project can support the center for its development.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Nutritious food	3,000 x 12 months	36,000	Recurring
Learning & recreational materials		20,000	Non recurring
Furniture	3,000 x 10	30,000	Non recurring
Total		**86,000**	

D. The project can start a scholarship and sponsorship programme for children from economically back ward families. This initiation will help children to pursue higher education.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Scholarship for medicine, engineering, CA, IT courses	40,000 x 3	1,20,000	Recurring
School Kit (Bag, Uniform etc)	1,000 x 50	50,000	Recurring
Sponsorship for vocational courses	10,000 x 10	1,00,000	Recurring
Total		**2,70,000**	

2. ENVIRONMENTAL SUSTAINABILITY

A. The project can plant 500 saplings in the region in association with various schools and clubs. This will help to aware children and public about the importance of nature.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Saplings	20 x 500	10,000	Non recurring
Protection net	150 x 500	75,000	Non recurring
Maintenance	50 x 500	25,000	Recurring
Working cost		10,000	Non recurring
Total		**1,20,000**	

B. To reduce the magnitude of drinking water scarcity, the project can introduce well recharge programme. This will help to increase the ground water level.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Well recharge	15,000 x 10	1,50,000	Recurring
Total		**1,50,000**	

3. HEALTH CARE

A. There is no physical educator in schools. To develop the physical fitness of children, the project can appoint a physical educator on contract basis for three schools around the project site. He/she can also conduct camps in summer vacation for students.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Physical educator	500 x 300 days	1,50,000	Recurring
Working cost	2,000 x 12months	24,000	Recurring
Total		**1,74,000**	

B. The project can conduct cancer detection camp in association with RCC and CHC, Vellarada. The deserving patients will get treatment support from the project proponent.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Cancer detection camp		60,000	Recurring
Treatment support	30,000 x 4	1,20,000	Recurring
Total		**1,80,000**	

C. The project can support the people from economically backward families to construct houses and toilets. This initiation will help them to lead a safe and secure life.

Particulars	Basis of Calculation	Total (in Rs.)	Type of Expense
Houses	50,000 x 3	1,50,000	Non recurring
Toilets	15,000 x 6	90,000	Non recurring
Total		**2,40,000**	

SUMMARY OF CSR ACTIVITIES PROPOSED:

Sl. No	Areas of Intervention	No. of Intervention	Recurring Expenses (in Rs.)	Non Recurring Expenses (in Rs.)
01	Promotion of education	04	3,10,000	6,15,000
02	Environmental sustainability	02	1,75,000	95,0000
03	Health care	03	3,54,000	2,40,000
		09	**8,39,000**	**9,50,000**

✓ **MINE CLOSURE PLAN**

Various works that are to be taken up under the mine closure plan includes:-

(i) Re-vegetation: It is proposed to develop green belt to about 80 % which includes areas like along mine lease boundary (7.5 m width), all along the periphery of the mine lease area and the reclaimed area.

Grass and bushes will be planted in areas prone to erosion especially at the foot of the mine lease area. Other areas will be fertilized and planted with local species. The characteristics of this vegetation will resemble that of the natural environment except for the early growth, which may be a protective cover crop of non-seeding annuals.

Before re-vegetation, the land will be properly prepared by spreading the top soil which is rich in organic contents. Vegetation will be self-sufficient after planting and require no fertilization or maintenance.

(ii) Buildings and Infrastructure

a. Site office building, Rest Room and Toilets

These structures may be utilized for the mining project as the life of the mine is much more than the present lease period.

b. Support & Transport Infrastructures

As such there is no major infrastructure facilities planned in this project and does not call for importance. The main mining site and secondary access road will be kept in a sufficient condition to allow access for monitoring till such time any other authorities wish to maintain and legally accept responsibility for the access roads.

c. Surface Equipment and Heavy Machinery

No heavy and surface equipment are proposed in this project. Open cast semi-mechanized method is used in this case. The equipments and small machinery if used will be taken out of the premises.

d. Hazardous substances

The hazardous materials and explosives will be totally evacuated from the mine site and the site will cleared of any such materials and substances.

(iii) Water Resource Management

Prior to the commissioning of the project area the surface run-off used to flow naturally and used to join the nearby drainage nallahs/ streams. It is proposed to collect and hold this runoff/ storm water from the lease area including own property and use it for various purposes within the lease area. The grounding of the project will not be causing any alteration to the drainage pattern of the area. The quality of the water will be maintained in compliance with the general effluent standards / drinking water standards.

