

# Tamil Nadu Minerals Limited

(A Government of Tamil Nadu Undertaking)



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Rc. No: 12991/ML1/2014

Date: 01.07.2019

To,  
The Member Secretary (Violation)  
3<sup>rd</sup> Floor, Vayu wing  
Ministry of Environment, Forest & Climate Change  
Indira Paryavaran Bhawan  
Jor Bagh Road, New Delhi 110003

Sir,

Sub: Sivaganga Graphite Mine of M/s Tamil Nadu Mineral Limited, (TAMIN), Sivaganga Taluk & District of TamilNadu State-ADS reply – submitted-regarding.

Ref: 1. M/s Tamil Nadu Minerals Ltd, Sivaganga Graphite Mine.  
(Proposal No. IA/TN/MIN/94181/2017

2. Agenda S.No. 22.3.6 of Minutes of 22<sup>nd</sup> Meeting of EAC for the proposal involving violation held on 21.05.2019.

3..ADS received from the MoEF& CC on 04.06.2019.

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In continuance of the reference 2<sup>nd</sup> and 3<sup>rd</sup> cited, we hereby furnish the reply in connection with Sivaganga Graphite Mine project of M/s Tamil Nadu Minerals Ltd, over an extent of 236.85 Ha, in Pudupatti, Kumarapatti and Senthudayanathapuram villages, Sivaganga Taluk, Sivaganga District, Tamil Nadu State as mentioned below.

S. No	Additional Sought details	Compliance																		
1	Damage Assessment needs to be worked out from 93/94 instead of 2000/2001 as submitted by the PP. Though the profit accrued from 2000/2001 as per Hon'ble	As instructed by the EAC, we have reworked the damage Assessment from 1993-1994. The summary of DAR is given below: a) Air Environment: <table border="1"><thead><tr><th>Parameter</th><th>Units</th><th>1993-2017 (Mining and Beneficiation Plant)</th></tr></thead><tbody><tr><td>TSPM</td><td>µg/m<sup>3</sup></td><td>43.21</td></tr><tr><td>PM<sub>10</sub></td><td>µg/m<sup>3</sup></td><td>8.585</td></tr><tr><td>PM<sub>2.5</sub></td><td>µg/m<sup>3</sup></td><td>1.638</td></tr><tr><td>SO<sub>2</sub></td><td>µg/m<sup>3</sup></td><td>0.0053</td></tr><tr><td>NO<sub>x</sub></td><td>µg/m<sup>3</sup></td><td>3.596</td></tr></tbody></table>	Parameter	Units	1993-2017 (Mining and Beneficiation Plant)	TSPM	µg/m <sup>3</sup>	43.21	PM <sub>10</sub>	µg/m <sup>3</sup>	8.585	PM <sub>2.5</sub>	µg/m <sup>3</sup>	1.638	SO <sub>2</sub>	µg/m <sup>3</sup>	0.0053	NO <sub>x</sub>	µg/m <sup>3</sup>	3.596
Parameter	Units	1993-2017 (Mining and Beneficiation Plant)																		
TSPM	µg/m <sup>3</sup>	43.21																		
PM <sub>10</sub>	µg/m <sup>3</sup>	8.585																		
PM <sub>2.5</sub>	µg/m <sup>3</sup>	1.638																		
SO <sub>2</sub>	µg/m <sup>3</sup>	0.0053																		
NO <sub>x</sub>	µg/m <sup>3</sup>	3.596																		

S.C order dated 02.08.2017 to be submitted.

**b) Land Environment:**

**Land Cover /use pattern changes from 1994 and 2017**

S. No	Land Description	Area in Ha		Land Cover Pattern Changes in Ha.	Percentage (%)	Impact Identified
		1994	2017			
1	Agriculture, Cropland	34.61	31.45	3.16	1.33	Moderate Impact
2	Agriculture, Fallow	83.25	81.73	1.52	0.64	Moderate Impact
3	Waste Land Open.	31.51	37.62	6.11	2.58	Moderate Impact
4	Water bodies, lakes/ Ponds	87.48	86.05	1.43	0.60	Moderate Impact
Total		236.85	236.85	12.22	5.15	Moderate Impact

**c) Noise Environment:**

Noise Modeling is carried out and contours were generated, since, all the values are within the limit as per DGMS Rules. Damage due to mining activities is negligible. the max predicted noise levels are as follows:

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from Source(m)
1	Drilling activities	41.34	300
2	Blasting	91.89	300
3	Vehicles movement	50.16	500
4	Mining machinery	34.45	300
5	Cumulative sources	90.90	300

**d) Water Environment:**

Ground Water consumption through bore well is given as follows:

Water Consumption(KL)	1993 to 2017
Monsoon	6279
Non monsoon	204240

**e) Biological Environment:**

The core area consists of Barren land. It is devoid of any major trees. Only small shrubs and bushes were present. No Damage to the Biological Environment is anticipated.

The detailed revised Damage Assessment is carried out from 93/94 instead of 2000/2001 is enclosed as Annexure-I.

2

The ROM is transported to beneficiation plant which is located at a distance approx. 550 m from the mining lease boundary.

PP is advised to rework the cumulative impacts including the impact on water regime and the rejects handling and disposal to tailing ponds taking into consideration of the beneficiation plant.

#### Impacts identified by Cumulative Impact studies:

##### a) Air Environment:

Parameter	Units	Predicted cumulative concentrations due to Mining and Beneficiation Plant)	NAAQ Standard
TSPM	ug/m <sup>3</sup>	43.21	500
PM <sub>10</sub>	ug/m <sup>3</sup>	8.585	100
PM <sub>2.5</sub>	ug/m <sup>3</sup>	1.638	60
SO <sub>2</sub>	ug/m <sup>3</sup>	0.0053	80
NO <sub>x</sub>	ug/m <sup>3</sup>	3.596	80

The predicted concentrations due to the operation of mining & beneficiation plant are within the stipulated norms and the impact envisaged is moderate.

##### b) Land Environment:

Graphite beneficiation plant covers an area of 5.34.0 Ha (13.20 Acres). Land is owned by Tamil Nadu Mineral Limited. Beneficiation plant is located at a distance of 0.5 km from the Mine lease boundary (Outside the mine lease area).

There is no major change in the land terrain as the existing facilities are already available at the site. No major change in land use is anticipated.

##### c) Water Environment:

Ground water samples were collected nearby beneficiation plant and analyzed. The analytical result shows that, all the parameters are within the permissible limit of IS 10500:2012 (Drinking water standard).

##### d) Noise Environment:

###### i. Mine site:

The main sources of noise in the mine are as follows:

- Transportation vehicles
- Loading & unloading of Graphite
- Drilling & Blasting
- DG Set.

Noise Modeling is carried out and contours were generated for Sivaganga mine, the noise levels are identified as follows:

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from Source(m)
1	Drilling activities	41.34	300
2	Blasting	91.89	300
3	Vehicles movement	50.16	500
4	Mining machinery	34.45	300
5	Cumulative sources	90.90	300

**ii. Beneficiation Plant:**

The main sources of noise pollution within the Beneficiation Plant identified as follows:

- Crusher
- Grinder
- Rod mill
- Rotary Dryers
- DG sets of 1X500 & 1X380 kVA Capacity

Noise Modeling is carried out & contours were generated for individual sources such as Crusher, Grinder, Rotary dryers and DG Sets. Max Noise level is found at 150 meters. Noise level contours are generated for crusher & DG Sets only. No contours are generated for Grinder & Rotary dryers.

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from the source(m)
1	Crusher	23.08	20m (within the plant boundary)
2	Grinder	No contour is generated	--
3	Rotary Dryers	No contour is generated	--
4	DG set 1 x 500 kVA	35.94	10m (within the plant boundary)
5	DG Set 1 x 500 kVA	46.92	15m (within the plant boundary)

Note: Max Noise levels from all sources are within the standard.

**e) Biological Environment**

- Beneficiation Plant is located at 500m distance from the mine lease boundary (Outside of Mine lease area)
- In the Mine Lease area or its proximate areas there is no wetland and the natural flow of water not available.
- There is no rare or endangered species
- There are no wild animals in the area. In the post mining stage, proper fencing will be carried in the mined out area to prevent fall of animals in the mine pits.

		<p>➤ There are no any wetlands, fish breeding grounds, marine ecology nearby the quarry area, which will be affected due to this project.</p> <p>f) <b>Socio Economic</b></p> <p>➤ There is no residential area within lease area. Hence, there is no likelihood of effect of outside people or influx on the existing local population. The lessee is spending substantial amount for peripheral developments such as education, health, sports, afforestation etc. Hence, the benefits to the community and its economy because of this project are quite appreciable.</p> <p>The Detailed Cumulative impacts study is carried out including the rejects, handling and disposal to tailing ponds taking into consideration of the beneficiation plant is enclosed as Annexure-II.</p>
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Hence, we request you to place the subject proposal during the forthcoming EAC meeting and kindly issue the Environmental Clearance for subject at the earliest.

Thanking you sir,

Yours faithfully,  
for Tamil Nadu Minerals Limited

*Dew*  
1.2.2019  
(E. Ganesan)  
Deputy Manager (ML)  
Authorized signatory

Encl: As stated above

**ANNEXURE-I**

**DAMAGE ASSESSMENT REPORT**  
**(1994 to 2017)**

For  
**SIVAGANGA GRAPHITE MINE**

**OVER AN EXTENT OF 236.85 Ha.**

At  
Villages: Pudupatti, Senthitudayanathapuram and Kumarapatti

Taluk: Sivaganga

District: Sivaganga

State: Tamil Nadu

By



**M/s. Tamil Nadu Minerals Limited**  
**No. 31, Kamarajar Salai,**  
**Chepauk,**  
**Chennai – 600 005**

(Project termed under Schedule of I(a) Mining of Minerals 'A' Category as per EIA Notification 2006 and its Amendments & Project falls under Violation Category as per S.O. 804 (E) dated 14<sup>th</sup> March 2017)

**EIA Consultant:**  
**HUBERT ENVIRO CARE SYSTEMS PRIVATE LIMITED, CHENNAI**  
**(NABET Accredited vide Certificate No. NABET/EIA/1619/RA0083 Valid up to**  
**13.10.2019)**

**July 2019**

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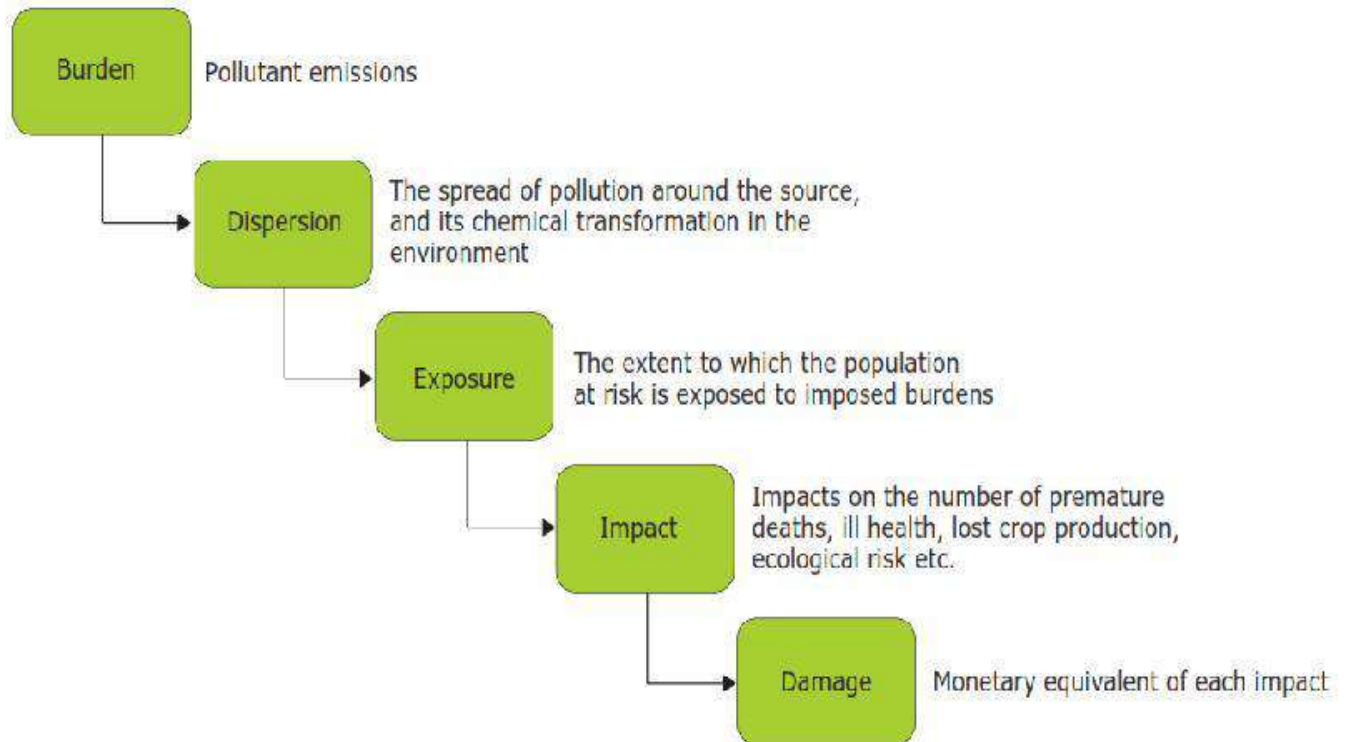
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# 1 Introduction of Enumerate the aspects of Violation

Quantification of the effects on human health of particulate matter emissions, for which inhalation is the only relevant exposure route. In this case, it is necessary to quantify the pollutant emission, describe its dispersion and the extent to which the population is exposed, apply a concentration response function and finally evaluate the economic impact. A pathway for estimating impacts & Impact Pathway Approach is shown in **Figure 1-1**.



**Figure 1-1 Impact Pathway Approach**

**Source:** European Environmental Agency - EEA Technical report N15/2011

## 2 Quantification of Environmental Damage

### 2.1.1 Land Environment

Land classification of the lease area is given in **Table 2-1**. Land cover/Land use Pattern of the lease area Google Imagery and NRSC (IRS P6 LISS-III) image in the year of 1994 are shown as

**Figure 2-1 &**

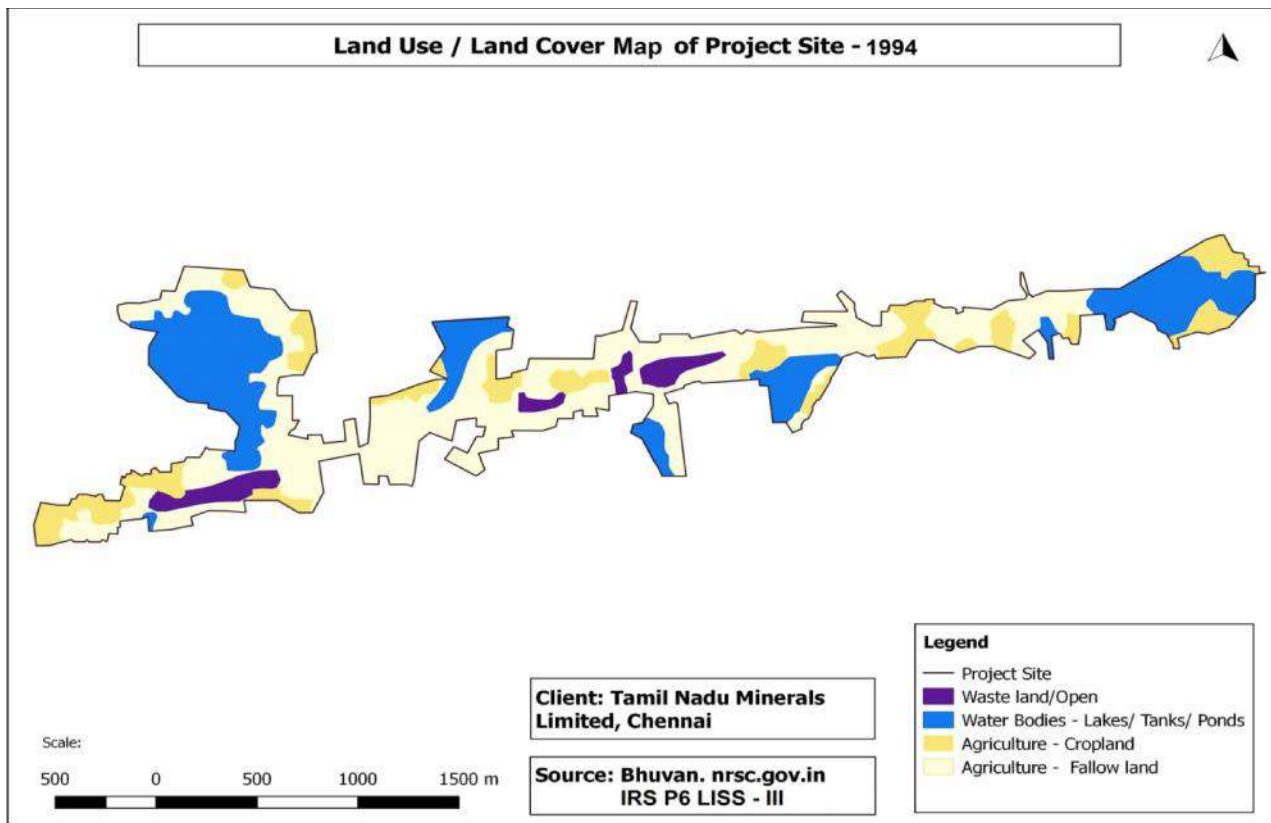
**Figure 2-2.** Land cover/Land use Pattern of the lease area Google and NRSC (IRS P6 LISS-III) in the year of 2017 are shown in **Figure 2-3&Figure 2-4**. Land Cover /use pattern changes from 1994 and 2017 are given in **Table 2-2**. Land Cover /Land use pattern changes (in bar chart) from 1994 and 2017 are shown in **Figure 2-5**.

**Table 2-1 Land Classification of the lease area**

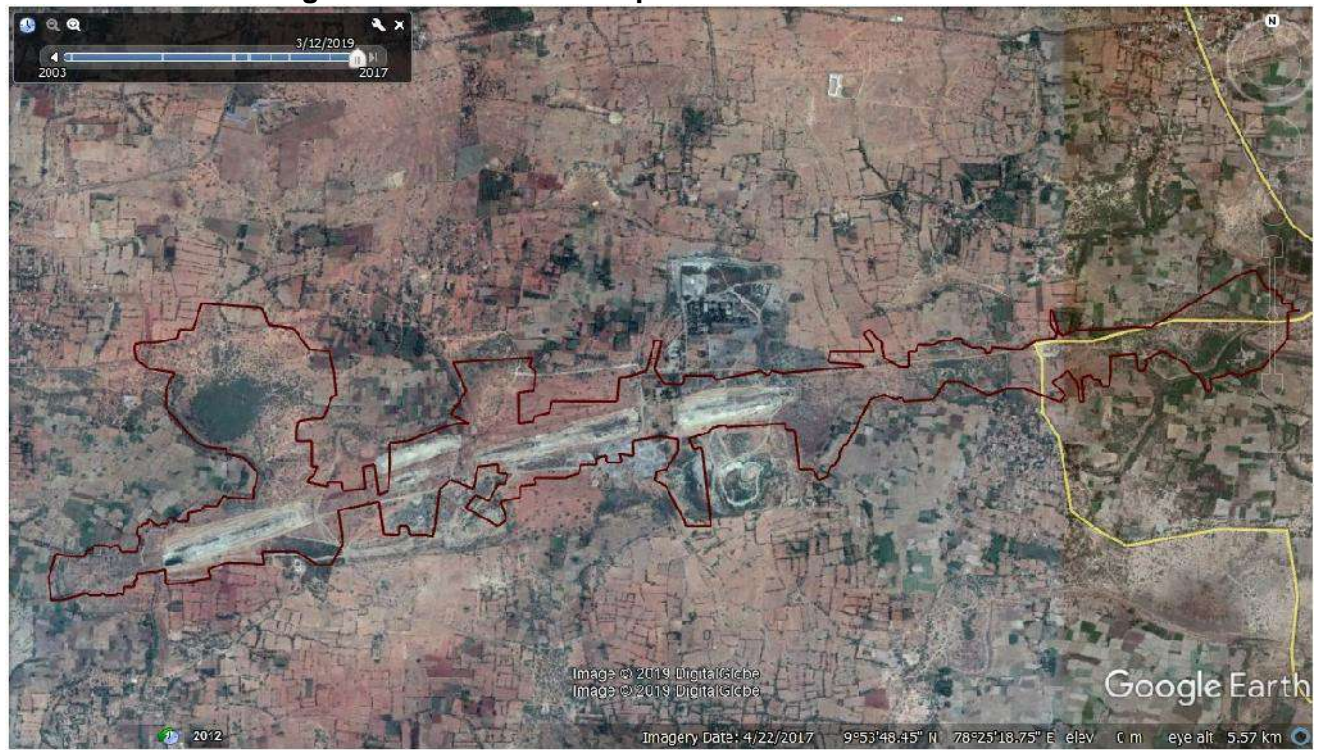
S. No	Land details	Pudupatti	Senthiudaya nathapuram	Kumarapatti	Total
1	Patta Land (TAMIN)(Ha)	11.38.5	28.12.5	36.45.5	75.96.5
2	Poramboke Land (Ha)	32.19.0	34.61.5	94.08.0	160.88.5
	<b>Total (Ha)</b>	<b>43.57.5</b>	<b>62.74.0</b>	<b>130.53.5</b>	<b>236.85.0</b>



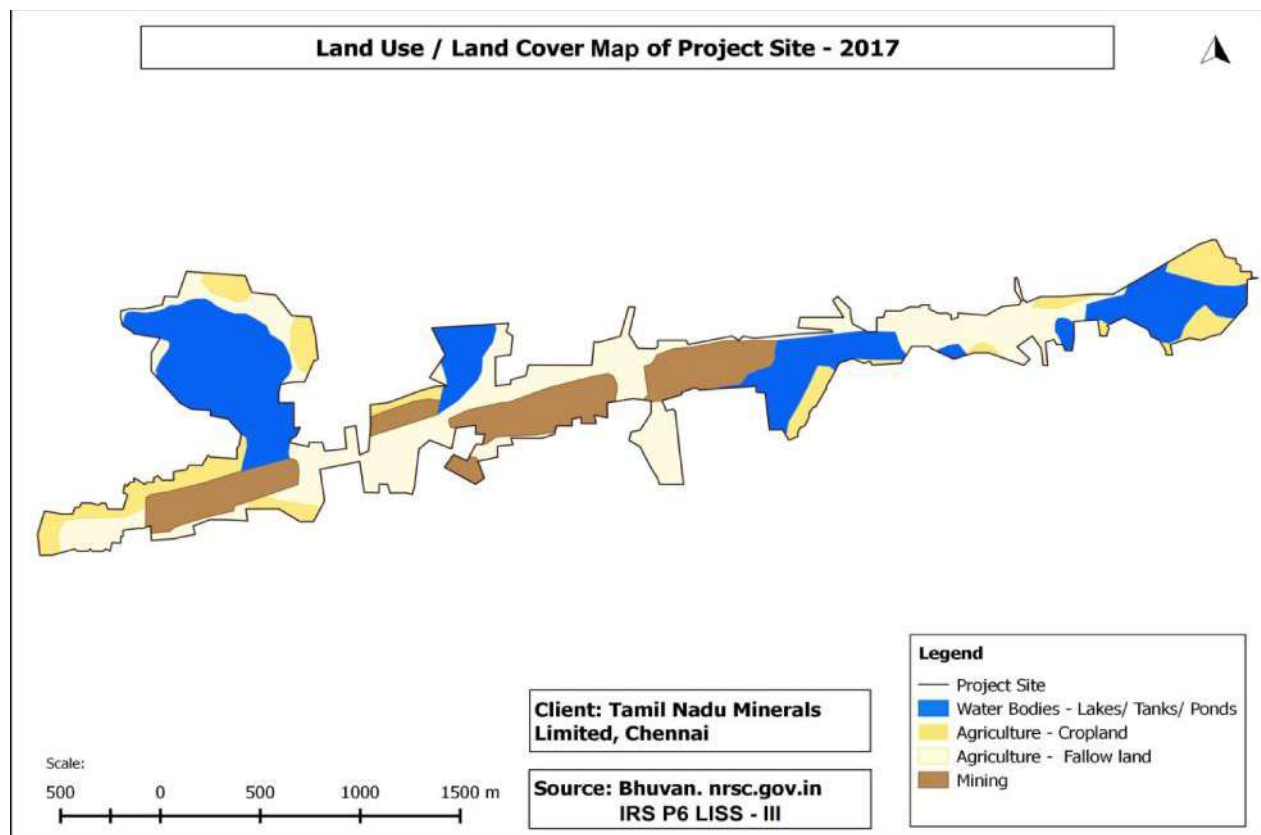
**Figure 2-1 1994 Year's Google Imagery of the Lease area**



**Figure 2-2 Land Cover map of the lease area in 1994**



**Figure 2-3 2017 Year's Google Imagery of the Lease area**

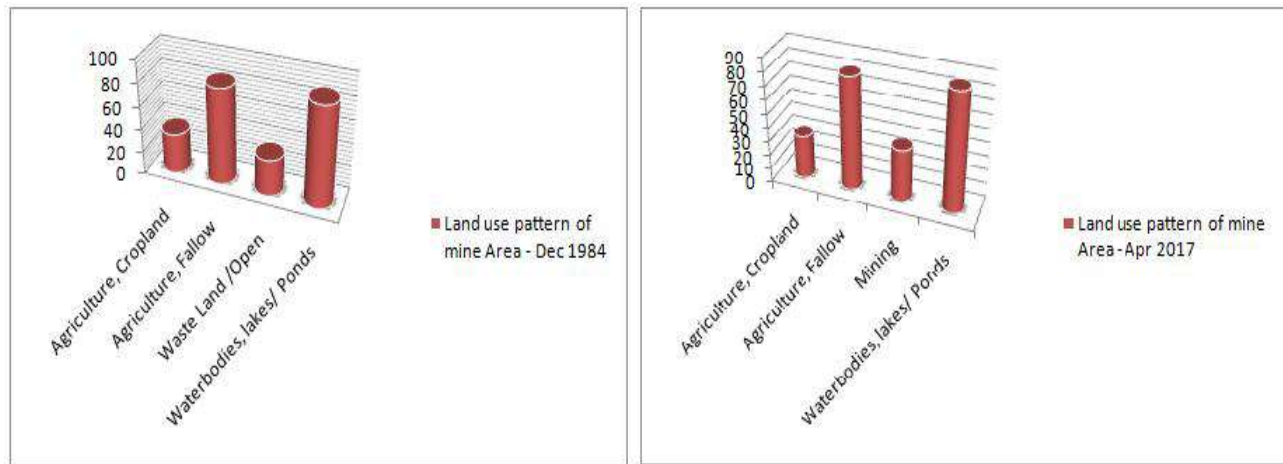


**Figure 2-4 Land Cover map of the lease area in 2017**

### 2.1.1.1 Summary of Land Environment Damage

**Table 2-2 Land Cover /use pattern changes from 1994 to 2017**

S. No	Land Description	Area in Ha		Land Cover Pattern Changes in Ha.	Percentage of changes (%)
		1994	2017		
1	Agriculture, Cropland	34.61	31.45	3.16	1.33
2	Agriculture, Fallow	83.25	81.73	1.52	0.64
3	Waste Land Open	31.51	37.62	6.11	2.58
4	Water bodies, lakes/ Ponds	87.48	86.05	1.43	0.60
<b>Total</b>		<b>236.85</b>	<b>236.85</b>	<b>12.22</b>	<b>5.15</b>



**Figure 2-5 Land Cover changes in Mine lease area from 1994 to 2017**

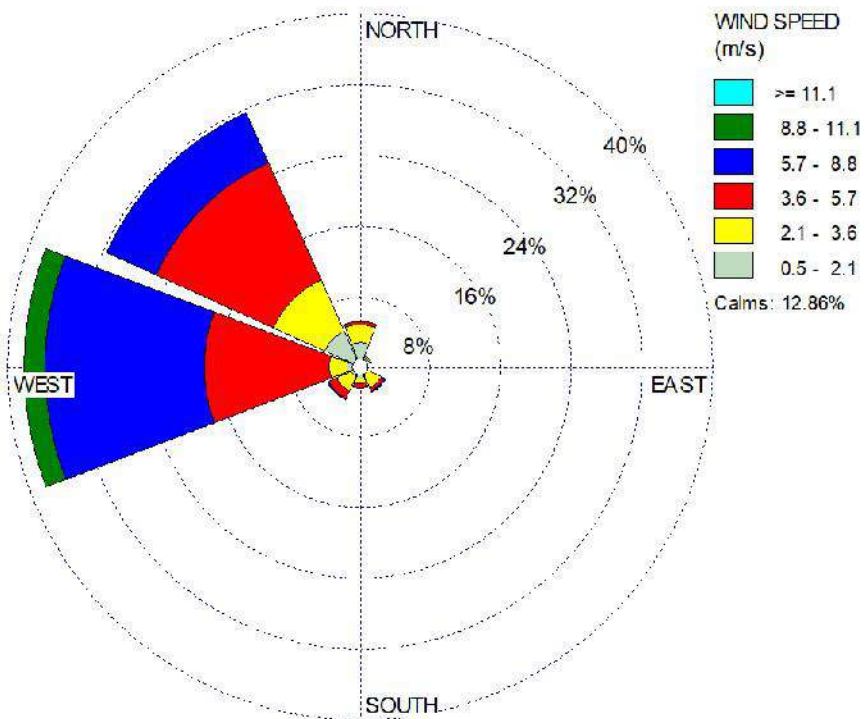
### 2.1.2 Air Environment

Base line data reveals that ambient air quality in the study area for the Parameters PM, SO<sub>2</sub> & NO<sub>2</sub>, are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural & Other areas.

The major air pollution sources from the mining operations are DG sets, mining activities like blasting, drilling, cutting etc., and transportation. The DG set are provided with stacks of adequate height so as to disperse the emanating flue gases containing suspended particulate matters, oxides of sulphur and nitrogen without affecting the ground level concentrations. The emissions mainly generated from the mining activities are Blasting, Drilling, Excavation, Loading, Unloading, and transportation etc. Machinery like compressors and jack hammers are used for Drilling.

#### 2.1.2.1 Meteorological Data

The site specific meteorological data for three months from Mar 2018 to May 2018 was obtained from secondary sources and processed in AERMET to plot wind rose diagram (**Fig 2-6**). Other data included for AERMET were daily wind speed, wind direction, temperature, relative humidity, air pressure, precipitation, and solar radiation recorded during the period. AERMET reformats meteorological data so that it can be used as input for AERMOD model.



**Figure 2-6 Wind rose diagram considered for Dispersion Modeling (March to May 2018)**

### 2.1.2.2 AERMET Process

For the 3 phase AERMET processing of the meteorological data, specifications of the land use in the area are required to determine the terrain roughness for modeling. The land use was characterized for in and around the site. The surface characteristics for the site and surroundings were selected and used to calculate the Albedo, Bowen ratio and surface roughness parameter.

The meteorological data were processed in the AERMET software to generate wind flow pattern & to generate surface meteorological data and profile meteorological data in a prescribed format that can be fed to AERMOD for modeling.

### 2.1.2.3 AERMOD Process

AERMOD Software Version 8.0.5 was used for air dispersion modeling and is applicable to a wide range of buoyant or neutrally buoyant emissions up to a range of 50 km. In addition to more straight forward cases, AERMOD is also suitable for complex terrain and urban dispersion scenarios.

AERMOD is a steady-state plume model. In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective

boundary layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function (pdf). This behavior of the concentration distributions in the CBL was demonstrated by Willis and Deardorff (1981) and Briggs (1993). Additionally, in the CBL, AERMOD treats “plume lofting,” whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into the elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate. For sources in both the CBL and the SBL, AERMOD treats the enhancement of lateral dispersion resulting from plume meander. The emissions mainly generated from the mining activities are Blasting, Drilling, Excavation, Loading, Unloading, and transportation etc. Machinery like compressors and jack hammers are used for Drilling are estimated and used as inputs for the air dispersion modeling as shown in **Table 2-3 to Table 2-8**.

