

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,
Principal Bench, New Delhi

Original Application No. 154/2020

News item published on 27.07.2020 in local daily named "Times of India" titled "Forest guard mowed down by mining mafia in Sariska".

Index

S. No.	Particulars	Page No.
1.	Joint committee study report in compliance to the Hon'ble NGT order dated 06.04.2021 in OA No. 154/2020, News item published on 27.07.2020 in local daily named "Times of India" titled "Forest guard mowed down by mining mafia in Sariska".	
2.	Annexure-I: A copy of Hon'ble NGT order dated 06.04.2021.	
3.	Annexure-II: A copy of Committee member nomination letters.	
4.	Annexure-III: A copy of the minutes of meetings of the committee.	
5.	Annexure-IV: A copy of details of the 157 mine lease around the 10 Kms periphery of the wildlife sanctuary.	
6.	Annexure-V: A copy of Mining department closure order of Baldeogarh mine leases in compliance of NGT (CZ) O.A. 45 of 2020 order dated 07.07.2021.	
7.	Annexure-VI: A copy of details of all the 84 consented mines leases and 42 valid consented leases as on 31.12.2021.	
8.	Annexure-VII: A copy of mine plans of M/s P K Goyal (mine lease-1 Ha) & M/s B L Meena (mine lease – 4.263 Ha) considered for emission load assessment.	
9.	Annexure-VIII: A copy of research articles referred for emission factor, load assessment & others.	
10.	Annexure-IX: A copy of meteorological data of January, 2020 for Alwar city.	
11.	Annexure-X: A copy of Article on Satellite driven Aerosol Optical Depth.	
12.	Annexure-XI: A copy of Continuous Ambient Air Quality Monitoring System (CAAQMS) to Aerosol Optical Density (AOD) ratio for PM _{2.5} of Alwar city.	
13.	Annexure-XII: A copy of field photographs of mines on periphery of Sariska Wildlife Sanctuary.	



(Nazimuddin)

Scientist-F

Central Pollution Control Board,
Parivesh Bhawan, East Arjun Nagar
Delhi- 110032.

Date: 25.01.2022

JOINT COMMITTEE REPORT

IN

OA NO.154/2020 (PB)

**News item published on 27/07/2020 in local daily named
“Times of India” titled "Forest guard mowed down by mining
mafia in Sariska".**

Vs

Union of India & Ors.

Committee members:-

1. Sh. RN Meena, IFS, CF & FD, STR Alwar
2. Sh. Mahesh Dutt Puhorit, MOEF & CC- IRO, Jaipur.
3. Sh. Keshav Meena, SDM Rajgarh, Dist: Alwar.
4. Sh Rajneesh Jain, Member Secretary SEAC- Jaipur.
5. Sh Sunil Kumar Meena, Sc-D & Sh. Milind Nimje, Sc-C, RD CPCB, Bhopal
6. Sh. Sharad Saxena, Regional Officer, RPCB, Alwar

Joint Committee report

Hon'ble National Green Tribunal (PB) vide its order dated 6th April 2021 in Original Application No. 154 of 2020 in the matter of "News item published on 27/07/2020 in local daily named "Times of India "titled "Forest guard mowed down by mining mafia in Sariska" directed as:

*"We further direct constitution of a joint Committee comprising MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SEIAA, Rajasthan and District Magistrate, Alwar to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' principle. The CPCB and State PCB will be the nodal agency for compliance and coordination. The joint Committee may give its report within three months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF. Copy of the order is enclosed as **Annexure-I**.*

In compliance of the order, Central Pollution Control Board (CPCB) as a nodal agency sought the nominations from the concerned departments vide its letter dated 16.04.2021. This office received nominations from all the members by 20th July 2021. The details of nomination received are as tabulated below:

S. No.	Name	Department	Date of receipt of nomination
1.	Sh. RN Meena, IFS, CF & FD	Sariska Tiger Reserve (STR) Alwar	15.07.2021
2.	Sh. Mahesh Dutt Puhorit, Sc-C	MOEF & CC-IRO, Jaipur.	15.07.2021
3.	Sh. Keshav Meena, SDM	Rajgarh, Dist: Alwar	Earlier nominated ADM got transferred, therefore Sh. Keshav Meena, SDM attended the visit
4.	Sh Rajneesh Jain, SEE	SEAC- Jaipur	Telephonically communicated on 20.07.2021
5.	Sh. Sharad Saxena	RSPCB, Alwar	18.06.2021
6.	Sh. Milind Nimje, Sci-C	Regional Directorate CPCB, Bhopal	23.04.2021

Copy of the nomination letters is enclosed as **Annexure-II**.

Subsequently, the committee members held meetings and carried out field visit to study the carrying capacity in light of sustainable development.

1.0 Committee meetings and Minutes of Meeting

S. NO.	Date of meeting & field visit	Particulars
1.	1 st Meeting (22.7.2021)	<p>The committee held discussion over the activities going on the said area of Sariska Tiger Reserve and discussed the available methodology for carrying out the carrying capacity study. The committee planned to have its field visit on 30.7.2021; to understand the field conditions and to plan monitoring accordingly.</p> <p>The committee was in the opinion to first collect few preliminary data related to mining activities, Aerosol Optical Depth (AOD) data & CAAQMS data of the nearby area etc before proceeding to the field visit.</p>
2.	1 st Field visit (30.07.2021)	<p>The committee conducted its field visit on 30th July 2021. The committee planned to visit mining areas to collect the monitoring data to assess the carrying capacity of the area w.r.to air quality. However, due to heavy rain in that area; no mining operation was going on and the committee was also unable to carry out air quality monitoring.</p> <p>Secondly, the committee was in the opinion to engage an expert institution viz. NEERI for extending the professional guidance in assessing the carrying capacity in holistic way.</p>
3.	2 nd meeting (5.10.2021)	<p>CPCB as a Nodal agency engaged Dr S K Goyal, Chief Scientist & Head, CSIR-NEERI Delhi Zonal Centre for extending his professional guidance to the committee for studying the carrying capacity of the area.</p> <p>Committee had discussions on the following aspects viz. operational hours, road conditions, status of Env. Clearance, CTO, consented capacity, annual production, transportation method, machineries of mining, meteorology of the area etc.</p>
4.	3 rd meeting (9.11.2021)	<p>A detailed discussion on the mining operation, machineries, transportation etc. was discussed with Mining engineer, Alwar to understand the ongoing practice. Further, a field visit of the committee members with expert was scheduled from 22nd Nov to 24th Nov. 2021.</p> <p>Sh Sunil Kumar Meena, Sc-D was nominated from CPCB vide letter dated 18.11.2021 to represent CPCB as nodal agency.</p>
5.	2 nd field visit (22 nd to 24 th Nov 2021)	<p>The committee members visited the mining area to understand the probable pollution sources, road condition, machineries, noise pollution and ambient</p>

		air pollution. The meteorological data were also collected from the established CAAQMS station at Alwar. The Aerosol Optical Depth Data (AOD) data of the mine cluster were also gathered from IIT, Delhi of PM2.5. The committee held discussion with the stakeholders and discussed on the practice adopted by them.
--	--	--

The minutes of meetings are enclosed as **Annexure-III**.

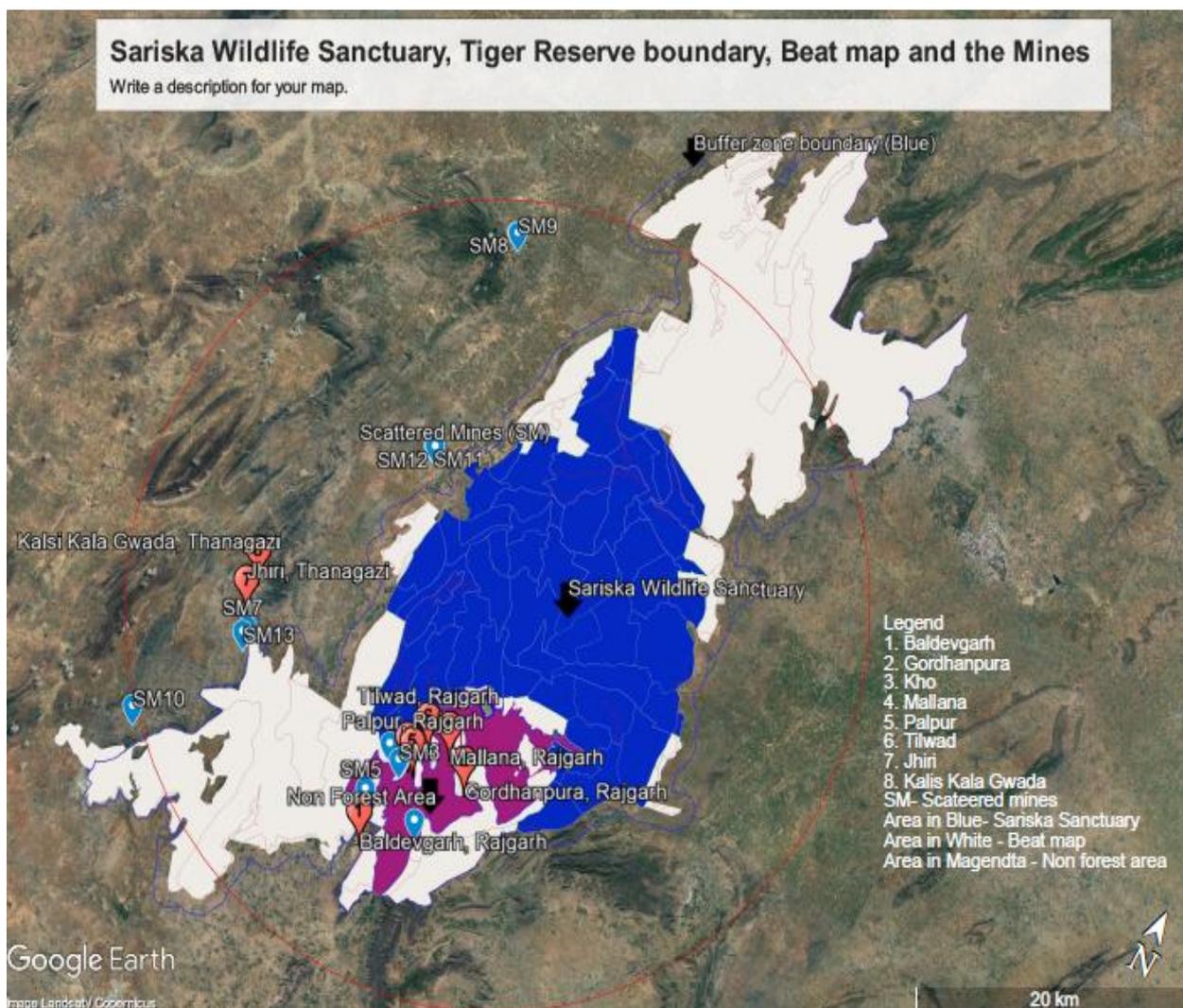
2.0 Study area

2.1 Sariska Tiger Reserve & Wildlife Sanctuary:

The Sariska Tiger Reserve (STR) spreads over an area of 1213.34 square kilometer and is situated in the Thanagazi, Rajgarh, Alwar, Bansur & Malakhera Tehsils of Alwar district in the state of Rajasthan. The Tiger Reserve with its unique biodiversity and undulating terrain provides habitat for the tropical dry deciduous species, dry thorn species and several other species of flora and fauna. The Sariska Tiger Reserve is unique as it is a part of Aravalli hill ranges having one of the densest forests in the state.

The Sariska Wildlife Sanctuary was notified by Government of Rajasthan *vide* notification no. f.39(2) Rev.A/54 dated 5th August 1958 and Sariska National Park was notified by Government of Rajasthan *vide* notification no. f 11(22) raj-8/78 dated 27th August 1982. The Critical Tiger Habitat of Sariska Tiger Reserve was notified by State Government *vide* notification no. F3(34)Forest/2007 dated 28th December 2007 over an area of 881.11 square kilometers (Reserve forest - 604.9750 KM² & Protected Forest - 276.1374 KM²). The buffer area of 332.23 square kilometers (Total Forest Area - 245.72 sq.km. & Revenue Buffer Area - 86.50 sq. km) was notified by notification No. F3(34) forest/2007 dated 06th July 2012. The Core Area of STR lies between (Latitude 27° 05' 45.6" to 27° 38' 54.9" North; Longitude 76° 14' 30.1" to 76° 32' 44.5" East). Sariska Wildlife Sanctuary area is about 492 Sq kms.

The google map below shows boundaries of Sariska wildlife sanctuary, buffer zone, beat map of Sariska tiger reserve (STR) with consented 08 mine clusters, scattered mines situated in South & South-West of the STR.



2.2 Mining area

There are 157 mines (Total lease area 353.14 Ha) situated within the periphery of 10Kms of Sariska Sanctuary boundary. The mining leases are allotted on non-forest land (revenue land). These 157 mines are spread in 08 mine clusters situated in South & South-West of the Sariska boundary. Out of these 157 mines, 33 scattered mines are also situated around the boundary. The cluster-wise distribution of the mines is as tabulated below:

S.No.	Mine cluster	Total No. of mines	Type of mines
1.	Baldeogarh, Rajgarh	09	Marble mines
2.	Goverdhanpura, Rajgarh	20	
3.	Kho, Rajgarh	28	
4.	Mallana, Rajgarh	08	
5.	Palpur, Rajgarh	05	

6.	Tilwad, Rajgarh	20	
7.	Jhiri	12	
8.	Kalsikalan Gwada	22	
9.	Scattered mines	33	

The details of the 157 mine lease are enclosed as **Annexure-IV**.

The geographical location (point co-ordinates) of the consented mine cluster and scattered mines are as tabulated below:

S. No.	Name of Cluster	Latitude	Longitude	
1	Baldevgarh, Rajgarh	27.14225278	76.38319167	
2	Gordhanpura, Rajgarh	27.20248889	76.43303889	
3	Kho, Rajgarh	27.19617222	76.38835	
4	Mallana, Rajgarh	27.21539167	76.41168333	
5	Palpur, Rajgarh	27.19508611	76.39330556	
6	Tilwad, Rajgarh	27.21311	76.394588	
7	Jhiri, Thanagazi,	27.22298611	76.22729722	
8	Kalsi Kala Gwada, Thanagazi	27.24256667	76.22426111	
9	Scattered mines (13)			
		S.No.	Latitude	Longitude
		1.	27.19087	76.38603333
		2.	27.19099	76.38594722
		3.	27.18954	76.38512778
		4.	27.16374	76.41625278
		5.	27.16354	76.37376944
		6.	27.19465	76.37376944
		7.	27.2068	76.23935556
		8.	27.51311	76.27125
		9.	27.51282	76.27221111
		10.	27.12746	76.19409722
		11.	27.36625	76.29519167
		12.	27.36634	76.29661667
		13.	27.20288	76.23814444

The distribution of 157 mine leases in 10Kms from the boundary of Sariska Wildlife Sanctuary is as tabulated below:

S. No.	Name of Clusters	1-<2 Km	2-<3 Km	3-<4 Km	4-<5 Km	5-<6 Km	6-<7 Km	7-<8 Km	8-<9 km	9-<10 Km	10 Km	Total Mine
1.	Baldeogarh, Rajgarh	1	---	---	--	---	3	5	---	---	---	9
2.	Goverdhan pura, Rajgarh	--	--	9	11	--	--	--	--	--	--	20

3.	Kho, Rajgarh	6	20	2	--	---	---	---	--	--	--	28
4.	Mallana, Rajgarh	--	--	8	--	---	---	---	---	---	---	8
5.	Palpur, Rajgarh	--	5	--	--	--	--	--	---	--	--	5
6.	Tilwad-Rajgarh	15	5	--	--	---	---	---	---	--	---	20
7.	Jhiri	--	--	--	--	12	---	--	---	---	---	12
8.	Kalsikala, Gawda	--	---	---	-	1	7	13	---	---	1	22
9.	Scattered Mines	10	6	--	1	8	2	2	1	--	3	33
	Total mines	32	36	19	12	21	12	20	1	--	4	157

2.2.1 Status of environmental clearance & consent to operate:

The details of the environmental clearance granted by SEIAA/DEIAA under Category B2 projects and the consent to establish & consent to operate granted by Rajasthan State Pollution Control Board is as tabulated below:

S.No.	Mine cluster	Total No. of mines	Environmental Clearance		Consent to Operate
			Granted	Not-granted	Granted
1.	Baldeogarh, Rajgarh	09	08	01	08
2.	Goverdhanpura, Rajgarh	20	09	11	06
3.	Kho, Rajgarh	28	26	02	26
4.	Mallana, Rajgarh	08	05	03	05
5.	Palpur, Rajgarh	05	04	01	04
6.	Tilwad, Rajgarh	20	04	16	03
7.	Jhiri	12	08	04	08
8.	Kalsikalan Gwada	22	14	08	11
9.	Scattered mines	33	13	20	13
Total		157	91	66	84

Out of 157 mine lease, 91 were granted environmental clearance from SEIAA/DEIAA. 86 marble mines & 05 scattered mines of Masonry mines were granted EC. Out of these, 91 mines lease, 84 were granted consent to operate (CTO). The categorization of these 84 mine lease as per their area (in hectare) is as tabulated below:

Area (in Hectare)	No. of mines
Upto 1 Ha	54
1-2 Ha	11
2-4 Ha	14

4-5Ha	04
5-10Ha	01 (10.186Ha)

Note: 83 mine lease area was below 5Ha.

2.2.2 Status of distance of mine from sanctuary boundary

The distribution of the 42 mine (valid as on 31.12.2021) from the sanctuary boundary is as tabulated below:

Item	No. of Mines lying in the Distance Range from Sanctuary boundary							
	0-1 km	1-2 km	2-3 km	3-4 km	4-5 km	5-6 km	6-7 km	7-8 km
No. of mines	0	10	30	8	6	10	9	11
No. of Valid mines as on 31.12.2021	0	05	14	03	05	06	04	05

As per the mine department record, none of the mine falls in the 1Km distance from the sanctuary boundary.

2.2.3 Status of mines consent

As per the Consent to Operate (CTO) issued by RSPCB, following numbers of mines has valid consent as on 31.12.2021 in the area:

S.No	Mine cluster	Consent to Operate Granted to	Valid CTO as on 31.12.2021
1.	Baldeogarh, Rajgarh	08*	00
2.	Goverdhanpura, Rajgarh	06	04
3.	Kho, Rajgarh	26	12
4.	Mallana, Rajgarh	05	02
5.	Palpur, Rajgarh	04	04
6.	Tilwad, Rajgarh	03	02
7.	Jhiri	08	05
8.	Kalsikalan Gwada	11	07
9.	Scattered mines	13	06
Total		84	42
Total Area of mine lease		144.83 Ha	54.39 Ha

Note: *In compliance of Hon'ble NGT (CZ) order dated 7.7.2021 in O.A. 45 of 2020 in the matter of Mukesh Sharma Vs State of Rajasthan; all the Consent to Operate of 08 mine lease of Baldeogarh, Rajgarh were revoked. Copy of the Mining department Office order is enclosed as **Annexure-V**.