(iv) Monitoring:

The monitoring of the mine closure plan is an essential requirement for review of the efficacy of the mine closure and to take corrective actions. The monitoring consists of measuring the air quality, water quality, preservation of landscape, aesthetic and other land use values.

(v) Submission of detailed Mine Closure Plan

The detailed mine de-commissioning plan will be made on the above-mentioned principles, before the closure which will be submitted for approval. This plan will also provide the fund provision for the mine closure plan.

The map showing conceptual plan (post mine closure plan) of the proposed mine area is enclosed as ***Annexure No. C***.

✓ RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

FALL OF SIDES

- Flatter slopes angles are adopted where occurrences of loose earth are encountered.
- No disaster like land slide, flood or inundation or fire is anticipated in this case.
- Unmanageable heights are not created.
- Loose rocks are properly dressed.
- Nature and structure of the rocks are properly studied for their slips.
- The faces will slope at 70°.
- The hanging wall, footwall & mineralized zone are competent to stand safely for long time.

STORAGE AND USE OF EXPLOSIVES

- Proper and safe storage of explosives in approved and Licensed Magazine.

- Proper, safe and careful handling and use of explosives by competent Blasters having Blaster's Certificate of Competency issued by DGMS.
- Proper security system to prevent theft/ pilferage, unauthorized entry into Magazine area and checking authorized persons to prevent carrying of match box, lights, mobile phones, cigarette or Beedi, etc.
- The explosives of class 2 will be used in their original cartridge packing and such cartridge shall not be cut to remove explosive for making cartridge of different size.
- Detonators will be conveyed in special containers. These will not be carried with other explosives.
- The holes which have been charged with explosives will not be left unattended till blasting is completed.
- Before starting charging, clear audible warning signals by Sirens will be given so that people nearby can take shelter.
- Blasting operations will be carried out in day times only. However, in this project the mining operations are proposed to be carried out in day times.

STORAGE OF OIL AND FUEL

- Due care will be taken to avoid oil spillage.
- Storage will not be allowed beyond necessity.
- Fuel oil and lubricants will be stored only in approved containers in separate store rooms. Match box, lighters, mobile phone, dry wood, plastic paper sheets and smoking will not be allowed near the storage area.

WATER

- Due care will be taken to provide channel all around the foot of the hill to collect run off and also to avoid soil erosion.
- There is no danger of flood or inundation as the proposed working is above the normal ground level. The area is not susceptible to floods.

✓ **DISASTER MANAGEMENT PLAN**

During mining activities, proper measures will be taken to ensure safety at site. In order to handle disaster/ emergency situations, an organizational chart entrusting responsibility to various project personnel will be prepared with their specific roles during emergency.

The possible composition of the management team shall be:-

1. Mines Manager
2. Section In-charge
3. Site Controller
4. Incident Controller
5. Fire and Security Officer
6. Transport Coordinator
7. Medical Coordinator

INFRASTRUCTURE

Following infrastructure and operational system will be provided to meet any emergencies.

EMERGENCY CONTROL ROOM

This will be situated in an area away from the places of fire and will be provided with the following facilities:-

a. Master plan of the mines.
b. First aid boxes.
c. Telephone line with STD facility.
d. Loud hailers.
e. Emergency lighting system.
f. Stretchers.
g. Transport facility.
h. Emergency control room / site office will function as control base.

ASSEMBLY POINTS

Assembly points are to be set up farthest from the location of likely hazardous events, where pre-designated persons from the works, contractors and visitors would assemble in case of emergency. Up-to-date list of pre-designated employees of various departments must be available at these points so that roll call could be taken. Pre-designated persons would take charge of these points and mark presence as the people come into it.

COMMUNICATION SYSTEM

Different types of alarms to differentiate types of emergencies will be provided. Alarms will be followed by an announcement over Public Address System. In case of failure of alarm system, communication will be by telephone operator who will make announcement in industrial complex through Public Address System which should be

installed. Walkie-talkie and paging systems, using predetermined codes of communication, are very useful during emergency. If everything fails, a messenger will be used for sending the information.

WARNING SYSTEM AND CONTROL

The Control Centers will be located at an area of minimum risk or vulnerability in the premises concerned, taking into account the wind direction, areas which might be affected by fire/explosion, toxic releases, etc. For promptness and efficiency, the premises/storage sites may be divided into number of zones, which should be clearly marked on the site plan.