Maximum incremental value for SO<sub>2</sub>, NO<sub>x</sub> and PM is shown in **Figures 2-7 to Figure 2-9** and Top 10 highest Ground Level Concentration (GLC) obtained from modelling are given in **Table 2-9 to Table 2-12** respectively.

#### 2.1.2.4 Emission Calculations

Each mining activities is a source of emission and the estimation of emissions depends on parameters such as meteorological, topographic conditions and material characteristics. It is necessary to calculate the amount of emissions for work or a source on site to the atmosphere. The following emission formulas are used to calculate the emission rate for the different emission source.

**Table 2-3 Overview of the Source Parameters**

Description	Symbol	Value	Units
Moisture Content	m	5	%
Silt Content	s	11	%
Wind Speed	u	2	m/s
Hole Dia	d	110	Mm
Frequency	f	8.3	Holes/Day
Average Vehicle Speed	v	5.5	m/s
No of Working Days in Year	n	300	Days
Waste Dumping Area	a	0.03	sq.Km
Open Pit Area	Aa	0.13	sq.Km
No of Working Hrs in Day	H	8	Hrs
Blast Area	A	30	Sq.m
No of Blasts per day		0.29	Nos

Hours of Bulldozing		1	Hrs/ Day
Over/Side Burden Silt Content		15	%
Over/Side Burden Moisture Content		8	%

**Table 2-4 Emission Factors Considered for emission estimation and Air Quality Modelling**

Description	Activity	Emission Factor/Equation	Units	Emission Factor
Top Soil Handling	Top Soil Removal	0.029	Kg-TSP/Tonn	0.029
	Bull Dozing	$2.6 * S^{1.2} * M^{-1.3}$	kg PM10/hour	5.7014
	Loading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00029
	Transportation	$[\{(100-m)m^{-1}\}^{0.35} * \{(us)(100-s)^{-1}\}^{0.7} * \{0.5+0.1(f+0.42v)\}] * 10^{-3}$	g/s	Variable
	Unloading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00029
Drilling and Blasting	Drilling	0.59	kg TSP/hole	0.59
	Blasting	$0.00022 * A^{1.5}$	kg TSP/Blast	0.0378
Over burden Handling	Bull Dozing at loading area	$0.74 * 0.0016 * (U/2.2)^{1.3} * (M/2)^{-1.4}$	kg TSP/Tonn	0.00029
	Loading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00349
	Transportation by trucks	$[\{(100-m)m^{-1}\}^{0.35} * \{(us)(100-s)^{-1}\}^{0.7} * \{0.5+0.1(f+0.42v)\}] * 10^{-3}$	g/s	Variable
	Unloading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00349
	Bull Dozing at unloading area	$0.74 * 0.0016 * (U/2.2)^{1.3} * (M/2)^{-1.4}$	kg TSP/Tonn	0.00029
Beneficiation Plant	Conveying	---	Kg-TSP/Tonn	0.005
		---	kg PM10/Tonn	0.002
	Crushing	---	Kg-TSP/Tonn	0.03
		---	kg PM10/Tonn	0.012
	Grinding	---	Kg-TSP/Tonn	1.2
		---	kg PM10/Tonn	0.16
	Drying	---	Kg-TSP/Tonn	9.8
---		kg PM10/Tonn	5.9	
Tailing Waste Handling & Dump Area	Transportation by trucks	$[\{(100-m)m^{-1}\}^{0.35} * \{(us)(100-s)^{-1}\}^{0.7} * \{0.5+0.1(f+0.42v)\}] * 10^{-3}$	g/s	Variable
	Unloading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00349
	Bull Dozing at unloading area	$0.74 * 0.0016 * (U/2.2)^{1.3} * (M/2)^{-1.4}$	kg TSP/Tonn	0.00029

- Source: 1** Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals by NPI, Nov 1999  
**2.** Determination of the emission rate from various opencast mining operations, S. K. CHAULYA\*, M. K. CHAKRABORTY, et. Al. *Water, Air, and Soil Pollution 140: 21–55, 2002.*  
**3.** AP-42, *Mining and processing non-metallic minerals*

**Table 2-5 Quantification of Emission due to Mining activities with quantity handled**

S. No	Year	Production (In Tones)	Production (TPD)	Ore Overburden Qty (Tonn/Day)	Side burden Qty (Tonn/Day)	Total Emission	
						kg/day	TPY
1	1994-1995	21329.008	71	163	488	14.50	4
2	1995-1996	15617.945	52	91	274	27.73	8
3	1996-1997	4658.985	16	31	94	13.03	4
4	1997-1998	39390.53	131	281	844	21.72	7
5	1998-1999	32655.85	109	256	767	19.86	6
6	1999-2000	17867	60	20	60	7.73	2
7	2000-2001	32464	108	27	81	9.57	3
8	2001-2002	50320	168	47	141	12.31	4
9	2002-2003	41320	138	41	124	11.12	3
10	2003-2004	42627	142	51	154	24.94	7
11	2004-2005	42840	143	75	224	20.85	6
12	2005-2006	57200	191	111	332	15.89	5
13	2006-2007	58961	197	87	380	16.36	5
14	2007-2008	49308	164	63	265	13.79	4
15	2008-2009	59227	197	90	321	15.74	5

16	2009-2010	50764	169	175	1136	<b>25.06</b>	8
17	2010-2011	49329	164	121	1001	<b>22.80</b>	7
18	2011-2012	57205	191	27	1427	<b>27.45</b>	8
19	2012-2013	67959	227	0	1472	<b>28.79</b>	9
20	2013-2014	87995	293	88	2452	<b>42.97</b>	13
21	2014-2015	71706	239	66	858	<b>22.89</b>	7
22	2015-2016	90275	301	105	1783	<b>35.76</b>	11
23	2016-2017	207	1	23	1161	<b>18.47</b>	6
<b>Total Emission during Violation period of 23 Yrs</b>						<b>450.85</b>	<b>135.25</b>

**Table 2-6 Summary of Emissions due to mining from 1994 to 2017**

S. No	Details	Kg/day	TPY
1	Total Emission during Violation period of 23 Yrs	450.85	135.25
2	Avg. Emission Per Year	20.41	6.12
3	Max. Emission in Year	42.97	12.89

**Table 2-7 Emission from Mining Equipment's**

Source	Fuel used	Stack Details					Emission per Stack (g/s)				
		No of Stack	Height (m) AGL	Dia (m)	Temp (°C)	Exit Velocity (m/s)	PM	SO <sub>2</sub>	NO <sub>x</sub>	CO	HC
125 KVA DG	Diesel	1	3	0.15	380	9	0.0340	0.0003	0.0500	0.0420	0.0110
*380 KVA DG		1	5	0.15	400	9	0.0476	0.0004	0.0700	0.0588	0.0154
*500 KVA DG		1	5	0.15	410	9	0.0666	0.0005	0.0980	0.0823	0.0216
<b>Total Emission (g/s)</b>							<b>0.148</b>	<b>0.011</b>	<b>0.218</b>	<b>0.183</b>	<b>0.047</b>

Note: \* Beneficiation Plant Power Backup sources.

**Table 2-8 Total Maximum Emission from all Sources**

Source	Average Emission per stack (g/s)						
	PM			SO <sub>2</sub>	NO <sub>x</sub>	HC	CO
	TSPM	PM <sub>10</sub>	PM <sub>2.5</sub>				
Mining	0.75	0.149	0.089	-	-	-	-
Beneficiation Unit	1.066	0.298	0.093	-	-	-	-
DG Sets	-	0.148		0.011	0.218	0.183	0.047
Vehicles	-	1.18E-03	7.08E-4	6.94E-07	1.55E-01	2.00E-02	8.89E-02
<b>Total (g/s)</b>	<b>1.816</b>	<b>0.5916</b>	<b>0.182708</b>	<b>0.011001</b>	<b>0.373</b>	<b>0.203</b>	<b>0.1359</b>

**Note:** Since emission factors are available for TSPM the following assumptions are made for PM<sub>10</sub> and PM<sub>2.5</sub> estimation

1. 20% of TSPM is considered as PM<sub>10</sub> and
2. 60% of PM<sub>10</sub> is considered as PM<sub>2.5</sub>

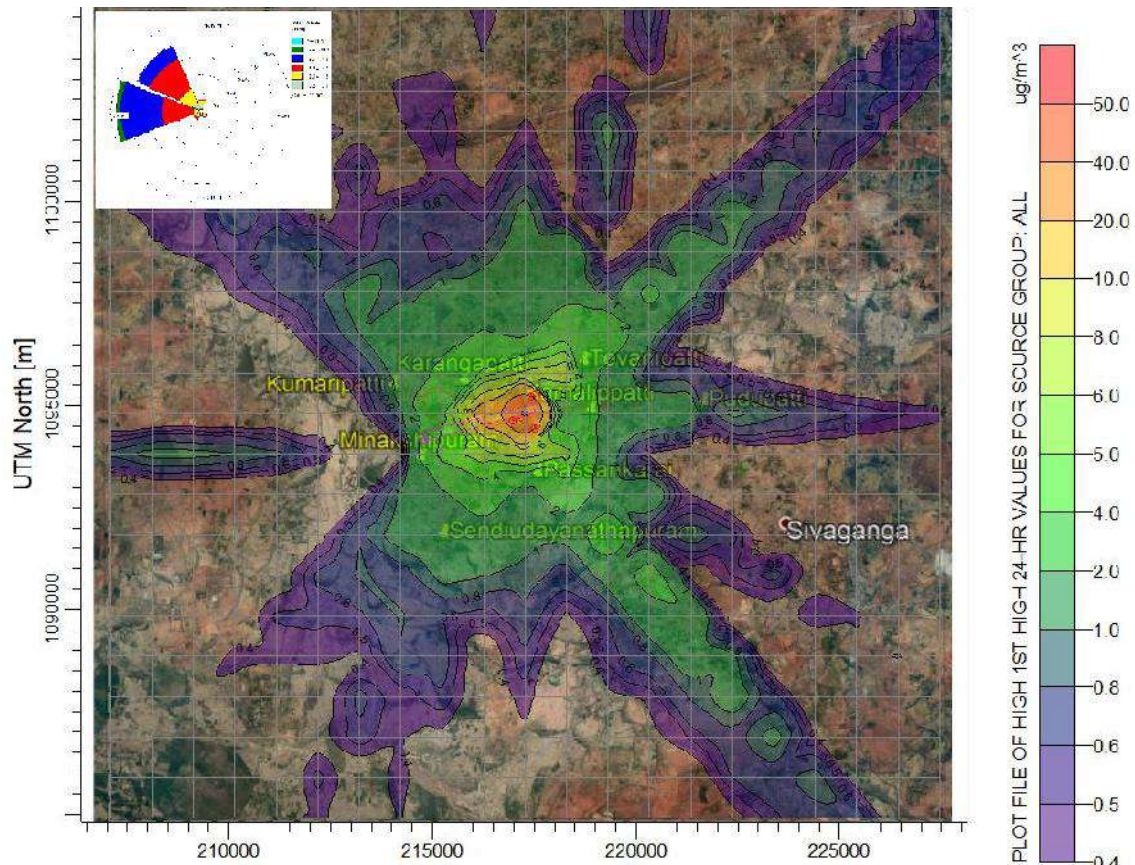


Figure 2-7 Predicted 24 Hrs GLC's of TSPM within 10 km radius of the Study area

Table 2-9 Predicted Top 10 Highest Concentration of Particulate Matter

S.NO	Name of the Receptor	Conc. ( $\mu\text{g}/\text{m}^3$ )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.96154	3.3	WNW
2	Karangapatti	3.56242	1.6	W
3	Tevanipatti	2.90192	1.8	NE
4	Minskshipuram	1.67878	2.8	WSW
5	Kamalippatti	2.29951	1.6	E
6	Pudupatti	0.74023	4.3	E
7	Passankari	2.56209	1.6	S
8	Sendiudayanathapuram	1.36625	3.7	SSW
9	Sakkanthi	0.14742	5.4	ESE

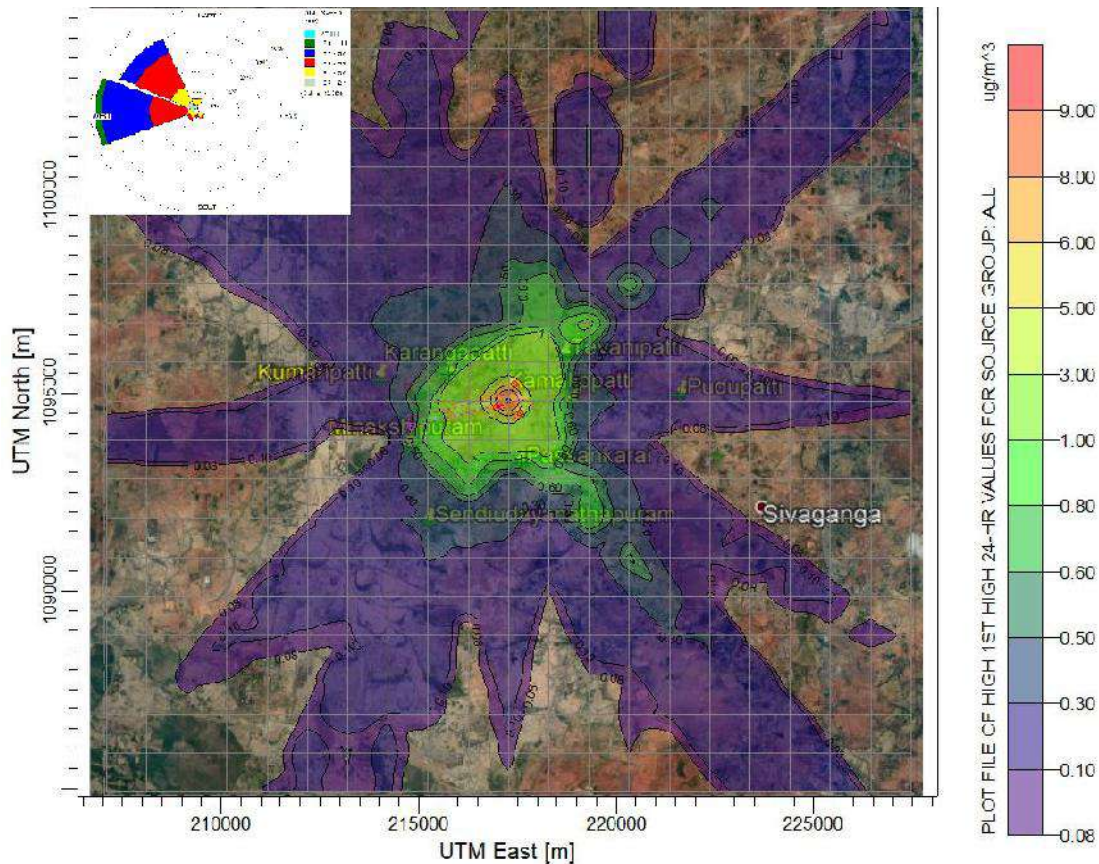


Figure 2-8 Predicted 24 hrs GLC's of PM within 10 km radius of the Study area

Table 2-10 Predicted Concentration of PM10 at different receptors

S.NO	Name of the Receptor	Conc. ( $\mu\text{g}/\text{m}^3$ )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.19436	3.3	WNW
2	Karangapatti	0.72516	1.6	W
3	Tevanipatti	0.67801	1.8	NE
4	Minskshipuram	0.33425	2.8	WSW
5	Kamalippatti	0.48546	1.6	E
6	Pudukatti	0.16443	4.3	E
7	Passankari	0.64258	1.6	S
8	Sendiudayanathapuram	0.34114	3.7	SSW
9	Sakkanthi	0.03897	5.4	ESE

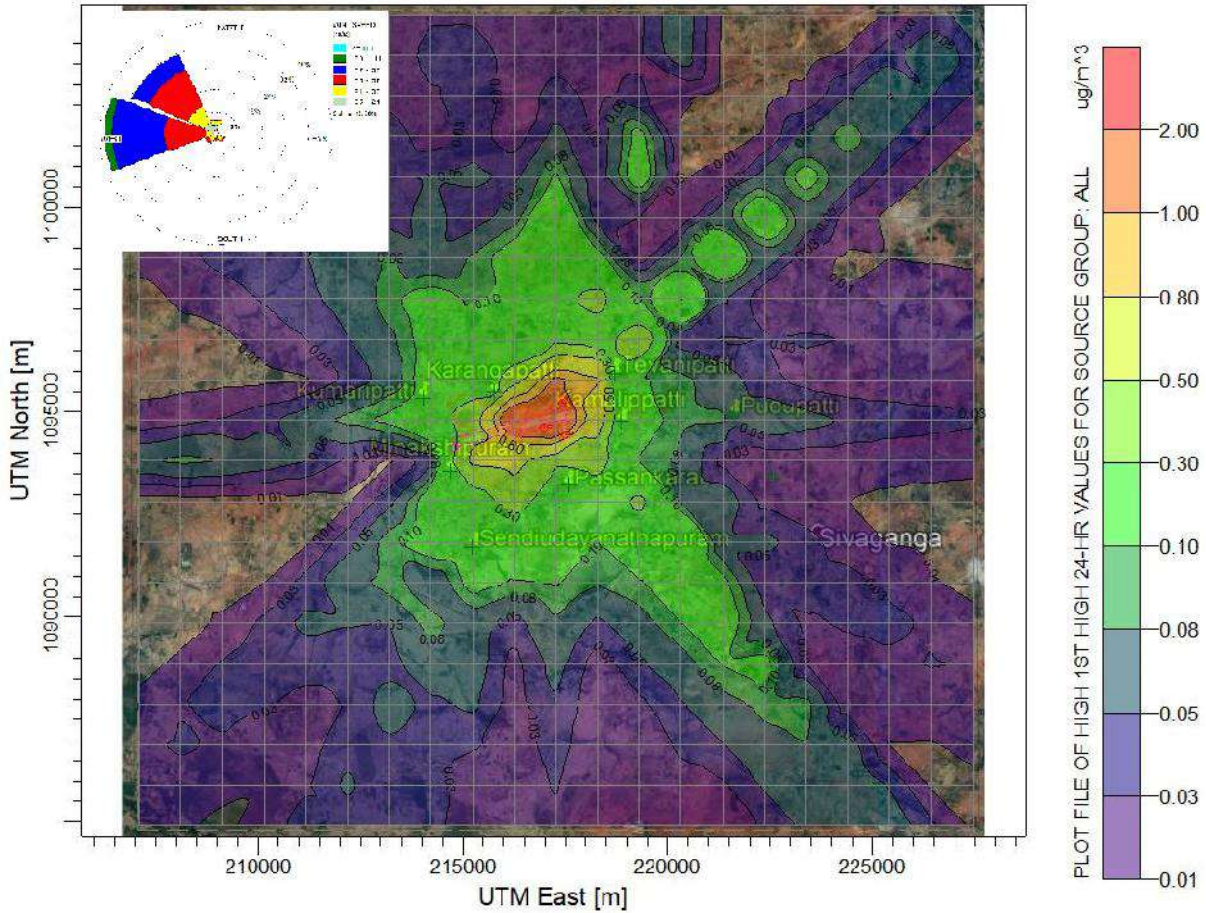


Figure 2-9 Predicted 24-Hrs' GLC's of PM<sub>2.5</sub> within 10 km Radius of the Study Area

Table 2-11 Predicted Concentration of PM<sub>2.5</sub> at different receptors

S.NO	Name of the Receptor	Conc. (µg/m <sup>3</sup> )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.10972	3.3	WNW
2	Karangapatti	0.2721	1.6	W
3	Tevanipatti	0.1999	1.8	NE
4	Minskshipuram	0.19968	2.8	WSW
5	Kamalippatti	0.16567	1.6	E
6	Pudupatti	0.06119	4.3	E
7	Passankari	0.18072	1.6	S
8	Sendiudayanathapuram	0.12632	3.7	SSW
9	Sakkanthi	0.01528	5.4	ESE

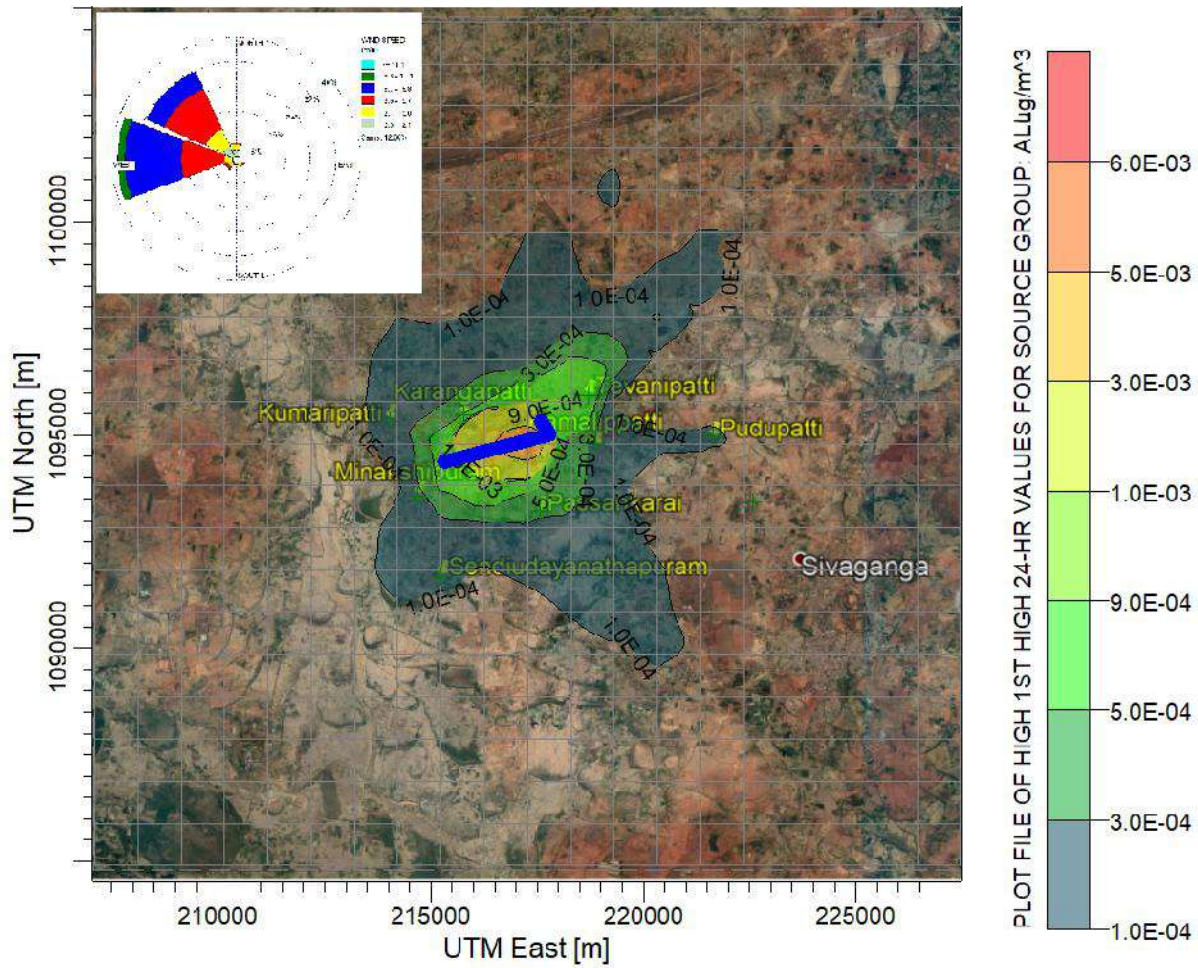


Figure 2-10 Predicted 24 hrs GLC's of SO<sub>2</sub> within 10 km radius of the Study area

Table 2-12 Predicted Top 10 Highest Concentration of Sulfur Dioxide

S.NO	Name of the Receptor	Conc. (µg/m <sup>3</sup> )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.00013	3.3	WNW
2	Karangapatti	0.0005	1.6	W
3	Tevanipatti	0.00072	1.8	NE
4	Minskshipuram	0.00021	2.8	WSW
5	Kamalippatti	0.00025	1.6	E
6	Pudupatti	0.00012	4.3	E
7	Passankari	0.00032	1.6	S
8	Sendiudayanathapuram	0.00012	3.7	SSW
9	Sakkanthi	1E-5	5.4	ESE

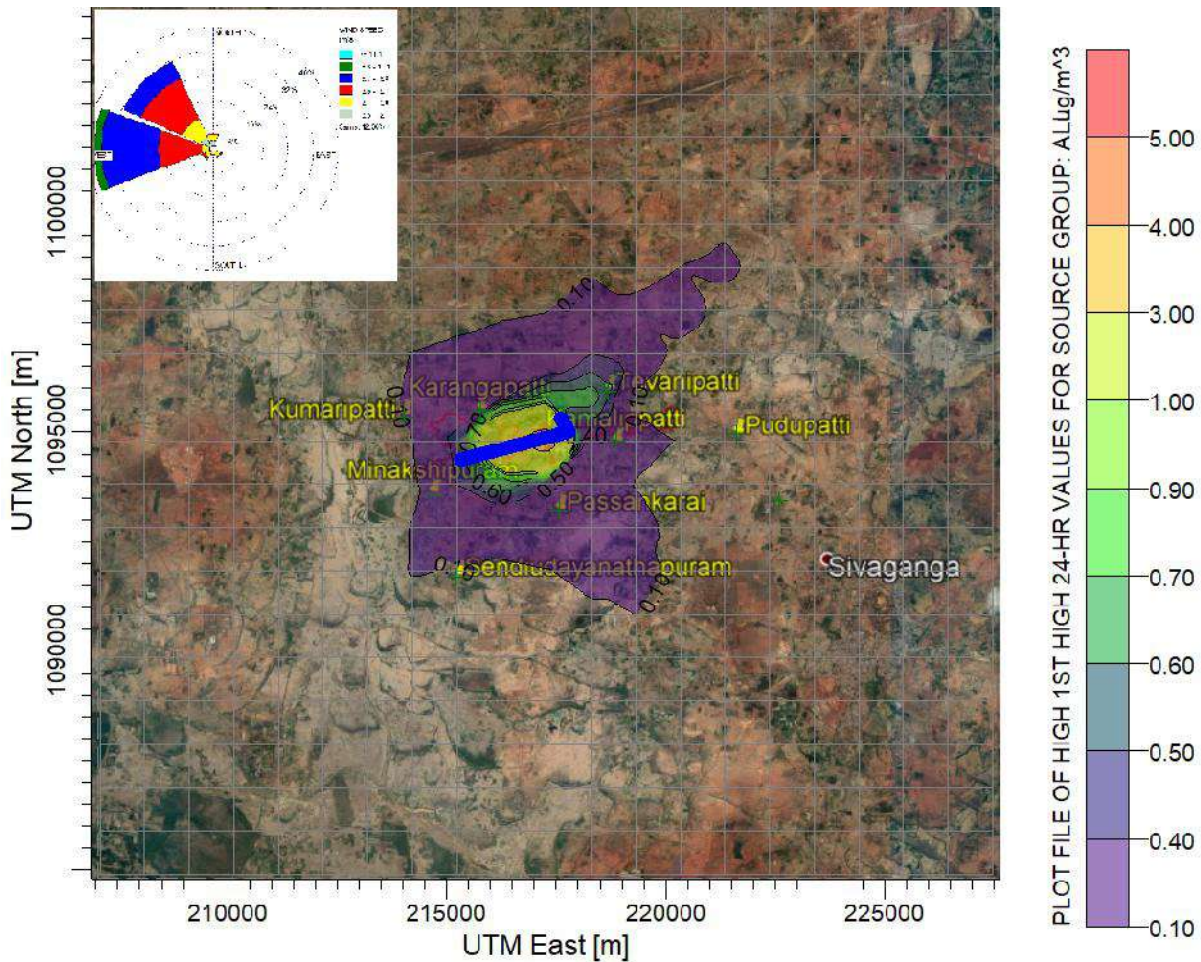


Figure 2-11 Predicted 24-Hrs' GLC's of NOx within 10 km Radius of the Study Area

Table 2-13 Predicted Top 10 Highest Concentration of Nitrogen Oxide

S.NO	Name of the Receptor	Conc. ( $\mu\text{g}/\text{m}^3$ )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumariipatti	0.102	3.3	WNW
2	Karangapatti	0.347	1.6	W
3	Tevanipatti	0.531	1.8	NE
4	Minskshipuram	0.162	2.8	WSW
5	Kamalippatti	0.189	1.6	E
6	Pudupatti	0.089	4.3	E
7	Passankari	0.247	1.6	S
8	Sendiudayanathapuram	0.089	3.7	SSW
9	Sakkanthi	0.112	5.4	ESE

### 2.1.2.5 GLC modeling Conclusion

It was observed that the maximum ground level concentration observed due to mining activities and traffic movement for TSPM, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>x</sub> are 43.21 µg/m<sup>3</sup>, 8.858 µg/m<sup>3</sup>, 1.638 µg/m<sup>3</sup>, 0.0053 µg/m<sup>3</sup> and 3.5965 µg/m<sup>3</sup>. So it can be concluded that even after the operation of mines the impact envisaged is moderate. The total increase in concentrations above baseline status to estimated and the percentage increase is summarized in **Table 2-14**.

**Table 2-14 Total Maximum GLCs due to Mining Activities without Control measures**

Pollutant	Predicted Cumulative Maximum Conc. at Mining + Beneficiation Unit (µg/m <sup>3</sup> )	NAAQ standard
TSPM	43.21	500
PM10	8.585	100
PM2.5	1.638	60
SO <sub>2</sub>	0.0053	80
NO <sub>x</sub>	3.596	80

### 2.1.3 Water Environment

The total Water requirement is 40 KLD. The total water requirements met through Mine sump water and Bore well water within the factory premises. The Water Balance charts for Non monsoon and monsoon are shown as **Figure 2-10, Figure 2-11**. Ground Water consumption estimation in season wise is given in **Table 2-17**. Ground Water quantity season wise from 1994 to 2017 is shown in **Table 2-18**.