Copy of the total 84 consented mines leases and 42 consented leases as on 31.12.2021 is enclosed as **Annexure-VI**.

Consented capacity of production of 84 mines is as tabulated below:

S.No	Mine cluster	Consent to Operate Granted to	Consented capacity in TPA	Approx. Daily Production (Tons/day @ 300 days/year)
1.	Baldeogarh, Rajgarh	08	811691	2706
2.	Goverdhanpura, Rajgarh	06	498374	1661
3.	Kho, Rajgarh	26	2587554	8625
4.	Mallana, Rajgarh	05	573700	1912
5.	Palpur, Rajgarh	04	261376	871
6.	Tilwad, Rajgarh	03	487420	1625
7.	Jhiri	08	641305	2138
8.	Kalsikalan Gwada	11	1000267	3334
9.	Scattered mines	13	1488448	4961
Total		84	8350135	27834

Considering 300days of annual operation, the daily average production from single mine on an average is **330TPD**.

The details of the 42valid consent mines w.r.t. consented capacity, validity of CTO, area and distance from Sariska sanctuary boundary is as tabulated below:

S.NO.	ML.NO.	NAME OF LESSEE	AREA IN (HECT.)	DISTANCE FROM BOUNDARY OF SANCTUARY (KM.)	CTO VALIDITY AND CAPACITY	Consented capacity (TPA)
1.	67/97	DEEPAK MINING COMPNY	1	2.299KM.	31.03.2023	125270
2.	Feb-96	M/S RAJSTHAN MINERAL & TRADERS	1	2.625KM.	30.09.2022	84160
3.	40/97	SH.PARMOD GOYAL	1	2.315KM.	31.08.2022	48000
4.	35/97	SH. DWARKA PARSAD MEENA	0.6347	2.514KM.	28.02.2022	45376
5.	33/96	SH. RAMKESH MEENA	1.188	2.172.KM.	30.04.2022	7500
6.	51/96	ABHISHKE SHARMA	0.8625	2.393KM.	30.06.2022	45000
7.	104/01	SH.B.L.MEENA	4.263	3.721M	31.10.2022	302380
8.	66/96	M/S VISHV MARBLE COMPANY PVT. LTD.	1	4.409KM.	30.04.2022	39310
9.	133/04	SH. MANJU SHARMA	4	2.511KM.	28.02.2022	163500
10.	54/02	PALPUR MINING COMPNY	4	1.999KM.	31.05.2023	40000
11.	56/02	PALPUR MINING COMPANY	4	1.949KM.	31.05.2023	40000

12.	261/06	SH. MAAN SHINGH MEENA	1.24	1.867KM.	31.07.2022	250000
13.	120/07	SH. RANJIT SHINGH	0.8	3.835KM.	31.08.2022	34430
14.	335/09	SH.MOOLCHAND MEENA	1	6.435KM.	30.06.2022	75920
15.	39/99	RADHEY KRISHNA GRANITE AND MARBLES	1	1.483KM.	28.02.2022	104900
16.	267/88	SH.ASHOK GUPTA	1	2.276M	31.03.2022	54000
17.	199/86	RAJESH SHARMA	1	2.518KM.	31.05.2022	113260
18.	208/84	M/S YASH MARBLE	4.3625	3.223KM.	31.03.2022	154900
19.	922/88	SMT MAYA GAOYAL	1	2.406KM.	31.03.2022	30000
20.	46/88	M/S RAM NARAYAN & BROTHERS	1	2.307KM.	30.04.2022	100000
21.	923/88	SH. SANTOSH SHARMA	1.7	2.294KM.	31.03.2022	104186
22.	246/85	M/S SHREE RAM MINERAL	1	2.605KM.	30.04.2022	100000
23.	217/86	SH. RADHY SHYAM GUPTA	1	4.681KM.	31.03.2022	60000
24.	49/86	SH. SAMPTRAM CHOUDHRY	1	4.483KM.	30.04.2022	90000
25.	148/85	SH. PARDEEP PARIK	1	1.332KM.	30.04.2022	126520
26.	Jul-87	SH. SUBE SHING	1	4.277KM.	31.07.2023	122304
27.	34/96	M/S ARPIT PVT. LTD.	1	5.214KM.	31.01.2022	160000
28.	35/96	M/S ARPIT PVT. LTD.	1	5.257KM.	31.01.2022	170000
29.	158/81 (9/93)	SH. CHANDRA SHEKHAR GUPTA	1.7779	7.416KM.	28.02.2023	82730
30.	815/88	M/S DIKSHIT MARBLE	1	5.938KM.	31.10.2022	43500
31.	87/97	M/S MANSI MINERAL	1	5.483KM.	31.03.2023	36000
32.	30/96	ANDHI MINERAL AND MARBLE	1	5.553KM.	28.02.2022	18000
33.	1767/91	SH. RAKESH MEENA	1	6.158KM.	28.02.2022	160000
34.	1770/91	SH. RAKESH MEENA	1	6.115KM.	28.02.2022	168000
35.	327/88	SHARMA MARBLE AND MINERAL	1	7.202KM.	31.07.2022	54920
36.	39/96	SH. KELASH CHANDRA GUPTA	1	5.400KM.	30.11.2022	20000
37.	43/94	SITARAM SAINI	1	2.481KM	30.06.2022	108888
38.	103/01	AMBIKA MARBLE	0.56	4.953KM.	31.03.2022	10000
39.	834/88	MAHEHWARI KNWAR	1	6.631KM.	31.05.2023	96967
40.	Dec-85	SH. RAMAVTAR KUMHAR	1	7.263KM.	30.9.2022	63390
41.	91/98	TEZ RAM SAINI	1	7.580KM.	30.04.2023	54000
42.	92/98	TEZ RAM SAINI	1	7.380KM.	30.04.2023	54000

- The total consented capacity of the 42 mines is 37,61,311TPA(12538TPD). Mines operate for 08 Hrs with total 300 operational days in a year.

3.0 Impact Assessment due to Marble Mining Activities on surrounding Air Quality (Inputs from CSIR-NEERI, Delhi Zonal Centre)

3.1.1 Air Quality Modelling

The ambient air quality depends upon the emission sources, meteorological conditions and the background concentration of specific pollutants. Air quality modelling is a mathematical replication of how air pollutants disperse and react in the atmosphere that affects ambient air quality of a region. An air quality model reflects a mathematical description of hypothesis conveying the behaviour of some physical process or other and not exact replica but contain some of nature's essential elements. The model estimates the relationship between sources of pollution and their effects on ambient air quality. The dispersion of air pollutants from any source is influenced by the three factors; a. source strength, b. meteorological conditions, and c. surface roughness/physical structures of the study regions.

In the present study, the air quality modelling is carried out using AERMOD model, which is recommended for regulatory purpose by USEPA and mostly used in EIA studies in India.

3.1.2 Marble Mining Practices near Sariska Tiger Reserve, Alwar

The mining actions and waste products may have significant impact on surrounding environment ranging from localized surface and ground water contamination to damaging effect of airborne pollutants on the regional ecosystem. However, the major impact in the present case was noticed on the air quality of the region. The damage from mining activities depends upon quantity of mineral extraction, area of lease and method of mining. The present analysis is focusing on the air quality impact analysis of marble mining in the study area. The scale of marble mining is very different than other major mine types like Coal, Iron, Sand etc. and so the impact on the surrounding environment.

In Alwar district, most of the marble mines are of size 1 ha to 4 ha lease area. The mines are located in clusters as well as in scattered form. Considering this aspect, the details of two mines of lease area size of 1 ha and

4 ha were collated and analysed to simulate their impact on the surrounding air quality. Basic details including various types of heavy machinery used in both the marble mines are given in **Table 1**. These details are compiled from mining plan and information gathered during the field visit to the mines. Marble mine, M/s Pramod K. Goyal was visited and discussed in detail.

Table 1: Details of Marble Mines of 1 ha and 4.263 ha Area

Sr. No.	Activities within Mine Lease Area	Details as per Mining Plan	
		M/s P.K. Goyal	M/s B L Meena
1.	Mine Lease Area (ha)	1	4.263
2.	Monthly Production Capacity (tons)	3300	7000
3.	Daily Production Capacity (tons)	110	233
4.	No. of Mine Pits	1	2
5.	Mine Pit Dimension (m)	100 x 95 x 85	290x150x85
6.	Dumping Location	Within lease area	Within lease area
7.	Dumping Area (ha)	0.1	0.24
8.	Haul Roads distance (total up & down) within the lease area	500	1000
9.	Tipper capacity , (ton)	10	10
10.	Daily No. of Tipper/Truck Trips, (10 tons capacity each)	11	23
11.	DG set Capacity (kVA) (mostly as standby unit)	200	200
12.	Bench Height , (m)	6 m	6 m
13	Mine Shift timing (8 hours)	8:00 am – 5:00 pm	8:00 am – 5:00 pm
Typical Stationary Machinery used in the Mines			
14.	Compressors (120 psi)- Tractor mounted	1	1 or 2
15.	Mobile crane (15-20 Tons capacity)	1 (42 HP)	1
16.	Derrick crane	-	2
17.	Excavator (0.3 m ³ capacity)	1	4

18.	Tippers (10 Tons capacity)	2	2
19.	Diamond Wire Saw	3	3 (2+1)
20.	Tractor with water tank	1	-
21.	Wagon Drill	-	1
22.	Total Diesel Consumption (ltr/day)	200	500

Mining plans are enclosed as **Annexure-VII**.

3.1.3 Quantification of Dust (SPM & PM₁₀) Emission Load

Development of pollutant emission inventory is essential part of any dispersion modelling and emission rate is one of the important input parameters. It is necessary to understand the sources of emissions of air pollution from each mining activity.

In marble mining, most of the major activities contribute to the emission of various air pollutants, directly or indirectly leading to the problem of air pollution. The activities in marble mining are limited as compared to other large scale mining for Coal, Iron, lime etc. The major pollution emitting activities are drilling, material loading and unloading, haul road, wind erosion of exposed open pit and exposed waste dump. Activity-wise pollutant emission load (for suspended particulate matter, SPM) can be estimated using approach suggested by Chakraborty et al. (2002) for open cast mining. These equations are general, and can be used for other mine types including marble in environment impact assessment (Chaulya and Singh, 2001). The site-specific weather and soil parameters are considered in the present analysis and only marble mining related activities are considered in emission estimation. **Table 2** presents the activities leading to SPM emissions due to marble mining and formulas used for emission rate estimation.

Table 2: Mining Activity-wise Equations used for SPM Emission Estimation

Activity	Parameter			Equation
	Symbol	Name	Unit	
Drilling	m	Moisture Content	%	$E = \left[0.0325 \left\{ \frac{(100 - m)su}{(100 - s)m} \right\}^{0.1} (df)^{0.3} \right]$
	s	Silt Content	%	
	u	Wind Speed	m/s	
	d	Hole Diameter	mm	
	f	Frequency	No. of holes/day	
	E	Emission Rate	g/s	
Overburden Loading	m	Moisture Content	%	$E = \left[0.018 \left\{ \frac{100 - m}{m} \right\}^{1.4} \left\{ \frac{s}{(100 - s)} \right\}^{0.4} (uhxl)^{0.1} \right]$
	s	Silt Content	%	
	u	Wind Speed	m/s	
	h	Drop Height	m	
	l	Size of Loader	m ³	
	x	Frequency of Loading	no./h	
Haul Road	m	Moisture Content	%	$E = \left[\left\{ \frac{100 - m}{m} \right\}^{0.8} \left\{ \frac{s}{100 - s} \right\}^{0.1} u^{0.3} \{2663 + 0.1(v + fc)\} 10^{-6} \right]$
	s	Silt Content	%	
	u	Wind Speed	m/s	
	v	Average Vehicle Speed	m/s	
	f	Frequency	No. of holes/ day	
	c	Capacity of Dumpers	ton	
	E	Emission Rate	g/s/m	
Overburden Unloading	m	Moisture Content	%	$E = \left[1.76h^{1/2} \left\{ \frac{(100 - m)}{m} \right\}^{0.2} \left\{ \frac{s}{100 - s} \right\}^2 u^{0.8} (cy)^{0.1} \right]$
	s	Silt Content	%	
	u	Wind Speed	m/s	
	h	Drop Height	m	
	y	Frequency of Unloading	No./h	
	c	Capacity of Unloader	ton	
	f	Frequency of Loading	no./h	
Exposed Overburden Dump	m	Moisture Content	%	$E = \left[\left\{ \frac{100 - m}{m} \right\}^{0.2} \left\{ \frac{s}{100 - s} \right\}^{0.1} \left\{ \frac{u}{2.6 + 120u} \right\} \left\{ \frac{a}{0.2 + 276.5a} \right\} \right]$
	s	Silt Content	%	
	u	Wind Speed	m/s	

	a	Area	km ²	$E = 2.4 \left[\left\{ \frac{(100 - m)}{m} \right\}^{0.5} \left\{ \frac{as}{(100 - s)} \right\}^{0.1} \left\{ \frac{u}{(4 + 66u)} \right\} 10^{-4} \right]$
	E	Emission Rate	g/s/m ²	
Exposed Pit Surface	m	Moisture Content	%	
	s	Silt Content	%	
	u	Wind Speed	m/s	
	a	Leasehold Area	km ²	
	E	Emission Rate	g/s	

Source:

- i. Chakraborty, M. K., Ahmad, M., Singh, R. S., Pal, D., Bandopadhyay, C., & Chaulya, S. K. (2002). Determination of the emission rate from various opencast mining operations. *Environmental Modelling & Software*, 17(5), 467-480.
- ii. Chaulya, S. K., Chakraborty, M. K., & Singh, R. S. (2001). Air pollution modelling for proposed limestone quarry. *Water, Air, and Soil Pollution*, 126(1), 171-191.
- iii. Priyanka Yadav, Narendra Swaroop & Tarence Thomas (2020). Analysis of Physico-Chemical Properties and Available Macro Nutrient Status of Soil Blocks of Alwar District Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences* ISSN: 2319-7706 Volume 9 Number 7 (2020)

Copy of the articles referred is enclosed as **Annexure-VIII**.

Values considered from available mine plans, literatures, monitoring data to calculate the emission factor for each activity of the mines is as tabulated below:

S.No.	Particulars	Value considered
1.	Wind speed	1.5m/s
2.	Soil moisture content	6%
3.	Silt content	8%
4.	Waste drop height	3m
5.	Avg. vehicle speed	10.8 km/hr
6.	Density of mined material	2.5kg/cm ³

It is assumed that PM₁₀ portion in the generated dust from mining activities is 40% of the SPM. The PM₁₀ emission load is estimated separately for each activity in the mine. Control measures including water sprinkling on the haul road are assumed empirically to reduce about 80% of the SPM/PM₁₀ emissions within the mine lease area. Considering the information given in **Table 1** and using the equations given in **Table 2**, SPM and PM₁₀ emission loads due to each activity is estimated, as presented in **Table 3**.

Table 3: Estimated SPM and PM₁₀ Emission Load from Marble Mine Activities

Sr. No.	Activities within Mine Lease Area	Emission Load (kg/day of 8 hrs Shift)			
		SPM		PM ₁₀	
		1 ha	4 ha	1 ha	4 ha
	Mine Lease Area→				
1.	Drilling	1.0	3.6	0.4	1.44
2.	Exposed Pit Area	12.7	68.0	5.08	27.2
3.	Exposed dump area	2.0	6.4	0.8	2.56
4.	Waste/overburden loading	11.2	12.1	4.48	4.84
5.	Waste/overburden unloading	1.9	2.0	0.76	0.8
6.	Haul Road	306	613.8	122	245
7.	Total	335	706	134	282

Perusal of table indicates that movement of tippers/trucks on the haul roads (inside the mine lease area) contribute as high as 91% for 1 ha area mine and 87% for a 4 ha area mine. Dust generation from the haul roads needs to be further controlled.

3.1.4 Meteorological Data Analysis for Air Quality Modelling

Meteorological conditions play an important role in dispersion of air pollutants emitted from various sources. Meteorological parameters vary from season to season, day to day and even hour to hour. The meteorological conditions during summer season have high dispersion potential while during winter season have least dispersion potential and result in build-up of the pollution levels. AERMOD requires meteorological data of both; at the surface level and upper air level. The meteorological data required at surface level are ambient temperature, relative humidity, wind speed, wind direction, solar radiation, cloud cover, rainfall and atmospheric pressure. The meteorological data required at upper air level are ambient temperature, wind speed, wind direction and atmospheric pressure at different vertical height, which are calculated by AERMET, pre-processor of AERMOD. AERMET, Met. Pre-processor of AERMOD uses these surface and upper air data and estimates the boundary layer parameters. It is always suggested to use these sets of data for

air quality modelling. However, if site specific upper air data are not available, then upper air estimator of AERMET can be used for generation of boundary layer parameters. This option uses well-referred algorithms and estimates upper air parameters based on the surface meteorological data.

3.1.5 Meteorological Parameters of the Alwar Region

The meteorological data for the Alwar region was obtained from Regional Office of RSPCB, Alwar for the year 2020. Copy of the meteorological data is enclosed as **Annexure-IX**. The modelling is carried out for the month of January 2020 as representative of winter period. Wind rose plot and wind class frequency distribution for January 2020 are presented in **Fig. 1**. It is observed that the wind is blowing from different directions with wind speed ranging from 0.5 to 4.0 m/s, whereas calm conditions prevailed only 4.6% of the time. The dominant wind speed was in the range of 1-2 m/s (55.4%), whereas the dominant wind direction was northeast. Further, **Figs. 2 & 3** show the diurnal profile of wind speed and solar radiation.