EMERGENCY SERVICES

This includes the fire-fighting system, first aid center, hospital etc. Alternate sources of power supply for operating fire pumps, communication with local bodies, fire brigade etc., will also be clearly identified. Adequate number of external and internal telephone connections will be installed.

FIRE PROTECTION SYSTEM

The fire protection system for the proposed mine will consist of,

a. Hydrant system for all the areas of the mine.
b. Portable hand appliances of suitable types/ capacities for extinguishing small fires in selected areas of the mine/storage areas.

✓ **OCCUPATIONAL HEALTH AND SAFETY**

The main areas of concern for ensuring adequate occupational health and safety are:-

- All working places will have safe means of access, safe working platform and exit. Persons working in hazardous dust prone area will be provided with dust mask.
- Personal protective equipments like respirators, ear plug, noise muff, helmet etc. will be provided to the workers.
- Proper unit design and engineering controls in order to protect workers, including by control of process and fugitive emissions.
- Adequate arrangement of drinking water will be done.
- Education & training will be provided to the workforce about facilities, protective equipment, risk associated, potential health effects, etc.
- Display board will be provided showing the hazards associated and recommended precautionary measures.

Medical Surveillance

Following tests are proposed during Medical Surveillance conducted for employees:-

- Pre-employment medical check-up.

* Pulmonary Function Test
* Complete Physical Examination
* Blood Test
* Urine Test
* Chest X ray

- Once in Six months medical check-up of each employee.
- Form 27A Fitness Certificate will be obtained every year from certified surgeon.
- Form 25 Health Register of each employee will be obtained every year from certified surgeon.
- Individual medical record will be maintained.

OCCUPATIONAL HEALTH

Occupational health needs attention during mining activities. The problem of occupational health in the mining operation and maintenance phase is primarily due to dust and noise which could affect the workers from respiratory and hearing problems. The necessary personal protective equipments will be given to all the workers. The working personnel will be given the following appropriate personnel protective equipments.

- Industrial Safety Helmet;
- Cylindrical type earplug;
- Dust mask;
- Leather apron;
- Safety belt/line man's safety belt;
- Leather hand gloves;
- Industrial safety shoes with steel toe.

Well equipped medical facilities will be available round the clock for attending emergency arising out of accidents, if any. All working personnel will be medically examined at least once in every year and at the end of his term of employment. This is in addition to the pre-employment medical examination.

SAFETY PLAN

Safety of both men and materials during mining of operation phases is of concern. Safety plan will be prepared and implemented in the proposed site. The preparedness

of an industry for the occurrence of possible disasters is known as emergency plan. The disaster is possible due to collapse of rock structures and fire/explosion etc. Keeping in view the safety requirement during mining a safety policy will be formulated with the following regulations:-

- To allocate sufficient resources to maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the operation and maintenance of men, machinery and equipment;
- To ensure that adequate safety instructions are given to all employees;
- To provide wherever necessary protective equipment, safety appliances and clothing and to ensure their proper use;
- To inform employees about materials, equipment or processes used in their work which are known to be potentially hazardous to health or safety;
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and upto date knowledge;
- To provide appropriate facilities for first aid and prompt treatment of injuries and illness at work;
- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters;
- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving people injury or injury to health with a view to taking corrective, remedial and preventive action;
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;
- To publish / notify regulations, instructions and notices in the local language.
- To prepare separate safety rules for each type of occupation / processes involved in at site; and
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

SAFETY ORGANIZATION

Conceptual / Planning Phase

A qualified and experienced safety officer shall be appointed. The responsibilities of the safety officer include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions.

SAFETY CIRCLE

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circles would be constituted in each area of work. The circle would consist of 3-5 employees from that area. The circle normally will meet for about an hour every week.

SAFETY TRAINING

A full-fledged training center will be set up at the plant. Safety training will be provided by the Safety Officers with the assistance of faculty members called from Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors will also be provided safety training. To create safety awareness safety films will be shown to workers and leaflets will be distributed. Some precautions and remedial measures proposed to be adopted to prevent fires are:-

- Spread of fire in horizontal direction would be checked by providing fire stops;
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods;
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and
- Proper fire watching by all concerned would be ensured.