#### 2.1.3.1 Ground Water Consumption

##### 2.1.3.1.1 Post Monsoon Water Requirement

**Table 2-15 Non monsoon season Water requirement**

S. No	Description	Water Requirement(KLD)
1	Domestic Use	3.5
2	Dust suppression	20
3	Green belt	16.5
<b>Total</b>		<b>40.0</b>

**Source of Water: Ground Water (Bore Well) 40 KLD**

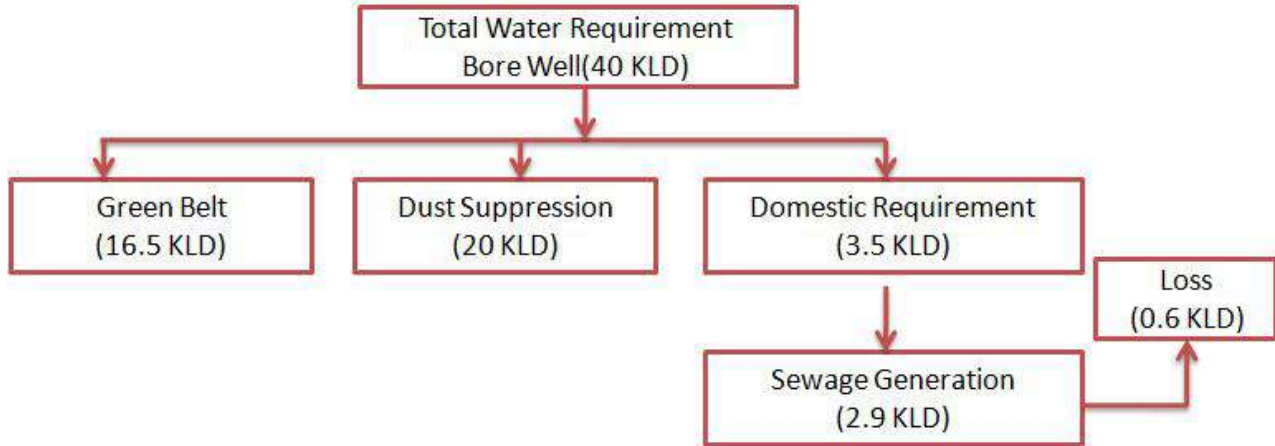


Figure 2-12 Non monsoon Season water Balance

### 2.1.3.2 Monsoon Water Requirement

Table 2-16 Monsoon season Water Requirement

S. No	Description	Water Requirement(KLD)
1	Domestic Use	3.5
<b>Total</b>		<b>3.5</b>

2) Bore well : 3.5 KLD

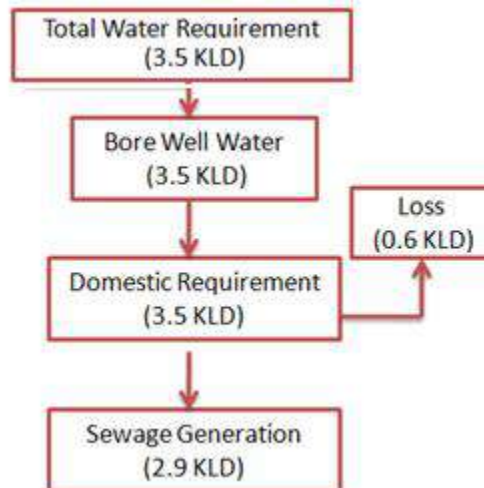


Figure 2-13 Monsoon water Balance

Table 2-17 Ground Water consumption estimation in season wise

S. No	Details	Monsoon	Post Monsoon
1	Water Quality in KLD	3.5	40
2	No of working days in year	78	222
3	KL/Year	<b>273</b>	<b>8880</b>

**Table 2-18 Ground Water Quantity season wise from 1994 to 2017**

S. No	Year	Year wise Water Quantity (KL)	
		Monsoon	Non Monsoon
1	1994-1995	273	8880
2	1995-1996	273	8880
3	1996-1997	273	8880
4	1997-1998	273	8880
5	1998-1999	273	8880
6	1999-2000	273	8880
7	2000-2001	273	8880
8	2001-2002	273	8880
9	2002-2003	273	8880
10	2003-2004	273	8880
11	2004-2005	273	8880
12	2005-2006	273	8880
13	2006-2007	273	8880
14	2007-2008	273	8880
15	2008-2009	273	8880
16	2009-2010	273	8880
17	2010-2011	273	8880
18	2011-2012	273	8880
19	2012-2013	273	8880
20	2013-2014	273	8880
21	2014-2015	273	8880
22	2015-2016	273	8880
23	2016-2017	273	8880
<b>Sub total</b>		<b>6279</b>	<b>204240</b>
<b>Grand Total</b>		<b>210519</b>	
<b>Total Bore well Water consumption: 1994 to 2017 = 210519</b>			

### 2.1.3.3 Surface Water

Run off Estimated as follows:

**Table 2-19 Estimation of Runoff**

S. No.	Land Use	Area (m <sup>2</sup> )	Volume (m <sup>3</sup> )	Run off Coefficient	Volume harvested (m <sup>3</sup> )	Volume of runoff harvested (KLD)
1	Mining	335700	147037	0.4	58814.60	1589.58
2	Overburden/Side burden Dump	79400	34777	0.7	24344.00	657.947
3	Storage for Topsoil	15900	6964.2	0.1	696.42	18.8222
4	Infrastructure	7200	3153.6	0.8	2522.88	68.1859
5	Mineral stockyard	122500	53655	0.6	32193.00	870.081
6	Mine Roads	52050	22798	0.3	6839.37	184.848
7	Area Under plantation(Green Belt)	59850	26214	0.4	10485.70	283.398
8	Unutilized area	169590	74280	0.4	29712.20	803.032
<b>Total</b>		<b>842190</b>	<b>368879</b>	<b>3.7</b>	<b>165608</b>	<b>4475.9</b>
<b>Total Volume per Year</b>						<b>1633703</b>
<b>Total Volume for 23 Years</b>						<b>37575166</b>

### 2.1.4 Noise Environment

Noise Modeling is carried out and contours were generated for Sivaganga mine. Sources for Noise in Open Cast mining is considered as follows:

#### Various Noise Sources in Mining Activities (Open Cast)

- 1) Noise pollution due to Blasting : 164 dB (A) at 30m  
: 144 dB (A) at 70m
- 2) Noise pollution due to Vehicles movement : 86 dB (A) at 1m
- 3) Noise pollution due to drilling activities : 115 dB (A) at 1m
- 4) Noise pollution due to mining machinery : 105 dB (A) at 1m

Source: <http://www.environmentalpollution.in/noise-pollution/control/noise-pollution-and-its-control-in-mining/6138>

**Table 2-20 Noise levels as per Noise Modeling**

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from Source(m)
1	Drilling activities	41.34	300
2	Blasting	91.89	300
3	Vehicles movement	50.16	500
4	Mining machinery	34.45	300
5	Cumulative sources	90.90	300

Noise Modeling is carried out & contours were generated for individual sources such as Blasting, Drilling, Mining machineries, Transportation. Cumulative of all sources are also shown in **Figure 2-14 to Figure 2-18** respectively.

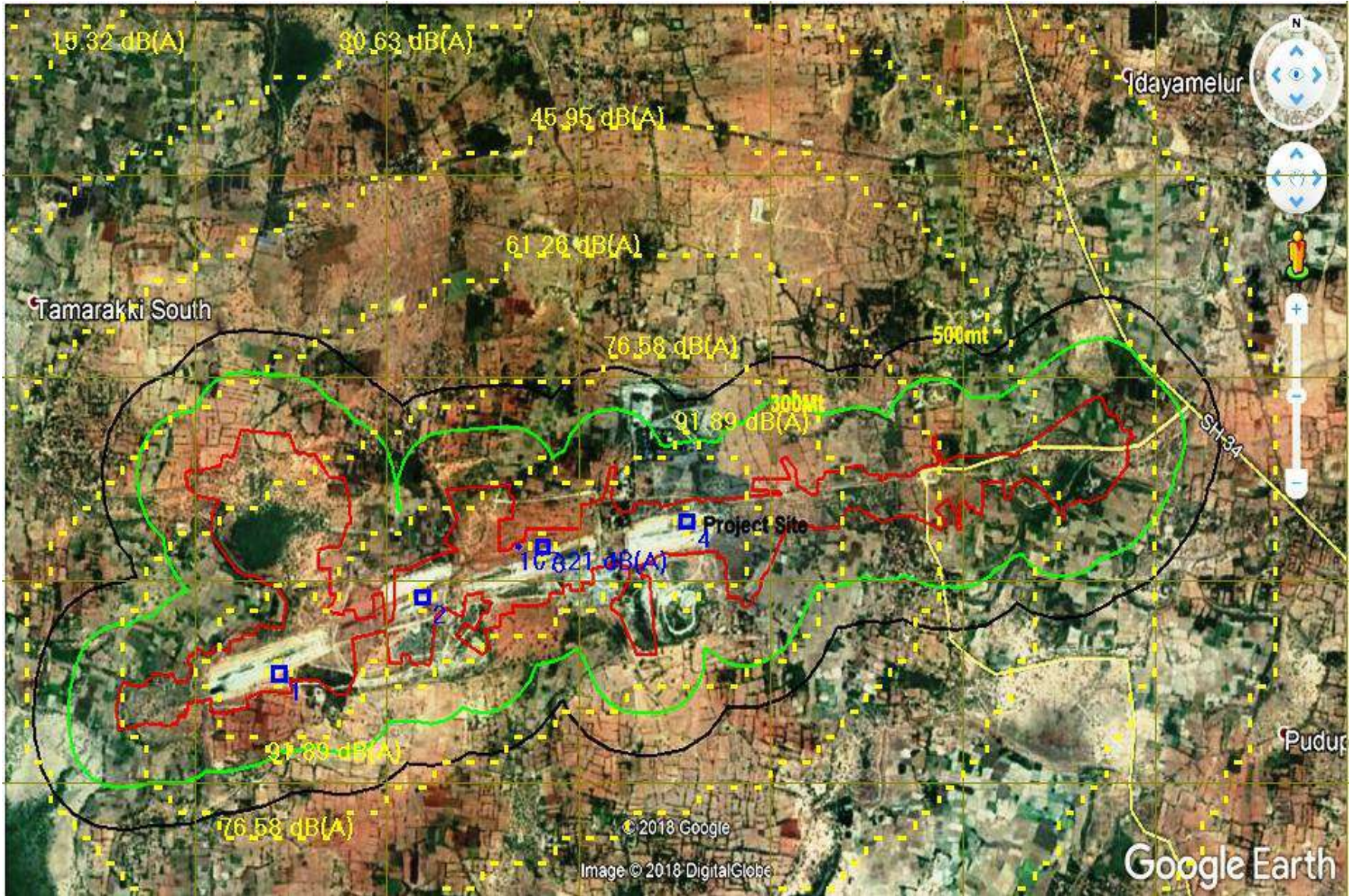


Figure 2-14 Noise contours due to Blasting

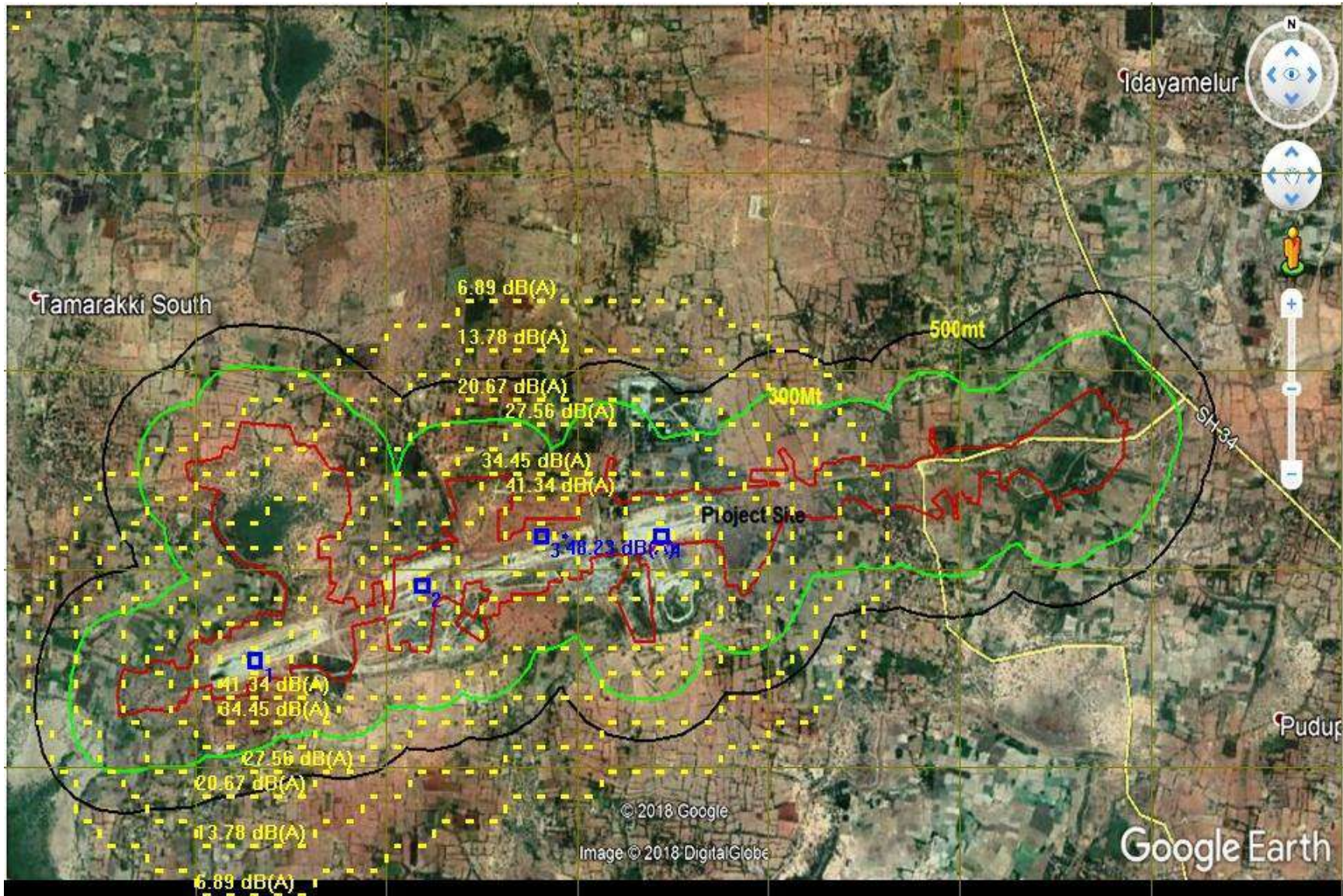


Figure 2-15 Noise contours due to Drilling

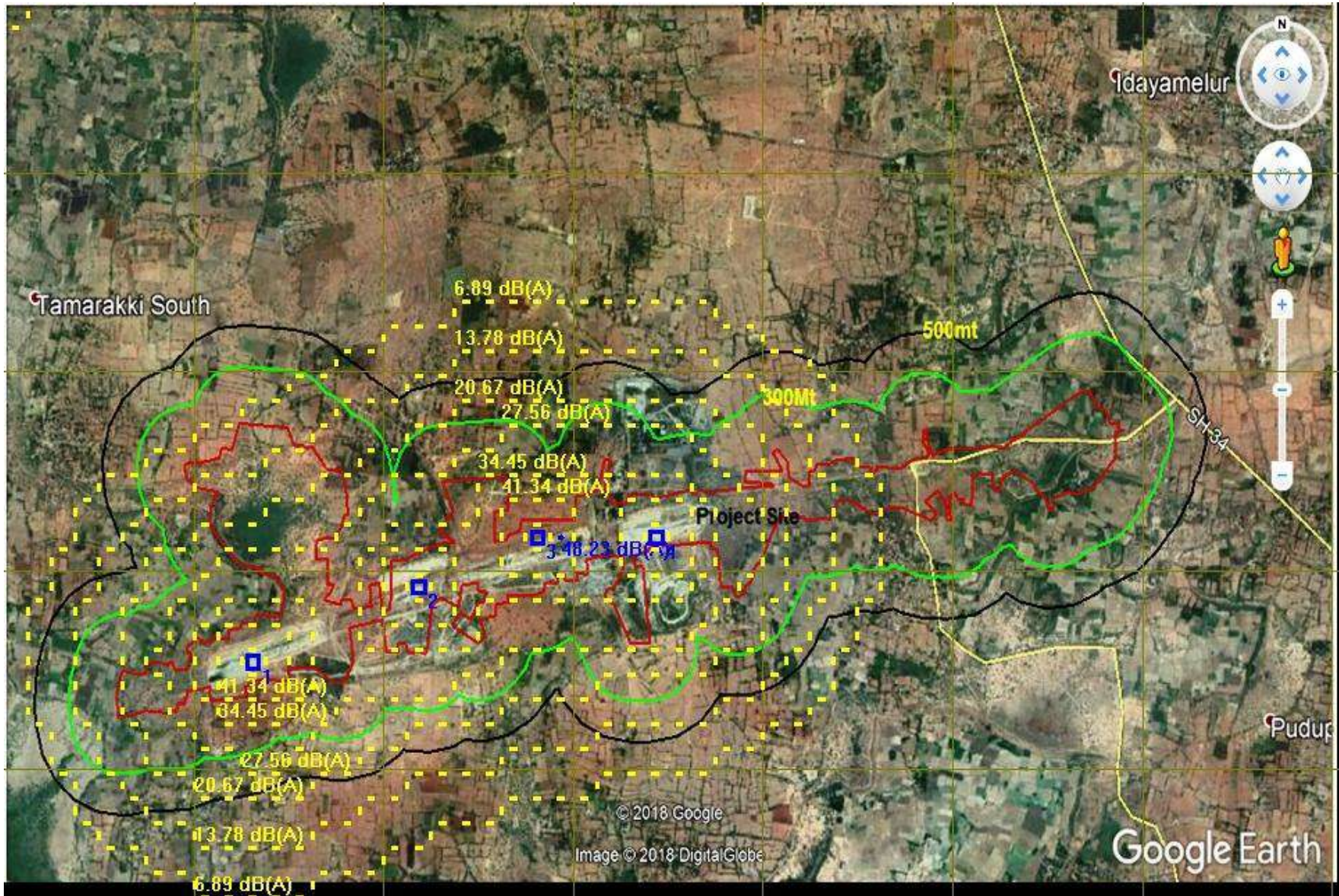


Figure 2-16 Noise contours due to Mining Machineries

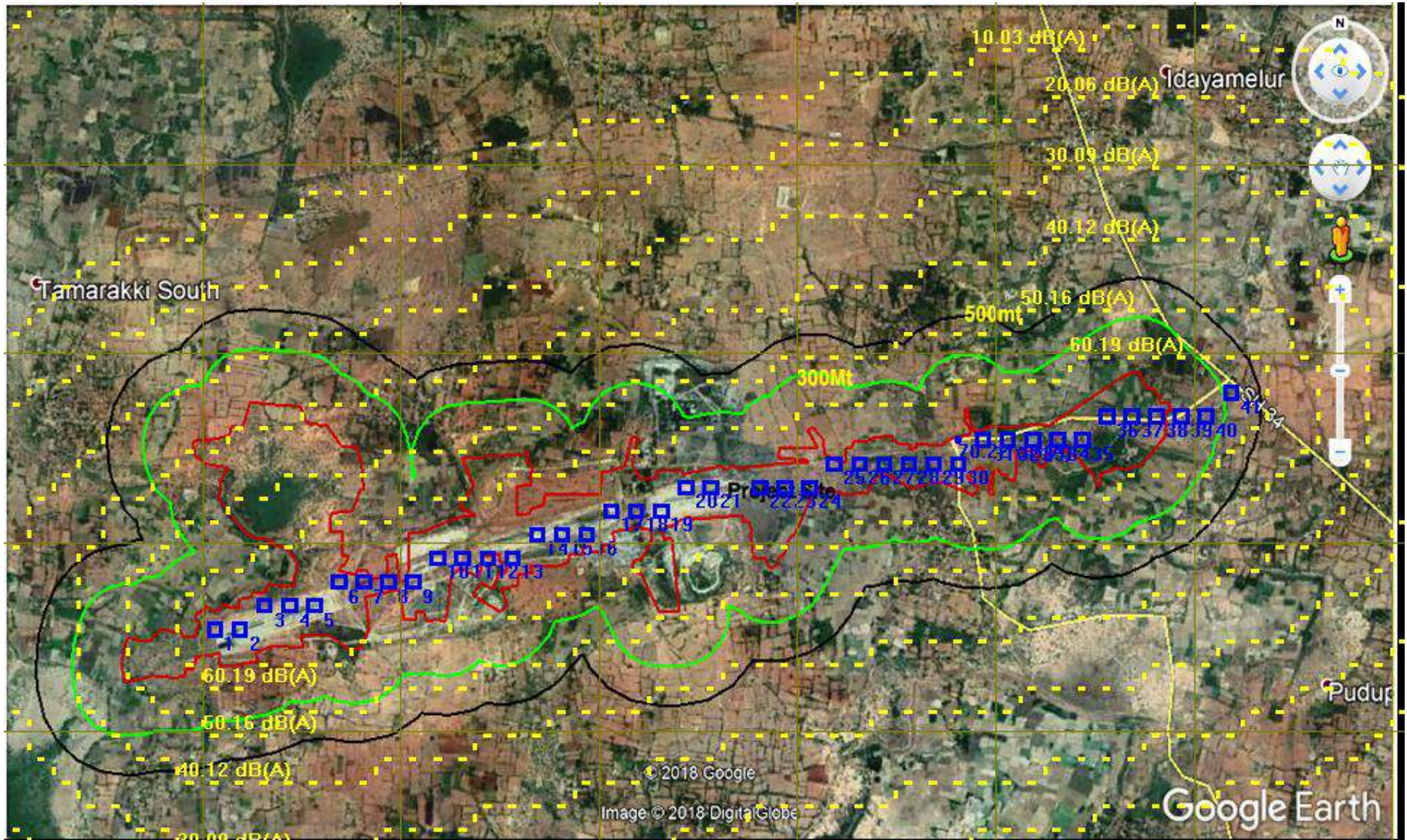


Figure 2-17 Noise contours due to Traffic/Transportation

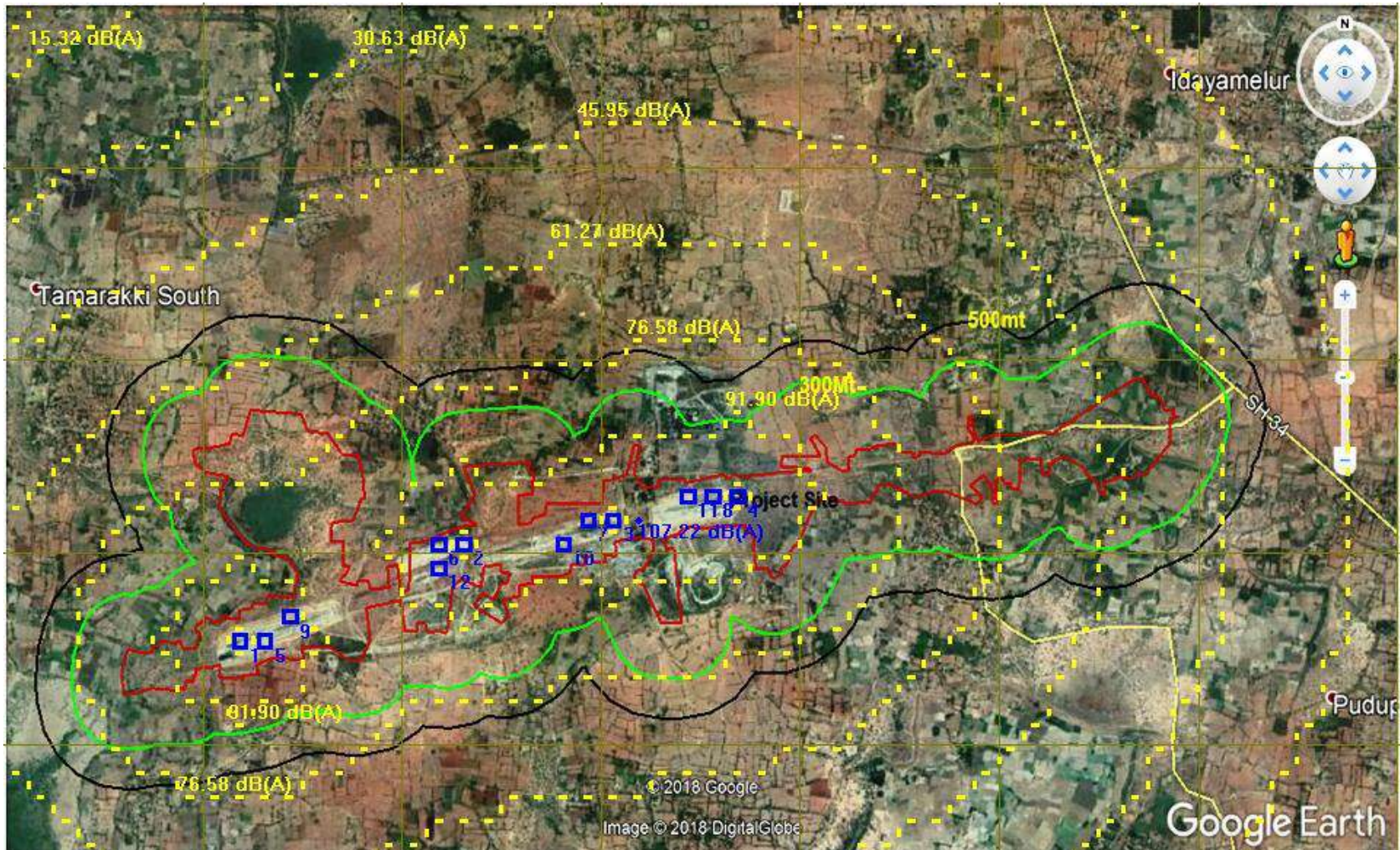


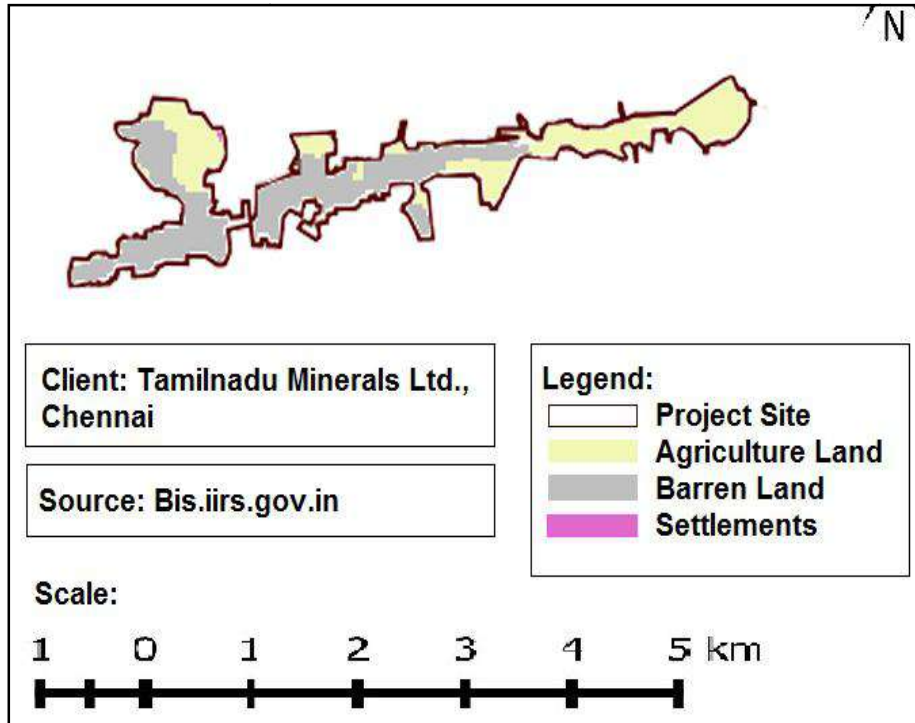
Figure 2-18 Noise contours for Cumulative sources

#### 2.1.4.1 Summary of Noise Modeling:

Since, All Noise levels are within the limit as per DGMS Rules. Damage due to Noise during Mine activities are negligible.

### 2.1.5 Biological Environment

The core area consists of Barren land. It is devoid of any major trees. Only small shrubs and bushes are present. No Damage to the Biological Environment is anticipated. The biodiversity biological richness map of the core area is shown as **Figure 2-19**.



**Figure 2-19 Biodiversity Biological Richness map of the core area**

#### Biological Environment Damages due to Land Pattern Changes:

S. No	Land Description	Area in Ha		Land Cover Pattern Changes in Ha.	Percentage (%)
		1994	2017		
1	Agriculture, Cropland	34.61	31.45	3.16	1.33
2	Agriculture, Fallow	83.25	81.73	1.52	0.64
3	Waste Land Open	31.51	37.62	6.11	2.58
4	Water bodies, lakes/ Ponds	87.48	86.05	1.43	0.60
<b>Total</b>		<b>236.85</b>	<b>236.85</b>	<b>12.22</b>	<b>5.15</b>

### **2.1.6 Occupational Health & Safety**

Mining operations exposes the workers/staff, work discomfort to machinery, dust, noise, vibration, Heat and radiation.

#### **Impacts:**

- Air pollution due to Mining Activities (Mainly dust generation)
- Noise due to mining activities(Drilling, Blasting & Mining Machinery)

#### **Measures taken by TAMIN for Occupational Health & Safety:**

- Water sprinkling on haul roads.
- Green Belt development within the mine lease area.
- Conducting Initial Medical examination (IME) at pre-entry level stage for workers by qualified doctors, as per DGMS circulars.
- Periodical health check up to employees.
- Provided Personnel Protective Equipments (PPE) to all staff and workers to guard against excess noise levels, dust generation and inhalation, etc., as per standards prescribed by DGMS.

### **2.1.7 Socio Economic Environment**

#### **Impacts on Socio Economic Environment:**

- Air pollution due to Mining Activities (Mainly dust generation)
- Noise due to mining activities(Drilling, Blasting & Mining Machinery)
- Water Scarcity due to exploitation of Ground Water

#### **Measures taken by TAMIN:**

- Green Belt development
- Supporting locals through CSR/CER activities

### 3 Conclusion

Damage assessment is carried out for Air Environment, Noise Environment, Water Environment, Land Environment, and Biological Environment & Socio Economic Environment. The following are our observations:

#### 3.1 Land Environment

Total Lease area classified as Patta Land (75.96.5 Ha) and Poramboke Land (160.88.5Ha).Land cover maps are prepared as per Satellite images and Google images. It was observed that changes of land coverage from 1994 to 2017 are as followed:

##### Land Cover/Land use Pattern changes:

S. No	Land Description	Land Cover Pattern Changes in Ha.	Impacts due to Land Cover Pattern Changes	Percentage (%) of Changes	Impact identified
1	Agriculture, Cropland	3.16	Reduced	1.33	Moderate impact
2	Agriculture, Fallow	1.52	Reduced	0.64	Moderate impact
3	Waste Land Open	6.11	Increased	2.58	Moderate impact
4	Water bodies, lakes/ Ponds	1.43	Reduced	0.60	Moderate impact
<b>Total</b>		<b>12.22</b>	<b>--</b>	<b>5.15</b>	

#### 3.2 Air Environment

- Total Emission due to mining activities was calculated. The total emission for 23 years is 135.25 TPY.
- Air Modelling is carried out considering the worst case in the past 23 years from 1994 to 2017.It It was observed that the maximum ground level concentration observed due to mining activities and traffic movement for TSPM, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>x</sub> are 43.21 µg/m<sup>3</sup>, 8.858 µg/m<sup>3</sup>, 1.638 µg/m<sup>3</sup>, 0.0053 µg/m<sup>3</sup> and 3.5965 µg/m<sup>3</sup>. So it can be concluded that even after the operation of mines the impact envisaged is moderate.

##### Total Maximum GLCs due to Mining Activities:

Pollutant	Predicted Cumulative Maximum Conc. at Mining + Beneficiation Unit (µg/m <sup>3</sup> )	NAAQ standard
TSPM	43.21	500
PM10	8.585	100
PM2.5	1.638	60
SO <sub>2</sub>	0.0053	80
NO <sub>x</sub>	3.596	80

### 3.3 Water Environment

- c) Total Ground water consumptions 210519 KL from 1994 to 2017. (In monsoon 6279 KL and Non monsoon is 204240 KL) without approval from concern Authority.
- d) Rain water stored and supplied to farmers for agriculture purposes to nearby villages without permission .Estimated runoff water quantity is 1633703 KL per year and total volume for 23 years is about 37575166 KL.

### 3.4 Noise Environment

Noise Modelling is carried out for individual sources such as Blasting, Drilling, Mining machineries, Transportation & Cumulative of all sources. All Noise levels are within the limit. As per Noise contours max. Noise levels as follows;

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from Source(m)
1	Drilling activities	41.34	300
2	Blasting	91.89	300
3	Vehicles movement	50.16	500
4	Mining machinery	34.45	300
5	Cumulative sources	90.90	300

### 3.5 Biological Environment

The core area consists of Barren land. It is devoid of any major trees. Only small shrubs and bushes are present. No Damage to the Biological Environment is anticipated.

### 3.6 Occupational Health & Safety

TAMIN has provided all safety measures as per DGMS Rules.

### 3.7 Socio Economic Environment

- a) TAMIN provided employment to local on permanent bases for 70 persons from to local/nearby village
- b) Provided support through CSR/CER activities.
- c) Most villages have benefitted mutually at Pudupatti, Kumarapatti, Senthudayanathapuram villages where the Mine site has provided indirect jobs for labour and the villages provide accommodation for the labour and staff.
- d) Supportive industries like food supply and essential shops which are set up to cater to the need of the Mine operation will spur are economic growth in the villages.