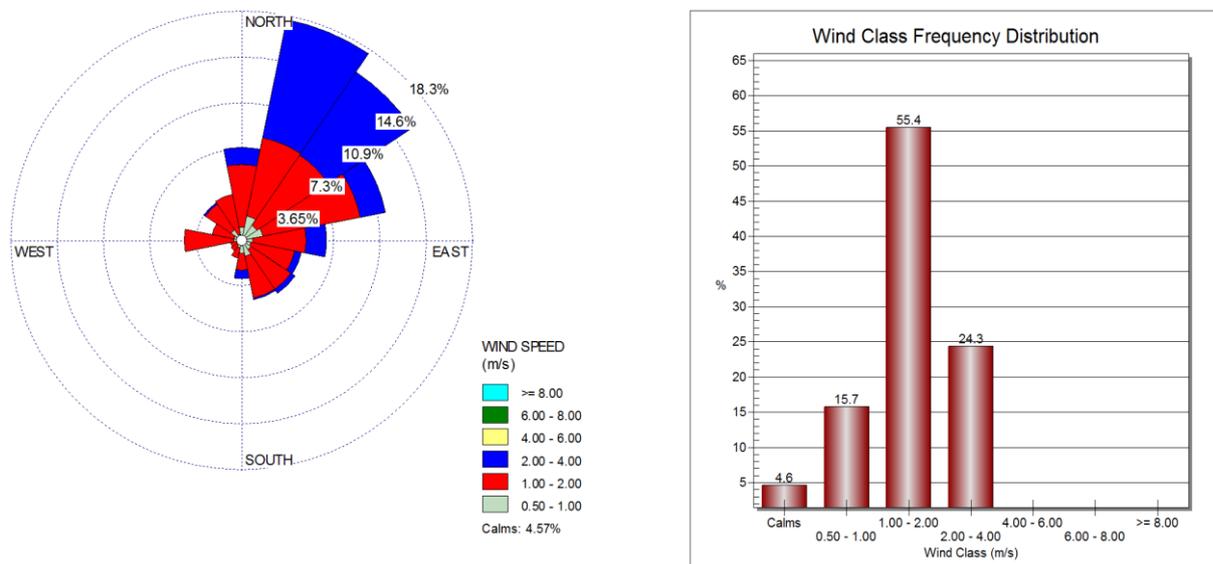


Fig. 1: Wind Rose and Wind Class Frequency Distribution Chart of Alwar during January 2020

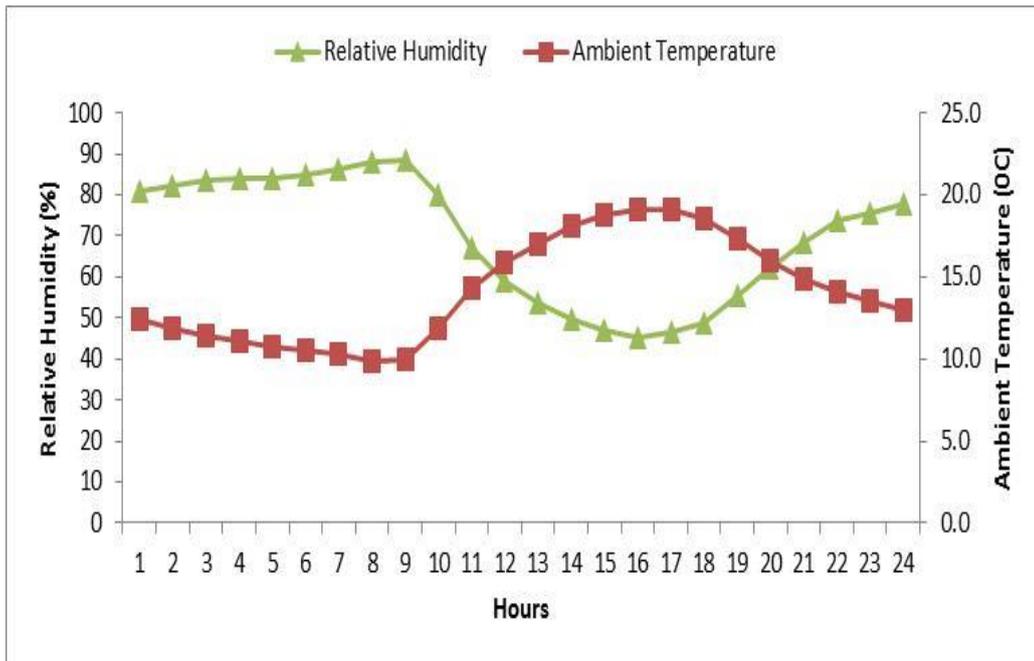


Fig. 2: Diurnal Profile of Relative Humidity and Ambient Temperature (January 2020)

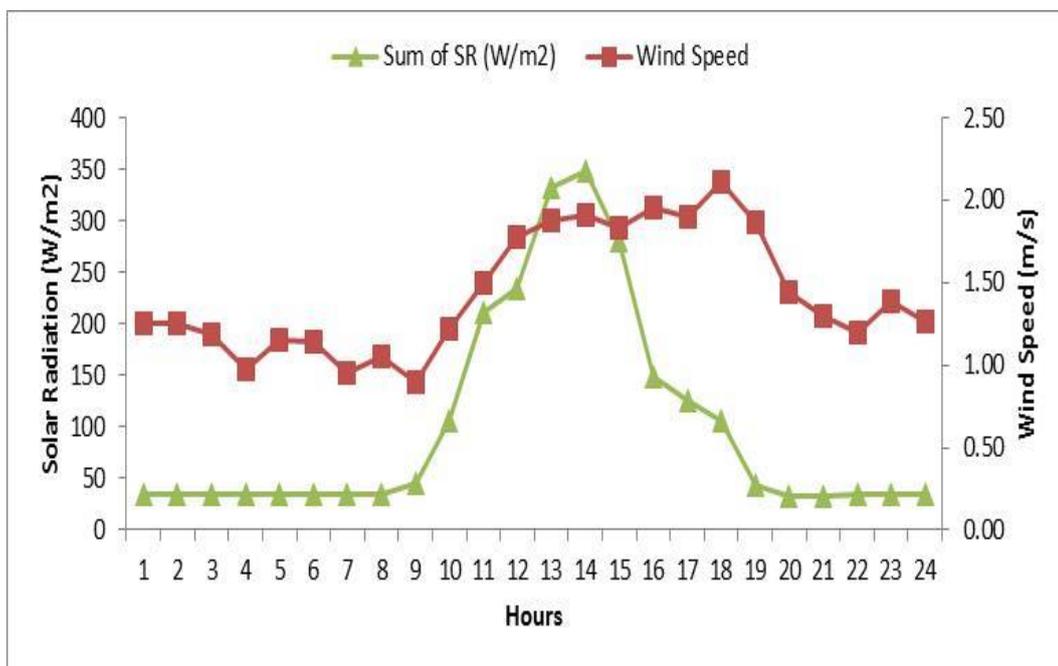


Fig. 3: Diurnal Profile of Solar Radiation and Wind Speed (January 2020)

3.1.5 Model Setup and Run

The model domain has been setup for 5 km radius from the centre of the mine's pit. Due to complexity in sources and numerous types of sources within the mine, mine is modelled as an Open pit area source by combining emission from all the activities. The receptor grid cell size is taken as 50 m x 50 m considering the ground level emissions. The model has been run for winter season (January month of year 2020) which is a critical month from the air pollution dispersion point of view due to poor vertical mixing, resulting in to built-up of pollutants in the area. Spatial distribution of PM₁₀ concentration emitted from mine activities of 1 ha and 4.263 ha are presented in **Figs. 4 & 5**, respectively. The modelling results of 08 hours working indicate that the maximum ground level concentration (GLC) of PM₁₀ was within the mine lease area only (50-60 m from centre of the mine pit). The max. GLC for 1 ha mine was 31 $\mu\text{g}/\text{m}^3$ and for 4 ha mine it was 101 $\mu\text{g}/\text{m}^3$. This prediction exercise also includes emissions from diesel consumption in stationary machineries.

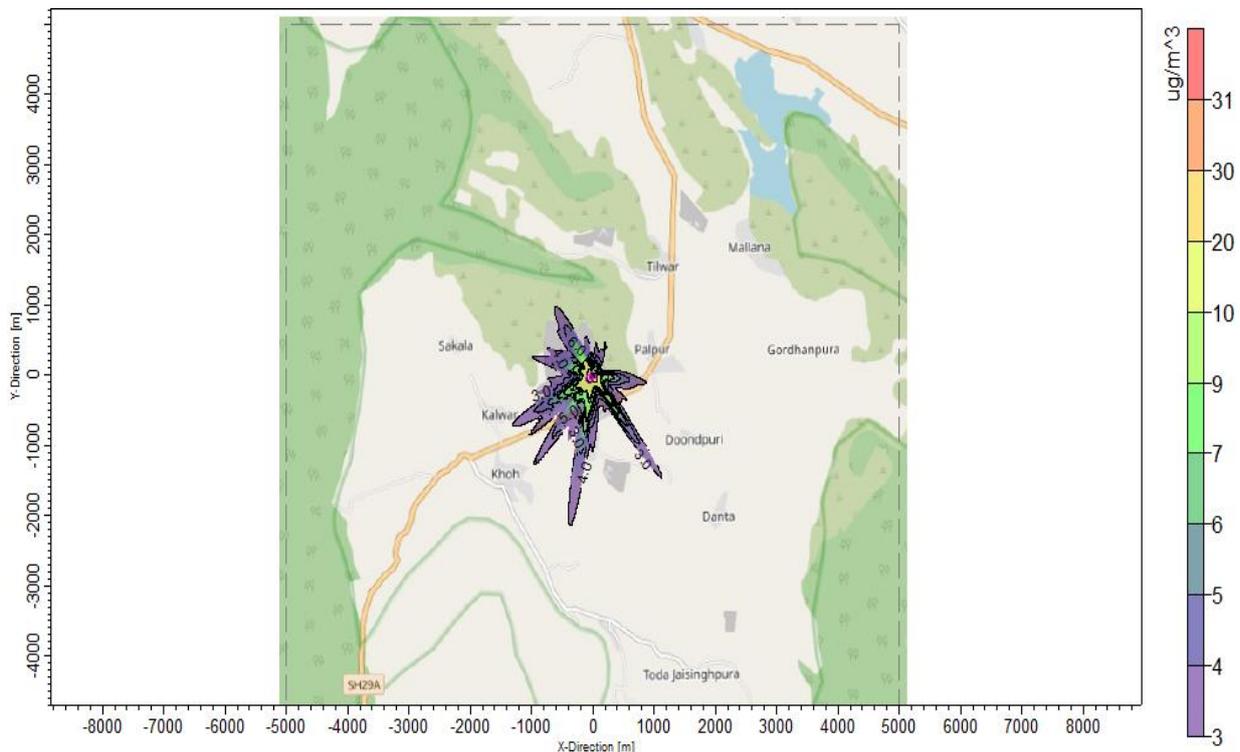


Fig. 4: Predicted PM₁₀ Concentration from Various Activities in a 1 ha Marble Mine

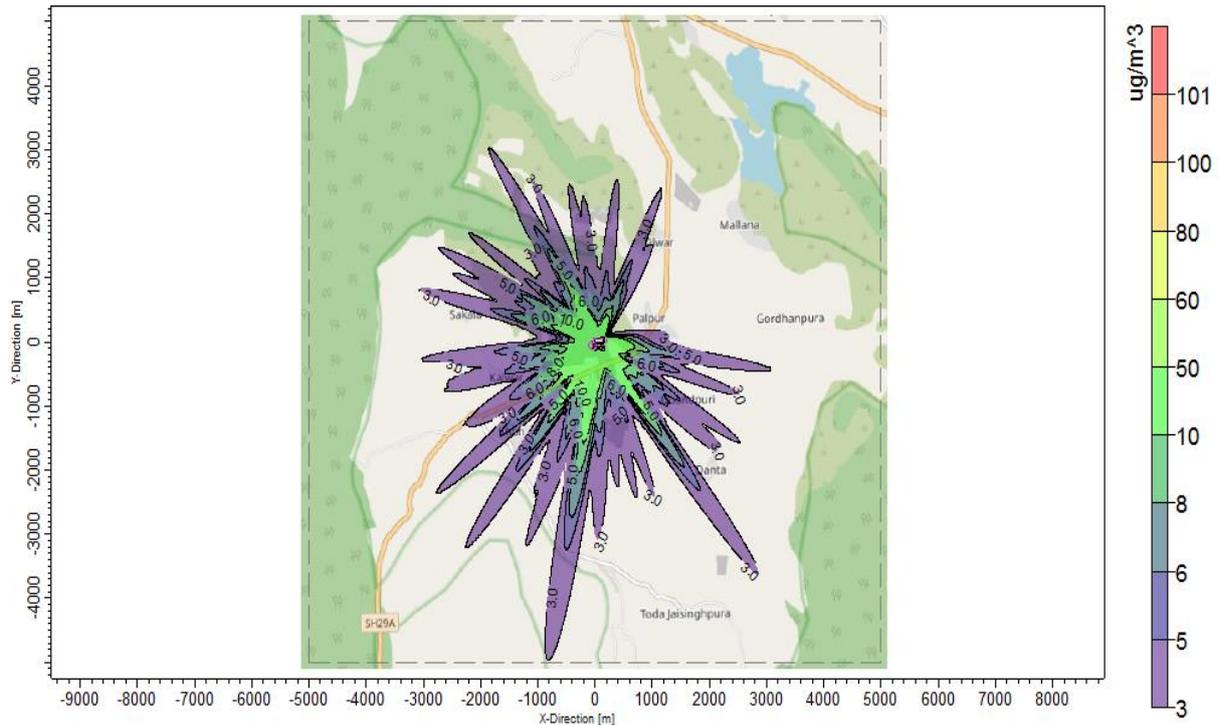


Fig. 5: Predicted PM₁₀ Concentration from Various Activities in a 4.263 ha Marble Mine

3.1.6 Summary & Conclusion

Most of the Marble mines in Alwar district around Sariska are having small mine lease area, mostly in the range of 1.0 ha - 4 ha, maximum number being of 1.0 ha mine. The modelling results indicate that the activities within small mines do not affect the surrounding air quality significantly, and the impact remains mostly within the mine lease area, unless there is high wind speed.

Contribution to surrounding air quality as a function of distance is given in **Table 4**, which indicates that PM₁₀ concentration reduces significantly as we move away from the mine. At a distance of 1 km, the contribution from 1 ha and 4.263 ha mine could be 5.4 $\mu\text{g}/\text{m}^3$ and 13 $\mu\text{g}/\text{m}^3$. This concentration represents 8 hourly time duration of mining activity, whereas for the remaining 15-16 hours of day, there may be negligible activity, thus reducing 24 hourly concentrations drastically.

Table 4: Impact of Marble Mines on the surrounding Atmosphere

Mine Area	PM ₁₀ Emission Load (Kg per day) with 80% Control	Ground Level Concentration (µg/m ³) from the Mine's Pit				
		Max.	100 m	500 m	1000 m	5000m
1 ha	26.8	31	20	9	5.4	<1
4.263 ha	56.4	101	64	19	13	3

Conclusion of the dispersion modelling

Though impact of individual mine appears to be very less, but cumulative impact of all the mines working simultaneously could be significant. This could be even more significant depending upon the movement of trucks on the roads carrying mined materials and condition of roads. Therefore, road network needs to be strengthened and made dust free to ensure minimum impact on the surrounding air quality of the region.

4.0 Estimation of the carrying capacity of the area

To estimate the carrying capacity of the mine area around the Sariska wildlife sanctuary, methodology earlier adopted in **Hon'ble NGT (PB) Original Application No. 1016/2019 in the matter of Utkarsh Panwar Vs CPCB & Ors** was considered here too.

4.1 Estimation of Existing Pollution Load w.r.t PM_{2.5}

There are 84 mines (In cluster & scattered) situated with Consent to Operate in about 25KMs radius from the centre of Sariska Wildlife Sanctuary. The annual consented capacity of these 84 mines is 83,50,135 T. As on 31.12.2021, 42 mines are having valid CTO having consented annual capacity of 3761311T.

- Total area **(a) : 1963 km²** (All the mines situated in the radial distance of 25 kms from the centre of the Sariska Wildlife Sanctuary)

- Average atmospheric mixing height during a particular month in km **(b)** : The Mixing height of Rajasthan is as per the "Atlas of Hourly Mixing Height and Assimilative Capacity of Atmosphere in India", published in 2008 by India Meteorological Department, New Delhi. The Hourly mixing height is as tabulated below:

Mixing height of Rajasthan as per the "Atlas of Hourly Mixing Height and Assimilative Capacity of Atmosphere in India", published in 2008 by India Meteorological Department, New Delhi										
Day time (hour of the day)	Month & Season		March		Month & Season		Month & Season		Month & Season	
	Dec-Feb				April-June		July-Sept		Oct-Nov	
	winter		Intermediate month of winter & summer		Summer		Monsoon		Post Mansoon	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
7	20	40	60	75	100	110	70	85	40	60
8	30	60	85	105	140	150	110	145	80	140
9	80	110	165	205	250	300	275	340	300	380
10	180	220	365	410	550	600	525	590	500	580
11	370	420	635	735	900	1050	850	975	800	900
12	580	680	1015	1140	1450	1600	1265	1420	1080	1240
13	720	900	1210	1460	1700	2020	1540	1800	1380	1580
14	900	1020	1450	1660	2000	2300	1775	2040	1550	1780
15	950	1100	1525	1775	2100	2450	1850	2205	1600	1960
16	950	1120	1500	1760	2050	2400	1800	2150	1550	1900
17	900	940	1400	1660	1900	2380	1600	2015	1300	1650
18	600	700	1150	1450	1700	2200	1270	1610	840	1020
19	370	440	785	920	1200	1400	825	990	450	580
Average Mixing height (m)	512	596	873	1027	1234	1458	1058	1259	882	1059

The monthly minimum mixing height in KMs is as tabulated below:

Month wise minimum mixing height in KMs	
Month	Mixing Height in KMs
January	0.512
February	0.512
March	0.873
April	1.234
May	1.234
June	1.234
July	1.058
August	1.058
September	1.058
October	0.882
November	0.882
December	0.512

- Total volume of Air in the 25KMs radial spread of mines from the centre of sanctuary during a particular month in KM^3 **(C)** : **a x b**
- Average $\text{PM}_{2.5}$ concentration for a particular month in kg/km^3 **(d)**:
- **About the Aerosol Optical Depth** data converted to $\text{PM}_{2.5}$ are Satellite-Based database of high-resolution (1-km). The aerosol optical depth converted from Moderate Resolution Imaging Spectroradiometer (MODIS) retrieved by Multi-angle Implementation of Atmospheric Correction (MAIAC) algorithm to surface $\text{PM}_{2.5}$ using a dynamic scaling factor from Modern-Era Retrospective analysis for Research and Applications Version 2 (MERRA-2) data. The satellite-derived daily (24-h average) and annual $\text{PM}_{2.5}$ show a R^2 of 0.8 and 0.97 and root mean square error of 25.7 and $7.2 \mu\text{g}/\text{m}^3$, respectively against surface measurements from the Central Pollution Control Board India network. The database is freely disseminated through a web portal 'satellite-based application for air quality monitoring and management at a national scale' (SAANS) for air quality management, epidemiological research and mass awareness. (Sagnik Dey et al (2020) "A Satellite-Based High-Resolution (1-km) Ambient $\text{PM}_{2.5}$ Database for India over Two Decades (2000–2019): Applications for Air Quality Management. *Remote Sens.* 12, 3872). Copy of the article is enclosed as **Annexure-X**.