HEALTH AND SAFETY MONITORING PLAN

The health of all employees will be monitored once in a year for early detection of any ailment due to exposure of dust, heat and noise. The format of the Report of Medical Examination under Rule 29B is attached at **Annexure No. D.**

✓ ENVIRONMENT MONITORING PROGRAMME

A centralized environmental monitoring cell will be established for monitoring of important and crucial environmental parameters which are of immense importance to assess the status of environment during mine operations.

The following routine monitoring programme as detailed below shall be implemented at site. Besides to this monitoring, the compliances to all environmental clearance conditions and consents / approvals from KSPCB / MoEF & CC / SEIAA will be monitored and reported periodically.

Sr. No.	Potential Impact	Action to be Followed	Parameters for Monitoring	Frequency of Monitoring	Location
1.	Air Emissions	Ambient air quality within the premises of the proposed unit and nearby habitations to be monitored.	PM_{10}, $PM_{2.5}$, SO_2, NO_x and CO.	Once in a year	Atleast one location at site and nearest habitation
		Exhaust from vehicles to be minimized by use of fuel efficient vehicles and well maintained vehicles having PUC certificate.	Vehicle logs to be maintained		-
		Vehicle trips to be minimized to the extent possible	Vehicle logs	Daily records	Main gate
2.	Noise	Noise generated from various mining operation like drilling / blasting/ vehicular to be optimized and monitored	Spot Noise Level recording; L_{eq}(day), L_{eq}(Night)	Once in a year	Noise measurements at site and nearby habitations
		Generation of vehicular noise	Maintain records of vehicles	Periodic during operation phase	-
3.	Wastewater Discharge	No untreated discharge to be made to surface water, groundwater or soil.	No discharge hoses in vicinity of watercourses.	Periodic during operation phase	-
4.	Drainage and effluent Management	Ensure drainage system and specific design measures are working effectively. Design to incorporate existing drainage pattern and avoid disturbing the same.	Visual inspection of drainage and records thereof	Periodic during operation phase	-
5.	Water Quality and Water Levels	Monitoring used water quality & groundwater quality and levels	Comprehensive monitoring as per IS:10500 & ground water level bgl	Periodic during operation phase	Three locations surrounding mine site
6.	Energy Usage	Energy usage for air-	Energy audit	Annual audits	-

Sr. No.	Potential Impact	Action to be Followed	Parameters for Monitoring	Frequency of Monitoring	Location
		conditioning and other activities to be minimized Conduct annual energy audit for the buildings	report	and periodic checks during operational phase	
7.	Emergency preparedness, such as fire fighting	Fire protection and safety measures to take care of fire hazards, to be assessed and steps taken for their prevention.	Mock drill records, on site emergency plan, evacuation plan	Periodic during operation phase	--
8.	Maintenance of flora and fauna	Vegetation, greenbelt / green cover development	No. of plants, species	Periodic during operation phase	-
9.	Waste Management	Implement waste management plan that identifies & characterizes every waste arising associated with proposed activities which identifies the procedures for collection, handling & disposal of waste arising.	Records of solid waste generation, treatment and disposal	Periodic during operation phase	--
10.	Soil quality	Maintenance of good soil quality	Physio-chemical parameters and metals.	Periodical monitoring	Plantation areas
11.	Health	Employees and migrant labour health check ups	All relevant parameters including HIV	Regular check ups	-

Expenditure Proposed for Environmental protection activities:-

It is proposed to invest an amount of Rs. 9.0 Lacs per annum towards environmental action plan and the details of the same are given below:-

S. No.	Description of item	Recurring cost (in lac)
1	Air Pollution Control - Water sprinkling	2.0
2	Water Pollution Control	1.0
3	Environmental Monitoring and Management	5.0
4	Green belt Development	1.0
Total		**9.0**

✓ CONCLUSION

It is predicted that socio-economic impact due to this project will positively increase the chance of more employment opportunities for local inhabitants. There are no Resettlement and Rehabilitation issues involved in this project. The project infrastructures will be of use to people of the area. The revenue of the State Govt. will be definitely increase due to the proposed activity. The entire project area is devoid of any endemic / endangered flora and fauna. **It is proposed to reclaim the land and develop green cover for eco-restoration with native species to a maximum possible extent. Additionally, an area is earmarked outside the proposed mining area for compensatory mass plantation. Also, a large storm water pond is proposed outside the mining area for storage of rain water and for its subsequent use so as to conserve fresh water consumption.** Thus the proposed project is not likely to affect the environment or adjacent ecosystem adversely.