## 1. REMEDIATION MEASURES & PLAN FOR DAMAGE ASSESSMENT

S. No	Activity/ Causes of Pollution	Probable Impacts	Damage Assessment	Remediation plan proposed Remediation Measures	CostAllocation
1	<b>Land Environment</b>				
	<b>A) Excavation of Soil</b>				
	<ul style="list-style-type: none"> <li>Excavation of Top Soil</li> <li>Site clearance removal of grasses growing in the mine area.</li> <li>Diversion of Grazing land for mining activity.</li> </ul>	<ul style="list-style-type: none"> <li>Change in Land use/ Land cover of site. Change in topography and drainage pattern. Reducing productivity and fertility of the soil. Soil erosion</li> <li>Effects on Flora/ Fauna</li> </ul>	<ul style="list-style-type: none"> <li>Excavated Top Soil Quantity: 36450 m<sup>3</sup></li> <li>Used Qty: 7290 m<sup>3</sup></li> <li>Unused Qty: 29160 m<sup>3</sup></li> </ul>	<ul style="list-style-type: none"> <li>Developing Green Belt at neighborhoods</li> </ul>	<ul style="list-style-type: none"> <li>No. of Trees :1000 Nos x Rs 1500</li> </ul> <p><b>Sub Total Rs. 15,00,000</b></p>
	<ul style="list-style-type: none"> <li>Generation of Hazardous waste like empty cans of diesel and its spills.</li> </ul>	<ul style="list-style-type: none"> <li>Unmanaged dumping.</li> <li>Runoff during rains may lead to contamination in surface water bodies</li> </ul>	<ul style="list-style-type: none"> <li>Health effects on workers handling chemical/oil/fuel/ paints etc.</li> <li>Contamination of soil/water.</li> </ul>	<ul style="list-style-type: none"> <li>Using designated/earmarked areas for refueling and washing of machinery &amp;empty fuel cans</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle checkup camp Twice in a year 2 x 10, 000</li> </ul> <p><b>Sub Total Rs 20, 000</b></p>
	<b>B) Solid Waste generation</b>				
	<ul style="list-style-type: none"> <li>Generation of solid waste, Mine waste &amp;dumping of waste</li> </ul>	<ul style="list-style-type: none"> <li>Contamination of Soil.</li> <li>Leaching may impact Ground water contamination.</li> </ul>	<ul style="list-style-type: none"> <li>Contamination or degradation of soil/ water quality</li> <li>Unmanaged disposal of domestic solid waste without segregation</li> </ul>	<ul style="list-style-type: none"> <li>Proper segregation (degradable and non-biodegradable) at source</li> </ul>	<ul style="list-style-type: none"> <li>Organic Waste converter installation at project site</li> </ul> <p><b>Sub Total Rs. 3, 00, 000</b></p>
				<ul style="list-style-type: none"> <li>Awareness among villagers in the neighborhood shall be provided for collection and segregation of Solid waste.</li> </ul>	<ul style="list-style-type: none"> <li>Rs. 10, 000 (LS) for printing&amp; distribution of leaflets.</li> </ul>
			<ul style="list-style-type: none"> <li>Waste collection center shall be provided in villages</li> </ul>	<ul style="list-style-type: none"> <li>2 bins for each of the 3 villages(Pudupatti, Senthudayanathapuram and Kumaripatti) 6 x 35000</li> </ul> <p><b>Sub Total Rs.2,10,000/-</b></p> <p><b>Total Rs.5,20,000/-</b></p>	
		<ul style="list-style-type: none"> <li>Effect on plant growth Nuisance due to un-managed disposal or storage of MSW and construction wastes</li> </ul>	<ul style="list-style-type: none"> <li>Proper storage bins for biodegradable waste and disposal through microbial composting and non-biodegradable wastes, recycle through vendors.</li> </ul>	<ul style="list-style-type: none"> <li>Non-Biodegradable waste is being disposed through TNPCB Authorized Recycling Vendors</li> </ul> <p><b>Sub Total Rs. 10,000</b></p>	
<b>Total Cost of Remediation Measures for Land Environment</b>					<b>Rs. 20,50,000</b>

2	<b>Air Environment</b>				
	1. Air Emissions from Site preparation ,Drilling, Blasting, Heavy Machinery movement, &Loading and Unloading of materials	<ul style="list-style-type: none"> <li>Dust emission, Gaseous Emission</li> <li>Aerial distance of nearest habitation is around form the mines.</li> <li>Increase in GLCs may lead to health issues to the nearby habitation.</li> </ul>	<ul style="list-style-type: none"> <li>24 hrs maximum increment GLC of baseline value of TSPM – 43.21 &amp;PM by 8.585 ppm, considering all the activities together.(Mine activities and Beneficiation Plant)</li> <li>Beneficiation Plant is located at 500m from the mine lease boundary</li> </ul>	<ul style="list-style-type: none"> <li>Suppression of Dust by sprinkling of water through water tankers on haul roads , drilling areas and dust deposited areas including neighborhoods areas</li> </ul>	<ul style="list-style-type: none"> <li>Dust Sprinkling System(Tipper with fabricated water storage tank along with Sprinkling arrangements) Tippers (1 No) Rs. 6,00,000/- Water Storage tank Rs.50, 000/- Maintenance per Year Rs. 30, 000/- <b>Total Rs. 6, 80, 000/-</b></li> </ul>
		<ul style="list-style-type: none"> <li>Dust emission, Gaseous Emission from vehicles which are using for sprinkling of water through water tankers on haul roads , drilling areas and dust deposited areas including neighborhoods areas</li> </ul>	<ul style="list-style-type: none"> <li>Proper maintenance of water tankers and vehicle.</li> </ul>	<ul style="list-style-type: none"> <li>Maintenance charges per Year Rs. 5000/- No of Vehicle: 21 x 5000 <b>Total Rs.1,05,000/-</b></li> </ul>	
		<ul style="list-style-type: none"> <li>Dust Deposition on trees loss of photosynthesis</li> </ul>	<ul style="list-style-type: none"> <li>Plantation / Provision of Green Belt development in nearby villages.</li> </ul>	<ul style="list-style-type: none"> <li>Already considered in Land Environment</li> </ul>	
	1. Extraction of Ore/OB, Ore and Over burden transportation ,Wind impact on dumps, Gas Emissions from equipments Operation of DG Sets, Operation of heavy machinery &Temporary Stay of Workers	<ul style="list-style-type: none"> <li>Dust emission,Gaseous Emission</li> <li>Aerial distance of nearest habitation is around form the mines.</li> <li>Health problems due to dust inhalation</li> <li>Loss of vegetation due to Dust deposition</li> </ul>	<ul style="list-style-type: none"> <li>Wind impact due to dust/air pollutions on surrounding villages/areas</li> </ul>	<ul style="list-style-type: none"> <li>Planting and maintaining trees along the highway in collaboration with NHA/Forest Dep't.</li> </ul>	<ul style="list-style-type: none"> <li>No. of trees 100 x 1500(cost of each plant) <b>Total Rs.1,50,000</b></li> </ul>
		<ul style="list-style-type: none"> <li>24 hrs maximum increment GLC of baseline value of TSPM – 43.21 &amp;PM by 8.585 ppm, considering all the activities together.(Mine activities and Beneficiation Plant)</li> <li>Beneficiation Plant is located at 500m from the mine lease boundary</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring of Ambient Air Quality (3 Samples, twice a year) in nearby villages (Pudupatti, Senthudayanathapuram and Kumaripatti)</li> </ul>	<ul style="list-style-type: none"> <li>AAQ monitoring twice in a year for 3 villages (Pudupatti, Senthudayanathapuram and Kumaripatti)  Rs.5000 x 3Nos x 2 times in a Years <b>Total Rs. 30, 000</b></li> </ul>	
		<ul style="list-style-type: none"> <li>Health problems due to dust inhalation</li> </ul>	<ul style="list-style-type: none"> <li>PPE for mine employees</li> <li>Health camps arrangements in the areas of villages. (Pudupatti, Senthudayanathapuram and Kumaripatti)</li> </ul>	<ul style="list-style-type: none"> <li><b>Rs. 2,50,000</b> per Year (70 employees)</li> <li>1 Health Camp for each of the 3 villages 3 Nos x 20,000 <b>Total Rs. 60, 000</b></li> </ul>	
		<ul style="list-style-type: none"> <li>Loss of vegetation due to Dust deposition</li> </ul>	<ul style="list-style-type: none"> <li>Regular maintenance nearby village's connectivity roads will help to reduce air pollution/ dust deposition</li> </ul>	<ul style="list-style-type: none"> <li>Water sprinkling systems already considered in above section.Labour charges for removal of weeds and grass No. of labours 5 x 25,000 <b>Total Rs. 1,25,000</b></li> </ul>	
<b>Total Cost of Remediation Measures for Air Environment</b>					<b>Rs. 14,00,000/-</b>

3	<b>Water Environment</b> <b>a) Surface Water</b> 1. Generation of suspended solids in storm water run-offs during monsoon seasons 2. Wastewater generation during mining <b>b) Ground Water</b> 1. Usage of Ground water for mining activities. 2. Obstruction of rainwater percolation 3. Percolation of contaminated ground water near the mine. 4. Waste water from work shop/service building 5. Domestic effluent 6. Disturbance-Drainage 7. Mine discharge water 8. Wash out from waste dump/stack piles.	<ul style="list-style-type: none"> <li>All surface run offs from the mine lead to increase in Suspended Solids concentrations of Natural Water bodies.</li> <li>Contamination of ground water</li> <li>Depletion of ground water level may result in water shortage in nearby villages during dry seasons.</li> <li>Discharge of polluted water to nearby villages.</li> <li>The direct impact on human beings due to poor water quality can lead to various water borne diseases like diarrhea, jaundice, dysentery etc.</li> <li>Polluted water may not be useful for human or animal consumption etc., if not treated to standards</li> </ul>	<ul style="list-style-type: none"> <li>There will be a considerable increase in TSS, if partially controlled.</li> <li>Decrease of Depth of water bodies due to deposition dust</li> <li>Polluted water discharge to drains/streams/neighborhood</li> <li>aquatic ecosystem also will effect</li> <li>Change in ground water quantity and quality nearby villages.</li> <li>Rain water Infiltration will be reduced due to dust accumulation</li> <li>Loss of Aquifer recharge</li> <li>Improper maintenance /disposal of will be leads to health problems to community</li> </ul>	<ul style="list-style-type: none"> <li>Ground Water Quantity used:210519 KL from 1994 to 2017</li> <li>Permission Status/NoC: Not obtained during violation period. Now NOC is obtained on 28.03.2019 from Tamil Nadu -PWD Water resources department for 50 KLD.</li> <li>Rain Water harvested at site and surface run-off collection in tank within the lease area</li> <li>Rain water Harvesting ponds construction: Rainwater Harvesting &amp; Groundwater Recharging Annual average rainfall of Sivaganga district = 876 mm (as per IMD) Volume of water received (m<sup>3</sup>) = Area of catchment in Sq.mt x Runoff coefficient x Rainfall per day (m) Volume of water received (m<sup>3</sup>) 4475.9 = KLD.</li> <li>Mine pit water = 1589 KLD</li> <li>Maintenance of existing garland and diversion to nearby water bodies</li> <li>Rehabilitation of abandoned public wells</li> <li>Construction of Recharge Pits in 3 villages (Pudupatti, Senthudayanathapuram and Kumaripatti)</li> <li>Existing sewage disposed in to Septic tank followed by Soak pit.</li> </ul>	<ul style="list-style-type: none"> <li>To Pump out mine pit water for nearby villages agriculture land</li> <li>Cost of Motor (10HP Diesel based)Rs. 50,000</li> <li>Hose pipe with suction valve along with filter: Rs 5,000</li> <li>Diesel Consumption for Day in Lts: 144 x 75= Rs. 10,800</li> <li><b>Total Rs. 65,800</b></li> <li><b>Rs. 50,000 per year</b></li> <li>20,000/- per village (3 villages (Pudupatti, Senthudayanathapuram and Kumaripatti) <b>Total Rs 60,000/-</b></li> <li>2 pits per village (3 villages (Pudupatti, Senthudayanathapuram and Kumaripatti) Each pit cost 10,000 x 6 Nos <b>Total Rs 60,000/-</b></li> <li>Cost of Sewage Disposal: <b>Rs. 5,000 per year.</b></li> </ul>
<b>Total Cost of Remediation Measures for Water Environment</b>					<b>Rs. 2,40,800</b>

4	<b>Noise &amp; Vibration Environment</b> 1. Movement of Mining equipments and activities 2. Transportation of Trucks and Dumpers	<ul style="list-style-type: none"> <li>Prolonged exposure to high noise level is harmful to human auditory system</li> <li>Creation of Vibration Effect</li> </ul>	<ul style="list-style-type: none"> <li>Accident and injury</li> <li>damage to the nearby structures due to vibration</li> </ul>	<ul style="list-style-type: none"> <li>Controlled Blasting Methods &amp; Drilling</li> <li>Providing in-built mechanism for reducing sound emissions</li> </ul>	<ul style="list-style-type: none"> <li>Rs. 50,000/Month x 12 Months</li> <li><b>Total Rs. 6,00,000</b></li> </ul>
			<ul style="list-style-type: none"> <li>Increase in ambient noise levels causing discomfort to residents</li> </ul>	<ul style="list-style-type: none"> <li>Providing medical assistance to nearby villages periodically</li> </ul>	<ul style="list-style-type: none"> <li>Health camps are considered in above section Air Environment.</li> </ul>
			<ul style="list-style-type: none"> <li>Approx 54db (A) noise level has been observed in project site</li> </ul>	<ul style="list-style-type: none"> <li>Regular medical health checkups to workers including audiometric test for the workers engaged in noise prone area.</li> </ul>	<ul style="list-style-type: none"> <li>PPE &amp; Health checkup for employees are considered in above section Air Environment.</li> </ul>
			<b>Total Cost of Remediation Measures for Noise &amp; Vibration</b>		
5	<b>Ecological Environment</b> 1. Impacts on plants and trees in the vicinity of the mine/impact on fauna 2. Clearance of vegetation/trees in the lease area 3. Impact of tree growth stop 4. Impact on surface water quality/siltation 5. Forest Land diversion	<ul style="list-style-type: none"> <li>Loss of vegetation in the lease area</li> <li>Habitation loss to fauna specially avi-fauna.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of native flora and aesthetic view</li> <li>Removal of some native plant species while clearing the land</li> </ul>	<ul style="list-style-type: none"> <li>Compensatory additional plantation outside the mine lease</li> </ul>	Considered in Air Environment
			<ul style="list-style-type: none"> <li>Change of land use</li> </ul>	<ul style="list-style-type: none"> <li>Avenue plantation on external road</li> </ul>	Considered in Air Environment
			<ul style="list-style-type: none"> <li>Habitat disturbance</li> </ul>	<ul style="list-style-type: none"> <li>Development of green belt along the boundary of water bodies away from the lease boundary</li> </ul>	considered in above section Land Environment
			<ul style="list-style-type: none"> <li>Health complication in cattle's</li> </ul>	<ul style="list-style-type: none"> <li>Distribution of tree seedling to peripheral villagers preferably native plants</li> </ul>	<b>Total Rs. 50,000</b> per year
<b>Total</b>					<b>50,000</b>
6	<b>Socio-Economic Environment</b> 1. Occupational Health and Amenities 2. Other social attributes 3. Generation of source of income 4. Inflow of people	<ul style="list-style-type: none"> <li>Health of the n workers and facilities related to hygiene and sanitation</li> <li>Pressure on the existing infrastructure</li> <li>Loss of livelihood</li> <li>Air emission lead to damage to human health inflow of mining workers may increase load on local infrastructure. Workers increased load on local infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>Impacts of pollution on the health of neighborhood</li> </ul>	<ul style="list-style-type: none"> <li>1. Providing periodical medical check-up for respiratory &amp; general health problems to neighboring community</li> </ul>	Health camps are considered in above section Air Environment.
			<ul style="list-style-type: none"> <li>Serious health complications to employees and neighborhoods</li> </ul>	<ul style="list-style-type: none"> <li>2. Distribution of PPE kits to workers</li> </ul>	Health camps are considered in above section Air Environment.
			<ul style="list-style-type: none"> <li>Loss of cattle health</li> </ul>	<ul style="list-style-type: none"> <li>3. Provision of ambulance for transportation of injured labour</li> </ul>	Ambulance is already available at site.
			<ul style="list-style-type: none"> <li>Inflow of mining</li> </ul>	<ul style="list-style-type: none"> <li>4. Community based rehabilitation of differently abled persons</li> </ul>	<b>Rs. 1,00,000</b>
			<ul style="list-style-type: none"> <li>Workers increased load on local infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>5. Solar street lamps to community</li> </ul>	Solar street lamps installation in 3 villages (Pudupatti, Senthudayanathapuram and Kumaripatti) <b>Total Rs. 1,00,000</b>

				6. Supplying of Computers to Govt. Schools 3 village (Pudupatti, Senthudayanathapuram and Kumaripatti)	3 Nos x 35,000 per computer with accessories  <b>Total Rs. 1,05,000</b>
<b>Total Cost of Remediation Measures for Socio Economic</b>					<b>Rs. 3,05,000</b>
<b>7 Occupational Health and safety</b> 1. Mining operations exposes the workers/staff , work discomfort to machinery, dust, noise, vibration. Heat and radiation	<ul style="list-style-type: none"> <li>• Impact on health or workers due to dust generation.</li> <li>• Noise and vibration</li> <li>• Effect</li> </ul>	<ul style="list-style-type: none"> <li>• Dust respiratory problems, general health problems like hyper tension.</li> <li>• Impacts of pollution on health of neighborhood</li> </ul>	<ul style="list-style-type: none"> <li>• Health camps for neighborhoods (Pudupatti, Senthudayanathapuram and Kumaripatti)</li> </ul>	<b>1,00,000</b>	
			<ul style="list-style-type: none"> <li>• First Aid Facilities for nearby villages</li> </ul>	<b>60,000</b>	
			<ul style="list-style-type: none"> <li>• Occupational Health Hazard training programme to neighborhoods (Once in 3 Years)</li> </ul>	<b>Total Rs. 1,00,000</b>	
			<b>Total Cost of Remediation Measures for Occupational Health &amp; Safety</b>		
<b>Grand Total</b>					<b>49,05,800</b>

## 2. NATURAL& COMMUNITY RESOURCES AUGUMENTATION PLAN

**Introduction:** A need assessment survey was carried out for the purposes to formulate the Natural and community resources augmentation plan. The need assessment survey covered the 1.0 Km radius study area mainly Pudupatti, Senthidayanathapuram and Kumaripatti villages.

### Identified Activities:

The following activities were identified during the survey:

1. Development of Greenery in the surrounding area and road side plantation
2. Provision of Drinking water facilities through hand pumps/dug wells/tube wells(5 hand pumps/wells per year in the nearby villages with maintenance
3. Renovation of open wells in nearby villages

### Natural Resource Augmentation Plan

S. No	Activity	Year wise Implementation and Budgetary provision			Total Cost
		Year 1	Year 2	Year 3	
1	Development of Greenery in the surrounding area and road side plantation	70000	70000	60000	200000
2	Provision of Drinking water facilities through hand pumps/dug wells/tube wells (3 hand pups/wells per year in the nearby villages with maintenance	100000	100000	100000	300000
3	Renovation of open wells in nearby villages	50000	50000	50000	150000
4	Ground Water Recharge Wells in 3 Villages	50000	50000	50000	150000
<b>Total</b>					<b>800000</b>

### 3. COMMUNITY RESOURCES AUGUMENTATION PLAN

**Introduction:** A need assessment survey was carried out for the purposes to formulate the community resources augmentation plan. The need assessment survey covered the 1.0 Km radius study area mainly Pudupatti, Senthudayanathapuram and Kumaripatti villages.

**Identified Activities:**

The following activities were identified during the survey

1. Providing water to the farmers & supporting for irrigation
2. Construction of sanitation facilities(toilet) in schools and villages  
(5 toilets each year)
3. Assistance in development of technical skills and training to the children of farmers.
4. Scholarship to the clever students for higher education

#### Community Resource Augmentation Plan

S. No	Activity	Year wise Implementation and Budgetary provision			Total Cost
		Year 1	Year 2	Year 3	
1	Providing water to the farmers & supporting for irrigation	50000	50000	50000	150000
	Construction of village roads, repair and maintenance	100000	100000	100000	300000
2	Construction of sanitation facilities(toilet) in schools and villages(3 toilets in 3 villages)	50000	50000	50000	150000
3	Technical skill development programmes to the children of farmers/poor people	20000	20000	10000	50000
4	Scholarship to the clever students for higher education	50000	50000	50000	150000
<b>Total</b>					<b>8,00,000</b>

## Summary Remediation Plan, Natural Resource Augmentation Plan & Community Augmentation Plan for Damage Assessment

S. No	Name of the area	Budget (Rs)
1	Land Environment	20,50,000
2	Air Environment	14,00,000
3	Water Environment	2,40,800
4	Noise & Vibration Environment	6,00,000
5	Ecological Environment	50,000
6	Socio-Economic Environment	3,05,000
7	Occupational Health & Safety	2,60,000
<b>Total Budget allocated for remediation measures</b>		<b>49,05,800</b>

### Total Budget proposed

S. No	Name of the area	Budget(Rs)
1	Estimation cost for remediation plan based on the Damage Assessment due to violation	49,05,800
2	Natural Resource Augmentation Plan	800000
3	Community Resource Augmentation Plan	800000
<b>Grand total</b>		<b>65,05,800</b>

# **ANNEXURE-II**

## **CUMULATIVE IMPACT ASSESSMENT REPORT**

For

### **SIVAGANGA GRAPHITE MINE (236.85Ha.) & BENEFICIATION PLANT (200 TPD)**

At

**Villages: Pudupatti, Senthudayanathapuram and Kumarapatti**

**Taluk: Sivaganga**

**District: Sivaganga**

**State: Tamil Nadu**

By



**M/s. Tamil Nadu Minerals Limited  
No. 31, Kamarajar Salai,  
Chepauk,  
Chennai – 600 005**

**EIA Consultant**

**HUBERT ENVIRO CARE SYSTEMS PRIVATE LIMITED, CHENNAI  
(NABET Accredited vide Certificate No. NABET/EIA/1619/RA0083 Valid up to  
13.10.2019)**

**JULY 2019**

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# 1 INTRODUCTION

The Cumulative Assessment Report is prepared for Sivaganga Graphite Mine and Graphite Beneficiation Plant to measure the environmental risk associated with the project and identify the respective mitigation measures, in order to conform environmental acceptability in addition to the statutory requirements. Establish existing environmental scenario in respect of various physical and biological environmental parameters, demography & socioeconomics etc.

Assessment of the likely impacts due to the mining & beneficiation activities. A detailed survey of these attributes has been carried out and the probable impacts have been identified qualitatively and quantitatively.

Suggests methods and measures contemplated for minimizing environmental damage;  
Manpower and organization set up for implementation of environmental control measures;

EIA scoping is an early and open process for determining the scope of issues to be addressed and for identifying significant issues related to proposed action. The present scope of the study broadly includes detailed characterization of the status of environment in the core area and within 1km radius around the project site envisaging:

- (i) Description of Mine site and Beneficiation Plant
- (ii) Assessment of the present status of air (including meteorology), noise, water, land, biological and socio-economic components of environment;
- (iii) Identification and quantification of extent and magnitude of the impacts of various operations on environmental components;
- (iv) Evaluation of existing and proposed pollution control measures; need of new installation and up-gradation of the existing pollution control measures;
- (v) Risk assessment including preparation of a disaster management plan dealing with emergency planning for mitigation;
- (vi) Preparation of environmental management plan outlining additional control technologies to be adopted for mitigation of adverse impacts;
- (vii) Occupational Health Hazards and its remedial measures.
- (viii) Delineation of post-project environmental quality monitoring program to be pursued after commissioning.

## METHODOLOGY ADOPTED FOR CUMULATIVE IMPACT ASSESSMENT:

The ambient air quality data was collected Measurements were carried out in continuous manner during twenty four (24) hour sampling.

Land use mapping was carried out by using satellite data of IRS-1C- LISS III in a GIS platform for studying land use pattern of the area.

Spot noise levels (A-weighted) were measured using precision sound level meter at regular intervals during day and night. Traffic survey was also conducted to find out the existing status.

Study was carried out for the quantity and quality of water resources (ground/surface) available in the area. Sampling and laboratory tests were carried out on the physical, inorganic, organic and chemical constituents. Besides, data on biological aspects were also collected.

Socio-economic survey has been carried out from secondary information and census data. Demographic pattern, population density and occupational structure were also depicted. The census data was used to characterize the socio-economic environment of the area.

### 1.1 Salient Features of Graphite Beneficiation Plant:

S. No	Description	Details
1	Project Area	5.34.00 Ha. (13.20 Acres)
2	Land Status	Own Land
3	Location	Tamil Nadu Minerals Limited (Graphite Beneficiation Plant)Senthil Udayanathapura, Village, Sivaganga panchayat Union, Sivaganga district
4	Land status	TAMIN Owned
5	Production Capacity (TPD) throughput	200
6	Product Recovery (%) by Beneficiation	96 % fixed carbon
7	Process Technology	Wet Beneficiation Process involves grinding-washing-froth floatation-filtration & packing.
8	Capacity of the Plant (TPD)	200
9	Tailing Waste Disposal capacity(m <sup>3</sup> )	12000
10	Tailing Pond Area (Acres )	3.89(3 Ponds with 80m*50m*2.5 m)
11	Water requirement (KLD)	425
12	Source of Water	Bore well within the premises
13	Sewage Generation (KLD)	5.0
14	Disposal of Sewage	Septic Tank
15	Trade Effluents (KLD)	400
16	Power requirement (kVA) Source :TNEB	700
17	Power Backup (DG Set) kVA	1 x 500 1 x 380

18	Manpower requirement (Nos)	149
19	Project Cost (Lakhs)	2800

ROM graphite ore will be transported to the Beneficiation Plant for enhancement of grade. The site is suitable due to interlinking of both the mine & beneficiation plant is located nearby only involving less transportation activities.

## 1.2 Land Use Pattern:

### Beneficiation Plant Land Breakup:

S. No	Description	Acres	Hectares
1	Built up area	6.12	2.477
2	Solid Waste Storage/Disposal area	2.59	1.050
3	Green Belt/Irrigation area	3.44	1.390
4	Vacant area	1.05	0.423
<b>Total</b>		<b>13.20</b>	<b>5.340</b>

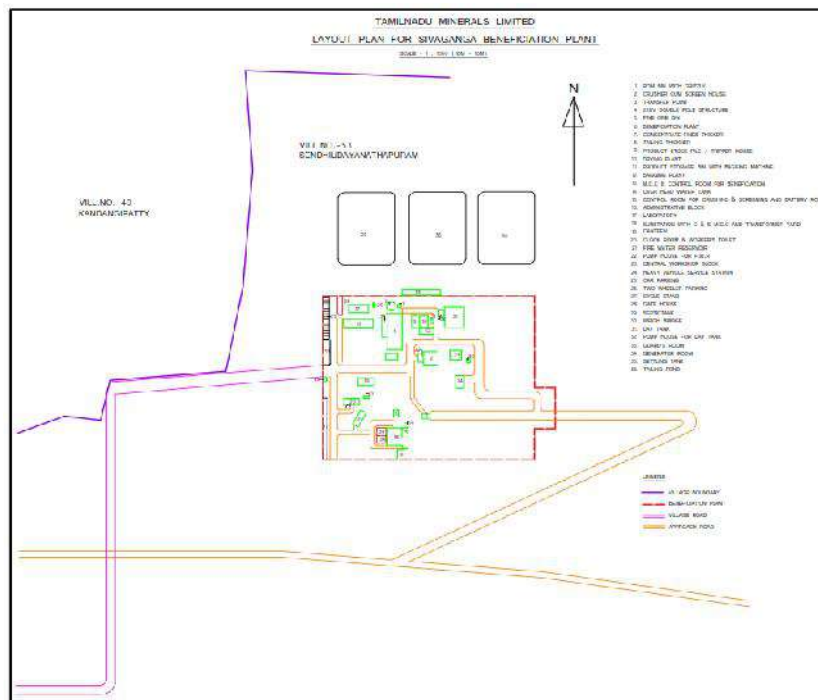


Figure 1-1 Beneficiation Plant Layout

## 1.3 Brief Description of Beneficiation Plant:

### 1.3.1 Crushing /Grinding and Screening:

Up to 250mm size of Graphite ore from Mine (RoM) is being fed to Hopper ROM passing through grizzly is fed to Double Deck Vibrating Screen provided with screening surfaces having openings of 50mm and 10mm. The +50mm material is fed to a primary double toggle jaw crusher to produce 80-85% passing 50mm and the -50 + 10mm material is fed to an

Impactor. The crushing section is operated in closed circuit with the double deck screen. The -10mm material from the double deck screen is wet ground in a rod mill with the addition of requisite amount of Sodium Silicate and Sodium Carbonate solutions (10%). Proper functioning of the rod mill is monitored through measurement of

- a) Pulp density of mill discharge
- b) Screen analysis of the mill discharge and
- c) Power drawn by the mill

### **1.3.2 Beneficiation Section:**

- The Beneficiation section is operated in three shifts round the clock.
- The discharge from the rod mill (around 95% passing 600 microns) is conditioned with reagents in a conditioner and is subjected to rougher floatation bank in six floatation cells at a pH of 8.5 – 9.0, which is maintained by the addition of sodium carbonate solution.
- The tailings from the rougher bank are sent to another similar tank of six cells for scavenging after addition of froth (MIBC + DIESEL/KEROSENE mixture)
- The froth from the rougher cell is fed to a regrinding ball mill through a cyclone, the under flow of the cyclone being feed to the mill.
- The over flow of the cyclone along with the mill discharge is subjected to first stage cleaning in a floatation column.
- The froth product from the column is subjected to grinding in a ball mill and the mill product is further cleaned in a bank of two cells (one twin cells).
- The froth product from this bank is subjected to screening and washing in a screen for further improving the grade, while the tailings from the bank are fed to the scavenger banks.
- The under size of the screen is fed to a regrinding primary ball mill through a cyclone; the under flow of the cyclone being the feed to the mill.
- The overflow of the cyclone along with the mill discharge is fed to a floatation column for further cleaning.
- The froth product from this column is re-cleaned in another column. The froath product from the re-cleaner is collected in the thickener.
- The tailings from the product cleaner and re-cleaner columns are fed to the scavenger column cell along with the tailings of the coarse cleaner and the product of the coarse scavenger cells.
- The froth from this scavenger column is fed to secondary regrinding ball mill through a hydro-cyclone, the feed to the mill being the under flow of the cyclone.

- The discharge from this mill and the over flow from the cyclone are fed to the first cleaner column along with the discharge from the primary regrind mill for cleaning. The tailings from the scavenger column are re-circulated to the rougher bank.

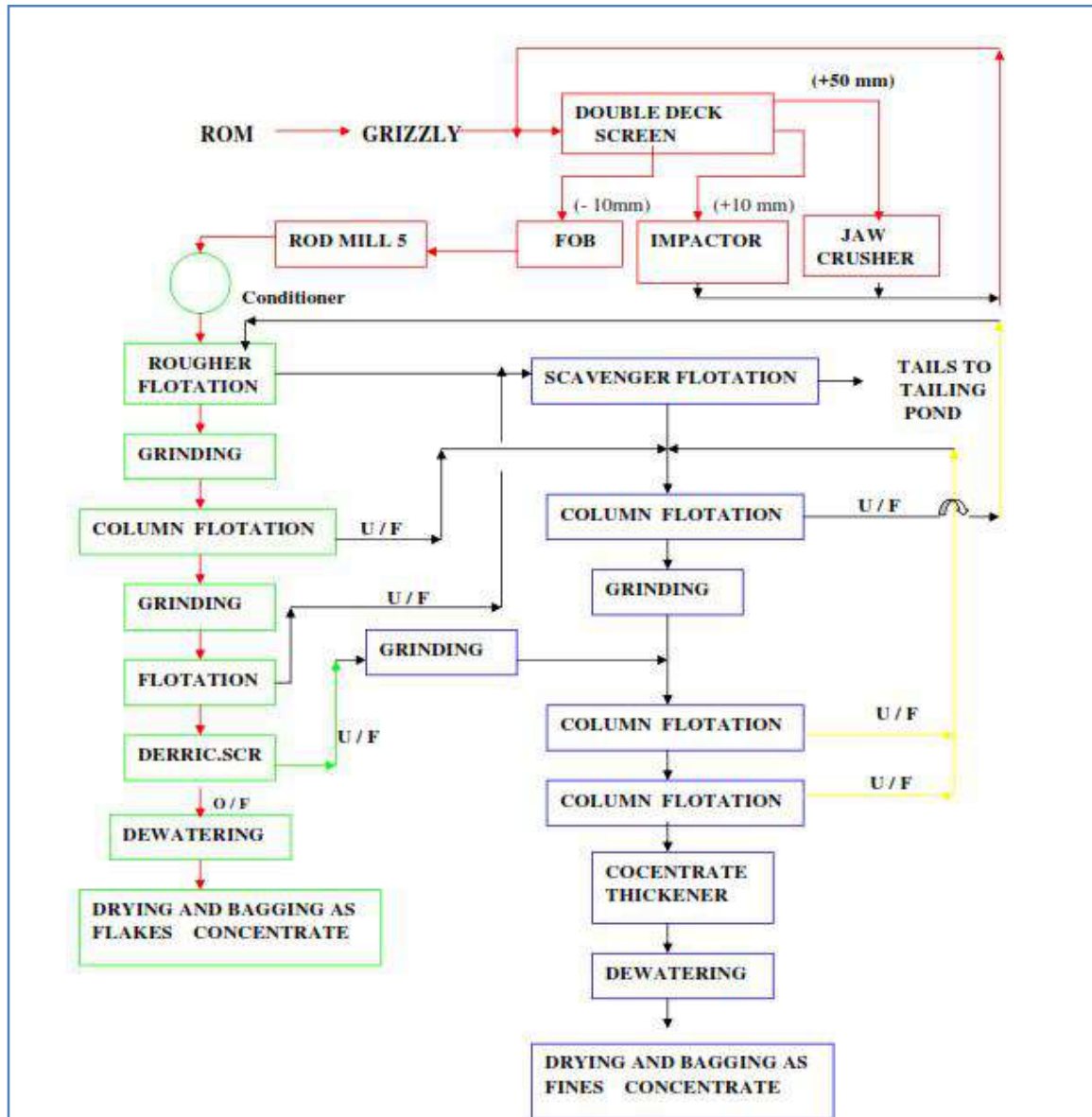


Figure 1-2 Process Flow chart

### 1.3.3 Dewatering and Drying:

- The froth product from rougher flotation is collected in the concentrate thickener and the thickened product slurry is dewatered and filtered in the form of cakes. The moist filter cakes are dried in double drum rotary driers, where the moisture content is reduced to less than 2% from 30-35%.