For understanding the ratio of CAAQMS to Aerosol Optical Depth (AOD) data of $\text{PM}_{2.5}$, the available daily $\text{PM}_{2.5}$ data of CAAQMS & AOD satellite data of year 2020 were studied. The monthly ratio is as tabulated below for the Alwar city:

S.NO.	Month	CAAQMS/AOD ratio of 2020
1.	January	0.35
2.	February	0.54
3.	March	0.75
4.	April	0.70
5.	May	0.96
6.	June	1.12
7.	July	0.75
8.	August	0.68
9.	September	1.05
10.	October	0.75
11.	November	0.75
12.	December	0.75

Note: The annual ratio of CAAQMS to AOD $\text{PM}_{2.5}$ Data i.e. 0.75 was taken for the month (July, October, November & December) as data of AOD were not available for these months.

The CAAQMS & AOD data is enclosed as **Annexure-XI**.

The Aerosol Optical Depth (AOD) PM_{2.5} data for the year 2020 of Palpur mine cluster, Sariska area (GPS location: 27.193473,76.390757) is as tabulated below:

S.NO.	Month	AOD values of PM_{2.5} for 2020 of Palpur mine cluster
1.	January	109
2.	February	109
3.	March	54
4.	April	37
5.	May	45
6.	June	33
7.	July	28
8.	August	24
9.	September	37
10.	October	64
11.	November	88
12.	December	57

The month-wise AOD derived 24 hourly Concentration of PM_{2.5} values for the year 2020 is as tabulated below:

Month	CAAQMS/AOD ratio of 2020 (Based on Alwar data)	AOD values of PM_{2.5} for 2020 of Palpur mine cluster	24 hourly Concentration of PM_{2.5} in $\mu\text{g}/\text{m}^3$ (kg/km^3)
			2020
Jan	0.35	109	38
Feb	0.54	109	59
Mar	0.75	54	41
Apr	0.70	37	26
May	0.96	45	43
Jun	1.12	33	37
Jul	0.75	28	21
Aug	0.68	24	16
Sep	1.05	37	39
Oct	0.75	64	48
Nov	0.75	88	66
Dec	0.75	57	43

Therefore, total estimated pollution load (in MT) of $PM_{2.5}(x) = c \times d$

Month	Total volume of Air in the 25KMs radial spread of mines from the centre of sanctuary during a particular month in $KM^3(c)$	24 hourly Concentration of $PM_{2.5}$ in $\mu g/m^3$ (kg/km^3) (d)	$PM_{2.5}$ pollution load in MT/day during 2020 $(X_{PM_{2.5}}) = c \times d$
Jan	1005	38	38.2
Feb	1005	59	59.3
Mar	1714	41	70.3
Apr	2422	26	63.0
May	2422	43	104.2
Jun	2422	37	89.6
Jul	2077	21	43.6
Aug	2077	16	33.2
Sep	2077	39	81.0
Oct	1731	48	83.1
Nov	1731	66	114.3
Dec	1005	43	43.2

4.2 Estimation of assimilative capacity w.r.t. PM_{10}

Total volume of Air in the 25KMs radial spread of mines from the centre of sanctuary during a particular month in $KM^3(c)$

Particulate Matter (PM_{10}) concentration in ambient air as per NAAQ standard: $100 \mu g/m^3$ i.e. **100 Kg/ Km^3** (Ref. Air Quality Index/NAAQ Standards, 2009)

Therefore, daily Assimilative capacity w.r.t. PM_{10} in ambient air of the area during a particular month (**y**): **$c \times 100 = y$ Kgs**

Month	Average Daily Permissible PM_{10} Emission Load (MT/day) [Permissible Assimilative capacity] in 2020 (in MT/day)
Jan	100.5
Feb	100.5
Mar	171.4
Apr	242.2
May	242.2
Jun	242.2

Jul	207.7
Aug	207.7
Sep	207.7
Oct	173.1
Nov	173.1
Dec	100.5

4.3 Estimation of supportive capacity based on PM₁₀

Supportive Capacity (**z**) = Assimilative Capacity (**y**) - Total Estimated Load (PM₁₀) (**X_{PM10}**)

For the estimation of the pollution load, Aerosol Optical Depth (AOD) data of PM_{2.5} were considered. The PM_{2.5} values have been extrapolated to PM₁₀. The month-wise ratio of PM₁₀ to PM_{2.5} was calculated based on the nearest (42kms from Sariska) Continuous Ambient Air Quality Monitoring Station at Alwar (Data year 2020).

Month	PM10	PM2.5	Ratio PM ₁₀ /PM _{2.5}
Jan	82	44	1.88
Feb	88	52	1.70
Mar	79	39	2.04
Apr	43	21	2.01
May	62	29	2.16
Jun	76	39	1.94
Jul	68	37	1.84
Aug	54	29	1.88
Sep	71	39	1.82
Oct	93	51	1.82
Nov	107	59	1.81
Dec	112	55	2.05

The estimated supportive capacity for the year 2020 is

Month	Existing PM_{2.5} Pollution load (MT/day)	Ratio of PM₁₀/PM_{2.5}	Existing PM₁₀ Pollution load (MT/day) (X_{PM10})	Permissible PM₁₀ Emission Load (MT/day) [Permissible Assimilative capacity] (y)	Available PM₁₀ Emission Load (MT/day) [Available Supportive capacity] (z) = (y-X_{PM10})
January	38.2	1.88	71.8	100.5	28.7
February	59.3	1.7	100.8	100.5	-0.3
March	70.3	2.04	143.3	171.4	28.0
April	63.0	2.01	126.6	242.2	115.6
May	104.2	2.16	225.0	242.2	17.2
June	89.6	1.94	173.9	242.2	68.4
July	43.6	1.84	80.2	207.7	127.4
August	33.2	1.88	62.5	207.7	145.2
September	81.0	1.82	147.4	207.7	60.3
October	83.1	1.82	151.3	173.1	21.9
November	114.3	1.81	206.8	173.1	-33.7
December	43.2	2.05	88.6	100.5	11.9

5.0 Summary

The 157 mines (total 353.14 Ha lease area) are majorly situated in South & South-West of the Sariska Wildlife Sanctuary. The 84 mines have obtained environmental clearance and Consent to Operate from the authority's viz. SEIAA/DEIAA and RSPCB. The mines operate for about 300days annually (8 hours daily during 8AM to 5PM). The sources of air pollution within the mining lease area are drilling, exposed pit area, exposed dump area, overburden loading & unloading and transportation on haul road. The activity-wise emission load study w.r.t. themining operation indicates that movement of tippers/trucks on the haul roads (inside the mine lease area) contribute as high as 91% for 1 ha area mine and 87% for a 4.263 ha area mine.

Contribution to surrounding air quality as a function of distance indicates that PM₁₀ concentration reduces significantly as we move away from the mine. At a distance of 1 km, the contribution from 1 ha and 4.263 ha mine could be 5.4 µg/m³ and 13 µg/m³. This concentration represents 8 hourly time duration of mining activity, whereas for the remaining 15-16 hours of day, there may be negligible activity, thus reducing 24 hourly concentrationsdrastically.

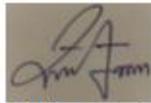
The supportive capacity assessed (2020) for the airshed falling under 25KMs radial distance from the centre of the Sariska Sanctuary based on the available PM10 & PM2.5 monitoring data of nearest city i.e. Alwar and satellite (AOD) data of PM2.5 & mixing height as per the IMD atlas indicate that in the month of February & November the supportive capacity got exhausted w.r.t. the permissible capacity. Site-specific air quality monitoring and meteorological data will give more accurate assessment of the supportive capacity.

The metalled road and proper water sprinkling along with plantation may reduce the dust generation from the haul roads significantly.

6.0 Recommendations

1. Among the various activities during the mine operation, movement of trucks/tippers on the haul roads (within the mine lease area) and upto the main road becomes the major source of air pollution, therefore each mine lease holder has to ensure proper and regular sprinkling of water on the haul road and the road till the main road to minimize the dust emissions.
2. Each mine lease holder is to strictly comply with the EC conditions and consent to operate conditions and carryout periodic monitoring of the ambient air in consultation with RSPCB. Based on such database, periodic assessment of the supportive capacity may be done by RSPCB to regulate the mines.
3. During the field visit, it was observed that mined out materials were dumped at many places outside the mining lease area, fine fraction of which may contribute to air pollution due to winds. Such mined out materials lying outside the mine lease area may be suitably disposed of/ utilized by the concerned mine lease holders or by the Mining Department.
4. To minimize the direct & indirect impact on the forest & wildlife, air quality, road etc. of the periphery of sariska sanctuary due to the mines operating in South & South-West of the Sanctuary, part of the funds contributed by the mine lease holders of the Alwar district to District Mineral Foundation (DMF) may be utilized. The amount (to the tune of 0.5% or so) may be allocated to the State Govt. foundation "Sariska Tiger Conservation Foundation" for the betterment/management of forest & wildlife activities of Sariska Tiger Reserve and towards welfare activities of nearby villagers.

5. In view of large number of mines in the vicinity of wildlife sanctuary (STR), a detailed study on “assessment of the cumulative impact of all the mines located in the region including transportation on the surrounding environment” needs to be conducted by a nationally reputed institute. Environmental management plans so derived from the study will need to be adopted by the concerned stakeholders. Such study may be conducted by the Mining Association or RSPCB. This is also important from the fact that various data used in the present analysis have been taken from different sources and region-specific data needs to be established to ensure environmentally sustainable operation of mines.



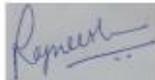
(R N Meena, IFS)
CF & FD, STR Alwar



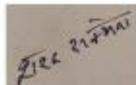
(Mahesh Dutt Puhorit)
Sc-C, MoEF&CC, IRO, Jaipur



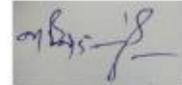
(Keshav Meena)
SDM, Rajgarh, Alwar



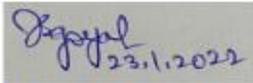
(Rajneesh Jain)
MS SEAC- Jaipur



(Sharad Saxena)
RO, RSPCB, Alwar

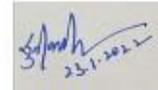


(Milind Nimje)
Sc-C, CPCB, Bhopal



23.1.2022

(Dr S K Goyal)
Chief Scientist & Head
CSIR-NEERI, Delhi



23.1.2022

(Sunil Kumar Meena)
Sc-D, CPCB
RD, Bhopal

Item No. 7

Court No. 1

**BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI**

(By Video Conferencing)

Original Application No. 154/2020

In Re: News item published on 27.07.2020 in the local daily named "Times of India" titled "Forest guard mowed down by 'mining mafia' in Sariska"

Date of hearing: 06.04.2021

**CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON'BLE MR. JUSTICE BRIJESH SETHI, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER**

Respondent: Ms. Punam Singh, Mr. Kumar Rajesh Singh, Advocates for MoEF & CC

ORDER

1. Proceedings in this matter have been initiated based on media report¹ dated 27.07.2020 under the heading "Forest guard mowed down by 'mining mafia' in Sariska". The report is to the effect that a forest home guard was mowed down by a tractor belonging to suspected mining mafia inside Sariska Tiger Reserve on Sunday after he attempted to stop them along with his colleague. The guard was rushed to a hospital where he succumbed to injuries. Cops are yet to arrest the accused, but have seized the tractor. This is not the first time that forest officials have been attacked inside the Sariska Tiger Reserve. The deceased has been identified as Keval Singh. He was in his mid – 40s. Sariska Tiger Reserve, DFO Seduram Yadav said, "On Sunday, the guard along with his colleague went for patrol in Baldevgarh checkpost area of the tiger

¹ News item published in Times of India

reserve where they saw certain individuals illegally transporting *bajri* from the forest area. When the guards tried to stop them, they mowed him down with a tractor. This is not the first time that villagers have attacked forest officials. On January 25, a forest ranger of STR Jitendra Chaudhary had to run for his life after being attacked by villagers. The villagers attacked him after he and this 10-member team confiscated 18 sheeps and 30 goats for illegal grazing in the tiger reserve. On December 15, 2019, senior forest officials were allegedly manhandled by villagers in the tiger reserve. Following this, a case against 20 identified accused was registered at the Bansur police station. The reserve is spread across 1,281 sq. km. area and is divided into six ranges. There are just 108 forest guards, which is far less than its sanctioned strength of 132. Moreover, with the menace of frequent attacks in Sariska, unarmed forest guards often struggle to protect the area.”

2. The matter was last considered on 10.08.2020 and it was observed that there was failure of oversight regulatory mechanism in enforcing provision of the Wildlife (Protection), Act, 1972 and Sustainable Sand Mining Guidelines, 2020. Accordingly, a joint Committee comprising State PCB, District Magistrate, Alwar and PCCF (HoFF), Rajasthan was constituted to take further remedial action and to file a report specifically mentioning estimate of illegal mining, number of mines sanctioned in the area and regulatory mechanism to check the illegal mining in the said eco sensitive area.

3. Accordingly, DCF, Sariska Tiger Reserve, Rajasthan has filed a report on 15.02.2021 giving the list of mining within 10 kms. of the Sariska Tiger Reserve with the steps taken to control illegal mining in the said eco sensitive zone. The annexure to the report is an action taken

report by Member Secretary, Forest Conservation and Director, Sariska Tiger Reserve, Alwar to the effect that eco sensitive zone of Sariska Tiger Reserve has not been notified yet. 157 mines exist within 10 km. of the said Tiger Reserve. There is also a report by the State PCB dated 29.12.2020 to the effect that out of 157 mining leases, 69 leases are having valid consent to operate from the State PCB, 17 have applied for consent to operate and remaining 71 have not applied for consent to operate. 88 mines are not working.

4. We have heard learned Counsel for the appearing parties. Order of the Hon'ble Supreme Court dated 11.12.2018, in WP 2020/1995, *TN Godavarman v. UOI*, is as follows:

“The learned ASG has informed us that there are 104 National Parks and 558 Wildlife Sanctuaries making a total of 662 National Parks and Wildlife Sanctuaries in the country.

The proposals for declaring areas around these National Parks and Wildlife Sanctuaries as Eco Sensitive Zone have been received from State Governments / UT Administrations for 641 National Parks and Wildlife Sanctuaries. No proposals have been received in respect of 21 National Parks and Wildlife Sanctuaries.

The proposals have been accepted and Notification has been issued in respect of 289 National Parks and Wildlife Sanctuaries as on 26.11.2018 and draft Notification has been prepared in respect of 206 National Parks and Wildlife Sanctuaries.

The declaration with regard to Eco Sensitive Zone is under process with the Ministry of Environment, Forests and Climate Change (MoEF) as well as with the State Governments in respect of 146 National Parks and Wildlife Sanctuaries.

We expect the Ministry of Environment, Forests and Climate Change to actively pursue the preparation of the draft Notification and to issue a final Notification at the earliest.

The proposals for 21 National Parks and Wildlife Sanctuaries in respect of which proposals have not yet been received by the MOEF are as follows:-

ASSAM

1. Pobitora Sanctuary

JAMMU AND KASHMIR

2. Hemis High Altitude National Park

3. *Kishtewar National Park*
4. *Changthang Sanctuary*
5. *Hokersar Sanctuary*
6. *Trikuta Sanctuary*

KARNATAKA

7. *Jogimatti Sanctuary*
8. *Thimlapura Sanctuary*
9. *Yadahalli Chinkara Sanctuary*

MAHARASHTRA

10. *Deolgaon Rehekuri Sanctuary*
11. *Thane Creek Flamingo Sanctuary*
12. *Malvan Marine Sanctuary*

MANIPUR

13. *Siroi National Park*
14. *Khongjaingamba Ching Sanctuary*

MEGHALAYA

15. *Baghmara Pitcher Plant Sanctuary*

NAGALAND

16. *Fakim Sanctuary*
17. *Puliebadze Sanctuary*
18. *Rangapahar Sanctuary*

UTTAR PRADESH

19. *Dr. Bhimrao Ambedkar Bird Sanctuary*
20. *Pilibhit Sanctuary*

WEST BENGAL

21. *Jorepokhri Sanctuary*

It is submitted by the learned Amicus that this issue has been pending since sometime in December, 2006. 12 years have gone-by but no effective steps have been taken by the State Governments in respect of the National Parks and Wildlife Sanctuaries mentioned above.

Under the circumstances, we direct that an area of 10 Kms around these 21 National Parks and Wildlife Sanctuaries be declared as Eco Sensitive Zone by the MoEF. The declaration be made by the MoEF at the earliest.

Liberty is granted to the State Governments to move an application for modification of this order along with proposal only two weeks after submission of the proposals to the MoEF.”

5. Following the above order, this Tribunal vide order dated 20.12.2018 in Appeal No. 48/2016, *Nityendra Manav vs. UOI*, prohibited mining within 10 km of Sariska Tiger Reserve and quashed the EC in

question against which appeal was filed before the Tribunal. Relevant part of the order is reproduced below:

“ xxx.....xxx.....xxx

Learned Counsel for respondent brought to our notice an order issued by Hon'ble Supreme Court on 11-12-2018 in WP (C) No. 202/1995 wherein Hon'ble Supreme Court had ordered that in respect of 21 National Parks/Sanctuary, the Eco-sensitive zone will be 10 kms as the proposal for the same had not been sent to MoEF by the States. The Learned Counsel for the respondent tried to make a distinction that in this case the Government of Rajasthan had sent the proposal to MoEF and it is pending consideration by MoEF.

It is the admitted position that the final notification of Eco-sensitive zone for Sariska Tiger Reserve/Sanctuary is yet to be issued by the MoEF. We, therefore, direct that all mining activities of any mineral will be stopped within 10 kms of the boundary of Sariska Tiger Reserve/Wildlife Sanctuary till mining leases are cleared by the standing committee of the National Board of Wildlife. All the ECs of the mining leases may be referred to the standing Committee of the NBWL. In case MoEF issues final notification on Eco-sensitive Zone, the mining lease which fall within the Eco-sensitive Zone will have to have clearance of the standing committee of the NBWL.”

6. In view of above, it is necessary for the authorities to take further remedial measures to enforce the law of the land. The State PCB and District Magistrate, Alwar may take steps to stop operation of mining leases, operating illegally, without requisite consents and also to examine whether the leases for which consents are given are permissible. The State PCB may also recover compensation for damage to the environment by illegal mining activities, following due process. on 'Polluter Pays' principle.

7. Though counsel appears for the MoEF&CC, she says that she has no instructions. Let the State of Rajasthan and the MoEF&CC take further steps in the light of order of the Hon'ble Supreme Court for issuance of requisite notification for declaring the area around the Tiger Reserves to be eco sensitive zone for protection of the said Reserve. The

State of Rajasthan may furnish the requisite proposal in the light of Guidelines dated 09.02.2011 issued by the MoEF&CC to all the Chief Wildlife Wardens for eco sensitive zones.