### 1.3.4 Bagging Section:

- The dried material from the driers will be bagged in bagging machine in water proof HDPE Bags and shifted to product storage building for dispatching.

### 1.3.5 Tailing disposal

- The tailings collected in tailing thickener from the scavenger cells are taken and allowed to settle in the nearby 3 settling ponds, each having a size of 80m X 50m X 2.5m with storage capacity of 12000cum.
- Periodically these ponds are cleaned for accommodating new plant tailings.



Figure 1-3 Photographs of Beneficiation plant



Figure 1-4 Beneficiation Plant Photographs

#### 1.4 Tailing Waste Treatment and Disposal:

Final Tailings being treated before pumping to Settling ponds, 3 settling ponds are being established with SIZE: 80m X 50m X 2.5m dimensions. Photographs of Trailing Waste Treatment and Disposal are shown in **Figure 1-5**. Tailings being Allowed to Settle for Removal and Safe Stacking at Industry's Own Land for drying after drying (settled tailings) being loading to tippers than being disposal at dump area in beneficiation own land.



Figure 1-5 Photographs of Tailing Waste Treatment and Disposal



**Figure 1-6 Tailing waste dump yard**

### **1.5 Recycling Process of Settled tailing water of Beneficiation Process:**

Tamil Nadu Minerals Limited has set up a Graphite Beneficiation Plant in the year 1994 near by the Graphite Mine.

For beneficiating Graphite ore, the Plant requires around 3.00Lakhs to 6.00Lakhs liters of water per day. The Plant takes water for beneficiation from its own bore wells dug in the lease area and the water accumulating from the Mine Pits.

Due to shortage of rains the plant also suffering for getting water for its day to day operations. Considering this alarming situation, the available water has to be utilized in a proper manner and by recycling the used water. As there is no presence of any harmful chemicals/particles in the tailing water it can be recycled and reused in the plant for beneficiation process.

Around 2.50Lakhs Liters water can be recycled at a time for processing by adding a chemical namely Potassium Permanganate in the ratio of 12.5gms/10000Litrs (ie. 0.00125gms/01Litr). By this simple method, around 40-45Lakhs Liters of tailing water has been recycled and reused in the Plant. While using the recycled water, the quality of the Graphite concentrate is not affected and also there is no harm to the employees working with this water.

### 1.6 Method of Recycling Process:

The tailing water discharged from the Plant is first stored in a concrete tank, having capacity around 3.0Lakhs Liters. Then the Potassium Permanganate Chemical is added in the ration of 0.00125gms/Liters, and thoroughly agitates using compressor air; the agitated water is allowed to settle for around 24Hours. After 24hours of settling the clear water will be tapped for Graphite Processing.

By using this recycling process, the Graphite Plant is utilizing less Ground Water and saving around 3.0Lakhs Liters of Ground Water.



Figure 1-7Photographs of tailing water recycling

## 2 DESCRIPTION OF GRAPHITE MINE

The Proposal of Sivaganga Graphite Mines of M/s. Tamil Nadu Minerals Limited is for expansion of Graphite production capacity from 0.6 LTPA to 1.05 LTPA, from Mine lease area of 236.85 Ha. The mine is located in Pudupatti, Senthudayanathapuram and Kumarapatti Villages, Sivaganga Taluk, Sivaganga District, Tamil Nadu. Mine lease area falls in the survey of India Topo sheet no 58 K/5 and lies between East longitude 78°23'40.20" to 78°27'0.36" and North latitude, 9°53'11.76" to 9°54'0.72". The Mine area exhibits plain terrain; the altitude of the area is above 87 m to 108 m AMSL. The method of mining is Open cast fully mechanized.

M/s Tamil Nadu Minerals Ltd, (popularly known by its acronym TAMIN) is a wholly owned company of Government of Tamil Nadu. This company was established in 1978, by GOTN to carry out systematic development and exploitation of the mineral resources in Tamil Nadu. At present TAMIN is producing and marketing Granite dimensional blocks and Granite value added products, Graphite Flake and Fines concentrates, Indian Standard Sand, Vermiculite in three grades and limestone.

TAMIN has been granted mining lease over an extent of 236.85 Ha, in various survey Numbers in Pudupatti, Senthudayanathapuram and Kumarapatti villages in Sivagangai Taluk and District vide GO No 1328, industries Department, dated 24.12.1986, over an extent of 237.39.5 Ha. for 20 Years which expired on 15.05.2007. Resurvey of lands was taken by the Govt, of Tamil Nadu and corrections were made in revenue records leading to a reduction of 0.54.5 Ha. in the original extend of 237.39.5 Hectares. The difference in extent in respective in village wise, Survey field number wise and sub division wise, totaling an extent of 0.54.5 Ha. as reduced from the original extent certified by the Revenue Department Official. Subsequently, the renewal lease application was duly made on 24.04.2006 for 236.85.00 Hectares,. The lease period is deemed to have been extended up to 50 years i.e. 15.05.2037 as per Section As per Section 8A (5) of Mines & Minerals Development & Regulations Amendment Act, 2015 and rule 3(1) of the Mineral (Mining by Government Company) Rules, 2015,

The production capacity of the mine was 60000 Tons per annum. Mine lease area falls in the survey of India Topo sheet no 58 K/5 and lies between East longitude 78°23'40.20" to 78°27'0.36" and North latitude, 9°53'11.76" to 9°54'0.72".

A beneficiation plant to process the Graphite ore into Graphite Flake and Fines concentrate was also set up outside the mine lease area, near to the captive Mine lease area. TAMIN has been producing graphite ore in this lease for nearly three decades. The total mine lease area based on the revised Government resurvey of the land records is 236.85.00Ha as against 237.39.50 Ha mentioned in the GO.Ms.No.1328. The list of Survey numbers are detailed in **Table 2-1**.

**Table 2-1 Survey numbers of the Mine**

Name of the villages	Survey Nos	Extent in Ha
Kumarapatti	89/1,2,3,4,5,6&7,90/1,4A,4B,4C,4D,4E,3,5,6,7,8,9,10 &2,97/1,2,3,4,5,6,7,8,9,10&11,99/5&7,100/1,2,3,4&5, 101/3,1,2,4&5,142/3,4,5,6,7&1,143/1,2,3,4&5,147/1,2, 4,5,6&7,148/1,2,3&4,149/1&2,167/1,2,3&4,168/1,2,3, 4&5,194,196/4,5&6,197/1&2,199,184,139,144	130.53.5
Senthiudayanathapuram	32/2&4,39/1&3,41/1&3,42/1&2,231/1,2,3,4,6A,6B,7A, 7B,8A,8B,9A&9B,232/1,2,3&4,233/1,2,3,4,5,6,7,8,9&1 0,234/1.4.5.6.7.8.9&10,235/3,4&5,248/2,4,6,7,8,9&10,4 4,249,250,282/1,2&3,309/1,2,11,12,13&14,312/1,7&3 08	62.74.0
Pudupatti	3/14,17,18A&18B,6/7,4D&4E,14/2,3&1,15/2&1,17/1,3, 4,5,6&7,19/1,2,13&22,20/2&5,150/1,12,16,18,149,51/ 1,302/11	43.57.5
<b>Total</b>		<b>236.85.0</b>

## 2.1 Mine Lease Details

The Government of Tamil Nadu had granted mining lease to TAMIN over an extent of 237.39.50 Ha. in Pudupatti, Senthiudayanathapuram and Kumarapatti villages, Sivaganga Taluk and District for 20 years to Graphite Ore Mine, vide G.O. Ms No. 1328, Industries Department, dated: 24.12. 1986. The original extent leased out to TAMIN was 236.85.0 Ha. as per land records. The lease deed was executed on 16.05.1987. The lease period was from 16.05.1987 to 15.05.2007.

TAMIN had submitted an application for renewal of the above mining lease in letter no. 25203/ML1/2005, Dated: 24.04.2006 and the same is under process in the office of the Director of Geology and Mining, Tamil Nadu. As per Section 8A (5) of Mines & Minerals Development & Regulations Amendment Act, 2015 and rule 3(1) of the Mineral (Mining by Government Company) Rules, 2015, the mining lease granted on 16.05.1987 is deemed to have been extended up to 15.05.2037 as it is a captive mine.

Hence, as per Rule 3 (3) of the Mineral (Mining by Government Company) Rules, 2015, the pending renewal application of TAMIN shall be deemed to be application for extension of the period of the mining lease. The Additional Chief Secretary to Government, Industries

Department, Tamil Nadu has also informed that the lease extension of the Sivgangai Captive Graphite Mines, submitted by TAMIN, on 24.04.2006, will be considered positively on the submission of valid Environmental Clearance by TAMIN, vide their Letter No. 11270/MMA.1/2018 -1, Dated: 28.9.2018 to the Ministry of Environment, Forests and Climate Change, New Delhi.

## **2.2 Mining Plan & Scheme of Mining Details**

The Mining Plan for Sivaganga Graphite Mine was approved by the Regional Controller of Mines, Indian Bureau of Mines, Chennai vide TN/PMT/MP/GM- 676, MDS, dated: 11.03.1994 over an extent of 242.46.5Ha. Subsequently, the First Phase of Scheme of Mining for the above said area was approved by the Controller of Mines, Indian Bureau of Mines, Bangalore vide TN/SG/GR/MS-75/SZ, dated: 20.07.2000 for the period pertaining to the years from 1999-2000 to 2003-2004 over an extent of 242.46.5Ha.

Second Phase of Scheme of Mining pertaining to the years from 2004-2005 to 2008-2009 was also approved by the Controller of Mines, Indian Bureau of Mines, Bangalore vide TN/SG/GR/MS-260-SZ, dated: 24.12.2004 over an extent of 242.46.5Ha.

The Scheme of Mining for Renewal of Lease over an extent of 236.85.0Ha was approved by the Regional Controller of Mines, Indian Bureau of Mines, Chennai-90 vide TN/59/GR/MS-SZ, dated: 24.12.2004 pertaining to the years from 2009-2010 to 2013- 2014 over an extent of 236.85.0Ha.

Subsequently, the Scheme of Mining pertaining to the years from 2014-2015 to 2018-2019 was approved by the Regional Controller of Mines, Indian Bureau of Mines, Chennai-90 vide TN/SGN/GR/MS-1123.MDS, dated: 03.09.2014 over an extent of 236.85.0Ha. Subsequently, the Review of Mining Plan for period 2019-2020 to 2023-2024 was prepared and submitted, to the Regional Controller of Mines, Indian Bureau of Mines, Chennai-90, for approval vide TAMIN letter Rc. No.11595/ML1/2005; dated 13.11.2018. This REVIEW OF MINING PLAN, was approved by the Regional Controller of Mines, Indian Bureau of Mines, Chennai-90 vide their letter No TN/SGN/GR/ROMP-1544.MDS, dated: 21.03.2019 over an extent of 236.85.0Ha, valid for the period from 2019-2020 to 2023-2024.

## **2.3 Environmental Clearance Mile stones of the Project**

Earlier, TAMIN applied for environmental clearance from MoEF, New Delhi for a total project area of 319.01 Ha (Comprising 236.85 Ha of ML area and 82.16 Ha external dump area outside the lease). ToR was issued vide letter No. J.11015/204/210 – IA.II (M) dated 19<sup>th</sup> August 2010 and the validity of which was subsequently extended vide MoEF

letter No. J-11015/204/2010 – IA.II (M) dated 26<sup>th</sup> March 2013. Draft EIA/EMP report was prepared and public hearing was conducted on 27.06.2013 at DDC Hall, Collector's Office, Sivaganga District through District Collector of Sivaganga. Final EIA report was prepared and submitted to MoEF vide letter No.11595/ml1/2006 dated 14.08.2013.

In the meantime, in view of the Hon'ble Supreme Court Judgment dated 21.04.2014 in writ petition (Civil) 435/2012 all activities like waste dumping stacking ore are to be within the lease area. Hence, the EC applied area got reduced from 319.10 Ha to 236.85Ha i.e., ML area. Subsequently, TAMIN decided to increase the production to 1.05 LTPA from the earlier applied quantity of 0.6 LTPA. Thus the TAMIN decided to apply for fresh environmental clearance.

The proposal for enhancing the production from 0.6 Lakh TPA to 1.05 Lakh TPA was submitted vide Proposal No. IA/TN/MIN/26592/2015 dated 4<sup>th</sup> Feb 2015. The ToR for this Mine was issued by MoEF&CC by their letter No. J-11015/64/2015-IA. II (M) dated 28<sup>th</sup> May, 2015 enclosed as **Annexure-2**. Public Hearing was conducted on 29.07.2016 Public Hearing minutes are enclosed as **Annexure-3**. Final EIA Submission vide letter No.12991/ML1/2014 dated 30<sup>th</sup> Nov 2016.

During the EAC Meeting held on 30-31<sup>st</sup> Jan 2017, (EC Meeting) it was informed that based on the anticipation of EC, TAMIN increased the production quantity is about 92901 Tons during 2016-2017, so, the Project falls under Violation Category as per S.O 804(E) dated 14<sup>th</sup> March 2017.

Environmental Clearance application was submitted under violation category vide proposal no IA/TN/MIN/64509/2017 dated 19<sup>th</sup> May 2018. Proposal Acceptance letter received from Ministry on 20.06.2018. Proposal was considered for 9<sup>th</sup> meeting of EAC Violation meeting held on 27-28 June 2018 & ToR was issued vide No. 23-153/2018-IA.III (V) dated 13.11.2018. EIA/EMP report with ecological damage assessment, remediation plan, natural resource augmentation plan and community resource augmentation plan was prepared and submitted.

The Proposal of Sivaganga Graphite Mines of M/s. Tamil Nadu Minerals Limited is for expansion of Graphite Mine with production capacity from 0.6 LTPA to 1.05 LTPA, from Mine lease area of 236.85 Ha. The mine is located in Pudupatti, Senthudayanathapuram and Kumarapatti Villages, Sivaganga Taluk, Sivaganga District, Tamil Nadu. Mine lease area falls in the survey of India Toposheet no 58 K/5 and lies between East longitude 78°23'40.20" to 78°27'0.36" and North latitude, 9°53'11.76" to 9°54'0.72". The Mine area exhibits plain

terrain; the altitude of the area is above 87 m to 108 m AMSL. The method of mining is Open cast fully mechanized.

## 2.4 Land Use Pattern of the Mine

The mine is located in Pudupatti, Senthudayanathapuram and Kumarapatti Villages, Sivaganga Taluk, Sivaganga District, Tamil Nadu. The Mine lease area falls in the survey of India Toposheet no 58 K/5 and lies between East longitude 78°23'40.20" to 78°27'0.36" and North latitude, 9°53'11.76" to 9°54'0.72".

**Table 2-2 Land Use Patterns of the lease area**

S.No	Description	Present Area (in Hectares)	Additional area required during the five years Review Of Mining Plan period 2019-2020 to 2023-2024(Ha.)	Total (Ha.)
1	Mining	33.72.0	0.31.5	34.03.5
2	Inter-burden/Side burden Dump	5.90.0	9.29.0	15.19.0
3	Storage for Topsoil	1.08.0	0.33.0	1.41.0
4	Infrastructure	0.72.0	--	0.72.0
5	Mineral stockyard	4.62.5	--	4.62.5
6	Mine Roads	2.61.5	--	2.61.5
7	Area under plantation (Green Belt)	5.98.5	0.52.5	6.51.0
8	Unutilized area	182.20.5	-	171.74.5
<b>Total</b>		<b>236.85.0</b>	<b>10.46.0</b>	<b>236.85.0</b>

### 2.4.1 Land Classification of Lease area

The land classification of the Captive Mine lease area is given in the table 2.4.1. **Error! Reference source not found..** Land use pattern of the Lease area is shown in Table 2-2.

**Table 2-3 Land Classification of the lease area**

S. No	Land details	Pudupatti	Senthudaya nathapuram	Kumarapatti	Total
1	Patta (TAMIN)(Ha)	11.38.5	28.12.5	36.45.5	75.96.5
2	Poramboke (Ha)	32.19.0	34.61.5	94.08.0	160.88.5
<b>Total</b>		<b>43.57.5</b>	<b>62.74.0</b>	<b>130.53.5</b>	<b>236.85.0</b>

## **2.5 Location of the Project**

Mine lease area falls in the survey of India Topo sheet no 58 K/5 and lies between East longitude  $78^{\circ}23'40.20''$  to  $78^{\circ}27'0.36''$  and North latitude,  $9^{\circ}53'11.76''$  to  $9^{\circ}54'0.72''$ . Site Elevation is above 87 m to 108 m AMSL.

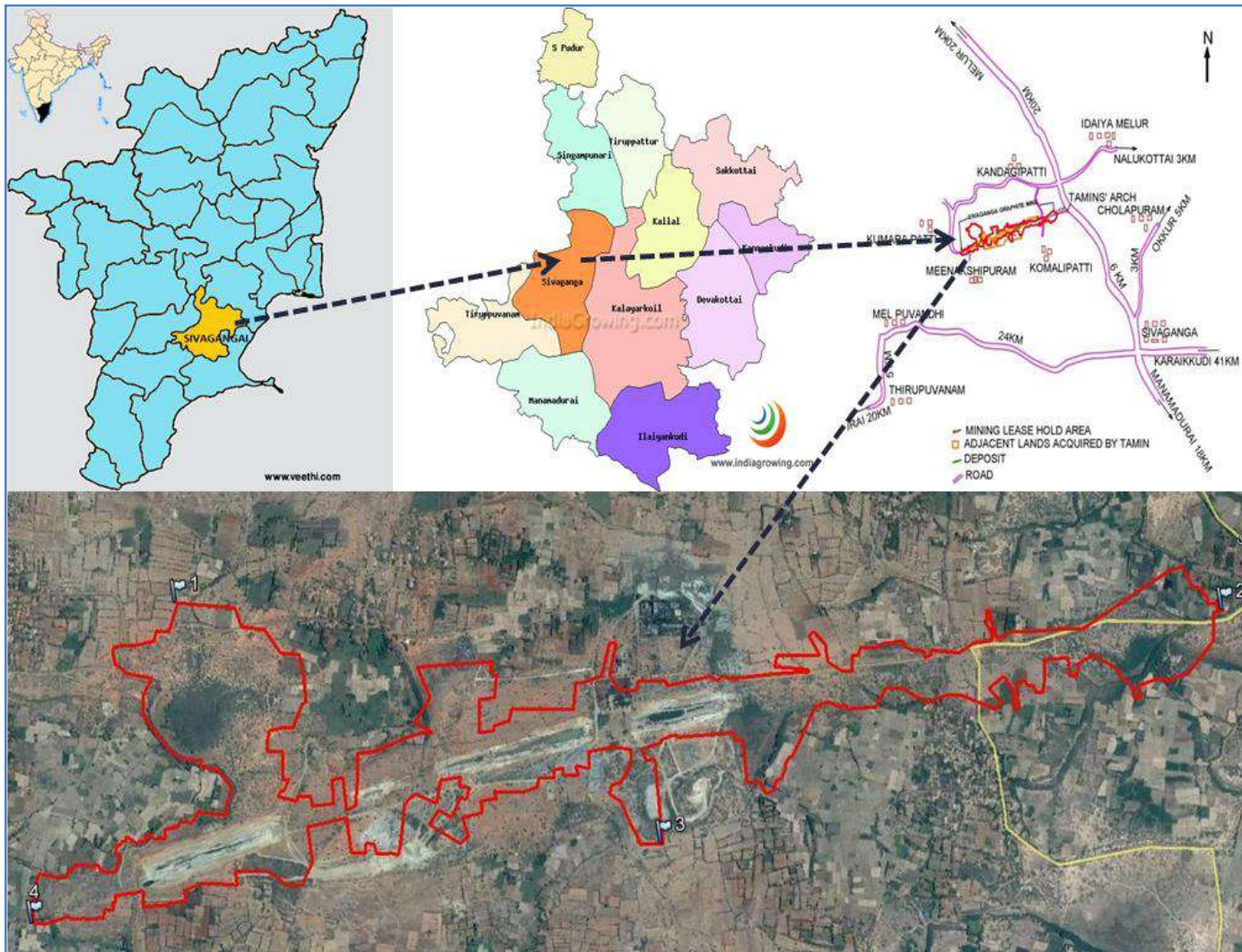


Figure 2-1 Project Location Map

## 2.6 Connectivity of the Project

The graphite mine is located at 3km, West of Pudupatti village on Sivaganga Melur Road (SH-34) and 0.4km, NW of Sivaganga Town. Sivagangai town is the headquarters of the Sivganga District. The Mine lease area is well connected both by road and Rail. The nearest Railway station is Sivaganga on Trichy-Rameswaram Melur gauge section and is 8km from the mine. The site is quite accessible & has good communication & transport facilities.

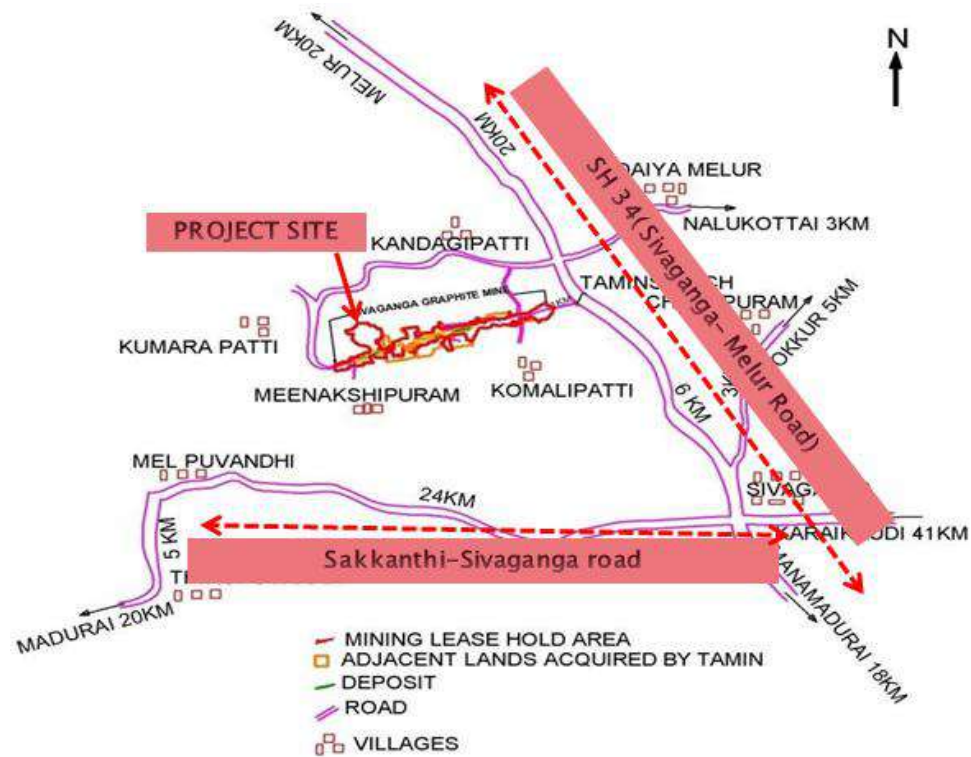


Figure 2-2 Connectivity of Graphite Mine site

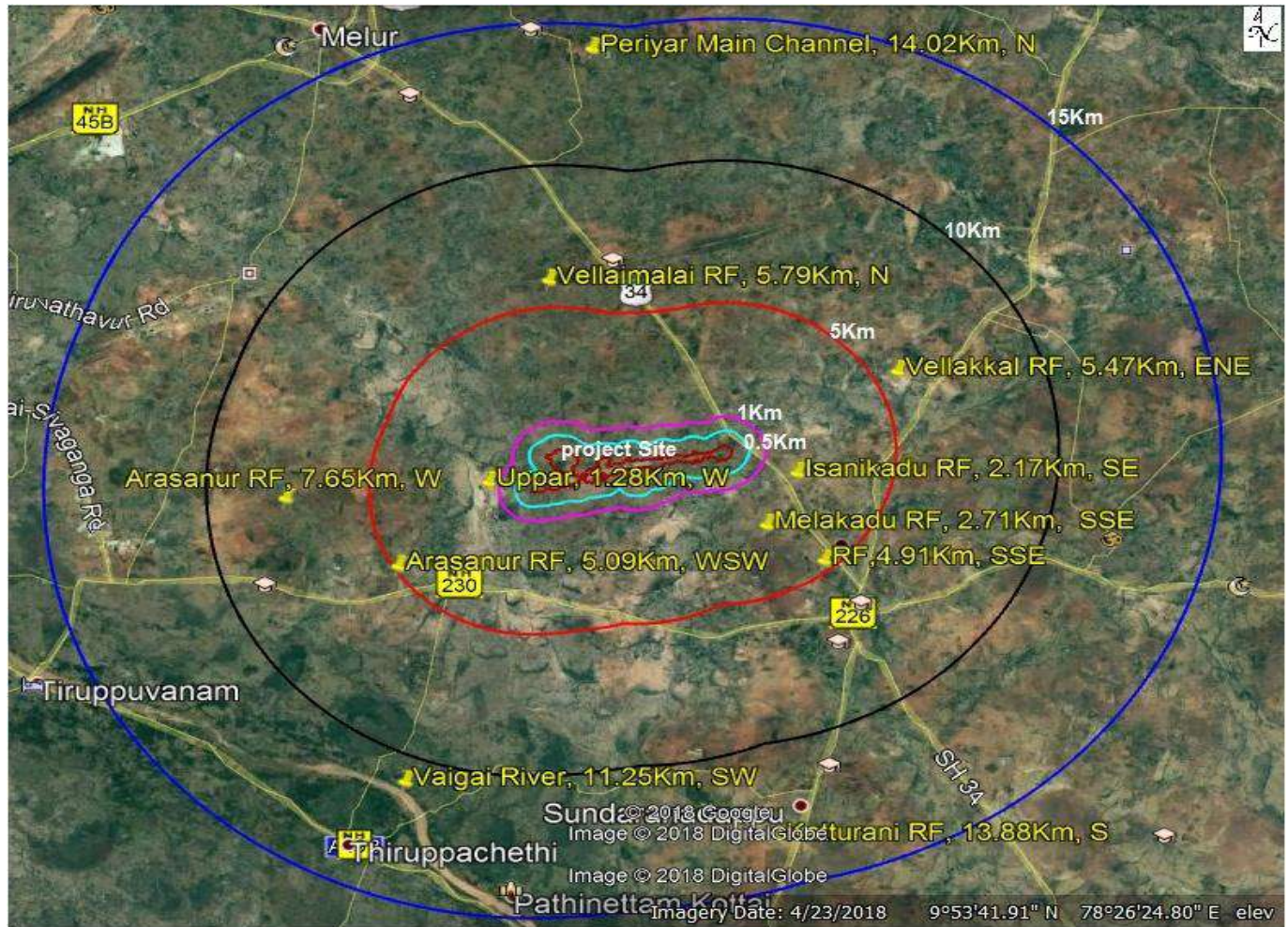


Figure 2-3 Google Image of Environmental Sensitive areas are demarcated within 15 km radius of the project boundary

## 2.7 Salient Features of the Mine Site:

S. No	Particulars	Details
1.	Latitude & Longitude	North :9° 54'0.72" E 78° 24' 4.32" East :9° 53'59.64 E 78° 27' 0.36" South:9° 53' 24.00 E 78° 25' 26.04" West :9° 53' 11.76 E 78° 23'40.20"
2.	Site Elevation above MSL	87 to 108 m above MSL
3.	Topography	Plain terrain
4.	Lease area Topo Sheet details	58 K/5
5.	Land use of the site	Government poramboke land and TAMIN patta land
6.	Extent of lease area	236.85
7.	Quarry Lease (G.O. No.1328)	Lease Renewal from 16.05.2007 to 15.05.2037
8.	Lease Period	30 Years
9.	Depth of Mining	30m Below Ground level
10.	Graphite production (Lakh TPA)	1.05
11.	Proposed Production in Mining Plan (2009-10 to 2013-14) Tonnes	1, 25, 004
12.	Actual Production in Mining Plan period (2009-10 to 2013-14) Tonnes	2, 92, 894
13.	Proposed Production in SOM-I (2014-15 to 2018-19) Tonnes	5, 16, 288
14.	Actual Production in SOM-I (2014-15 to 2018-19) Tonnes	2, 55, 089 (up to 2017-18)
15.	Proposed Production in SOM-II (2019-20 to 2020-24) Tonnes	5, 21, 052
16.	Actual Production in SOM-II (2019-20 to 2020-24) Tonnes	Mine is not in Operation Since 2016-17.
17.	Water Requirement (KLD)	40
18.	Source of Water	Ground Water & Mine Sump water
19.	Power requirement (kVA)	230 (Sourced from TNEB Commercial connection for Lighting load in Mines office)
20.	Power requirement source	TNEB
21.	Power Backup (DG set)	1* 125 kVA 1* 72.5 kVA
22.	Fuel requirements (Lts/Day)	160
23.	Manpower (Nos)	Direct: 70 (Only at Mine Site) (In beneficiation Plant 98 persons Direct & Indirect more than 200 persons)
24.	Municipal Solid Waste Generation (kg/day)	31.5
25.	Waste Oil generation (Lts/Year)	400
26.	Project Cost in Lakh	200

27. Nearest Habitations	<b>S. No.</b>	<b>Name of the Villages</b>	<b>Distance &amp; direction from project site (~km)</b>	<b>Population (Census 2011)</b>
	1	Komalipatti	5.18 (SE)	1,107
	2	Sivaganga	4.66 (SE)	1,339,101
	3	Sakkanthi	2.01 (SE)	1638
	4	Tamarakki South	1.26 (NW)	1955
	5	Sendiudaiyanat hapuram Village	adjacent to Boundary(SE)	2526
	6	Kumarapatti Village	0.5(NW)	1832
28. Nearest highway	1. SH-34 (Sivaganga Melur Road) ~0.4Km(NW)			
29. Nearest Railway station	Sivaganga is about ~8 km (SE)			
30. Nearest Airport	Madurai, ~50 km (West)			
31. Nearest Town / City	Sivaganga ~4.66km (SE)			
32. Water bodies	1. Uppar river ~1.28 km, W 2. Vaigai River ~11.25 km, SW 3. Periyar Main Channel 14.02 Km, N			
33. Nearest Temples within 1km radius of the lease area	<b>S. No</b>	<b>Name of the Temple</b>	<b>Distance(~ km)</b>	<b>Direction</b>
	1	Sri Pathra Kali amman temple	0.03	SW
	2	Shri Aai Karuppan Temple	0.38	NNE
	3	Sri Pachaivalli Amman & Sri Kathayi Amman	0.67	NNE
	4	Sri Sithi Vinayagar Temple	0.47	NNW
	5	Amarajan Temple. Kumarapatti	within the lease area	SW
	6	Vinayagar temple kumarapatti	1.0	NW
	7	Malaikannan Temple	0.71	NNE
34. Hills / valleys	Nil within 15 km radius			
35. Archaeologically places	Nil within 15 km radius			
36. National parks / Wildlife Sanctuaries	Nil within 15 km radius			
37. Reserved / Protected Forests	<b>S. No</b>	<b>Description</b>	<b>Distance(~ Km)</b>	<b>Direction</b>
	1	Isanikadu RF	2.17	SE
	2	RF(unnamed)	4.91	SSE
	3	Melakadu RF	2.71	SSE

		4	Arasanur RF	5.09	WSW
		5	Arasanur RF	7.65	W
		6	Vellaimalai RF	5.79	N
		7	Vellakkal RF	5.47	ENE
		8	Katturani RF	3.88	S
38.	Seismicity	Seismic zone-II			
39.	Defense Installations	Nil within 15 km radius			
40.	Interstate Boundary	Nil within 15 km radius			

**Table 2-4 Graphite Reserves of the Mine**

S. No	Description	Quantity
1	Graphite Reserves/Resources (Million Tonnes)	3.853
2	Graphite Proved Reserves upto 30m (Million Tonnes)	3.211
3	Graphite Mineable Reserves up to 30m (Million Tonnes)	3.211
4	Waste generation tonnes /day	792 to 1,960
5	Percent (%) of extraction (%)	83.34%

### **Mining Methodology**

Open cast fully mechanized mining method is being adopted to extract the Mineral. A thickness of 1.5m top Alluvial soil is being dozed out by using dozer or excavated by excavator and loaded and transported to separate dump yard located in non-mineralized zone in southern side of working pit.