8. We further direct constitution of a joint Committee comprising MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SEIAA, Rajasthan and District Magistrate, Alwar to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' principle. The CPCB and State PCB will be the nodal agency for compliance and coordination. The joint Committee may give its report within three months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

9. The MoEF&CC and State of Rajasthan may also file their respective action taken reports in the matter by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF, before the next date.

A copy of this order be forwarded to the MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SEIAA, Rajasthan and District Magistrate, Alwar by e-mail for compliance.

List for further consideration on 11.08.2021.

Adarsh Kumar Goel, CP

Sudhir Agarwal, JM

Brijesh Sethi, JM

Dr. Nagin Nanda, EM

April 6, 2021
Original Application No. 154/2020
A



Milind Nimje <milindnmj07@gmail.com>

Nomination of officer in NGT O.A NO. 154/2020 titled as News item published on 27.07.2020 in the local daily named "Times of India" titled "Forest guard mowed down by 'mining mafia' in Sariska" as a member of committee

1 message

Regional Directorate, Bhopal <cpcb.bhopal@gmail.com>

Mon, Apr 19, 2021 at 1:11 PM

To: Member Secretary <mshc.cpcb@gov.in>, mshc.cpcb@nic.in, prashant_gargava@hotmail.com, PRASHANT GARGAVA <aqm.cpcb@gov.in>

Cc: Nazim <nazim.cpcb@nic.in>, Nazim Uddin <nazim.cpcb@gmail.com>, urmila.cpcb@gov.in, G Rambabu Scientist D <grbabu.cpcb@nic.in>, sunil <biosunil2006@gmail.com>, poulami Chakraborty Patil <poulamichakrabortyp@gmail.com>, Milind Nimje <milindnmj07@gmail.com>

Respected sir,

Hon'ble NGT via its order dt. 06.04.2021 in O.A NO. 154/2020 titled as "News item published on 27.07.2020 in the local daily named "Times of India" titled "Forest guard mowed down by 'mining mafia' in Sariska", directed to constitute a joint Committee comprising of MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SEIAA, Rajasthan and District Magistrate, Alwar to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' principle. **The CPCB and State PCB will be the nodal agency for compliance and coordination (copy of order is attached).**

The matter is filed against granting of permission for mining lease in the proximity of Sariska Tiger Reserve.

It is proposed to nominate Sh. Milind Kumar Nimje, Sc. C as a member of the joint committee in compliance of order mentioned above.

Submitted for your kind information and approval of nomination, please.

Regards
P Jagan)
Regional Director
CPCB RD Bhopal

2 attachments

Sariska Order 06.04.21.pdf
295K

Letter - Mail Copy.pdf
761K

GOVT. OF RAJASTHAN
OFFICE OF THE Pr. CHIEF CONSERVATOR OF FORESTS & CHIEF WILDLIFE
WARDEN, RAJASTHAN, ARANYA BHAWAN, JHALANA INSTITUTIONAL AREA,
JAIPUR

Email:- cwlw.raj@gmail.com

Phone No:-0141 2700151

No. F4(NGT/CWIW/2020-21) 505

16.04.21

To,

The Member Secretary,
Central Pollution Control Board,
Parivesh Bhawan, East Arjun Nagar,
New Delhi-110032

Sub:- Hon'ble National Green Tribunal order dated 06.04.2021 in Original application no. 154/2020 In Re: News item published on 27.07.2020 in "Times of India" titled "Forest guard mowed down by mining mafia in Sariska".

Ref:- Office Rajasthan State Pollution Control Board, Jaipur Letter No. F.10 Letter No.F.1 (329)RPCB/Legal/NGT/2020/1047 Dated 18.06.2021

Sir,

With reference to above subject matter, it is to inform that the Hon'ble Tribunal by order dated 06.04.2021 directed inert-alia as follow:-

"8. We further direct constitution of a joint Committee comprising MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SELAA, Rajasthan and District Magistrate, Alwar to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' Principle. The CPCB and State PCB will be the nodal agency for compliance and coordination. The joint Committee may give its report within three months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF.

The MoEF&CC and State of Rajasthan may also file their respective action taken reports in the matter by e-mail at judicialngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF, before the next date."

For compliance of the Hon'ble Tribunal order dated 06.04.2021, CF & FD, STR, Alwar (Mobile-9414056620) is hereby nominated as member of the committee on behalf of CWI W. The Hon'ble NGT order dated 06.04.2021 is enclosed with this letter for ready reference.

Enclosed:- As above.

Yours sincerely,

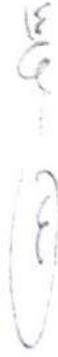
(M. Meena)
PCCF & Chief Wildlife Warden,
Rajasthan, Jaipur

No. 14 (NGT CWI W. 2020) 506 - 511

Copy to following for information and necessary action

1. Secretary, MoEF&CC, New Delhi.
2. Member Secretary, Rajasthan State Pollution Control Board, Jaipur.
3. CE & PD, SIR, Alwar.
4. District Collector, Alwar.
5. Member Secretary, SLEVA, Government of Rajasthan, Jaipur.
6. Regional Officer, RSPCB, Alwar.

Dated 15.07.2021



CCF & Chief Wildlife Warden,
Rajasthan, Jaipur



भारत सरकार

GOVERNMENT OF INDIA

पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय

MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE

एकीकृत क्षेत्रीय कार्यालय, जयपुर / Integrated Regional Office, Jaipur



Through e-mail / Speed Post

IRO/JPR/NGT/-१०

Dated: 15.07.2021

To

Sh. P. Jagan,
Regional Director
Zonal Office Bhopal
Central Pollution Control Board,
3rd Floor, Sehkaar Bhawan,
North TT Nagar,
Bhopal- 462003

Sub: Nomination of the officer from IRO Jaipur for the Joint Committee constituted by Hon'be NGT in the matter of O.A. No. 154/2020: Reg.

Sir,

With reference to the cited subject and captioned letter regarding nomination of the officer from Ministry of Environment Forest and Climate Change, GoI this is to inform that the undersigned (Mob: 9413845550; e-mail: maheshdutt.purohit@gov.in) has been nominated from Integrated Regional Office Jaipur for the Joint Committee constituted by Hon'be NGT in the matter of O.A. No. 154/2020.

This bears the approval of competent authority.

Sincerely,

(Mahesh Dutt Purohit)

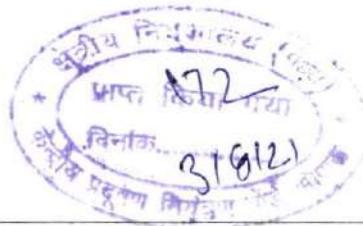
Deputy Director (S)/Scientist-C

Copy to:-

Member Secretary, Rajasthan State Pollution Control Board, 4-Institutional Area, Jhalana Doongri, Jaipur. - For kind information please.

(Mahesh Dutt Purohit)

Deputy Director (S)/Scientist-C



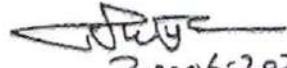
कार्यालय जिला कलक्टर, अलवर (राज0)

क्रमांक: सामा./प्रतिनिधि/2021/2681

दिनांक 30/06/2021

-: कार्यालय आदेश :-

क्षेत्रीय अधिकारी, राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर का पत्रांक 261 दिनांक 18.06.2021 के क्रम में माननीय राष्ट्रीय हरित अधिकरण, नई दिल्ली के आदेश दिनांक 06.04.2021 प्रकरण संख्या O.A. 154/2020 के संबंध में COMPRISING MoEF&CC, CPCB, STATE PCB CHIEF WILDLIFE WARDEN, SEIAA RAJASTHAN हेतु संयुक्त कमेटी गठित की जानी है। जिसमें जिला कलक्टर के प्रतिनिधि के रूप में अतिरिक्त जिला कलक्टर (प्रथम), अलवर को मनोनीत किया जाता है।


30-06-2021
(नन्मूल पहाड़िया)
जिला कलक्टर
अलवर

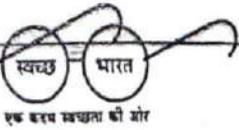
दिनांक : 30/06/2021

क्रमांक: सामा./प्रतिनिधि/2021/2682

प्रतिलिपि:-सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित है:-

01. अतिरिक्त जिला कलक्टर (प्रथम), अलवर।
02. क्षेत्रीय अधिकारी, राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर।
03. रक्षित पत्रावली


30-06-2021
जिला कलक्टर
अलवर



Contact: 0144-2337565(0), 2336101 (F) e-mail: dm-alw-rj@nic.in

स्वच्छ अलवर-स्वस्थ अलवर

D:\RAJINI\RAJINI\RAJINI WORK\pratiniधि\PRATINIDHIEE.doc (276)



Nomination of officer in NGT O.A NO. 154/2020 titled as News item published on 27.07.2020 in the local daily named "Times of India" titled "Forest guard mowed down by 'mining mafia' in Sariska" as a member of committee

Sunil Kr Meena <sunil.cpcb@gov.in>
To: cpcb bhopal <cpcb.bhopal@gmail.com>

Mon, Apr 19, 2021 at 12:00 PM

Respected sir,

Hon'ble NGT via its order dt. 06.04.2021 in O.A NO. 154/2020 titled as "News item published on 27.07.2020 in the local daily named "Times of India" titled "Forest guard mowed down by 'mining mafia' in Sariska", directed to constitute a joint Committee comprising of MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SEIAA, Rajasthan and District Magistrate, Alwar to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' principle. **The CPCB and State PCB will be the nodal agency for compliance and coordination (copy of order is attached).**

The matter is filed against granting of permission for mining lease in the proximity of Sariska Tiger Reserve.

It is proposed to nominate Sh. Milind Kumar Nimje, Sc. C as a member of the joint committee in compliance of order mentioned above.

Submitted for your kind information and approval of nomination, please.

Regards

2 attachments

 Sariska Order 06.04.21.pdf
295K

 Letter - Mail Copy.pdf
761K



राजस्थान राज्य प्रदूषण नियंत्रण मण्डल
RAJASTHAN STATE POLLUTION CONTROL BOARD
4, Institutional Area, Jhalana Doongri, Jaipur.
Phone: 5101871, 5101872, EAPBX: 5159600, 5159699

MOST- URGENT

No. F.10 (329) RPCB/Legal/NGT/2020/

1045-50

Date:

10/06/2021

Member Secretary,
Central Pollution Control Board,
Parivesh Bhawan, East Arjun Nagar,
New Delhi-110032.

Sub: - Hon'ble National Green Tribunal order dated 06.04.2021 in Original application no. 154/2020 In Re: News item published on 27.07.2020 in "Times of India" titled "Forest guard mowed down by mining mafia in Sariska".

Sir,

With reference to above subject matter, it is to inform that the Hon'ble Tribunal by order dated 06.04.2021 directed inert-alia as follow:-

"8. We further direct constitution of a joint Committee comprising MoEF&CC, CPCB, State PCB, Chief Wildlife Warden, SEIAA, Rajasthan and District Magistrate, Alwar to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' principle. The CPCB and State PCB will be the nodal agency for compliance and coordination. The joint Committee may give its report within three months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

9. The MoEF&CC and State of Rajasthan may also file their respective action taken reports in the matter by e-mail at judicialngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF, before the next date."

For compliance of the Hon'ble Tribunal order dated 06.04.2021, Regional Officer, RSPCB, Alwar (Mobile-9413259185) is hereby nominated as member of the committee and also appointed as Nodal Officer on behalf of RSPCB. The Hon'ble NGT order dated 06.04.2021 is enclosed with this letter for ready reference.

Enclosed-As above

Yours sincerely,

(Dr. Gobind Sagar Bhardwaj)
Member Secretary ok

Copy to following for information and necessary action:-

1. Secretary, MoEF& CC, New Delhi
2. Chief Wildlife Warden, Government of Rajasthan, Aranay Bhawan, Jaipur.
3. District Collector, Alwar.
4. Member Secretary, SEIAA, Government of Rajasthan, Jaipur.
5. Regional Officer, RSPCB, Alwar

Member Secretary ok

**Minutes of Meeting held Virtually on 22.7.2021 03:00PM in
Hon'ble NGT O.A. No. 154 of 2020;**

**In Re: News item published on 27.07.2020 in the local daily
named "Times of India" titled "Forest guard mowed down by
'mining mafia' in Sariska"**

The joint committee constituted by Hon'ble NGT to conduct a study about the carrying capacity of the area to sustain the mining activities on 'Sustainable Development' principle hold its first virtual meeting on 22.7.2021 3:00PM. The name of the officers nominated as committee members from concern departments is as below:

1. Sh R N Meena, IFS, CF& FD STR, Alwar
2. Sh. Mahesh Dutt Purohit. Sci 'C, MoEF&CC, IRO, Jaipur
3. Sh. Ram Sharan Sharma, Additional Collector, Alwar
4. Sh. Rajneesh Jain, SEE, Member Secretary SEAC, Jaipur
5. Sh. Sharad Saxena, Regional Officer, RSPCB, Alwar
6. Sh Milind Kumar Nimje, Sc-C, CPCB, RD, Bhopal

Official of MoEF&CC and District Administration was unable to join the meeting due to pre-planned field visits.

The committee hold discussion over the activities going on the said area of Sariska Tiger Reserve and discussed the available methodology for carrying out the carrying capacity study. The committee planned to have its field visit on **30.7.2021**; to understand the field conditions and to plan monitoring accordingly.

The committee was in the opinion to first collect few preliminary data related to mining activities, Aerosol Optical Density data & CAAQMS data of the nearby area etc before proceeding to the field visit. The following was decided during meeting:

1. Details of the mining activities going on in the said area w.r.to. Name of Lease holder, location, area of mine, lease period, annual production, GPS location, status of CTO etc.
(Action By: RSPCB by 27th July 2021)
2. Collection of CAAQMS monitoring data & meteorological data of Alwar from January 2018 to till date.
(Action By: RSPCB by 27th July 2021)
3. Aerosol Optical Density data of last 05 years of particular GPS location viz. Palpur, Baldeogarh of Rajgarh.
(Action by: CPCB by 27th July 2021)
4. An expert agency may be engaged to run the model based on the available data to assess the pollutant dispersion.
(Action by: CPCB by 27th July 2021)

The committee will have its field visit on 30th July 2021.


 (Milind Kumar Nimje)
 Sc-C, CPCB, RD, Bhopal

**Minutes of Meeting held Virtually on 05.10.2021 04:00 PM in
Hon'ble NGT O.A. No. 154 of 2020**

**In Re: News item published on 27.07.2020 in the local daily
named "Times of India" titled "Forest guard mowed down by
'mining mafia' in Sariska"**

The joint committee constituted by Hon'ble NGT hold its second virtual meeting on 05.10.2021 4:00 PM with Expert Member Dr. S.K. Goyal, Chief Scientist & Head Acsir, Delhi Zonal Center, CSIR-NEERI, New Delhi to discuss on the available information and methodology of studying carrying capacity. Following member attended the meeting:

1. Sh R N Meena, IFS, CF& FD STR, Alwar
2. Sh. Rajneesh Jain, SEE, Member Secretary SEAC, Jaipur
3. Sh. Sharad Saxena, Regional Officer, RSPCB, Alwar
4. Sh Milind Kumar Nimje, Sc-C, CPCB, RD, Bhopal &
5. Dr S K Goyal, NEERI, Delhi - Invited Expert Member

Representative of MoEF&CC and Sub District Administration were not present during the virtual meet.

The agenda of the meeting was briefed by Sh Milind Nimje, Sc-C (Nodal Officer from CPCB). Further, Expert Member has discussion on the ongoing activities, their operational hours, road conditions, distance of mine clusters from Sariska Tiger Reserve, Status of Ambient Air Quality etc.

Sh R N Meena, IFS informed that the transportation of mined material continue in night period too and the roads to main road are majorly 'Kaccha'. As per the information, there are total 157 mine are in 6 clusters (including few scattered mines) are in operation. The mine lease areas are small and the EC was obtained by few mines from DEIAA only. To carry out the carrying capacity of the area majorly in light of air pollution, few information were required by expert member before proceeding to the field visit & further meetings. The required information and the concern committee member responsible for supplying the same with scheduled time lines is as below:

1. Information related to mines viz.
 - i. Name of clusters
 - ii. GPS locations of the clusters
 - iii. Number of mines in each clusters with details of Consent to Operate (valid/expired/without CTO), Environmental Clearance, Consented capacity (TPA), Daily operating hours & annual operation days.
 - iv. GPS location of scattered mines with other details as per point no. iii

(Action By: RSPCB, Alwar by 13.10.2021)

2. Information related to mines viz.
 - i. Route of transportation of mined mineral (A map showing major road network of transportation)
 - ii. Average Road length from each mine cluster to main road
 - iii. Condition of road from mine to main road

- iv. Details of machineries used by miners, daily operation hours, Days of operation/annually, Daily operational hours of transporting vehicles, type of transporting vehicle, Daily Quantity of water used in mining, source of water

(Action By: Mine department under the instruction of Sh Sh R N Meena, IFS, CF& FD STR, Alwar by 13.10.2021)

3. Details of any notification related to industrial operation in Sariska Tiger Sanctuary.

4. State govt. Policy on mining& minerals

(Action on S. No. 3 & 4 by: CF& FD STR, Alwar and SEAC by 13.10.2021)

5. Carry out Ambient Air Quality monitoring of Sariska mine area at upwind and downwind for 2-3 clusters and 1-2 near by village and submit to CPCB with earlier monitoring reports.

(Action By: RSPCB, Alwar by 13.10.2021)

6. Meteorological data of Sariska & Alwar

(Action By: CPCB, RSPCB, Alwar by 13.10.2021)

7. Recent/latest EIA report of 02 mines of different capacity and copy of environmental clearance of 05 valid mines & their Six monthly compliance report of last 2 financial year.

(Action By: CF& FD STR, SEAC and MoEFCC IRO by 13.10.2021)

8. Details of any other study related to air pollution carried out in Sariska area.

(Action By: CF& FD STR, SEAC, MoEFCC & RSPCB by 13.10.2021)

Concerns are requested to please arrange to furnish the information to CPCB on Email: sunil.cpcb@gov.in, milindnmj07@gmail.com by **13th October 2021** so that same shall be furnished to expert members and all the committee members for further course of action.

The meeting ended with thanks.