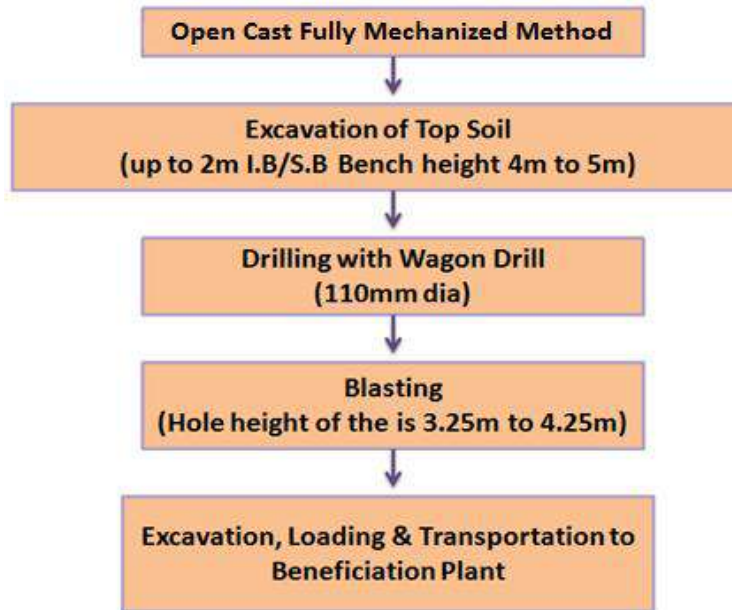
Since the Graphite deposit occurs as bands of varying widths between 0.3m and 16m and dipping almost vertical and exploiting the Graphite Ore adopting a Fully Mechanized method of working along the Strike direction to avoid contamination of Over burden / Inter Burden as well as to extract pure Graphite Ore from Graphite Bands.

The exploited Graphite Ore transported to stockyard for blending. In stockyard, both high and low grades are stacked separately and depends up on the plant requirements, blending works being carried out and blended ore is dispatched to plant. In the Mining Operations the following basic parameters are being considered.

Blasting is being carried out with the hole diameter 110 mm depth of hole 5.75 m, with inclination of 18° from vertical, spacing 2.20 m and a burden of 1.75 m is being adopted.

**Table 2-5 Blasting Parameters**

S. No	Name of the Activity	Method	Range/Measurements
1	Drilling holes	Wagon Drill	110 mm
		Jack Hammer	32 mm
2	Depth of Holes	Wagon Drill	12 feet to 17 feet (5m to 6m)
		Jack Hammer	1 feet to 3 feet
3	Spacing between holes	Wagon Drill	3m (10 feet) Ore 1.5 to 2.0m (5 feet to 7 feet)
4	No of Holes in one blast	Wagon Drill holes	20 to 25 nos
		Jack Hammer holes	200 to 250 nos
5	Average trips made / Day	By Tipper	25 to 30 trips (depends up on the lead)
6	Average Hours of working / Day	Excavator	8 Hrs/Day
7	Average tippers per day	Transportation by tippers	7 Nos



**Figure 2-4**Flow diagram of method of Mining

**Table 2-6 Year wise Production details from 1994-2017**

Year	Proposed in MP/ SPM (Tonnes)		Total	Actual production achieved (Tonnes)		
	ROM	O.B/S.B/I.B	(TONNES)	ROM	O.B/S.B/I.B	Total (Tonnes)
1994-1995	59080	540148	599228	21329	195004	216333
1995-1996	61,410	421,887	483297	15975	109748	125723
1996-1997	62,678	513,899	576577	4569	37461	42030
1997-1998	65,525	607,745	673270	36415	337749	374164
1998-1999	64,876	627,139	692015	31729	306716	338445
1999-2000	34,689	46,430	81119	17867	23914	41781
2000-2001	34,488	34,715	69203	32464	32577	65041
2001-2002	36,888	41,307	78195	50320	56348	106668
2002-2003	37,188	44,503	81691	41320	49448	90768
2003-2004	33,203	52,078	85281	39180	61453	100633
2004-2005	44,963	93,891	138854	42840	89458	132298
2005-2006	47,263	109,867	157130	57200	132966	190166
2006-2007	46,283	125,120	171403	58961	159393	218354
2007-2008	48,521	93,392	141913	49308	94907	144215
2008-2009	46,538	114,581	161119	59227	145823	205050
2009-2010	50,764	393,244	444008	50764	393244	444008
2010-2011	49,329	336,585	385914	49329	336585	385914
2011-2012	37,489	250,649	288138	37489	250649	288138
2012-2013	60,402	141,496	201898	67959	441734	509693
2013-2014	64,602	563,732	628334	87353	762262	849615
2014-2015	103450	371240	474690	71706	257324	329030
2015-2016	102365	642201	744566	90275	566353	656628
2016-2017	104791	400562	505353	92901	355113	448014
2017-2018	104557	259930	364487	207	515	722
2018-2019	101125	278315	379440	0	0	0
2019-2020	103540	588143	691683	0	0	0
2020-2021	104757	469470	574227	0	0	0
2021-2022	103955	237633	341588	0	0	0
2022-2023	104250	273090	377340	0	0	0
2023-2024	104550	299102	403652	0	0	0
<b>TOTAL</b>	<b>2023519</b>	<b>8972094</b>	<b>10995613</b>	<b>1106687</b>	<b>5196744</b>	<b>6303431</b>

## **Transportation**

The sized and blended graphite ore will be transported to the captive beneficiation plant located at a distance of 0.5 km from the Mine lease boundary.

Waste will be transported to the internal dumps located in within the lease area.

### **Details of Internal Dumps:**

- Number of internal dumps : Nil
- Area of each dump : Northern side of the Pit-II extension (2.0.0Ha)
- Height of each dump : 20m with two benches each of 10m.
- Quantity of wastes piled (MCm) :3, 71, and 240 Tonnes
- No back filing envisaged now.

### 3 CUMULATIVE ENVIRONMENTAL IMPACTS

#### General

The project activities w.r.t. Mining & Beneficiation as discussed in previous sections have certain effects on various environmental domains that exist in the area. A scientific assessment of these impacts those are likely to influence the existing environmental scenario is needed. This could also facilitate in formulating a suitable environmental management plan depicting all mitigation measures. It can help in implementing the project in an eco- friendly manner. The project activities influencing the following environmental attributes have been studied and their impacts on the following attributes have been assessed.

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

#### 3.1 Land Environment:

##### 3.1.1 Anticipated Impacts (Mine) - Land Environment:

The Mine is in operations since 1994 and extent of lease area is 236.85.0 Ha, and Land classified as Government poramboke land & TAMIL PATTU Land. Mining Lease was initially granted by the Tamil Nadu Government for a period of 20 years, vide G.O. (3D) No. 1328, industries (MME-II) department, dated 24.12.1986. The lease period was valid up to 15.05.2007. As per Section 8A (5) of Mines & Minerals Development & Regulations Amendment Act, 2015 and rule 3(1) of the Mineral (Mining by Government Company) Rules, 2015, the mining lease granted on 16.05.1987 is deemed to have been extended up to 15.05.2037 as it is a captive mine.

Prediction of environmental impact of the mining activity on land environment are based on the nature of activities, extent of area covered and land use characteristics. Land degradation is inevitable during mining particularly in opencast mines, where the original soil ecosystem and structure are drastically degraded within the core zone.

The impact on land pattern in the area has been and will be due to

- Land degradation due to disposal of large volume of waste materials.

- Creation of infrastructural facilities like office, rest shelter, first-aid centre and other service facilities.
- Exposure of topsoil to wind and water erosion.

**Table 3-1 Land use Pattern of the lease area**

S. No	Description	Present Area (in Hectares)	Additional area required during the five years Review Of Mining Plan period 2019-2020 to 2023-2024(Ha.)	Total (Ha.)
1	Mining	33.72.0	0.31.5	34.03.5
2	Interburden/Side burden Dump	5.90.0	9.29.0	15.19.0
3	Storage for Topsoil	1.08.0	0.33.0	1.41.0
4	Infrastructure	0.72.0	--	0.72.0
5	Mineral stockyard	4.62.5	--	4.62.5
6	Mine Roads	2.61.5	--	2.61.5
7	Area under plantation(Green Belt)	5.98.5	0.52.5	6.51.0
8	Unutilized area	182.20.5	-	171.74.5
<b>Total</b>		<b>236.85.0</b>	<b>10.46.0</b>	<b>236.85.0</b>

The land environment is plain terrain. The land has been classified as Government poramboke and TAMIN's patta land. The entire lease hold area is dry land. The land has been planted with greenery. Existing and Proposed Green Belt Details at Mine Site is given in **Table 3-2**.

**Table 3-2 Existing and Proposed Green Belt Details at Mine Site**

S. No	Year	No. of Trees	Area in Ha.	Period
1	1986-1994	1470	0.98.5	<b>Before Mining Plan</b>
2	1994-1995	300	0.20.0	
3	1995-1996	300	0.20.0	
4	1996-1997	300	0.20.0	
5	1997-1998	300	0.20.0	
6	1998-1999	300	0.20.0	
7	1999-2000	300	0.20.0	
8	2000-2001	300	0.20.0	
9	2001-2002	300	0.20.0	
10	2002-2003	300	0.20.0	
11	2003-2004	300	0.20.0	
12	2004-2005	300	0.20.0	
13	2005-2006	300	0.20.0	
14	2006-2007	300	0.20.0	
15	2007-2008	300	0.20.0	
16	2008-2009	300	0.20.0	
17	2009-2010	300	0.20.0	

18	2010-2011	300	0.20.0	
19	2011-2012	300	0.20.0	
20	2012-2013	300	0.20.0	
21	2013-2014	300	0.20.0	
22	2014-2015	300	0.20.0	
23	2015-2016	300	0.20.0	<b>SOM-I</b>
24	2016-2017	300	0.20.0	
25	2017-2018	300	0.20.0	
26	2018-2019	300	0.20.0	
27	2019-2020	170	0.10.5	<b>SOM-II</b>
28	2020-2021	170	0.10.5	
29	2021-2022	170	0.10.5	
30	2022-2023	170	0.10.5	
31	2023-2014	170	0.10.5	
<b>Total</b>		<b>9,820</b>	<b>6.51.0</b>	

### 3.1.2 Anticipated Impacts (Beneficiation Plant)- Land Environment:

Graphite beneficiation plant covers an area of 13.20 Acres (5.34 ha). Land is owned by Tamil Nadu Mineral Limited. Beneficiation plant is located at a distance of 0.5 km from the Mine lease boundary.

There will not be any major change in the land terrain as the existing facilities are already available at the site. No major change in land use is anticipated. Also there will be no change in the drainage pattern, road connectivity as these infrastructures already exist in the area. No additional internal road will be developed for vehicular movement. Existing tailing pond located in TAMIN owned Land (1.050 ha.)

From 1994 to 2012 Beneficiation tailing waste disposed at outside of the lease area, on land owned by TAMIN, but outside the lease area. The Hon'ble Supreme court of India Judgment dated 21.04.2014 in Writ Petition(Civil) No. 435 of 2012, filed by Goa Foundation Vrs Union of India and others, judgment that, "All activities like waste dumping, stacking of ore, sub grade ore, Mineral rejects, Beneficiation depositing tailing are to be done within the lease area."

Existing External dump details are given below:

S.No	Name of the Waste dump	Length (M)	Width (M)	Height (M)	Area (m <sup>2</sup> )	Volume (m <sup>3</sup> )	Area in (Ha)	Quantity (MT)
1	Mining Waste Dump(Pit1)SE direction	51.94	30.76	7.60	1598	12142	0.16	21856
2	Mining Waste Dump(Pit1)SE	282.89	62.58	18.04	17703	319367	1.77	574260

	direction							
3	Tailing Waste (Pit 1) SE direction	322.0	93.0	18.0	29946	539028	3.0	1078056
4	Top Soil dump (Magazine back side)	157.05	56.87	6.22	8931	55554	0.89	111107
5	Mining Waste (Pit 2) SW Direction	687.49	84.69	16.97	58224	988053	5.82	178496
6	Top Soil dump(Pit 2) NW direction	114.69	60.44	12.44	6932	86232	0.69	172465
<b>Total</b>					<b>12334</b>	<b>2000376</b>	<b>12.33</b>	<b>2136240</b>

**Summary:**

There will not be any major change in the land terrain as the existing facilities are already available at the site. No major change in land use is anticipated. Also there will be no change in the drainage pattern, road connectivity as these infrastructures already exist in the area.

**3.2 Air Environment**

The main source of air pollution in an open cast mining activity is dust generation from excavation of graphite, movement of vehicles for transportation of product to stock yard, drilling, and wind erosion of dumps and also gaseous emission due to operation of diesel driven mining equipment. The sources of air emission are detailed below in **Table 3-3**.

**Table 3-3 Sources of air pollution at Mine Site**

S. No	Source of emission	Pollutant
1.	Excavation of Graphite	PM
2.	Operation of diesel driven equipment	Gaseous emission
3.	Transportation of Graphite to Beneficiation Plant	PM

Base line data reveals that ambient air quality in the study area for the Parameters PM, SO<sub>2</sub>&NO<sub>2</sub>, are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural & Other areas.

The major air pollution sources from the mining operations are DG sets, mining activities like drilling, and transportation. The DG set are provided with stacks of adequate height to disperse the emanating flue gases containing suspended particulate matters, oxides of sulphur and nitrogen without affecting the ground level concentrations. The emissions mainly

generated from the mining activities are Blasting, Drilling, Excavation, Loading, Unloading, and transportation etc.

The main source of air pollution is from Beneficiation Plant activities DG Sets, Crushing, and Grinding Rotary dryers and other units of beneficiation plant. Crusher is provided with dust collector, Rotary Dryer are provided with bag filters to arrest the dust emanating, Bag area/section have a bag filter and 2 DG Sets are provided with acoustic enclosures with stack height of 5m.

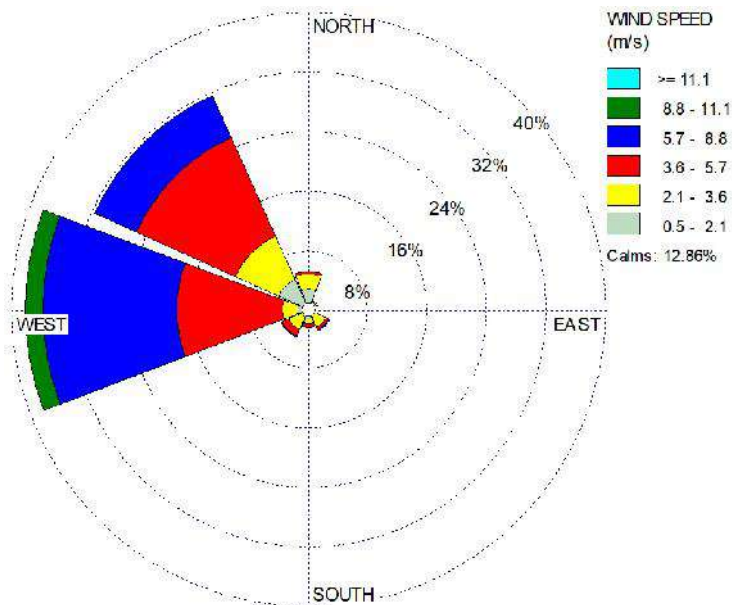
The cumulative Air modeling is carried out for Beneficiation Plant and Mining activities.

Base line data reveals that ambient air quality in the study area for the Parameters SPM, SO<sub>2</sub>& NO<sub>2</sub>, are well within the permissible Limits as prescribed by the National Ambient Air Quality Standards (NAAQS) for Industrial Area, Residential, Rural & Other areas.

The major air pollution sources from the mining operations are DG sets, mining activities like blasting, drilling, etc., and transportation. The DG set are provided with stacks of adequate height so as to disperse the emanating flue gases containing suspended particulate matters, oxides of sulphur and nitrogen without affecting the ground level concentrations. The emissions mainly generated from the mining activities are Blasting, Drilling, Excavation, Loading, Unloading, and transportation etc.

### **Meteorological Data**

The site specific meteorological data for three months from March 2018 to May 2018 was obtained from secondary sources and processed in AERMET to plot wind rose diagram (**Figure 3-1**). Other data included for AERMET were daily wind speed, wind direction, temperature, relative humidity, air pressure, precipitation, and solar radiation recorded during the period. AERMET reformats meteorological data so that it can be used as input for AERMOD model.



**Figure 3-1 Wind rose diagram considered for Dispersion Modeling (March to May 2018)**

### 3.2.1 AERMET Process

For the 3 phase AERMET processing of the meteorological data, specifications of the land use in the area are required to determine the terrain roughness for modeling. The land use was characterized for in and around the site. The surface characteristics for the site and surroundings were selected and used to calculate the Albedo, Bowen ratio and surface roughness parameter.

The meteorological data were processed in the AERMET software to generate wind flow pattern & to generate surface meteorological data and profile meteorological data in a prescribed format that can be fed to AERMOD for modeling.

### 3.2.2 AERMOD Process

AERMOD Software Version 8.0.5 was used for air dispersion modeling and is applicable to a wide range of buoyant or neutrally buoyant emissions up to a range of 50 km. In addition to more straight forward cases, AERMOD is also suitable for complex terrain and urban dispersion scenarios.

AERMOD is a steady-state plume model. In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function (pdf). This behavior of the concentration distributions in the CBL was demonstrated by Willis and Deardorff (1981) and Briggs (1993). Additionally, in the CBL, AERMOD treats "plume

lofting,” whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into the elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate. For sources in both the CBL and the SBL, AERMOD treats the enhancement of lateral dispersion resulting from plume meander. The emissions mainly generated from the mining activities are Blasting, Drilling, Excavation, Loading, Unloading, and transportation etc. Machinery like compressors and jack hammers are used for Drilling are estimated and used as inputs for the air dispersion modeling as shown in **Table 3-4** to **Table 3-5**.

Maximum incremental value for SO<sub>2</sub>, NO<sub>x</sub> and PM is shown in **Figures 3-2- 3-6** and Top 10 highest Ground Level Concentration (GLC) obtained from modeling are given in **Table 3-8 &3-12** respectively.

### 3.2.2.1 Emission Calculations

Each mining activities is a source of emission and the estimation of emissions depends on parameters such as meteorological, topographic conditions and material characteristics. It is necessary to calculate the amount of emissions for work or a source on site to the atmosphere. The following emission formulas are used to calculate the emission rate for the different emission source.

**Table 3-4 Overview of the Source Parameters**

S. NO	Description	Symbol	Quantity
1	Moisture Content (%)	m	5
2	Silt Content (%)	s	11
3	Wind Speed (m/s)	u	2
4	Hole Dia (mm)	d	110
5	Frequency (Holes/Day)	f	25
6	Frequency of Loading (No/Hr)	Ff	0.042
7	Production / Day		222.9
8	Average Vehicle Speed	v	4.0
9	No of Working Days in Year	n	300
10	Waste Dumping Area (Sq.Km)	a	0.03
11	Open Pit Area (Sq.Km)	Aa	0.13

**Table 3-5 Emission Factors Considered for emission estimation and Air Quality Modelling**

Description	Activity	Equation	Units	Emission Factor
Top Soil Handling	Top Soil Removal	0.029	Kg-TSP/Tonn	0.029
	Bull Dozing	$2.6 * S^{1.2} * M^{-1.3}$	kg PM10/hour	5.7014
	Loading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00029
	Transportation	$[\{(100-m)m^1\}^{0.35} * \{(us)(100-s)^{-1}\}]^{0.7} * \{0.5+0.1(f+0.42v)\} * 10^{-3}$	g/s	Variable
	Unloading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00029
Drilling and Blasting	Drilling	0.59	kg TSP/hole	0.59
	Blasting	$0.00022 * A^{1.5}$	kg TSP/Blast	0.0378
Over burden Handling	Bull Dozing at loading area	$0.74 * 0.0016 * (U/2.2)^{1.3} * (M/2)^{1.4}$	kg TSP/Tonn	0.00029
	Loading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00349
	Transportation by trucks	$[\{(100-m)m^1\}^{0.35} * \{(us)(100-s)^{-1}\}]^{0.7} * \{0.5+0.1(f+0.42v)\} * 10^{-3}$	g/s	Variable
	Unloading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00349
	Bull Dozing at unloading area	$0.74 * 0.0016 * (U/2.2)^{1.3} * (M/2)^{1.4}$	kg TSP/Tonn	0.00029
Beneficiation Plant	Conveying	---	Kg-TSP/Tonn	0.005
		---	kg PM10/Tonn	0.002
	Crushing	---	Kg-TSP/Tonn	0.03
		---	kg PM10/Tonn	0.012
	Grinding	---	Kg-TSP/Tonn	1.2
		---	kg PM10/Tonn	0.16
Drying	---	Kg-TSP/Tonn	9.8	
	---	kg PM10/Tonn	5.9	
Tailing Waste handling and Dump Area	Transportation by trucks	$[\{(100-m)m^1\}^{0.35} * \{(us)(100-s)^{-1}\}]^{0.7} * \{0.5+0.1(f+0.42v)\} * 10^{-3}$	g/s	Variable
	Unloading	$0.0012 * (U/2.2)^{1.3} * (M/2)^{1.4}$	Kg-TSP/Tonn	0.00349
	Bull Dozing at unloading area	$0.74 * 0.0016 * (U/2.2)^{1.3} * (M/2)^{1.4}$	kg TSP/Tonn	0.00029

**Source: 1.** Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals by NPI, Nov 1999

**2.** Determination of the emission rate from various opencast mining operations, S. K. CHAULYA\*, M. K. CHAKRABORTY, et. Al. Water, Air, and Soil Pollution 140: 21–55, 2002.

**3.** AP-42, Mining and processing non-metallic minerals

**Table 3-6 Emission from DG Set of Mining site**

Source	Fuel used	Stack Details					Emission per Stack (g/s)				
		No of Stack	Height (m) AGL	Dia (m)	Temp (°C)	Exit Velocity (m/s)	PM	SO <sub>2</sub>	NO <sub>x</sub>	CO	HC
125 KVA DG	Diesel	1	3	0.15	380	9	0.0340	0.0003	0.0500	0.0420	0.0110
*380 KVA DG		1	5	0.15	400	9	0.0476	0.0004	0.0700	0.0588	0.0154
*500 KVA DG		1	5	0.15	410	9	0.0666	0.0005	0.0980	0.0823	0.0216
<b>Total Emission (g/s)</b>							<b>0.148</b>	<b>0.011</b>	<b>0.218</b>	<b>0.183</b>	<b>0.047</b>

Note: \* Beneficiation Plant Power Backup sources.

**Table 3-7 Total Maximum Emission from all Sources**

Source	Average Emission per stack (g/s)						
	PM			SO <sub>2</sub>	NO <sub>x</sub>	HC	CO
	TSPM	PM10	PM2.5				
Mining	0.75	0.149	0.089	-	-	-	-
Beneficiation Unit	1.066	0.298	0.093	-	-	-	-
DG	-	0.148	--	0.011	0.218	0.183	0.047
Vehicles	-	1.18E-03	7.08E-4	6.94E-07	1.55E-01	2.00E-02	8.89E-02
<b>Total (g/s)</b>	<b>1.816</b>	<b>0.5916</b>	<b>0.182708</b>	<b>0.011001</b>	<b>0.373</b>	<b>0.203</b>	<b>0.1359</b>

**Note:** Since emission factors are available for TSPM the following assumptions are made for PM<sub>10</sub> and PM<sub>2.5</sub> estimation

1. 20% of TSPM is considered as PM 10 and
2. 60% of PM<sub>10</sub> is considered as PM<sub>2.5</sub>

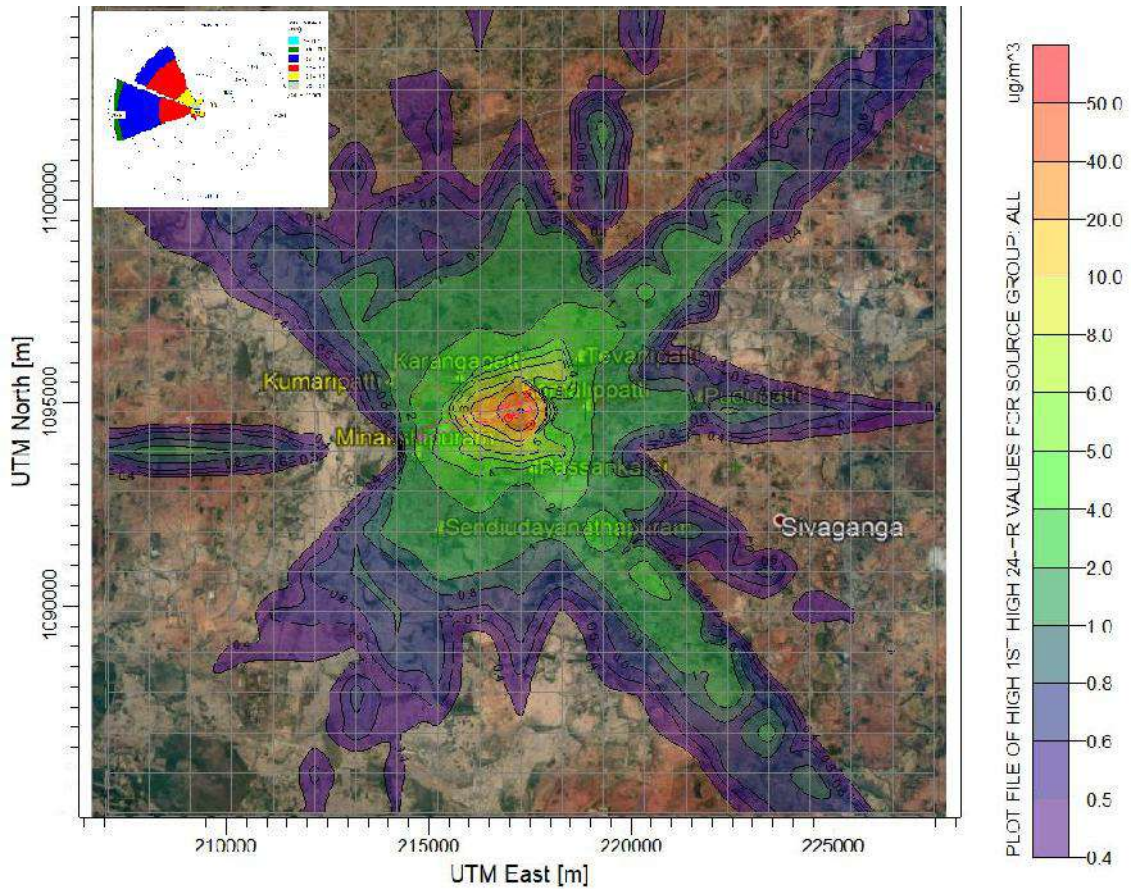


Figure 3-2 Predicted 24 Hrs GLC's of TSPM within 10 km radius of the Study area

Table 3-8 Predicted Top 10 Highest Concentration of Particulate Matter

S.NO	Name of the Receptor	Conc. ( $\mu\text{g}/\text{m}^3$ )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.96154	3.3	WNW
2	Karangapatti	3.56242	1.6	W
3	Tevanipatti	2.90192	1.8	NE
4	Meenakshipuram	1.67878	2.8	WSW
5	Kamalippatti	2.29951	1.6	E
6	Pudupatti	0.74023	4.3	E
7	Passankari	2.56209	1.6	S
8	Sendiudayanathapuram	1.36625	3.7	SSW
9	Sakkanthi	0.14742	5.4	ESE

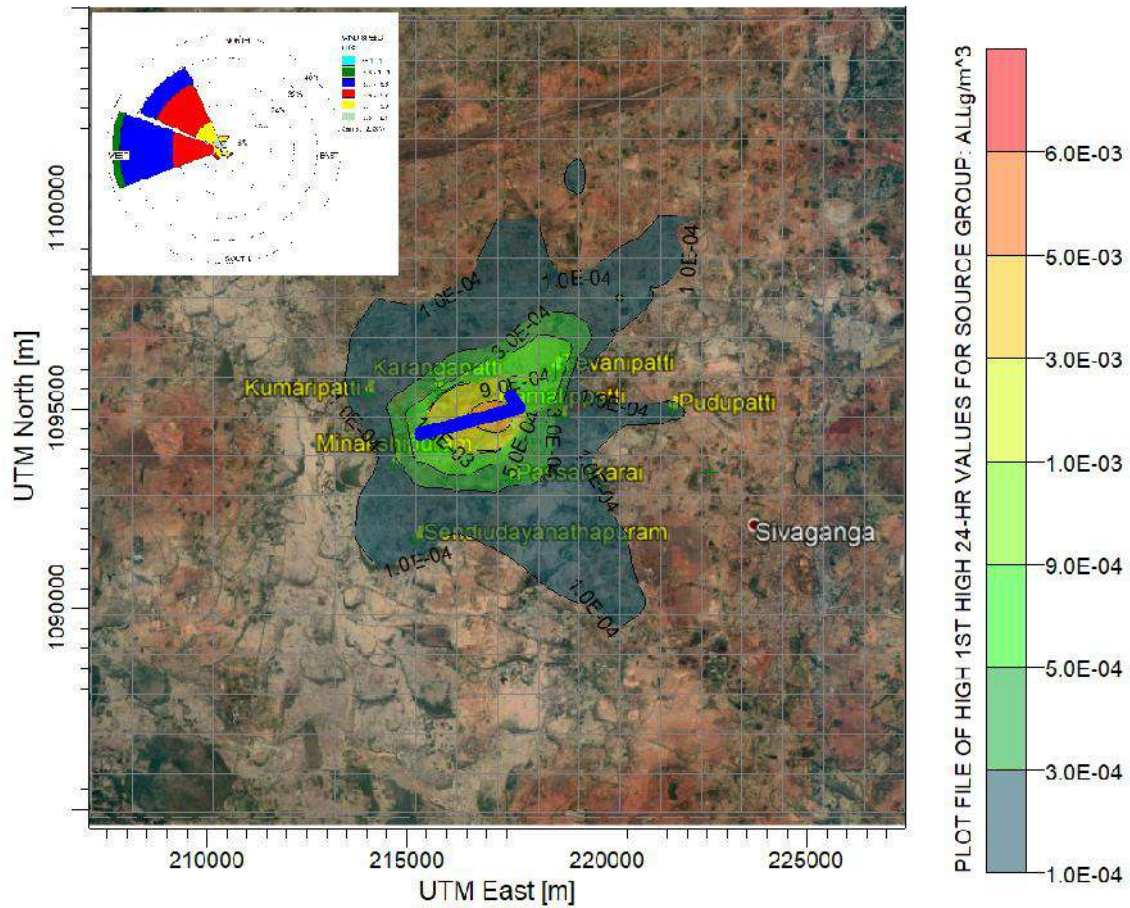


Figure 3-3 Predicted 24 Hrs GLC's of SO<sub>2</sub> within 10 km radius of the Study area