-Sd-
Sh Milind Kumar Nimje
Scientist-C
CPCB, RD, Bhopal

**3rd Minutes of Meeting held Virtually on 09.11.2021 05:00 PM in Hon'ble NGT
O.A. No. 154 of 2020**

In Re: News item published on 27.07.2020 in the local daily named "Times of India" titled "Forest guard mowed down by 'mining mafia' in Sariska"

The joint committee constituted by Hon'ble NGT hold its 3rd virtual meeting on 09.11.2021 5:00 PM with Expert Member Dr. S.K. Goyal, Chief Scientist & Head Acsir, Delhi Zonal Center, CSIR-NEERI, New Delhi to discuss on the available information and methodology of studying carrying capacity. Following member attended the meeting:

1. Sh. Mahesh Dutt Purohit, Scientist 'C' MoEF&CC, IRO Jaipur
2. Sh. Rajneesh Jain, SEE, SEAC, Jaipur
3. Sh. Sharad Saxena, Regional Officer, RSPCB, Alwar
4. Sh. Milind Kumar Nimje, Sc-C, CPCB, RD, Bhopal &
5. Dr S K Goyal, NEERI, Delhi - Invited Expert Member

Sh. Sunil Kumar Meena Scientist 'D' CPCB, RD, Bhopal and Sh. Zaid Ali, Mining Engineer, Alwar (Representative of Mining Dept.) were also present.

Representative of CF& FD STR, Alwar and Sub District Administration were not present during the virtual meeting due to pre-engaged assignment .

The brief on available information was briefed and presented by Sh. Sunil Kumar Meena, Sc-D CPCB). Further, Expert Member had discussion on the ongoing activities, their operational hours, road conditions, distance of mine clusters from Sariska Tiger Reserve, Status of Ambient Air Quality etc.

To carry out the study of carrying capacity of the area following more information were required by expert member during proposed field visit.

- i. Number of Application pending from NWBL for permissions.
(Action By: CF&FD, Alwar)
- ii. Autocad Map of the Sariska area & industrial/mining activities.
(Action By: Mining department, Alwar)

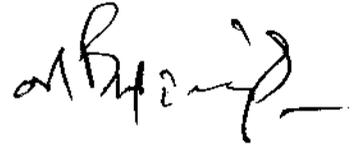
Further, a field visit of the member with expert member was proposed during 23rd to 24th Nov 2021. Tentative schedule of the field visit:

Date & Time	Proposed action
22.11.2021 4:00PM	● Kick-off meeting with committee members & expert at RSPCB, Alwar office
23.11.2021 9.30 AM - 5.30 PM	● Meeting with Mine association officials and miners ● Field visit of Baldeogarh, Jhiri, Palpur & Mallana mine area ● Drone monitoring of the mining area
24.11.2021 9.30 AM - 5.30 PM	● Field visit of Kalsikala, Kho, Goverdhanpura & other mine area ● Final meeting of committee for discussion the outcome and Report format.

Following arrangements are to be done by RSPCB, Alwar as one of the nodal agency in this matter

- To & fro and stay arrangement of Dr. S. K. Goyal, Expert member (**Mob no. +91-9423400470**)
- Organizing meeting with Mine Association & organized field visit on 23rd & 24th November 2021
-
- Arrangement of Drone Monitoring during Field visit

The meeting ended with thanks.



Sh Milind Kumar Nimje
Scientist-C
CPCB, RD, Bhopal

157 mines in the 10KMs periphery of the Sariska Sanctuary

Annexure-IV

कार्यालय खनि अभियन्ता,अलवर

सरिस्का टाइगर सेन्चुरी की 10 किमी में प्रभावशील खननपट्टो का विवरण:-

S.NO.	ML.N O.	NAME OF LESSEE	MINERAL	AREA IN (HECT.)	DATE OF INITIAL GARNT	NEAR VILLAGE /TEHSIL	EC GRANT No AND DATE	EC GRANTING AUTHORITY	PRESENT STATUS	DISTANCE FROM BOUNDARY OF SANCTUARY (KM.)	CTO VALIDITY AND CAPACITY	Cluster Area Name
1	12/84	SMT. BHRMA DEVI	SOAPSTON ECALCITE, FAIRCLY	62.5	28-1-1985 TO 50 YEAR	NAGAL CAHNDEL/RAJGARH	Not Granted	-	NON WORKING	8.509KM.	CTO Not Received	Scattered Mine
2	67/97	DEEPAK MINING COMPNY	MARBLE	1	13-04-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 220 /2016-2017/1961-9/7/16	DEIAA	WORKING	2.299KM..	13.04.18 to 31.03.2023 125270 TPA	KHO, RAJGARH
3	2/96	M/S RAJSTHAN MINERAL & TRADERS	MARBLE	1	10-02-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt214 /2016-2017/1889-9/7/16	DEIAA	WORKING	2.625KM.	01.10.17 to 30.09.2022 84160 TPA	KHO, RAJGARH
4	98/07	SMT.SUSHMA GOYAL	MARBLE	1	31-05-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 212 /2016-2017/1865-9/7/16	DEIAA	NON WORKING	2.390KM..	09.09.16 to 31.08.2021 42598 TPA expired	KHO, RAJGARH
5	64/97	M/S KHNIJ UDHYOG	MARBLE	1	02-06-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 194 /2016-2017/172-9/7/16	DEIAA	NON WORKING	2.722KM.	26.07.16 to 30.06.2019 100000 TPA expired	KHO, RAJGARH
6	40/97	SH.PARMOD GOYAL	MARBLE	1	02-04-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 80 /2016-2017/683-9/7/16	DEIAA	WORKING	2.315KM.	01.09.17 to 31.08.2022 48000 TPA	KHO, RAJGARH
7	7/2007	SH.PARMOD GOYAL	MARBLE	1	02-4-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 211 /2016-2017/1853-9/7/16	DEIAA	NON WORKING	2.204KM.	01.04.16 to 31.03.2019 39999 TPA expired	KHO, RAJGARH
8	1158/91	M/S RAM NARAYAN BROTHERS	MARBLE	1	01-9-2001 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt197 /2016-2017/1757-9/7/16	DEIAA	NON WORKING	2.667KM.	26.07.16 to 30.06.2021 100000 TPA Epried	KHO, RAJGARH
9	17/97	M/S RAM NARAYAN BROTHERS	MARBLE	1.88	28-9-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 200 /2016-2017/1769-9/7/16	DEIAA	NON WORKING	2.859KM.	07.10.16 to 30.09.2021 110540 TPA Expired	KHO, RAJGARH
10	55/97(187/02)	M/S MARBLE MINING COMPANYY	MARBLE	4.3789	14-5-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 205 /2016-2017/1781-9/7/16	DEIAA	NON WORKING	3.147KM.	05.10.16 to 30.09.2021 307170 TPA Expired	KHO, RAJGARH
11	34/97	SMT.SUSHMA GOYAL	MARBLE	1.3198	30-3-1998 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt213 /2016-2017/1877-9/7/16	DEIAA	NON WORKING	2.579KM.	09.09.16 to 31.08.2021 45511 TPA Expired	KHO, RAJGARH
12	32/96	SH.BHAGIRATH MEENA	MARBLE	1.0492	30-9-1997 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 229 /2016-2017/2069-9/7/16	DEIAA	NON WORKING	2.727KM.	26.09.16 to 31.08.2021 65910 TPA Expired	KHO, RAJGARH
13	35/97	SH. DWARKA PARSAD MEENA	MARBLE	0.6347	31-12-1998 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FIL E NOt 227 /2016-2017/2047-9/7/16	DEIAA	WORKING	2.514KM.	01.03.17 to 28.02.2022 45376 TPA	Palpur, Rajgarh

14	33/96	SH. RAMKESH MEENA	MARBLE	1.188	30-9-1997 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FIL E NO1228 /2016-2017/2057-9/7/16	DEIAA	WORKING	2.172.KM.	27.05.17 to 30.04.2022 7500 TPA	Palpur, Rajgarh
15	51/96	ABHISHKE SHARMA	MARBLE	0.8625	28-10-1997 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FIL E NO1 219 /2016-2017/1949-9/7/16	DEIAA	WORKING	2.393KM.	01.07.17 to 30.06.2022 45000 TPA	Palpur, Rajgarh
16	18/2001	M/S RNB MARBLE	MARBLE	2.25	16-7-2001 TO 50 YEAR	DUNDHPURI RAJGARH	DEIAA/AWR/FIL E NO1 206 /2016-2017/1793-9/7/16	DEIAA	NON WORKING	2.516KM..	26.01.16 to 30.05.2021 100000 TPA Expired	Scattered Mine
17	79/97	M/S SHRUTI MARMO PVT. LTD.	MARBLE	2.25	06-10-1997 TO 50 YEAR	DUNDHPURI RAJGARH	DEIAA/AWR/FIL E NO1 242 /2016-2017/1913-9/7/16	DEIAA	NON WORKING	2.552KM.	01.09.16 to 31.08.2021 388430 TPA Expired	Scattered Mine
18	80/97	M/S SHRUTI MARMO PVT. LTD.	MARBLE	2.25	06-10-1997 TO 50 YEAR	DUNDHPURI RAJGARH	DEIAA/AWR/FIL E NO1239 /2016-2017/1925-9/7/16	DEIAA	NON WORKING	2.701KM.	01.09.16 to 31.08.2021 320580 TPA Expired	Scattered Mine
19	114/2000	SH. NEERAJ PUROHIT	MARBLE	2.065	16-5-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FIL E NO1 44 /2016-2017/623-30/5/16	DEIAA	NON WORKING	3.171KM.	05.07.16 to 15.05.2021 113100 TPA Expired	Mallana, Rajgarh
20	106/01	M/S K R MARBLES	MARBLE	1.48	19-12-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FIL E NO1 71 /2016-2017/647-30/5/16	DEIAA	NON WORKING	3.431KM.	01.04.16 to 31.03.2019 42670 TPA Expired	Mallana, Rajgarh
21	104/01	SH.B.L.MEENA	MARBLE	4.263	21-12-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FIL E NO1 68 /2016-2017/1031-30/5/16	DEIAA	WORKING	3.721M	27.11.17 to 31.10.2022 302380 TPA	Mallana, Rajgarh
22	38/99	M/S RAMA MARBLE	MARBLE	1.94	16-7-1999 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NO1 165 /2016-2017/1307-31/05/16	DEIAA	NON WORKING	4.168KM.	28.03.17 to 15.07.2019 76700 TPA expired	Goverdhanpura, Rajgarh
23	66/96	M/S VISHV MARBLE COMPANY PVT. LTD.	MARBLE	1	23-7-1987 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NO1 67 /2016-2017/803-30/5/16	DEIAA	WORKING	4.409KM.	02.05.17 to 30.04.2022 39310 TPA	Goverdhanpura, Rajgarh
24	38/98	SH.BHAGWAN DAS MANGAL	MARBLE	1	12-4-1989 TO 50 YEAR	TILWAD RAJGARH	DEIAA/AWR/FIL E NO1 123 /2016-2017/671-30/5/16	DEIAA	NON WORKING	1.548KM.	05.07.16 to 30.06.2021 110900 TPA Expired	Tilwad-Tilwadi, Rajgarh
25	472/03	SH. RAMPYARI MEENA	MARBLE	1	18-10-2004 TO 50 YEAR	TODARAI SHINGH PURA	F.1(4)/SEIAA/SEA C-Raj/Sect/Cat-/projectCat.1(A)B2 (EC)14-15Jaipur-4/1/16	SEIAA	NON WORKING	6.422KM.	15.02.16 to 31.01.2019 65520 TPA expired	Scattered Mine
26	121/04	SH. PREM KUMAR KHANDELWAL	MARBLE	4	07-1-2005 TO 50 YEAR	BALDEVGHRD	F.1(4)/SEIAA/SEA C-Raj/Sect/Cat-/project.Cat.1(A)B 2(EC)14-15Jaipur-28/03/16	SEIAA	NON WORKING	7.205KM.	01.05.16 to 30.04.2019 150000 TPA expired	Baldevgarh, Rajgarh
27	114/02	SH. PARDEEP CHOHAN	MARBLE	4	20-1-2005 TO 50 YEAR	BALDEVGHRD RAJGARH	DEIAA/AWR/FIL E NO1 223 /2016-2017/1997-9/7/16	DEIAA	WORKING	1.880M	01.03.17 to 28.02.2022 150000 TPA	Baldevgarh, Rajgarh
28	133/04	SH. MANJU SHARMA	MARBLE	4	24-1-2005 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FIL E NO1 230 /2016-2017/2081-9/7/16	DEIAA	WORKING	2.511KM.	01.03.17 to 28.02.2022 163500 TPA	Palpur, Rajgarh

29	167/02	SH. BEENA MEENA	MARBLE	1.46	20-4-2005 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FIL E NOt 164 /2016-2017/1379-31/05/16	DEIAA	NOT WORKING	3.330KM.	3.11.16 to 31.10.2021 81120 TPA	Mallana, Rajgarh
30	500/03	SH. JAGDISH PARSAD MEENA	MARBLE	4	15-6-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 225 /2016-2017/2021-9/7/16	DEIAA	NOT WORKING	2.202KM.	23.01.17 to 31.12.2021 214500 TPA	KHO, RAJGARH
31	96/02	MALTI GUNAWAT	MARBLE	4	30-7-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 226 /2016-2017/2032-9/7/16	DEIAA	NON WORKING	1.677KM.	18.01.17 to 31.12.2020 75000 TPA Expired	KHO, RAJGARH
32	118/02	SH. CHAGAN LAL AACHARY	MARBLE	4	30-07-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 224 /2016-2017/2009-9/7/16	DEIAA	NON WORKING	2.338KM.	14.07.16 to 31.05.2019 187900 TPA expired	KHO, RAJGARH
33	54/02	M/S PALPUR MINING COMPNY	MARBLE	4	08-1-2003 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 209 /2016-2017/1829-9/7/16	DEIAA	WORKING	1.999KM.	01.06.18 to 31.05.2023 40000 TPA	KHO, RAJGARH
34	56/02	M/S PALPUR MINING COMPNY	MARBLE	4	08-1-2003 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt210 /2016-2017/1841-9/7/16	DEIAA	WORKING	1.949KM.	01.06.18 to 31.05.2023 40000 TPA	KHO, RAJGARH
35	261/06	SH. MAAN SHINGH MEENA	MARBLE	1.24	12-12-2007 TO 50 YEAR	TILWAD RAJGARH	F.1(4)/SEIAA/SEA C-Raj/Sectt/Cat-/project.Cat.1(A)B 2(EC)14-15Jaipur-19/05/16	SEIAA/DEIAA	WORKING	1.867KM.	16.08.17 to 31.07.2022 250000 TPA	Tilwad-Tilwadi, Rajgarh
36	73/06	SH. NARESH KUMAR VASHISHTH	MARBLE	1.06	24-08-2007 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NOt 129 /2016-2017/1319	DEIAA	NON WORKING	3.645KM.	14.09.16 to 31.08.2021 110060 TPA Expired	Goverdhanpura, Rajgarh
37	59/07	SH. RAJBALA JAIN	MARBLE	4	22-10-2008 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt231 /2016-2017/2093-9/7/16	DEIAA	NOT WORKING	1.803KM.	05.11.16 to 31.10.2021 79230 TPA	KHO, RAJGARH
38	120/07	SH. RANJIT SHINGH	MARBLE	0.8	03-9-2008 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FIL E NOt 70 /2016-2017/ 1043-30/5/16	DEIAA	WORKING	3.835KM.	01.09.17 to 31.08.2022 34430 TPA	Mallana, Rajgarh
39	335/09	SH.MOOLCHAND MEENA	MARBLE	1	21-7-2017 TO 50 YEAR	TODA JAISHING PURA RAJGARH	F.1(4)/SEIAA/SEA C-Raj/Sectt/Cat-/projectCat.1(A)B2 (EC)14-15Jaipur	SEIAA	WORKING	6.435KM.	01.04.19 to 30.06.2022 75920 TPA	Scattered Mine
40	39/99	RADHEY KRISHNA GRANITE AND MARBLES	MARBLE	1	14-7-1999 TO 50 YEAR	KALWAD RAJGARH	DEIAA/AWR/FIL E NOt 119 /2016-2017/995-30/5/16	DEIAA	WORKING	1.483KM.	06.03.17 to 28.02.2022 104900 TPA	Scattered Mine
41	53/2002	SH.MAHENDRA SHING	MARBLE	4	05-3-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 233 /2016-2017/2117-9/7/16	DEIAA	NON WORKING	2.1KM..	- 04.08.16 to 3.07.2021 119340 TPA Expired	KHO, RAJGARH
42	267/88	SH.ASHOK GUPTA	MARBLE	1	01&4&1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 218 /2016-2017/1937-9/7/16	DEIAA	WORKING	2.276M	- 22.04.17 to 31.03.2022 54000 TPA	KHO, RAJGARH
43	199/86	RAJESH SHARMA	MARBLE	1	25&4&1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 222 /2016-2017/1985	DEIAA	WORKING	2.518KM.	08.06.17 to 31.05.2022 113260 TPA	KHO, RAJGARH

44	208/84	M/S YASH MARBLE	MARBLE	4.3625	20-2-19855 TO 31-3-2025 rd	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 215 /2016-2017/1901-9/7/16	DEIAA	WORKING	3.223KM.	20.04.17 to 31.03.2022 154900 TPA	KHO, RAJGARH
45	922/88	SMT MAYA GAOYAL	MARBLE	1	31-5-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 208 /2016-2017/1817-9/7/16	DEIAA	WORKING	2.406KM.	- 17.04.17 to 31.03.2022 30000 TPA	KHO, RAJGARH
46	46/88	M/S RAM NARAYAN & BROTHERS	MARBLE	1	12-5-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 196 /2016-2017/	DEIAA	WORKING	2.307KM.	03.05.17 to 30.04.2022 100000 TPA	KHO, RAJGARH
47	19/88	NAMAN SHRMA	MARBLE	1	09-8-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 221 /2016-2017/1973-9/7/16	DEIAA	NON WORKING	2.227KM.	07.02.17 to 08.08.2019 106080 TPA expired	KHO, RAJGARH
48	923/88	SH. SANTOSH SHARMA	MARBLE	1.7	31-5-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 234 /2016-2017/2291-9/7/16	DEIAA	WORKING	2.294KM.	01.04.17 to 31.03.2022 104186 TPA	KHO, RAJGARH
49	246/85	M/S SHREE RAM MINERAL	MARBLE	1	10-2-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FIL E NOt 102 /2016-2017/815-30/5/16	DEIAA	WORKING	2.605KM.	01.05.17 to 30.04.2022 100000 TPA	KHO, RAJGARH
50	980/88	SH ASHOK VERMA	MARBLE	1	24-11-1989 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	4.483KM.	01.11.12 to 31.10.2013 0 TPA expired	Goverdhanpura, Rajgarh
51	217/86	SH. RADHY SHYAM GUPTA	MARBLE	1	25-9-1987 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NOt 72 /2016-2017/2528-24/08/17	DEIAA	WORKING	4.681 KM.	27.04.17 to 31.03.2022 60000 TPA	Goverdhanpura, Rajgarh
52	49/86	SH. SAMPTRAM CHOUDHRY	MARBLE	1	3-6-1986 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NOt 262 /2016-2017/2516-24/08/17	DEIAA	WORKING	4483KM.	01.05.17 to 30.04.2022 90000 TPA	Goverdhanpura, Rajgarh
53	341/87	SH. ASHOK AJMERA	MARBLE	1	01-9-1988 TO 50 YEAR	BALDEVGHDR RAJGARH	DEIAA/AWR/FIL E NOt 174 /2016-2017/1624-9/7/2016	DEIAA	WORKING	7.556KM.	03.05.17 to 30.04.2022 100000 TPA	Baldevgarh, Rajgarh
54	376/87	SH. ANIL SHARM	MARBLE	1	27-5-1988 TO 50 YEAR	BALDEVGHDR RAJGARH	DEIAA/AWR/FIL E NOt 266/2016-2017/2685	DEIAA	WORKING	7.362KM.	10.04.17 to 31.03.2022 115991 TPA	Baldevgarh, Rajgarh
55	278/88	SMT. NIRMALA SHRAMA	MARBLE	1	11-8-1988 TO 50 YEAR	BALDEVGHDR RAJGARH	DEIAA/AWR/FIL E NOt 178 /2016-2017/1673-9/7/16	DEIAA	WORKING	7.036KM.	03.04.17 to 31.03.2022 100000 TPA	Baldevgarh, Rajgarh
56	160/87	SH. MANOJ KUMAR SHARMA	MARBLE	1	23-4-1988 TO 50 YEAR	BALDEVGHDR RAJGARH	DEIAA/AWR/FIL E NOt 175 /2016-2017/1661-9/7/16	DEIAA	WORKING	6.905KM.	03.04.17 to 31.03.2022 90000 TPA	Baldevgarh, Rajgarh
57	342/87	SH. VINOD KUMAR AJMERA	MARBLE	1	01-9-1988 TO 50 YEAR	BALDEVGHDR RAJGARH	DEIAA/AWR/FIL E NOt 177 /2016-2017/1637-9/7/16	DEIAA	WORKING	7.653KM.	19.04.17 to 31.03.2022 100000 TPA	Baldevgarh, Rajgarh
58	148/85	SH. PARDEEP PARIK	MARBLE	1	05-5-1987 TO 50 YEAR	TILWAD RAJGARH	DEIAA/AWR/FIL E NOt 176 /2016-2017/2661	DEIAA	WORKING	1.332KM.	06.05.17 to 30.04.2022 126520 TPA	Tilwad-Tilwadi, Rajgarh
59	167/88	M/S SS MARBLE	MARBLE	0.5238	25-04-1988 TO 50 YEAR	BALDEVGHDR RAJGARH	DEIAA/AWR/FIL E NOt 176 /2016-2017/1649-9/7/16	DEIAA	WORKING	6.747KM.	17.04.17 to 31.03.2022 5700 TPA	Baldevgarh, Rajgarh

60	237/86	SH. RAMSWROOP SAINI	MARBLE	1	13-4-1987 TO 50 YEAR	KHO, RAJGARH	Not Granted	-	NON WORKING	1.638KM.	CTO Not Received	KHO, RAJGARH
61	40/86	SH.NARENDRA KUMAR GUPTA	MARBLE	1	2-2-87 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NO1 208 /2016-2017/1817-07/16	DEIAA	NON WORKING	4.368KM.	CTO Not Received	Goverdhanpura, Rajgarh
62	39/86	SMT. KAMLA DEVI	MARBLE	1	02-06-86 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	4.404KM.	CTO Not Received	Goverdhanpura, Rajgarh
63	177/87	SH. KAILASH CHAND KALA	MARBLE	1	16-4-87 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	2.276KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
64	174/87	SMT RATAN DEVI KALA	MARBLE	1	6-2-87 TO 50 YEAR	TILWAD RAJGARH	.	-	NON WORKING	2.062KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
65	233/88	M/S TILWAD MARBLES	MARBLE	1	8-3-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.625KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
66	Jul-87	SH. SUBE SHING	MARBLE	1	8-3-88 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NO1 277 /2016-2017/3018	DEIAA	WORKING	4.277KM.	20.08.18 TO 31.07.2023 122304 TPA	Goverdhanpura, Rajgarh
67	442/87	SH. AJAY MAALPANI	MARBLE	1	4-5-88 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.693KM.	CTO Not Received	Goverdhanpura, Rajgarh
68	351/88	SH. PARAS JAIN	MARBLE	1	30-7-87 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.780KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
69	331/1987	SMT. INDARA SHARMA	MARBLE	1	29-03-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.760KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
70	443/1987	SH. SURESH AGRWARL	MARBLE	1	5-8-88 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.475KM.	CTO Not Received	Goverdhanpura, Rajgarh
71	141/1987	SH. PABHU LAL PUROHITA	MARBLE	1	11-4-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.871 KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
72	445/1987	SH. ASHOKA SOMANI	MARBLE	1	29-03-88 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.888KM.	CTO Not Received	Goverdhanpura, Rajgarh
73	239/1987	SH. CHANDSHEKHAR SHARMA	MARBLE	1	11-9-87 TO 50 YEAR	BALDEVGHARD RAJGARH	Not Granted	-	NON WORKING	6.518KM.	CTO Not Received	Baldevgarh, Rajgarh
74	264/88	SH. BRIJKISHOR SHARMA	MARBLE	1	29-03-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.479KM..	CTO Not Received	Tilwad-Tilwadi, Rajgarh
75	265/88	SH. BRIJKISHOR SHARMA	MARBLE	1	12-01-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.565M	CTO Not Received	Tilwad-Tilwadi, Rajgarh
76	444/87	M/S ADARSH MARBLE	MARBLE	1	29-03-88 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.966KM.	CTO Not Received	Goverdhanpura, Rajgarh
77	316/87	SMT. SANTOSH KHETAN	MARBLE	1	29-03-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	2.416KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
78	150/88	SH. BHGAWAN DAS MANGAL	MARBLE	1	12-4-89 TO 50 YEAR	TILWAD RAJGARH	DEIAA/AWR/FIL E NO1 120/2016-2017/1055-30/5/16	DEIAA	NON WORKING	1.509KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
79	852/88	M/S HINDUUSTAN MARBLE	MARBLE	1	01-5-89 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NO1262 /2016-2017/2516	DEIAA	NON WORKING	4.472KM.	CTO Not Received	Goverdhanpura, Rajgarh
80	260/88	M/S CGM MINERAL	MARBLE	1	29-6-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.437KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
81	227/88	SMT ASHA DEVI KHETAN	MARBLE	1	8-7-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.863KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
82	224/88	SMT KOUSHLYA DEVI	MARBLE	1	8-7-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.708KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
83	472/88	SMT. SUVA DEVI	MARBLE	1	15-9-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.935KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh

84	471/88	SMT. SUVA DEVI	MARBLE	1	15-9-88 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	1.799KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
85	946/88	SH. RAJESH KHANNA	MARBLE	1	15-9-89 TO 50 YEAR	KHO, RAJGARH	Not Granted	-	NON WORKING	1.9KM.	CTO Not Received	KHO, RAJGARH
86	289/88	SH. DINESH KHETAN	MARBLE	1	12-04-89 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	2.112KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh
87	638/88	SMT. LAKSHMI SHKTAVAT	MARBLE	1	19-4-89 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FIL E NOt 182 /2016-2017/1197-9/7/16	DEIAA	NON WORKING	3.301KM.	CTO Not Received	Goverdhanpura, Rajgarh
88	728/88	SH. SURESH KALRA	MARBLE	1	17-6-89 TO 50 YEAR	MALLANA RAJGARH	Not Granted	-	NON WORKING	3.236KM.	CTO Not Received	Mallana, Rajgarh
89	921/88	SH. SARINNA BHADU	MARBLE	1	19-6-89 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	4.300KM.	CTO Not Received	Goverdhanpura, Rajgarh
90	920/88	SM. SUNIL BHADU	MARBLE	1	19-6-89 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	4.370KM.	CTO Not Received	Goverdhanpura, Rajgarh
91	742/1988	SMT. LALITA DEVI	MARBLE	1	12-07-89 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.417KM.	CTO Not Received	Goverdhanpura, Rajgarh
92	741/88	SMT. ALKA SINGH	MARBLE	1	12-07-89 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.491KM.	CTO Not Received	Goverdhanpura, Rajgarh
93	680/88	SH. SUBHASH CHANDRA	MARBLE	1	24-11-90 TO 50 YEAR	MALLANA RAJGARH	Not Granted	-	NON WORKING	3.481KM.	CTO Not Received	Mallana, Rajgarh
94	639/88	SH. RAVINDRA SINGH	MARBLE	1	5-5-89 TO 50 YEAR	GOVERDHANPURA	Not Granted	-	NON WORKING	3.267KM.	CTO Not Received	Goverdhanpura, Rajgarh
95	859/88	M/S TRIVENI MARBLE	MARBLE	1	9-6-1989 TO 50 YEAR	MALLANA RAJGARH	Not Granted	-	NON WORKING	3.375KM.	CTO Not Received	Mallana, Rajgarh
96	562/02	M/S ORIGNOIL MINERAL	MASONARY STONE	1	2-3-2010 TO 50 YEAR	BHAKHRI RAJGARH	Not Granted	-	NON WORKING	6.00KM	CTO Not Received	Scattered Mine
97	561/02	M/S ORIGNOIL MINERAL	MASONARY STONE	1	12-3-2010 TO 50 YEAR	BHAKHRI RAJGARH	Not Granted	-	NON WORKING	6.00KM	CTO Not Received	Scattered Mine
98	301/89	SH. MANISH VYASHY	LIMESTONE	2.25	1-8-90 TO 50 YEAR	PAI KA GWADA RAJGARH	Not Granted	-	NON WORKING	1.898	CTO Not Received	Scattered Mine
99	121/89	SH. SUBHASH CHANDRA VYAS	LIMESTONE	2.25	1-8-90 TO 50 YEAR	PAI KA GWADA RAJGARH	Not Granted	-	NON WORKING	1.787KM.	CTO Not Received	Scattered Mine
100	122/89	SH. UPENDRA VYAS	LIMESTONE	2.25	01-08-1990 TO 50 YEAR	PAI KA GWADA RAJGARH	Not Granted	-	NON WORKING	1.800KM.	CTO Not Received	Scattered Mine
101	105/89	SH. RAJENDRA VYAS	LIMESTONE	2.25	01-08-1990 TO 50 YEAR	PAI KA GWADA RAJGARH	Not Granted	-	NON WORKING	1.790KM.	CTO Not Received	Scattered Mine
102	107/89	SH. VIJAY VYAS	LIMESTONE	2.25	10-3-90 TO 50 YEAR	PAI KA GWADA RAJGARH	Not Granted	-	NON WORKING	1.800KM.	CTO Not Received	Scattered Mine
103	02-1981	SMT. SUMAN LATA PARIK	IRON ORE	69.367	29&4&82 TO 50 YEAR	NATATA THANAGAJI	Not Granted	-	NON WORKING	1.500KM.	CTO Not Received	Scattered Mine
104	34/96	M/S ARPIT PVT. LTD.	MARBLE	1	5&8&87 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FIL E NOt 260 /2016-2017/2189-9/7/16	DEIAA	WORKING	5.214KM.	15.02.17 to 31.01.2022 160000 TPA	Jhiri, Thanagazi
105	35/96	M/S ARPIT PVT. LTD.	MARBLE	1	5&8&87 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FIL E NOt 259 /2016-2017/2177-9/7/16	DEIAA	WORKING	5.257KM.	15.02.17 to 31.01.2022 170000 TPA	Jhiri, Thanagazi
106	03-1995	SH. APURVA KUMAR SHARMA	MARBLE	1	3&1&96 TO 50 YEAR	NATATA THANAGAJI	Not Granted	-	NON WORKING	1.200KM.	CTO Not Received	Scattered Mine

107	89/97	SMT. ANITA SHARMA	MARBLE	1	26&8&98 TO 50 YEAR	NATATA THANAGAJI	Not Granted	-	NON WORKING	1.280KM.	CTO Not Received	Scattered Mine
108	158/81 (9/93)	SH. CHANDRA SHEKHAR GUPTA	MARBLE	1.7779	28&7&93 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt 235 /2016-2017/2153-	DEIAA	WORKING	7.416KM.	05.03.2018 to 28.02.2023 82730 TPA	Kalsi Kala Gwada, Thanagazi
109	218/89	M/S C S MINES PVT. LTD.	MARBLE	4.645	19&2&70 TO 50 YEAR	JHIRI THANAGAJI	F.1(4)/SEIAA/SEA C-Raj/Sectt/ project Cat.1(a)B2(EC)14-15Jaipur-9/5/16	SE IAA	NON WORKING	5.665KM.	17.09.16 to 31.08.2021 110000 TPA Expired	Jhiri, Thanagazi
110	815/88	M/S DIKSHIT MARBLE	MARBLE	1	7&1&89 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FIL E NOt 236 /2016-2017/2611-	DEIAA	WORKING	5.938KM.	01.11.17 to 31.10.2022 43500 TPA	Jhiri, Thanagazi
111	258/89	M/S OM SHUBHAM HOUSING AND CONST. COMPANY	MARBLE	10.186	13&3&80 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	F.1(4)/SEIAA/SEA C-Raj/Sectt/ project Cat.1(a)B2(EC)14-15Jaipur date -22-08-16	-	NON WORKING	7.970KM.	01.01.17 to 12.03.2020 150000 TPA expired	Kalsi Kala Gwada, Thanagazi
112	881/88	SH. PRITHVI	MARBLE	1	27-7-92 TO 50 o'k	KALSI KALA GWADA THANAGAJI	F.1(4)/SEIAA/SEA C-Raj/Sectt/ project Cat.1(a)B2(EC)14-	SEIAA	NON WORKING	5.296KM.	10.08.16 to 30.11.2018 95340 TPA expired	Kalsi Kala Gwada, Thanagazi
113	87/97	M/S MANSI MINERAL	MARBLE	1	5&8&97 TO 50 YEAR	JHIRI THANAGAJI	F.1(4)/SEIAA/SEA C-Raj/Sectt/ project	SEIAA	WORKING	5.483KM.	27.04.2018 to 31.03.2023 36000 TPA	Jhiri, Thanagazi
114	30/96	ANDHI MINERAL AND MARBLE	MARBLE	1	14&7&87 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FIL E NOt 258 /2016-2017/2165-9/7/16	DEIAA	WORKING	5.553KM.	06.03.17 to 28.02.2022 18000 TPA	Jhiri, Thanagazi
115	596/88(156/08)	M/S NARUKA MARBLE	MARBLE	1	2&5&89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	F.1(4)/SEIAA/SEA C-Raj/Sectt/ project Cat.1(a)B2(EC)14-15Jaipur -	SEIAA	NON WORKING	7.200KM.	07.10.2016 TO 27-02-2019 50000 TPA expired	Kalsi Kala Gwada, Thanagazi
116	1767/91	SH. RAKESH MEENA	MARBLE	1	15&10&97 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt247 /2016-2017/2237-9/7/16	DEIAA	WORKING	6.158KM.	14.03.17 to 28.02.2022 160000 TPA	Kalsi Kala Gwada, Thanagazi
117	1770/91	SH. RAKESH MEENA	MARBLE	1	15-10-97 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt 254 /2016-2017/2225-9/7/16	DEIAA	WORKING	6.115KM.	14.03.17 to 28.02.2022 168000 TPA	Kalsi Kala Gwada, Thanagazi
118	327/88	SHARMA MARBLE AND MINERAL	MARBLE	1	8&9&88 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	F.1(4)/SEIAA/SEA C-Raj/Sectt/ project Cat.1(a)B2(EC)14-	SEIAA	WORKING	7.202KM.	09.08-17 to 31.07.2022 54920 TPA	Kalsi Kala Gwada, Thanagazi
119	39/96	SH. KELASH CHANDRA GUPTA	MARBLE	1	31&8&97 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt 255 /2016-2017/2213-9/7/16	DEIAA	WORKING	5.400KM.	01.12.17 to 30.11.2022 20000 TPA	Kalsi Kala Gwada, Thanagazi
120	43/94	SITARAM SAINI	MARBLE	1	28&6&85 TO 50 YEAR	DHANI NIJRA THANAGAJI	DEIAA/AWR/FIL E NOt./DEIAA/276/2016-2017/2999	DEIAA	WORKING	2.481KM	22.02.17 to 30.06.2022 108888 TPA	Scattered Mine
121	361/88	SH. ROHIT KUMAR	MARBLE	1	23&5&89 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FIL E NOt 252 /2016-2017/2249-9/7/16	DEIAA	NON WORKING	5.254KM.	09.09.16 to 22.05.2019 59805 TPA expired	Jhiri, Thanagazi