Table 3-9 Predicted Concentration of Sulphur Dioxide at different receptors

S.NO	Name of the Receptor	Conc. (µg/m <sup>3</sup> )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.00013	3.3	WNW
2	Karangapatti	0.0005	1.6	W
3	Tevanipatti	0.00072	1.8	NE
4	Meenakshipuram	0.00021	2.8	WSW
5	Kamalippatti	0.00025	1.6	E
6	Pudupatti	0.00012	4.3	E
7	Passankari	0.00032	1.6	S
8	Sendiudayanathapuram	0.00012	3.7	SSW
9	Sakkanthi	1E-5	5.4	ESE

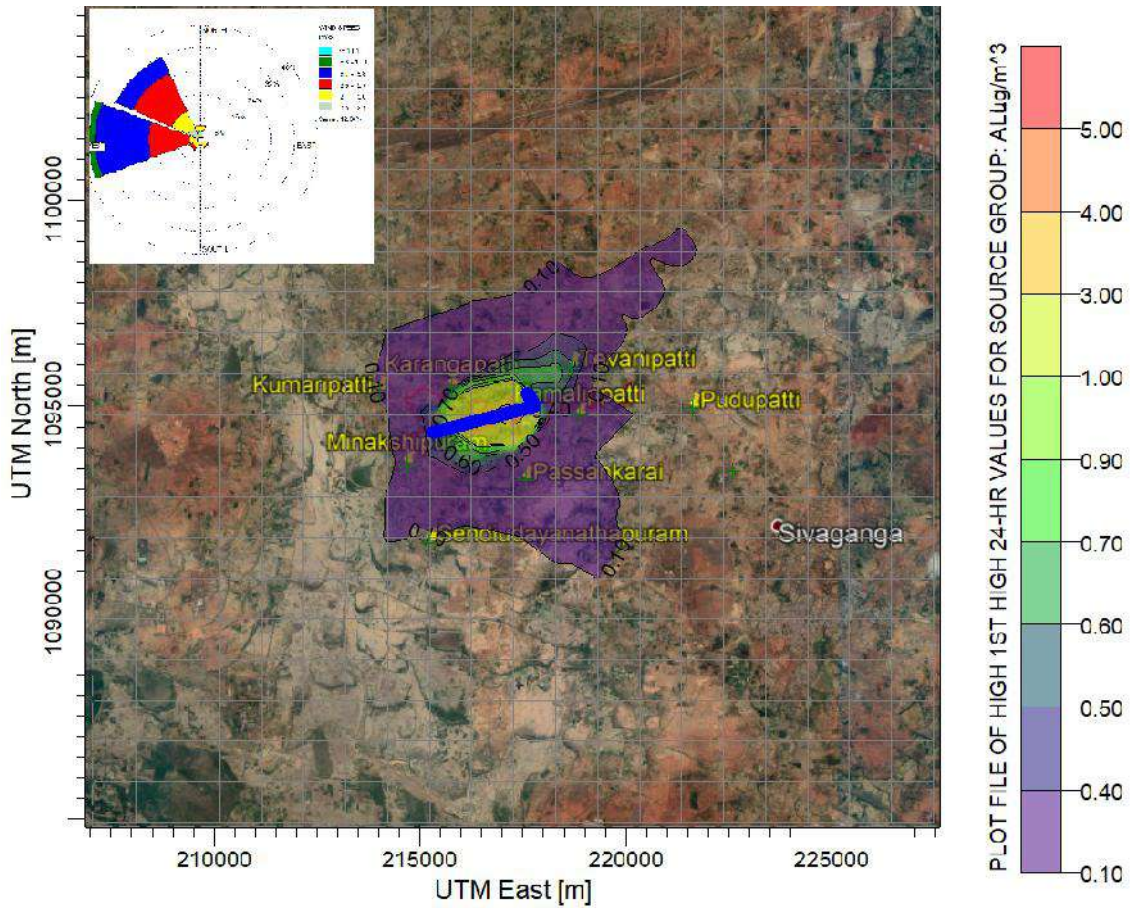


Figure 3-4 Predicted 24-Hrs' GLC's of NOx within 10 km Radius of the Study Area

Table 3-10 Predicted Concentration of Nitrogen Oxide at different receptors

S.NO	Name of the Receptor	Conc. ( $\mu\text{g}/\text{m}^3$ )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumariipatti	0.102	3.3	WNW
2	Karangapatti	0.347	1.6	W
3	Tevanipatti	0.531	1.8	NE
4	Meenakshipuram	0.162	2.8	WSW
5	Kamalipatti	0.189	1.6	E
6	Pudupatti	0.089	4.3	E
7	Passankari	0.247	1.6	S
8	Sendiudayanathapuram	0.089	3.7	SSW
9	Sakkanthi	0.112	5.4	ESE

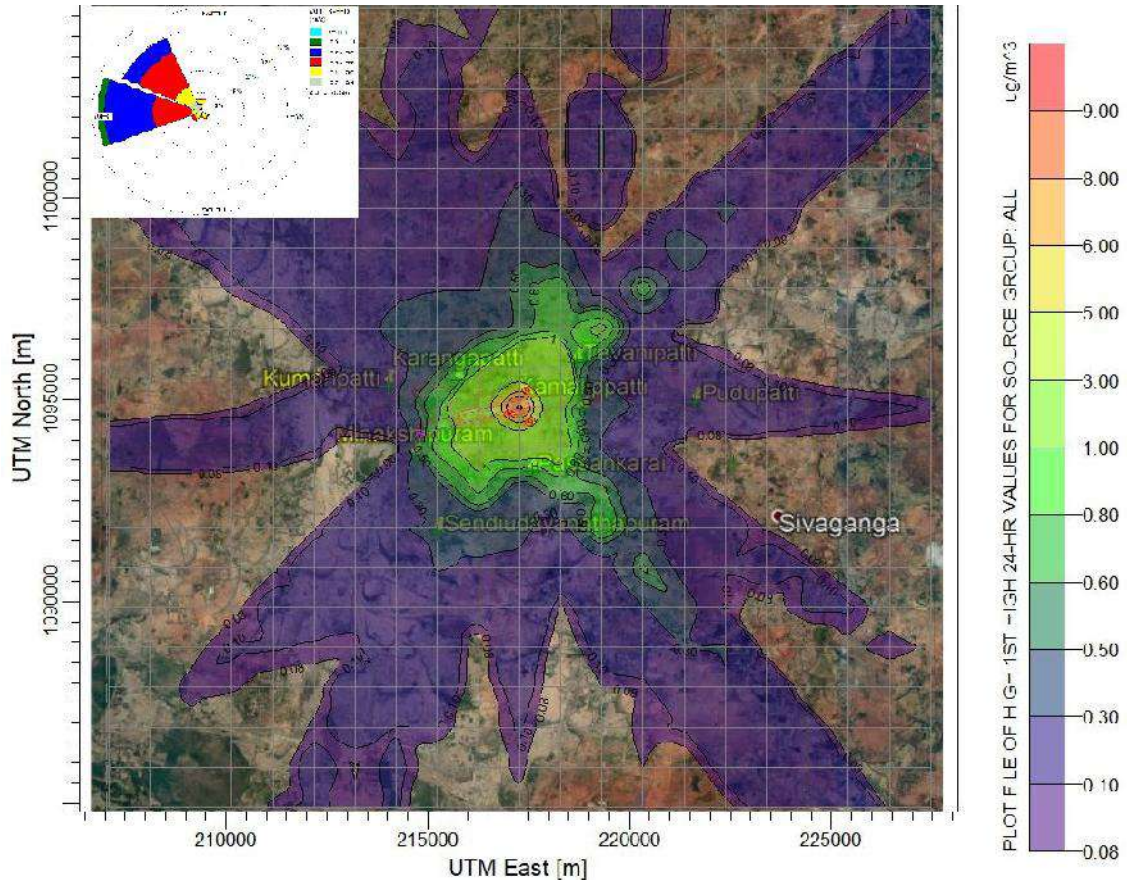


Figure 3-5 Predicted 24-Hrs' GLC's of PM<sub>10</sub> within 10 km Radius of the Study Area

Table 3-11 Predicted Concentration of PM<sub>10</sub> at different receptors

S.NO	Name of the Receptor	Conc. (µg/m <sup>3</sup> )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.19436	3.3	WNW
2	Karangapatti	0.72516	1.6	W
3	Tevanipatti	0.67801	1.8	NE
4	Meenakshipuram	0.33425	2.8	WSW
5	Kamalipatti	0.48546	1.6	E
6	Pudupatti	0.16443	4.3	E
7	Passankari	0.64258	1.6	S
8	Sendiudayanathapuram	0.34114	3.7	SSW
9	Sakkanthi	0.03897	5.4	ESE

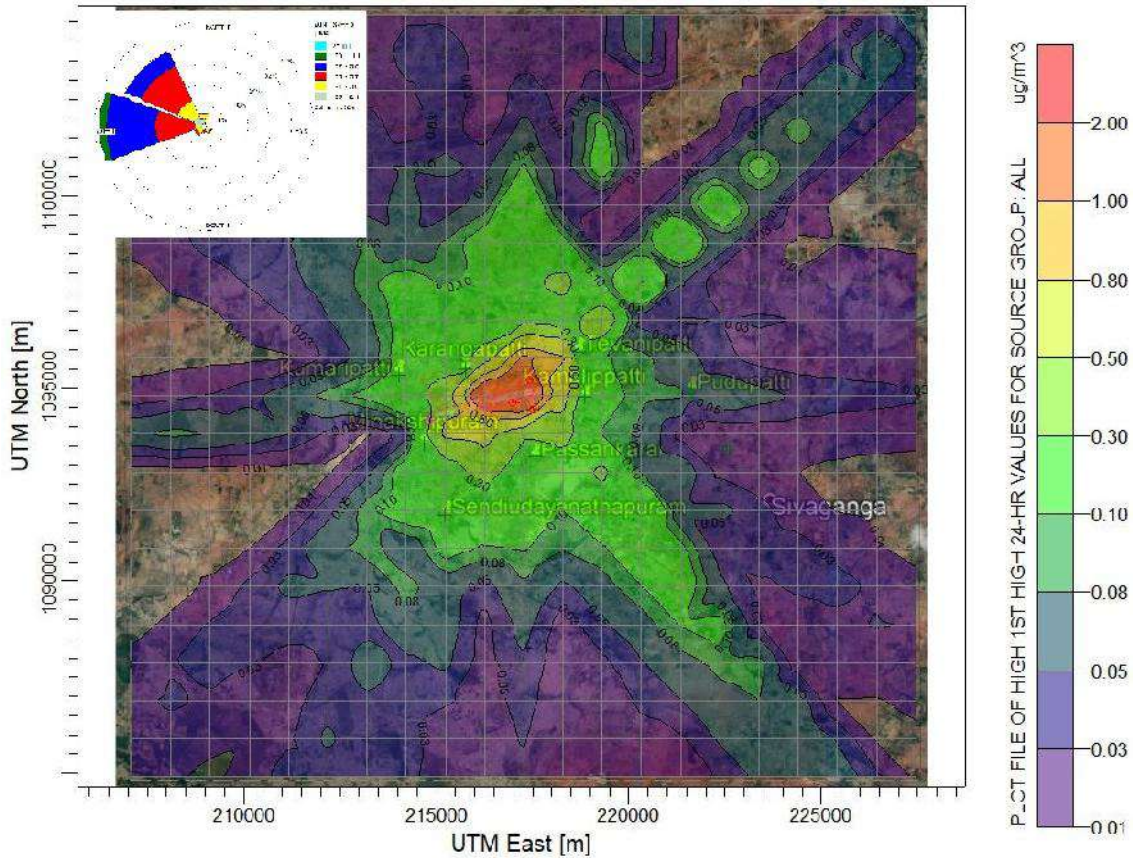


Figure 3-6 Predicted 24-Hrs' GLC's of PM<sub>2.5</sub> within 10 km Radius of the Study Area

Table 3-12 Predicted Concentration of PM<sub>2.5</sub> at different receptors

S.NO	Name of the Receptor	Conc. (µg/m <sup>3</sup> )	From Centre of Mine Lease Area	
			Distance (Km)	Direction
1	Kumaripatti	0.10972	3.3	WNW
2	Karangapatti	0.2721	1.6	W
3	Tevanipatti	0.1999	1.8	NE
4	Meenakshipuram	0.19968	2.8	WSW
5	Kamalippatti	0.16567	1.6	E
6	Pudukatti	0.06119	4.3	E
7	Passankari	0.18072	1.6	S
8	Sendiudayanathapuram	0.12632	3.7	SSW
9	Sakkanthi	0.01528	5.4	ESE

### 3.2.3 Conclusion:

It was observed that the maximum ground level concentration observed due to mining activities and traffic movement for TSPM, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>x</sub> are 43.21 µg/m<sup>3</sup>, 8.858 µg/m<sup>3</sup>, 1.638 µg/m<sup>3</sup>, 0.0053 µg/m<sup>3</sup> and 3.5965 µg/m<sup>3</sup>. So it can be concluded that even

after the operation of mines and beneficiation plant, the impact envisaged is moderate. The total increase in concentrations above baseline status to estimates is summarized in **Table 3-13**.

**Table 3-13 Total Maximum GLCs from the mining activities**

Pollutant	Predicted Cumulative Maximum Conc. at Mining + Beneficiation Unit ( $\mu\text{g}/\text{m}^3$ )	NAAQ standard
TSPM	43.21	500
PM10	8.585	100
PM2.5	1.638	60
SO <sub>2</sub>	0.0053	80
NO <sub>x</sub>	3.596	80

### Impacts due to Transportation

The Graphite is transported to Beneficiation Plant located outside of the lease area at a distance of 500m of the Mine lease boundary. The Factory is in operation since 1994 and Graphite is being transported through existing road by tippers and approx.30-35 trips are required per day.

#### 3.2.4 Water Environment

The existing water environment quality has been studied, which show that generally the water quality in the area is well within statutory standards. The major sources of water pollution due to this mining operation will be domestic sewage only. There is no effluent generation by open cast mining of Graphite Mine. The Mine water requirement is shown in **Table 3-14**. The total water requirement is met through from existing bore well & mine sump water (rain water storage) within the lease premises. NOC for abstracting the ground Water obtained from Govt. of TN Public Works Department.

**Table 3-14 Water requirement for Mine Site & break up**

S. No	Description	Water Requirement(KLD)
1	Domestic Use	3.5
2	Dust suppression	20.0
3	Green belt	16.5
<b>Total</b>		<b>40.0</b>

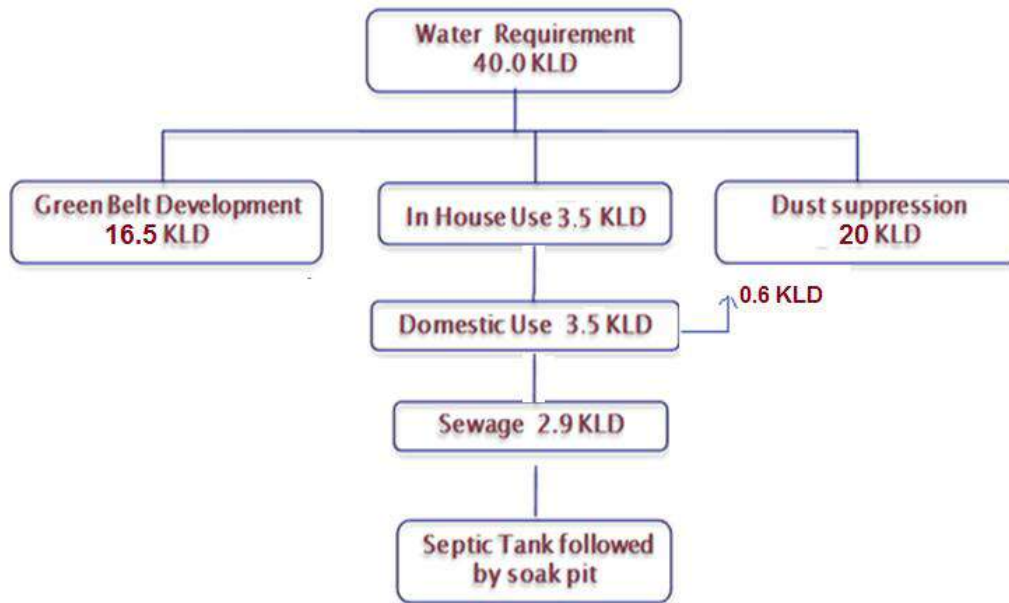


Figure 3-7 Water Balance of the Mine site

### 3.2.4.1 Impacts:

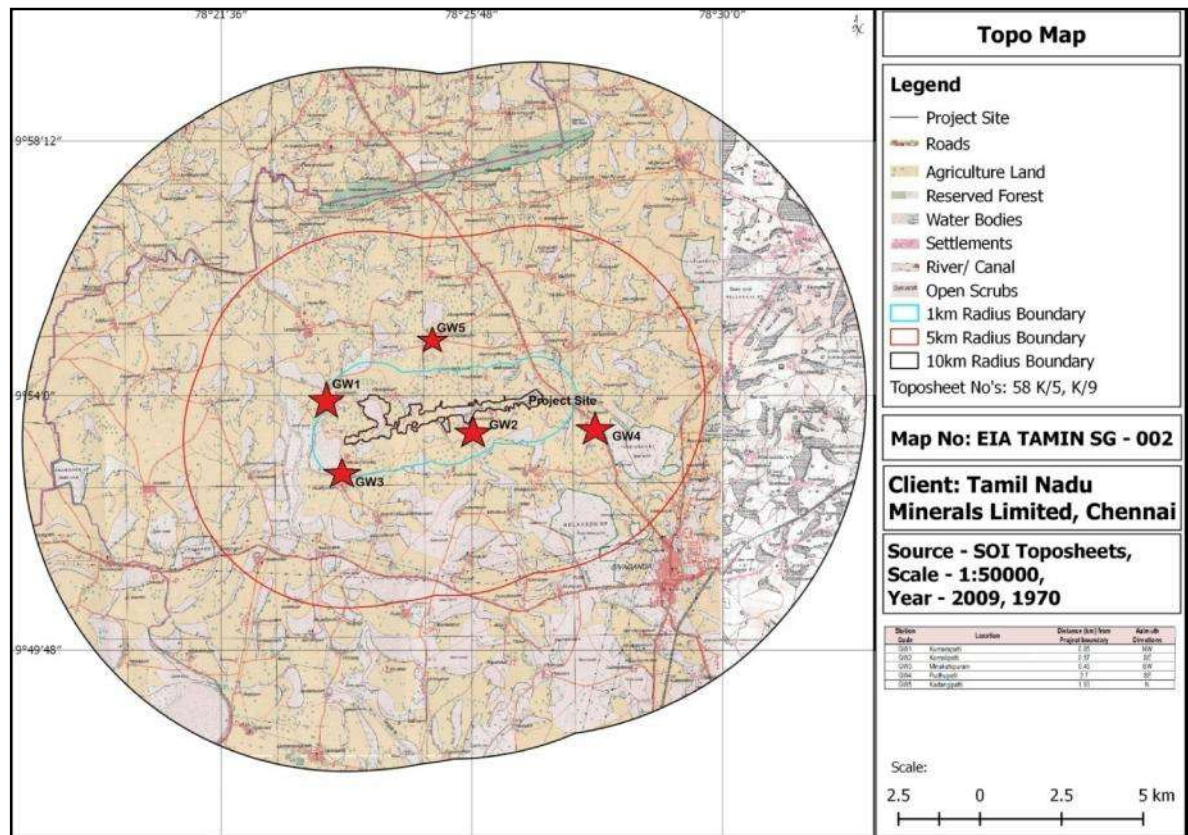
#### 3.2.4.1.1 Ground Water Monitoring at Mine Site

There is no process effluent generation; the domestic sewage approx. 2.9KLD is disposed through septic tank followed by soak pit.

- The domestic sewage from the toilets will be routed to septic tanks.
- Regular monitoring of water levels and quality in the existing open wells and bore well in the vicinity will be carried out.

The existing water environment quality has been studied in study area of Graphite mine.

Map showing the Ground Water monitoring locations is shown as a **Figure 3-8**.



**Figure 3-8 Map showing the Ground Water monitoring locations**

A summary of analytical results are presented below:

- The average pH ranges from 7.23-7.65, TDS Values were in the range of 290-560 mg/l, Chlorides values ranges from 21.3-158.8 mg/l & remaining all parameters are within the prescribed permissible limits of ISO 10500 Standard in Existing Baseline studies of 2015 EIA.
- Now, in 2018 One month validation studies shows the average pH ranges from 7.34-7.72. The concentrations of fluoride in all the ground water samples are within the Acceptable limit of IA 10500:2012, In the present findings the TDS value varied from 519 mg/l to 771 mg/l for the ground water and for all samples it exceeds the acceptable limits but are within the permissible limits of IS 10500: 2012. The acceptable and permissible limit of TDS for drinking water is 500 mg/l and 2000 mg/l, the Total hardness of the samples ranges is between 219mg/l – 431 mg/l. hardness of the samples exceeds the acceptable limit but are within permissible limits of IS 10500: 2012., The Total alkalinity as calcium carbonate, Magnesium and Chloride are well within the permissible limits & most of the heavy metals concentrations in the study area samples are below detection limits and all are well within the limits of IS 10500:2012.

- The analytical result shows that, all the parameters are within the permissible limit of IS 10500:2012(Drinking water standard).

Normally, wash-offs from the waste dump pollutes the nearby water sources during rain. Therefore, garland drain are developed or constructed to prevent / control of water pollution.

### 3.2.4.1.2 Water requirement for Beneficiation Plant

**Table 3-15 Water requirement for Mine Site & break up**

S. No	Description	Water Requirement(KLD)
1	Domestic Use	6.7
2	Process	400.0
3	Green Belt	18.3
<b>Total</b>		<b>425.0</b>

#### **Wastewater Management:**

- Total sewage generation quantity is about 5.0 KLD, it will be disposed through septic tank (2 Nos) followed by soak pit. The dimensions of septic tank are 4.0 x 1.4x 1.8 meters.
- Trade effluents are being generated from process is 400 KLD. The trade effluents (tailing wastewater) is being treated in Effluent treatment plant (270 KLD) and reused in process.
- Treated/Recycled water is about 270 KLD
- Daily fresh water requirement is 155 KLD
- Source of Water: Ground Water through Bore well located within the factory premises
- NoC is obtained for abstracting Ground water from Water Resource Department \_PWD Tamil Nadu State.

### 3.2.4.1.3 Ground Water Monitoring at Beneficiation Plant Site

Groundwater is the principal source for domestic and drinking purposes in almost all villages near Beneficiation Plant. The quality of the groundwater received is influenced by pollution of soil and air, industrial and domestic waste disposal, organic components, pathogenic microorganisms, application of fertilizers and pesticides in agriculture, etc. Total six (5) ground water monitoring locations were identified for assessment in different villages around the plant based on the usage of sub surface water by the settlements/ villages. The groundwater results are compared with the desirable and permissible water quality standards as per IS: 10500 (2012) for drinking water. The Groundwater quality monitoring locations are given in **Table 3-16**. Map showing the groundwater monitoring locations are given in **Figure 3-9**. In 2019 January month Tamil Nadu Water Supply and Drainage Board

also conducted Ground water monitoring in plant surroundings and the results are compared with current results are represented in **Table 3-17**.

**Table 3-16 Ground Water Monitoring Locations at Beneficiation Plant:**

Station Code	Location	Approx. Distance from project boundary in Km	Azimuth Directions	Latitude	Longitude
GW1	TAMIN Beneficiation plant	-	-	9°54'0.01"N	78°25'23.54"E
GW2	VagulathuPatti	0.38	N	9°54'20.06"N	78°25'23.73"E
GW3	Komalipatti	1.46	ESE	9°53'37.18"N	78°26'13.89"E
GW4	Sendiudaiyanathapuram	4.24	SSW	9°51'55.37"N	78°24'15.32"E
GW5	Karambodai	1.14	W	9°54'3.60"N	78°24'43.70"E



**Figure 3-9 Map showing the Ground Water monitoring locations including beneficiation Plant**

**Ground Water Quality Observations:**

Ground water samples were collected nearby beneficiation plant and analyzed. The analytical result shows that, all the parameters are within the permissible limit of IS 10500:2012(Drinking water standard). The results are represented in **Table 3-17**.

**Table 3-17 Physical chemical analysis of Ground water samples**

S. No.	Parameters	Units	GW1 (Beneficiation Plant)	GW2 (VagulathuPalli)		GW3 (Komalipatti)		GW4 (Sendiudaiyanathapuram)		GW5 (Karambodai)	
			July 2019	Jan.2019	Jul 2019	Jan.2019	Jul 2019	Jan2019	Jul 2019	Jan2019	Jul 2019
1	Appearance		clear	clear	clear	clear	clear	clear	clear	clear	clear
2	Odour		agreeable	agreeable	agreeable	agreeable	agreeable	agreeable	agreeable	agreeable	agreeable
3	Colour	Hazen Unit	BLQ (LOQ:1)	--	BLQ (LOQ:1)	--	BLQ (LOQ:1)	--	BLQ (LOQ:1)	--	BLQ (LOQ:1)
4	Turbidity	NTU	BLQ (LOQ:0.1)	0	BLQ (LOQ:0.1)	0	BLQ (LOQ:0.1)	0	BLQ (LOQ:0.1)	0	BLQ (LOQ:0.1)
5	pH (at 25 °C)	-	8.38	7.9	8.05	7.9	7.44	7.6	8.03	7.8	7.81
6	Electrical conductivity	µS/cm	986.0	1110	765	1120	1103	870	1301	935	1182
7	Total Dissolved Solids	mg/l	532	777	443	784	612	609	748	654	685
8	Total Alkalinity as CaCO3	mg/l	450	376	330	372	330	300	320	352	310
9	Total Hardness as CaCO3	mg/l	400	240	270	200	470	180	530	240	480
10	Sodium as Na	mg/l	23.0	0	37	0	61	0	106	0	90
11	Potassium as K	mg/l	1.0	0	2	0	4.0	0	6	0	6.0
12	Calcium as Ca	mg/l	72.14	48	48.10	40	108.22	35	112.22	48	128.26
13	Magnesium as Mg	mg/l	53.46	29	36.45	24	48.60	22	60.75	29	38.88
14	Chloride as Cl	mg/l	49.49	105	79.18	110	128.67	100	222.70	75	188.06
15	Sulphate as SO4	mg/l	32.55	20	18.27	21	31.65	18	20.87	26	19.97
16	Nitrate as NO <sub>2</sub>	mg/l	NA	0	NA	0	NA	0	NA	0	NA
17	Nitrate as NO <sub>3</sub>	mg/l	1.89	4	1.56	4	2.15	3	2.16	3	2.31
18	Phosphate as PO <sub>4</sub> #	mg/l	NA	0	NA	0	NA	0	NA	0	NA
19	Fluoride	mg/l	0.18	0.4	0.15	0.4	0.21	0.4	0.27	0.4	0.28
20	Iron as Fe	mg/l	BLQ (LOQ:0.02)	0	BLQ (LOQ:0.02)	0	BLQ (LOQ:0.02)	0	BLQ (LOQ:0.02)	0	BLQ (LOQ:0.02)
21	Manganese as Mn	mg/l	BLQ (LOQ:0.05)	-	BLQ (LOQ:0.05)	-	BLQ (LOQ:0.05)	-	BLQ (LOQ:0.05)	-	BLQ (LOQ:0.05)
22	Tidys Test 4 hrs as O <sub>3</sub>	mg/l	NA	0.30	NA	0.30	NA	0.33	NA	0.30	NA
23	Percent Sodium as Na	mg/l	10.98	NA	22.65	NA	21.70	NA	30.01	NA	28.66
24	Sodium Absorption ration	-	0.48	NA	0.29	NA	1.17	NA	1.91	NA	1.7

BLQ: Below Limit of Quantification, LOQ: Limit of Quantification, NA: Not Analyzed. NTU : Nephelometric Turbidity.

Note: Jan 2019 "Tamil Nadu Water Supply and Drainage Board Ground water monitoring results" Test reports are enclosed as **Enclosure-I (Page 58)**

July 2019 M/s Hubert Enviro Care Systems (P) Ltd' Ground Water Monitoring results" Test reports are enclosed as **Enclosure-II (Page 59 to 68)**

### **3.3 Noise Environment**

#### **3.3.1 Mine Site**

The noise level conforms to the existing rules and guidelines with the present level of operation. The noise generating locations were monitored during the study period. The results are within the CPCB guidelines. However, this activity is very much confined within the leasehold area.

The noise level is expected to rise due to enhancement of production capacity as there will be induct of higher capacity and new machineries matching with the production capacity.

Ambient noise levels in the core area are likely to increase from development of additional noise generating equipment like Heavy Earth Moving Machines & drilling operations. From the standpoint of occupational hazard of noise as to its effect on the threshold limit value (TLV) of hearing of individuals, a level of 90 dB(A) is considered as safe for 8 hours of exposure. No adverse impacts on surrounding habitations are anticipated.

As truck movements are restricted to transportation of ore from the mine stock yard to the processing plant within the core zone there will be no adverse impact on the surrounding.

The main sources of noise in the mine are as follows:

- Transportation vehicles
- Loading & unloading of Graphite
- Drilling & Blasting
- DG Set.

Noise Modeling is carried out and contours were generated for Sivaganga mine. Sources for Noise in Open Cast mining is considered as follows:

#### **Various Noise Sources in Mining Activities (Open Cast)**

- |   |                     |
|---|---------------------|
| 1) Noise pollution due to Blasting            | : 164 dB (A) at 30m |
|   | : 144 dB (A) at 70m |
| 2) Noise pollution due to Vehicles movement   | : 86 dB (A) at 1m   |
| 3) Noise pollution due to drilling activities | : 115 dB (A) at 1m  |
| 4) Noise pollution due to mining machinery    | : 105 dB (A) at 1m  |

Source: <http://www.environmentalpollution.in/noise-pollution/control/noise-pollution-and-its-control-in-mining/6138>

**Table 3-18 Noise levels as per Noise Modeling**

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from Source(m)
1	Drilling activities	41.34	300
2	Blasting	91.89	300
3	Vehicles movement	50.16	500
4	Mining machinery	34.45	300
5	Cumulative sources	90.90	300

**3.3.2 Beneficiation Plant:**

The main sources of noise pollution within the Beneficiation Plant identified as follows:

- Crusher
- Grinder
- Rod mill
- Rotary Dryers
- DG sets of 1X500 & 1X380 kVA Capacity

The above source's Noise levels at 1 meter distance given as follows:

S. No	Activity	Noise level dB(A) at 1meter
1	Crusher	75
2	Grinder	45
3	Rotary Dryers	45
4	DG set 1 x 500 kVA	95
5	DG Set 1 x 380 kVA	90

Noise Modeling was carried out & contours were generated for individual sources such as Crusher, Grinder, Rotary dryers and DG Sets. Max Noise are found at 150 meters. Noise level contours are generated for crusher & DG Sets (2 Nos) are shown in **Figure 3-10 to 3-12** respectively. No contours are generated for Grinder & Rotary dryers.

S. No	Activity	Predicted Max. Noise level dB(A)	Distance from the source(m)
1	Crusher	23.08	20m (within the plant boundary)
2	Grinder	No contour is generated	--
3	Rotary Dryers	No contour is generated	--
4	DG set 1 x 500 kVA	35.94	10m (within the plant boundary)
5	DG Set 1 x 500 kVA	46.92	15m (within the plant boundary)



**Figure 3-10 Noise contours due to crusher at beneficiation plant**



**Figure 3-11 Noise contours due to DG Set 380 kVA at beneficiation plant**



**Figure 3-12 Noise contours due to DG Set 500 kVA at beneficiation plant**

### 3.4 Biological Environment

Beneficiation Plant is located at 500m distance from the out of mine lease boundary. Biological studies are conducted within the 10km radius of mine lease boundary. The observations are as follows:

Melakadu, Isanikadu, Vellimalai, Arasanur, Velakkal, Kuttikadur, & Ponnankadu Reserve Forests are located within the 15km radius of the project. Other than these, there are no national park / wildlife sanctuary/mangroves/ Coastline/estuary/sea located within 10km from the mines. There will not be any adverse impact due to mining operations in this lease since only small production is involved from this lease and there will not be any major polluting source from the mining operations. Besides, all necessary mitigation measures will be implemented.

- In the Mine Lease area or its proximate areas there is no wetland and the natural flow of water not available.
- There is no rare or endangered species
- There are no wild animals in the area. In the post mining stage, proper fencing will be carried in the mined out area to prevent fall of animals in the mine pits.
- There are no any wetlands, fish breeding grounds, marine ecology nearby the quarry area, which will be affected due to this project.

The core area consists of Barren land. It is devoid of any major trees. Only small shrubs and bushes are present. No Damage to the Biological Environment is anticipated.

**Existing Green Belt development at Mine Site and Beneficiation Plant:**

The land environment is plain terrain. The land has been classified as Government poramboke and TAMIN's patta land. The entire lease hold area is dry land. The land has been planted with greenery. An Existing and Proposed Green Belt detail at Mine Site is given in **Table 3-19**.

**Table 3-19 Existing and Proposed Green Belt Details at Mine Site**

S. No	Year	No. of Trees	Area in Ha.	Period
1	1986-1994	1470	0.98.5	<b>Before Mining Plan</b>
2	1994-1995	300	0.20.0	
3	1995-1996	300	0.20.0	
4	1996-1997	300	0.20.0	
5	1997-1998	300	0.20.0	
6	1998-1999	300	0.20.0	
7	1999-2000	300	0.20.0	
8	2000-2001	300	0.20.0	
9	2001-2002	300	0.20.0	
10	2002-2003	300	0.20.0	
11	2003-2004	300	0.20.0	
12	2004-2005	300	0.20.0	
13	2005-2006	300	0.20.0	
14	2006-2007	300	0.20.0	
15	2007-2008	300	0.20.0	
16	2008-2009	300	0.20.0	
17	2009-2010	300	0.20.0	<b>Mining Plan</b>
18	2010-2011	300	0.20.0	
19	2011-2012	300	0.20.0	
20	2012-2013	300	0.20.0	
21	2013-2014	300	0.20.0	
22	2014-2015	300	0.20.0	<b>SOM-I</b>
23	2015-2016	300	0.20.0	
24	2016-2017	300	0.20.0	
25	2017-2018	300	0.20.0	
26	2018-2019	300	0.20.0	
27	2019-2020	170	0.10.5	<b>SOM-II</b>
28	2020-2021	170	0.10.5	
29	2021-2022	170	0.10.5	
30	2022-2023	170	0.10.5	
31	2023-2014	170	0.10.5	
<b>Total</b>		<b>9,820</b>	<b>6.51.0</b>	

- Green Belt is developed in 1.39 acres of land in beneficiation plant

### **3.5 Socio-economics**

#### **Impact on Socio-economic Environment:**

There is no residential area within lease area. Hence, there is no likelihood of effect of outside people or influx on the existing local population. The lessee is spending substantial amount for peripheral developments such as education, health, sports, afforestation etc. Hence the benefits to the community and its economy because of this project are quite appreciable.

#### **Occupational Health & Safety:**

Occupational safety and health is very closely related to productivity and good employer-employee relationship. The factors of occupational health in Sivaganga Beneficiation Plant and Mine site are mainly dust and noise & ground vibration.

Safety of employees during operation and maintenance etc. shall be implemented as per the provisions of the Metalliferous Mines Regulations, 1961 and the Mines Rules, 1955. To avoid any adverse effects on the health of workers due to various pollutants, sufficient measures have already been addressed in this chapter.

The following measures relating to safety and health shall also be practiced:

- Provision of rest shelters for mine workers with amenities like drinking water etc.
- All safety measures like use of safety appliances, safety signboards, posters, slogans related to safety etc. shall be ensured
- Training of employees on use of safety appliances and first aid.
- Regular maintenance and testing of all equipment as per manufacturers guidelines.
- Facilities for checking the levels of dust in the workplace are/shall be provided. The mineworkers are examined at regular intervals. The medical checkup is/shall be carried out with the help of a specialist.
- Pre-placement & Periodic Medical Examination (PME) of all workers by a medical specialist is/shall be conducted regularly, to assess the health status of the employees and take suitable corrective action. No notified diseases have been reported so far. PME will be carried out once a year.
- First Aid Organization in mines includes training and re-training of these staff of First Aid activity group.
- Close surveillance of the factors in working environment and work practices, which may affect environment and worker's health and safety.

- As per the chemical composition of ROM graphite ore, lead content in the ore is found in traces. As graphite beneficiation will be carried out in wet process, the dust generation at the work zone will be negligible. Hence, occupational health impacts due to lead poisoning in the project is not envisaged.

# 4. ENCLOSURE-I(TWAD TEST REPORTS)



**TEST WATER BEFORE TASTE**  
**TAMILNADU WATER SUPPLY AND DRAINAGE BOARD**  
 District Level Water Testing Laboratory  
 TWAD Board, Municipal Building, Weekly Market Street, SIVAGANGAI - 623 561.

**TEST REPORT**

Ph: 04575 - 243178

From  
 S.Vijayan B.Sc, MA.,  
 Assistant Water Analyst,  
 TWAD Board,  
 District Water Testing Laboratory,  
 Sivagangai.

To  
 The Factory Manager,  
 Graphite Beneficiation Plant,  
 Tamil Nadu Minerals Limited,  
 Sivaganagi.

Lr No. 25202-25205 / AWA / LAB / SVG / 2019 / Date 31.01.2019

Sir,

Sub: Examination of Water Sample report -furnished - reg.

Ref: 1. Your Lr:Nil / date, 29.01.2019

2. Invoice No.195 / Dated 30.01.2019 for Rs. 4000 /-

The result of analysis for the water sample sent under reference is furnished below.

Location:25202 : Open Well @ Karambodai Village (Western Side of Plant)

Location:25203 : Drinking Water TAP @ Komalipatti Village (Eastern Side of Plant)

Location:25204 : Bore Well @ Senthil Udayanathapuram Village (Southern Side of Plant)

Location:25205 : Hand Pump @ Vagulathupatti Village (Northern Side of Plant)

Date of Collection : 30.01.2019

Date of Receipt : 30.01.2019

IS 10500 : 2012	Acceptable limit	Permissible limit in the absence of alternate source	Result			
			25202	25203	25204	25205
<b>PHYSICAL EXAMINATION:</b>						
1. Appearance	-	-	Clear	Clear	Clear	Clear
2. Colour	5	15	-	-	-	-
3. Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4. Turbidity NT Units	1	5	0	0	0	0
5. Total dissolved Solids mg/L	500	2000	654	784	609	777
6. Electrical Conductivity Micro-mho/cm	-	-	935	1120	870	1110
<b>CHEMICAL EXAMINATION:</b>						
7. pH	6.5-8.5	6.5-8.5	7.8	7.9	7.6	7.9
8. Ph. Alkalinity as CaCO <sub>3</sub> mg/l	-	-	0	0	0	0
9. Total Alkalinity as CaCO <sub>3</sub> mg/L	200	600	352	372	300	376
10. Total Hardness as CaCO <sub>3</sub> mg/l.	200	600	240	200	180	240
11. Calcium as Ca mg/L	75	200	48	40	35	48
12. Magnesium as Mg mg/L.	30	100	29	24	22	29
13. Sodium as Na mg/L	-	-	0	0	0	0
14. Potassium as K mg/L	-	-	0	0	0	0
15. Iron as Fe mg/L	0.3	0.3	0	0	0	0
16. Manganese mg/L	0.1	0.3	-	-	-	-
17. Free Ammonia as NH <sub>3</sub> mg/L.	0.5	0.5	0	0	0	0
18. Nitrite as NO <sub>2</sub> mg/l.	-	-	0	0	0	0
19. Nitrate as NO <sub>3</sub> mg/l	45	45	3	4	3	4
20. Chloride as Cl mg/L	250	1000	75	110	100	105
21. Fluoride as F mg/L.	1.0	1.5	0.4	0.4	0.4	0.4
22. Sulphate as SO <sub>4</sub> mg/l.	200	400	26	21	18	20
23. Phosphate as PO <sub>4</sub> mg/l.	-	-	0	0	0	0
24. Tidy's Test 4 hrs as O <sub>2</sub> mg/l.	-	-	0.30	0.30	0.33	0.30

Report : 25202 to 25205 : The given water Samples are chemically Potable.

15/01/19  
 S. VIJAYAN  
 ASSISTANT WATER ANALYST,  
 TWAD BOARD, DISTRICT LABORATORY,  
 SIVAGANGAI.

15/01/19  
 Assistant Water Analyst,  
 TWAD Board, District Laboratory,  
 Sivagangai.

# 5. ENCLOSURE-II (HECS GW TEST REPORTS)

**Hubert Enviro Care Systems (P) Ltd.**  
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 Chennai - 600 083.  
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 E-mail : labsales@hecs.in

**Laboratory Services Division**  
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 ISO 9001, 14001 & OHSAS 18001 Certified.

## TEST REPORT

Page : 1 of 2

Name of the Client      M/S. Tamilnadu Minerals,  
 Address of the Client      Sivagangai.

Report No.      HECS/W/001/010719  
 Report Date      01/07/2019

Sample Description      WATER  
 Sample Mark      Ground Water-Karambodai  
 Sample Drawn By      Hubert Enviro Care Systems Pvt Ltd  
 Sampling/received Date      01/07/2019      01/07/2019  
 Analysis Commenced On      01/07/2019

Completed On      01/07/2019

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	7.81	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	1182.0	IS 3025 (Part - 14):1983
3	Colour	Hazen Unit	BLQ(LOQ: 1)	IS 3025(Part - 4):1983
4	Turbidity	NTU	BLQ(LOQ: 0.1)	IS 3025(Part - 10):1984
5	Total Hardness as CaCO <sub>3</sub>	mg/l	480.0	IS 3025 (Part - 21):1983
6	Calcium as Ca	mg/l	128.26	IS 3025 (Part - 40):1991
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l	310.0	IS 3025 (Part - 23):1986
8	Chloride as Cl	mg/l	188.06	4500 Cl --- B APHA 23rd Edn: 2017
9	Cyanide as CN	mg/l	BLQ(LOQ:0.01)	IS 3025 (Part - 27):1986
10	Magnesium as Mg	mg/l	38.88	IS 3025 (Part - 46) 1994
11	Total Dissolved Solids	mg/l	685.0	IS 3025(Part-16):1984
12	Sulphate as SO <sub>4</sub>	mg/l	19.97	IS 3025(Part - 24):1986
13	Fluoride	mg/l	0.28	IS 3025 (Part - 60):2008
14	Nitrate as NO <sub>3</sub>	mg/l	2.31	APHA 23rd Edition (4500 NO3B)
15	Iron as Fe	mg/l	BLQ(LOQ:0.02)	IS 3025 (Part - 53):2003
16	Boron as B #	mg/l	BLQ(LOQ:0.1)	IS:3025 (Part 57):2003
17	Anionic Detergents as MBAS	mg/l	BLQ(LOQ:0.05)	Annex K of IS 13428-2005
18	Zinc as Zn	mg/l	BLQ(LOQ 0.1)	US EPA Method 200.8
19	Chromium as Cr	mg/l	BLQ(LOQ 0.01)	IS 3025 (Part - 52):2003
20	Copper as Cu	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
21	Manganese as Mn	mg/l	BLQ(LOQ: 0.05)	IS 3025:(Part - 59):2006
22	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	US EPA Method 200.8
23	Lead as Pb	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
24	Selenium as Se	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8



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 Authorized Signatory

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## TEST REPORT

Page : 2 of 2

Name of the Client M/S. Tamilnadu Minerals.,  
Address of the Client Sivagangal.

Report No. HECS/W/001/010719  
Report Date 01/07/2019

Sample Description WATER  
Sample Mark Ground Water-Karambodai  
Sample Drawn By Hubert Enviro Care Systems Pvt Ltd  
Sampling/received Date 01/07/2019 01/07/2019  
Analysis Commenced On 01/07/2019

Completed On 01/07/2019

S.No.	Parameters	Units	Results	Test Method
25	Arsenic as As	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
26	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	US EPA Method 200.8
27	Percent Sodium as Na	%	28.66	HECS/W&WW/SOP/067
28	Sodium as Na	mg/l	90.0	IS3025 (Part - 45):1993
29	Potassium as K	mg/l	6.0	IS3025 (Part - 45):1993
30	Phosphate as PO4 #	mg/l	BLQ(LOQ:0.02)	IS 3025 (Part 31):1988
31	Total suspended solid	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 17):1984
32	Nickel	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
33	Total Phosphorous as P	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Pt 31) : 1988
34	Barium as Ba #	mg/l	1.03	US EPA Method 200.8
35	Carbonate #	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 23):1986
36	Bi Carbonate #	mg/l	310.0	IS 3025 (Part - 23):1986
37	Residual Sodium Carbonate #	mg/l	BLQ(LOQ: 1)	IS 11624 - 1986
38	Free Ammonia	mg/l	BLQ(LOQ: 0.02)	IS 3025 Part (34) 1982
39	Sodium Absorption Ratio #	-	1.7	IS 11624 - 1986
40	Total Chromium	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8

Note:-BLQ - Below Limit of Quantification, LOQ- Limit of Quantification, NTU-Nephelometric Turbidity Unit, mg/l - Milligrams per liter

\*\*\*End of Report\*\*\*



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**TEST REPORT**

Page : 1 of 2

Name of the Client M/S. Tamilnadu Minerals.,  
Address of the Client Sivagangai.

Report No. HECS/W/002/010719  
Report Date 01/07/2019

Sample Description WATER  
Sample Mark Ground Water-Benificiation Plant  
Sample Drawn By Hubert Enviro Care Systems Pvt Ltd  
Sampling/received Date 01/07/2019 01/07/2019  
Analysis Commenced On 01/07/2019

Completed On 01/07/2019

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	8.38	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	986.0	IS 3025 (Part - 14):1983
3	Colour	Hazen Unit	BLQ(LOQ: 1)	IS 3025(Part - 4):1983
4	Turbidity	NTU	BLQ(LOQ: 0.1)	IS 3025(Part - 10):1984
5	Total Hardness as CaCO3	mg/l	400.0	IS 3025 (Part - 21):1983
6	Calcium as Ca	mg/l	72.14	IS 3025 (Part - 40):1991
7	Total Alkalinity as CaCO3	mg/l	450.0	IS 3025 (Part - 23):1986
8	Chloride as Cl	mg/l	49.49	4500 Cl --- B APHA 23rd Edn: 2017
9	Cyanide as CN	mg/l	BLQ(LOQ: 0.01)	IS 3025 (Part - 27):1986
10	Magnesium as Mg	mg/l	53.46	IS 3025 (Part - 46):1994
11	Total Dissolved Solids	mg/l	532.0	IS 3025(Part -16):1984
12	Sulphate as SO4	mg/l	32.55	IS 3025(Part - 24):1986
13	Fluoride	mg/l	0.18	IS 3025 (Part - 60):2008
14	Nitrate as NO3	mg/l	1.89	APHA 23rd Edition (4500 NO3B)
15	Iron as Fe	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Part - 53):2003
16	Boron as B #	mg/l	BLQ(LOQ: 0.1)	IS:3025 (Part - 57):2003
17	Anionic Detergents as MBAS	mg/l	BLQ(LOQ: 0.05)	Annex K of IS 13428-2005
18	Zinc as Zn	mg/l	BLQ(LOQ 0.1)	US EPA Method 200.8
19	Chromium as Cr	mg/l	BLQ(LOQ 0.01)	IS 3025 (Part - 52):2003
20	Copper as Cu	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
21	Manganese as Mn	mg/l	BLQ(LOQ: 0.05)	IS 3025:(Part - 59):2006
22	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	US EPA Method 200.8
23	Lead as Pb	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
24	Selenium as Se	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8



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## TEST REPORT

Page : 2 of 2

Name of the Client M/S. Tamilnadu Minerals.,  
Address of the Client Sivagangai.

Report No. HECS/W/002/010719  
Report Date 01/07/2019

Sample Description WATER  
Sample Mark Ground Water-Benificiation Plant  
Sample Drawn By Hubert Enviro Care Systems Pvt Ltd  
Sampling/received Date 01/07/2019 01/07/2019  
Analysis Commenced On 01/07/2019

Completed On 01/07/2019

S.No.	Parameters	Units	Results	Test Method
25	Arsenic as As	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
26	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	US EPA Method 200.8
27	Percent Sodium as Na	%	10.98	HECS/W&WW/SOP/067
28	Sodium as Na	mg/l	23.0	IS3025 (Part - 45):1993
29	Potassium as K	mg/l	1.0	IS3025 (Part - 45):1993
30	Phosphate as PO4 #	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Part 31):1988
31	Total suspended solid	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 17):1984
32	Nickel	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
33	Total Phosphorous as P	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Pt 31) : 1988
34	Barium as Ba #	mg/l	0.202	US EPA Method 200.8
35	Carbonate #	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 23):1986
36	Bi Carbonate #	mg/l	450.0	IS 3025 (Part - 23):1986
37	Residual Sodium Carbonate #	mg/l	BLQ(LOQ: 1)	IS 11624 - 1986
38	Free Ammonia	mg/l	BLQ(LOQ: 0.02)	IS 3025 Part (34) 1982
39	Sodium Absorption Ratio #	-	0.48	IS 11624 - 1986
40	Total Chromium	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8

Note:-BLQ - Below Limit of Quantification, LOQ- Limit of Quantification, NTU-Nephelometric Turbidity Unit, mg/l - Milligrams per liter

\*\*\*End of Report\*\*\*



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**TEST REPORT**

Page : 1 of 2

Name of the Client **M/S. Tamilnadu Minerals.,**  
Address of the Client **Sivagangai.**

Report No. **HECS/W/003/010719**  
Report Date **01/07/2019**

Sample Description **WATER**  
Sample Mark **Ground Water-Vagulathupalli**  
Sample Drawn By **Hubert Enviro Care Systems Pvt Ltd**  
Sampling/received Date **01/07/2019 01/07/2019**  
Analysis Commenced On **01/07/2019**

Completed On **01/07/2019**

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	8.05	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	765.0	IS 3025 (Part - 14):1983
3	Colour	Hazen Unit	BLQ(LOQ: 1)	IS 3025(Part - 4):1983
4	Turbidity	NTU	BLQ(LOQ: 0.1)	IS 3025(Part - 10):1984
5	Total Hardness as CaCO3	mg/l	270.0	IS 3025 (Part - 21):1983
6	Calcium as Ca	mg/l	48.10	IS 3025 (Part - 40):1991
7	Total Alkalinity as CaCO3	mg/l	330.0	IS 3025 (Part - 23):1986
8	Chloride as Cl	mg/l	79.18	4500 Cl --- B APHA 23rd Edn: 2017
9	Cyanide as CN	mg/l	BLQ(LOQ: 0.01)	IS 3025 (Part - 27):1986
10	Magnesium as Mg	mg/l	36.45	IS 3025 (Part - 46) 1994
11	Total Dissolved Solids	mg/l	443.0	IS 3025(Part - 16):1984
12	Sulphate as SO4	mg/l	18.27	IS 3025(Part - 24):1986
13	Fluoride	mg/l	0.15	IS 3025 (Part - 60):2008
14	Nitrate as NO3	mg/l	1.56	APHA 23rd Edition (4500 NO3B)
15	Iron as Fe	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Part - 53):2003
16	Boron as B #	mg/l	BLQ(LOQ: 0.1)	IS:3025 (Part - 57):2003
17	Anionic Detergents as MBAS	mg/l	BLQ(LOQ: 0.05)	Annex K of IS 13428-2005
18	Zinc as Zn	mg/l	BLQ(LOQ 0.1)	US EPA Method 200.8
19	Chromium as Cr	mg/l	BLQ(LOQ 0.01)	IS 3025 (Part - 52):2003
20	Copper as Cu	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
21	Manganese as Mn	mg/l	BLQ(LOQ: 0.05)	IS 3025:(Part - 59):2006
22	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	US EPA Method 200.8
23	Lead as Pb	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
24	Selenium as Se	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8



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**TEST REPORT**

Page : 2 of 2

Name of the Client M/S. Tamilnadu Minerals.,  
Address of the Client Sivagangai.

Report No. HECS/W/003/010719  
Report Date 01/07/2019

Sample Description WATER  
Sample Mark Ground Water-Vaguathupalli  
Sample Drawn By Hubert Enviro Care Systems Pvt Ltd  
Sampling/received Date 01/07/2019 01/07/2019  
Analysis Commenced On 01/07/2019

Completed On 01/07/2019

S.No.	Parameters	Units	Results	Test Method
25	Arsenic as As	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
26	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	US EPA Method 200.8
27	Percent Sodium as Na	%	22.65	HECS/W&WW/SOP/067
28	Sodium as Na	mg/l	37.0	IS3025 (Part - 45):1993
29	Potassium as K	mg/l	2.0	IS3025 (Part - 45):1993
30	Phosphate as PO4 #	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Part 31):1988
31	Total suspended solid	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 17):1984
32	Nickel	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
33	Total Phosphorous as P	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Pt 31) : 1988
34	Barium as Ba #	mg/l	0.174	US EPA Method 200.8
35	Carbonate #	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 23):1986
36	Bi Carbonate #	mg/l	330.0	IS 3025 (Part - 23):1986
37	Residual Sodium Carbonate #	mg/l	BLQ(LOQ: 1)	IS 11624 - 1986
38	Free Ammonia	mg/l	BLQ(LOQ: 0.02)	IS 3025 Part (34) 1982
39	Sodium Absorption Ratio #	-	0.29	IS 11624 - 1986
40	Total Chromium	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8

Note:-BLQ - Below Limit of Quantification, LOQ- Limit of Quantification, NTU-Nephelometric Turbidity Unit, mg/l - Milligrams per liter

\*\*\*End of Report\*\*\*



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**TEST REPORT**

Page : 1 of 2

Name of the Client M/S. Tamilnadu Minerals.,  
Address of the Client Sivagangai.

Report No. HECS/W/004/010719  
Report Date 01/07/2019

Sample Description WATER  
Sample Mark Ground Water-Sendiudaiyanathapuram  
Sample Drawn By Hubert Enviro Care Systems Pvt Ltd  
Sampling/received Date 01/07/2019 01/07/2019  
Analysis Commenced On 01/07/2019

Completed On 01/07/2019

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	8.03	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	1301.0	IS 3025 (Part - 14):1983
3	Colour	Hazen Unit	BLQ(LOQ: 1)	IS 3025(Part - 4):1983
4	Turbidity	NTU	BLQ(LOQ: 0.1)	IS 3025(Part - 10):1984
5	Total Hardness as CaCO <sub>3</sub>	mg/l	530.0	IS 3025 (Part - 21):1983
6	Calcium as Ca	mg/l	112.22	IS 3025 (Part - 40):1991
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l	320.0	IS 3025 (Part - 23):1986
8	Chloride as Cl	mg/l	222.70	4500 Cl --- B APHA 23rd Edn: 2017
9	Cyanide as CN	mg/l	BLQ(LOQ: 0.01)	IS 3025 (Part - 27):1986
10	Magnesium as Mg	mg/l	60.75	IS 3025 (Part - 46):1994
11	Total Dissolved Solids	mg/l	748.0	IS 3025(Part -16):1984
12	Sulphate as SO <sub>4</sub>	mg/l	20.87	IS 3025(Part - 24):1986
13	Fluoride	mg/l	0.27	IS 3025 (Part - 60):2008
14	Nitrate as NO <sub>3</sub>	mg/l	2.16	APHA 23rd Edition (4500 NO <sub>3</sub> B)
15	Iron as Fe	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Part - 53):2003
16	Boron as B #	mg/l	BLQ(LOQ: 0.1)	IS:3025 (Part - 57):2003
17	Anionic Detergents as MBAS	mg/l	BLQ(LOQ: 0.05)	Annex K of IS 13428-2005
18	Zinc as Zn	mg/l	BLQ(LOQ 0.1)	US EPA Method 200.8
19	Chromium as Cr	mg/l	BLQ(LOQ 0.01)	IS 3025 (Part - 52):2003
20	Copper as Cu	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
21	Manganese as Mn	mg/l	BLQ(LOQ: 0.05)	IS 3025:(Part - 59):2006
22	Cadmium as Cd	mg/l	BLQ(LOQ 0.001)	US EPA Method 200.8
23	Lead as Pb	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
24	Selenium as Se	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8



*[Signature]*  
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HECS/Q/FMT/50

**Hubert Enviro Care Systems (P) Ltd.**

# 18, 92nd Street, Ashok Nagar,  
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Ph: 42985555 Fax : 42985500  
E-mail : labsales@hecs.in

**Laboratory Services Division**  
(Chemical & Biological Testing)  
Recognized by MoEF, BIS  
FSSAI Notified Laboratory  
ISO 9001, 14001 & OHSAS 18001 Certified.

**TEST REPORT**

Page : 2 of 2

Name of the Client **M/S. Tamilnadu Minerals.,**  
Address of the Client **Sivagangai.**

Report No. **HECS/W/004/010719**  
Report Date **01/07/2019**

Sample Description **WATER**  
Sample Mark **Ground Water-Sendiudaiyanathapuram**  
Sample Drawn By **Hubert Enviro Care Systems Pvt Ltd**  
Sampling/received Date **01/07/2019 01/07/2019**  
Analysis Commenced On **01/07/2019**

Completed On **01/07/2019**

S.No.	Parameters	Units	Results	Test Method
25	Arsenic as As	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
26	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	US EPA Method 200.8
27	Percent Sodium as Na	%	30.01	HECS/W&WW/SOP/067
28	Sodium as Na	mg/l	106.0	IS3025 (Part - 45):1993
29	Potassium as K	mg/l	6.0	IS3025 (Part - 45):1993
30	Phosphate as PO4 #	mg/l	0.12	IS 3025 (Part 31):1988
31	Total suspended solid	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 17):1984
32	Nickel	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
33	Total Phosphorous as P	mg/l	0.09	IS 3025 (Pt 31) : 1988
34	Barium as Ba #	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
35	Carbonate #	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 23):1986
36	Bi Carbonate #	mg/l	320.0	IS 3025 (Part - 23):1986
37	Residual Sodium Carbonate #	mg/l	BLQ(LOQ: 1)	IS 11624 - 1986
38	Free Ammonia	mg/l	BLQ(LOQ: 0.02)	IS 3025 Part (34) 1982
39	Sodium Absorption Ratio #	-	1.91	IS 11624 - 1986
40	Total Chromium	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8

Note:BLQ - Below Limit of Quantification, LOQ- Limit of Quantification, NTU-Nephelometric Turbidity Unit, mg/l - Milligrams per liter

\*\*\*End of Report\*\*\*



*[Signature]*  
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**TEST REPORT**

Page : 1 of 2

Name of the Client **M/S. Tamilnadu Minerals.,**  
Address of the Client **Sivagangai.**

Report No. **HECS/W/005/010719**  
Report Date **01/07/2019**

Sample Description **WATER**  
Sample Mark **Ground Water-Komalipatty**  
Sample Drawn By **Hubert Enviro Care Systems Pvt Ltd**  
Sampling/received Date **01/07/2019 01/07/2019**  
Analysis Commenced On **01/07/2019**

Completed On **01/07/2019**

S.No.	Parameters	Units	Results	Test Method
1	pH (at 25 °C)	-	7.44	IS 3025 (Part - 11):1983
2	Electrical conductivity	µS/cm	1103.0	IS 3025 (Part - 14):1983
3	Colour	Hazen Unit	BLQ(LOQ: 1)	IS 3025(Part - 4):1983
4	Turbidity	NTU	BLQ(LOQ: 0.1)	IS 3025(Part - 10):1984
5	Total Hardness as CaCO <sub>3</sub>	mg/l	470.0	IS 3025 (Part - 21):1983
6	Calcium as Ca	mg/l	108.22	IS 3025 (Part - 40):1991
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l	330.0	IS 3025 (Part - 23):1986
8	Chloride as Cl	mg/l	128.67	4500 Cl --- B APHA 23rd Edn: 2017
9	Cyanide as CN	mg/l	BLQ(LOQ: 0.01)	IS 3025 (Part - 27):1986
10	Magnesium as Mg	mg/l	48.60	IS 3025 (Part - 46) 1994
11	Total Dissolved Solids	mg/l	612.0	IS 3025(Part -16):1984
12	Sulphate as SO <sub>4</sub>	mg/l	31.65	IS 3025(Part - 24):1986
13	Fluoride	mg/l	0.21	IS 3025 (Part - 60):2008
14	Nitrate as NO <sub>3</sub>	mg/l	2.15	APHA 23rd Edition (4500 NO <sub>3</sub> B)
15	Iron as Fe	mg/l	BLQ(LOQ: 0.02)	IS 3025 (Part - 53):2003
16	Boron as B #	mg/l	BLQ(LOQ: 0.1)	IS:3025 (Part - 57):2003
17	Anionic Detergents as MBAS	mg/l	BLQ(LOQ: 0.05)	Annex K of IS 13428-2005
18	Zinc as Zn	mg/l	BLQ(LOQ: 0.1)	US EPA Method 200.8
19	Chromium as Cr	mg/l	BLQ(LOQ: 0.01)	IS 3025 (Part - 52):2003
20	Copper as Cu	mg/l	BLQ(LOQ: 0.01)	US EPA Method 200.8
21	Manganese as Mn	mg/l	BLQ(LOQ: 0.05)	IS 3025:(Part - 59):2006
22	Cadmium as Cd	mg/l	BLQ(LOQ: 0.001)	US EPA Method 200.8
23	Lead as Pb	mg/l	BLQ(LOQ: 0.005)	US EPA Method 200.8
24	Selenium as Se	mg/l	BLQ(LOQ: 0.005)	US EPA Method 200.8



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Name of the Client **M/S. Tamilnadu Minerals.,**  
Address of the Client **Sivagangai.**

Report No. **HECS/W/005/010719**  
Report Date **01/07/2019**

Sample Description **WATER**  
Sample Mark **Ground Water-Komalipatty**  
Sample Drawn By **Hubert Enviro Care Systems Pvt Ltd**  
Sampling/received Date **01/07/2019 01/07/2019**  
Analysis Commenced On **01/07/2019**

Completed On **01/07/2019**

S.No.	Parameters	Units	Results	Test Method
25	Arsenic as As	mg/l	BLQ(LOQ 0.005)	US EPA Method 200.8
26	Mercury as Hg	mg/l	BLQ(LOQ 0.0005)	US EPA Method 200.8
27	Percent Sodium as Na	%	21.70	HECS/W&WW/SOP/067
28	Sodium as Na	mg/l	61.0	IS3025 (Part - 45):1993
29	Potassium as K	mg/l	4.0	IS3025 (Part - 45):1993
30	Phosphate as PO4 #	mg/l	0.05	IS 3025 (Part 31):1988
31	Total suspended solid	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 17):1984
32	Nickel	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8
33	Total Phosphorous as P	mg/l	0.03	IS 3025 (Pt 31) : 1988
34	Barium as Ba #	mg/l	0.335	US EPA Method 200.8
35	Carbonate #	mg/l	BLQ(LOQ: 1)	IS 3025 (Part - 23):1986
36	Bi Carbonate #	mg/l	330.0	IS 3025 (Part - 23):1986
37	Residual Sodium Carbonate #	mg/l	BLQ(LOQ: 1)	IS 11624 - 1986
38	Free Ammonia	mg/l	BLQ(LOQ: 0.02)	IS 3025 Part (34) 1982
39	Sodium Absorption Ratio #	-	1.17	IS 11624 - 1986
40	Total Chromium	mg/l	BLQ(LOQ 0.01)	US EPA Method 200.8

Note:-BLQ - Below Limit of Quantification, LOQ- Limit of Quantification, NTU-Nephelometric Turbidity Unit, mg/l - Milligrams per liter

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