122	112/04	DIXIT MARBLE STONE	MARBLE	0.71	25-07-07 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FIL E NOt 237 /2016-2017/2623	DEIAA	NON WORKING	5.215KM.	26.10.16 to 30.09.2021 44000 TPA Expired	Jhiri, Thanagazi
123	103/01	AMBIKA MARBLE	MARBLE	0.56	14-12-01 TO 50 YEAR	SAMRA THANAGAJI	DEIAA/AWR/FIL E NOt 81 /2016-2017/1685-9/7/16	DEIAA	WORKING	4.953KM.	01.07.17 to 31.03.2022 10000 TPA	Scattered Mine
124	834/88	MAHEHWARI KNWAR	MARBLE	1	2&5&89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt	DEIAA	WORKING	6.631KM.	12.06.18 to 31.05.2023 96967 TPA	Kalsi Kala Gwada, Thanagazi
125	Dec-85	SH. RAMAVTAR KUMHAR	MARBLE	1	11&8&86 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt250 /2016-2017/2273-9/7/16	DEIAA	WORKING	7.263KM.	16.10.17 to 30.9.2022 63390 TPA	Kalsi Kala Gwada, Thanagazi
126	837/88	M/S AGRWAL MINES	MARBLE	1	25-04-89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt 241 /2016-2017/2129-9/7/16	DEIAA	NON WORKING	6.746KM.	25.08.16 to 24.04.2019 58920 TPA expired	Kalsi Kala Gwada, Thanagazi
127	91/98	TEZ RAM SAINI	MASONAR Y STONE	1	21&8&99 TO 50 YEAR	NARAYANPUR THANA GAJI	DEIAA/AWR/FIL E NOt 20 /2016-2017/92-30/5/16	DEIAA	WORKING	7.580KM.	01.05.18 to 30.04.2023 54000 TPA	Scattered Mine
128	92/98	TEZ RAM SAINI	MASONAR Y STONE	1	21&8&99 TO 50 YEAR	NARAYANPUR THANA GAJI	DEIAA/AWR/FIL E NOt 01 /2016-2017/104-30/5/16	DEIAA	WORKING	7.380KM.	01.05.18 to 30.04.2023 54000 TPA	Scattered Mine
129	109/04	SH. VISHNU PARSAD	MASONAR Y STONE	1	13&7&05 TO 50 YEAR	NITATA THANAGAJI	DEIAA/AWR/FIL E NOt186 /2016-2017/2504-31/05/16	DEIAA	NON WORKING	1.173KM.	01.08.13 to 31.07.2016 6210 TPA expired	Scattered Mine
130	108/09	NEHRA BILDURS AND DEVELOPERS PVT LTD.	MASONAR Y STONE	1	9-11-2011 TO 50 YEAR	BHANGDOLI THANAGAJI	DEIAA/AWR/FIL E NOt 131 /2016-2017/1511-31/05/16	DEIAA	NON WORKING	2.427KM.	01.07.2015 to 30.06.2018 100000 TPA expired	Scattered Mine
131	109/09	NEHRA BILDURS AND DEVELOPERS PVT LTD.	MASONAR Y STONE	1	9-11-2011 TO 50 YEAR	BHANGDOLI THANAGAJI	DEIAA/AWR/FIL E NOt 130 /2016-2017/1523-31/05/16	DEIAA	NON WORKING	2.370KM.	01.07.2015 to 30.06.2018 100000 TPA expired	Scattered Mine
132	14/87	M/S GANPATI MARBLE	MARBLE	1	5-8-87 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	Not Granted	-	NON WORKING	10.00KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
133	222/86	SH. PARKSH CHAND JAIN	MARBLE	1	5-8-87 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	Not Granted	-	NON WORKING	7.225KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
134	224/86	SMT. MANJUSH DAGA	MARBLE	1	5-8-87 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	Not Granted	-	NON WORKING	7.088KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
135	101/87	SH. KANHEYA LAL KUMHAR	MARBLE	1	17-10-87 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	Not Granted	-	NON WORKING	7.173KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
136	102/88	M/S RADHA GOVIND MARBLE	MARBLE	1	19-7-88 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt 276 /2016-2017/2999-21/7/17	DEIAA	NON WORKING	7.413KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
137	152/88	M/S RADHA GOVIND MARBLE	MARBLE	1	28-12-88 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	-	-	NON WORKING	7.503KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
138	153/88	SH. MANOHAR MARBLE	MARBLE	1	28-12-88 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOt 256 /2016-2017/2599-24/08/16	DEIAA	NON WORKING	7.303KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi

139	1001/88	SH. BHAWANI SHINGH	MARBLE	1	14-3-89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	-	-	NON WORKING	6.606KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
140	594/88	M/S KARNI MARBLE	MARBLE	1	2-1-89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FIL E NOT 248 /2016-2017/2540-24/08/16	DEIAA	NON WORKING	7.111KM.	CTO Not Received	Kalsi Kala Gwada, Thanagazi
141	1008/88	VIJAY CHWDA	MARBLE	1	4-10-89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	Not Granted	-	NON WORKING	6.810KM..	CTO Not Received	Kalsi Kala Gwada, Thanagazi
142	544/88	SH. LAXMI NARAYAN SHRAMA	MARBLE	1	TO 10 YEAR TO 50 YEAR	KALSI KALA GWADA THANAGAJI	Not Granted	-	NON WORKING	6.803KM	CTO Not Received	Kalsi Kala Gwada, Thanagazi
143	37/96	M/S ARPIT MARBLE	MARBLE	1	5-8-97 TO 50 YEAR	JHIRI THANAGAJI	Not Granted	-	NON WORKING	5.431KM.	CTO Not Received	Jhiri, Thanagazi
144	50/96	M/S ARPIT MARBLE	MARBLE	1	17-10-97 TO 50 YEAR	JHIRI THANAGAJI	Not Granted	-	NON WORKING	5.864KM.	CTO Not Received	Jhiri, Thanagazi
145	Aug-97	M/S ARPIT MARBLE	MARBLE	1	28-3-98 TO 50YEAR	JHIRI THANAGAJI	Not Granted	-	NON WORKING	5.301KM..	CTO Not Received	Jhiri, Thanagazi
146	59/97	M/S ARPIT MARBLE	MARBLE	1	21-7-97 TO 50 YEAR	JHIRI THANAGAJI	Not Granted	-	NON WORKING	5.904KM.	CTO Not Received	Jhiri, Thanagazi
147	174/90	MAHADEV PARSAD	MASONARY STONE	1	3-1-1990 TO 50 YEAR	MALUTANA	Not Granted	-	NON WORKING	9.008KM.	CTO Not Received	Scattered Mine
148	02-1975	M/S SHREE RAM MINERAL	BARITES	3.589	4&4&91 TO 50 YEAR	UMREN ALWAR	Not Granted	-	NON WORKING	8.675KM.	CTO Not Received	Scattered Mine
149	118/89	SH. RAM BHARTI	MASONARY STONE	0.35	2-9-89 TO 50 YEAR	SAHODI ALWAR	Not Granted	-	NON WORKING	6.342KM.	CTO Not Received	Scattered Mine
150	113/89	M/S INDU STONE	MASONARY STONE	0.25	8-10-88 TO 50 YEAR	SAHODI ALWARV	Not Granted	-	NON WORKING	6.769KM.	CTO Not Received	Scattered Mine
151	Jun-85	SHREE RAM BHARTI	MASONARY STONE	1	19-8-85 TO 50 YEAR	SAHODI ALWAR	Not Granted	-	NON WORKING	6.432KM.	CTO Not Received	Scattered Mine
152	133/83	M/S GOYAL CRUSHER	MASONARY STONE	0.5	4-6-81 TO 50 YEAR	SAHODI ALWAR	Not Granted	-	NON WORKING	6.249KM.	CTO Not Received	Scattered Mine
153	214/80	SH. LAXMI NARAYAN MEENA	MASONARY STONE	0.5	5-10-91 TO 50 YEAR	UMREN ALWAR	Not Granted	-	NON WORKING	10.00KM.	CTO Not Received	Scattered Mine
154	213/80	SH. LAXMI NARAYAN MEENA	MASONARY STONE	0.5	5-10-91 TO 50 YEAR	UMREN ALWAR	Not Granted	-	NON WORKING	10.00KM.	CTO Not Received	Scattered Mine
155	212/80	SH. LAXMI NARAYAN MEENA	MASONARY STONE	0.5	5-10-91 TO 50 YEAR	UMREN ALWAR	Not Granted	-	NON WORKING	10.00KM.	CTO Not Received	Scattered Mine
156	73/87	SH. RAJKUMAR AGRWAL	MARBLE	1	24-08-2007 TO 50 YEAR	PALPUR RAJGARH	Not Granted	-	NON WORKING	2.579KM.	CTO Not Received	Palpur, Rajgarh
157	160/86	SH. AMRCHAND KUMAWAT	MARBLE	1	6-2-87 TO 50 YEAR	TILWAD RAJGARH	Not Granted	-	NON WORKING	2.483KM.	CTO Not Received	Tilwad-Tilwadi, Rajgarh

Daily operation hour of each mine approx 8 hours/Day and 300 working days in a year

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

कमांक:- खअ/अल/एन.जी.टी.ओ.ए.नं./45/2021/315
कार्यालय आदेश

दिनांक:- 1.10.2021

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र कमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र कमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र कमांक F.12(CC-130)/RPCB/Gr.MINES/ 855 DATED:-29-09-2021 से खननपट्टा संख्या 342/1987 पट्टाधारी श्री विनोद अजमेरा निकट ग्राम -बलदेवगढ, तहसील-राजगढ, जिला -अलवर को जारी कन्सेन्ट टू ऑपरेट को रिवोक कर दिया गया है तथा उनके पत्रांक F.12(CC-130)/RPCB /Gr.MINES/ 894 DATED:-29-09-2021 से उक्त खनन पट्टा में खनन कार्य बन्द कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 342/1987 क्षेत्रफल 1.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्री विनोद अजमेरा के पक्ष में स्वीकृत/धृत में तत्काल प्रभाव से खनन कार्य प्रतिबंधित किया जाता है।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर
दिनांक:- 1.10.2021

कमांक:- खअ/अल/ओ.ए.नं./45/2020/316-334
प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कन्ट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत्त जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावें।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 342/1987 श्री विनोद अजमेरा पुत्र श्री भेंवरलाल अजमेरा निवासी 141 गायत्री नगर(ए) महारानी फार्म, दुर्गापुरा जयपुर को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिशुल्क निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा कार्यालय हाजा।
10. सूचना सहायक/ऑन-लाईन शाखा को दिया जाकर लेख है कि उक्तानुसार खनन पट्टे की सी. टी.ओ. को ऑनलाईन से हटाया जावे।
11. रक्षित पत्रावली।

(राजेन्द्र सिंह)
खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टी.ओ.ए.नं./45/2021/335

दिनांक:- 1.10.2021

कार्यालय आदेश

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदुषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदुषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 858 DATED:-29-09-2021 से खननपट्टा संख्या 167/1988 पट्टाधारी श्री शिशुपाल शर्मा प्रो० मैसर्स एस.एस. मार्बल निकट ग्राम -बलदेवगढ, तहसील-राजगढ, जिला -अलवर को जारी कन्सेन्ट टू ऑपरेट को रिवोक कर दिया गया है तथा उनके पत्रांक F.12(CC-130)/RPCB /Gr.MINES/ 889 DATED:-29-09-2021 से उक्त खनन पट्टा में खनन कार्य बन्द कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 167/1988 क्षेत्रफल 0.5238 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्री शिशुपाल शर्मा प्रो. मैसर्स एस.एस. मार्बल के पक्ष में स्वीकृत/धृत में तत्काल प्रभाव से खनन कार्य प्रतिबंधित किया जाता है।

भवदीय

(राजेंद्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/336-354

प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कंट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावें।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 167/1988 श्री शिशुपाल शर्मा पुत्र श्री नारायण सहाय प्रो० मैसर्स एस.एस. मार्बल निवासी ग्राम बलदेवगढ, तहसील राजगढ जिला अलवर को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करें।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिशुल्क निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा कार्यालय हाजा।
10. सूचना सहायक/ऑन-लाईन शाखा को दिया जाकर लेख है कि उक्तानुसार खनन पट्टे की सी. टी.ओ. को ऑनलाईन से हटाया जावे।
11. रक्षित पत्रावली।

(राजेंद्र सिंह)
खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टी.ओ.ए.नं./45/2021/ 356

दिनांक:- 1.10.2021

कार्यालय आदेश

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 846 DATED:-29-09-2021 से खननपट्टा संख्या 160/1987 पट्टाधारी श्री मनोज कुमार शर्मा निकट ग्राम -बलदेवगढ, तहसील-राजगढ, जिला -अलवर को जारी कन्सेन्ट टू ऑपरेट को रिवोक कर दिया गया है तथा उनके पत्रांक F.12(CC-130)/RPCB /Gr.MINES/ 874 DATED:-29-09-2021 से उक्त खनन पट्टा में खनन कार्य बन्द कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 160/1987 क्षेत्रफल 1.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्री मनोज कुमार शर्मा के पक्ष में स्वीकृत/धृत में तत्काल प्रभाव से खनन कार्य प्रतिबंधित किया जाता है।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/ 357-375

प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कन्ट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत्त जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावें।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 160/1987 श्री मनोज कुमार शर्मा पुत्र श्री कैलाश नारायण शर्मा निवासी 107, व्यास मोहल्ला, जिला दौसा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिशुल्क निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा कार्यालय हाजा।
10. सूचना सहायक/ऑन-लाईन शाखा को दिया जाकर लेख है कि उक्तानुसार खनन पट्टे की सी. टी.ओ. को ऑनलाईन से हटाया जावे।
11. रक्षित पत्रावली।

खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टी.ओ.ए.नं./45/2021/ 376

दिनांक:- 1.10.2021

कार्यालय आदेश

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 852 DATED:-29-09-2021 से खननपट्टा संख्या 341/1987 पट्टाधारी श्री अशोक अजमेरा निकट ग्राम -बलदेवगढ, तहसील-राजगढ, जिला -अलवर को जारी कन्सेन्ट टू ऑपरेट को रिवोक कर दिया गया है तथा उनके पत्रांक F.12(CC-130)/RPCB /Gr.MINES/ 869 DATED:-29-09-2021 से उक्त खनन पट्टा में खनन कार्य बन्द कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 341/1987 क्षेत्रफल 1.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्री अशोक अजमेरा के पक्ष में स्वीकृत/धृत में तत्काल प्रभाव से खनन कार्य प्रतिबंधित किया जाता है।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/ 377-395
प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कन्ट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत्त जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावे।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 341/1987 श्री अशोक अजमेरा पुत्र श्री भवर लाल अजमेरा निवासी 7 ड 17 पार्श्वनाथ मार्ग सैक्टर 7 जवाहर नगर जयपुर को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिशुल्क निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा कार्यालय हाजा।
10. सूचना सहायक/ऑन-लाईन शाखा को दिया जाकर लेख है कि उक्तानुसार खनन पट्टे की सी. टी.ओ. को ऑनलाईन से हटाया जावे।
11. रक्षित पत्रावली।

खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टी.ओ.ए.नं./45/2021/ 396
कार्यालय आदेश

दिनांक:- 1.10.2021

माननीय नेशनल ग्रीन ट्रिब्यूनल सेंट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेंट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेंट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदुषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 861 DATED:-29-09-2021 से खननपट्टा संख्या 376/1987 पट्टाधारी (पूर्व) श्री अनिल शर्मा निकट ग्राम -बलदेवगढ, तहसील-राजगढ, जिला -अलवर को जारी कन्सेन्ट टू ऑपरेट को रिवोक कर दिया गया है तथा उनके पत्रांक F.12(CC-130)/RPCB /Gr.MINES/ 864 DATED:-29-09-2021 से उक्त खनन पट्टा में खनन कार्य बन्द कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 376/1987 क्षेत्रफल 1.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ वर्तमान में मैसर्स तिरूपति माईन्स एण्ड मिनरल्स के पक्ष में स्वीकृत/धृत में तत्काल प्रभाव से खनन कार्य प्रतिबंधित किया जाता है।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/ 397-415
प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कंट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावें।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 376/1987 मैसर्स तिरूपति माईन्स एण्ड मिनरल्स निवासी डी-56, सिद्धार्थ नगर, उत्तर पश्चिम रेल्वे के मुख्यालय के पीछे, होटल ललित के पास, जवाहर सर्किल, जयपुर को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिगणक निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा कार्यालय हाजा।
10. सूचना सहायक/ऑन-लाईन शाखा को दिया जाकर लेख है कि उक्तानुसार खनन पट्टे की सी. टी.ओ. को ऑनलाईन से हटाया जावे।
11. रक्षित पत्रावली।

(राजेन्द्र सिंह)
खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टी.ओ.ए.नं./45/2021/ 416

दिनांक:- 1.10.2021

कार्यालय आदेश

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 849 DATED:-29-09-2021 से खननपट्टा संख्या 278/88 पट्टाधारी श्रीमती निर्मला शर्मा निकट ग्राम -बलदेवगढ, तहसील-राजगढ, जिला -अलवर को जारी कन्सेन्ट टू ऑपरेट को रिवोक कर दिया गया है तथा उनके पत्रांक F.12(CC-130)/RPCB /Gr.MINES/ 879 DATED:-29-09-2021 से उक्त खनन पट्टा में खनन कार्य बन्द कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 278/1988 क्षेत्रफल 1.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्रीमती निर्मला शर्मा के पक्ष में स्वीकृत/धृत में तत्काल प्रभाव से खनन कार्य प्रतिबंधित किया जाता है।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/ 417-435
प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कन्ट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावें।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 278/88 श्रीमती निर्मला शर्मा पत्नी श्री कृष्ण अवतार शर्मा निवासी 34, चौधरी कॉलोनी, दौसा तहसील एवं जिला दौसा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिशुल्क निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा कार्यालय हाजा।
10. सूचना सहायक/ऑन-लाईन शाखा को दिया जाकर लेख है कि उक्तानुसार खनन पट्टे की सी. टी.ओ. को ऑनलाईन से हटाया जावे।
11. रक्षित पत्रावली।

खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टीओ.ए.नं./45/2021/ 436

दिनांक:- 1.10.2021

कार्यालय आदेश

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 899 DATED:-29-09-2021 से खननपट्टा संख्या 239/1987 पट्टाधारी श्री चन्द्र शेखर शर्मा निकट ग्राम -बलदेवगढ, तहसील-राजगढ में खनन कार्य बंद (पूर्व से ही बन्द) कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 239/1987 क्षेत्रफल 1.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्री चन्द्र शेखर शर्मा के पक्ष में स्वीकृत/धृत में अग्रिम आदेशों तक खनन कार्य प्रतिबंधित रखा जावे।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/ 437-438
प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कन्ट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत्त जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावें।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 239/1987 श्री चन्द्र शेखर शर्मा पुत्र श्री रामचन्द्र मिश्रा निवासी खारी कोठी मौहल्ला, सिलमण्ड पाडा, दौसा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिशुल्क निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा/सूचना सहायक/ऑनलाईन शाखा कार्यालय हाजा।
10. रक्षित पत्रावली।

खनि अभियन्ता, अलवर

राजस्थान सरकार

कार्यालय खनि अभियन्ता, खान एवं भू विज्ञान विभाग, अलवर

क्रमांक:- खअ/अल/एन.जी.टीओ.ए.नं./45/2021/ 456

दिनांक:- 1.10.2021

कार्यालय आदेश

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल में विचाराधीन ओ.ए. नं. 45/2020 मुकेश शर्मा बनाम राजस्थान सरकार में पारित निर्णय दिनांक 07.07.2021 के संदर्भ में कार्यालय उप वन संरक्षक, बाघ परियोजना सरिस्का के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 13.07.2021 तथा कार्यालय वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना के पत्र क्रमांक/एफ/()विधि/बापस/2021-22/5664 दिनांक 16.07.2021 के द्वारा माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 07.07.2021 की पालना में ग्राम बलदेवगढ में स्थित खनन पट्टों को बन्द कर निर्णय की पालना रिपोर्ट चाही गई।

माननीय नेशनल ग्रीन ट्रिब्यूनल सेन्ट्रल जोन भोपाल द्वारा पारित आदेश दिनांक 7.7.2021 की पालना में कार्यालय द्वारा क्षेत्रीय अधिकारी राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, अलवर को पत्रांक खअ/अल/ओ.ए.नं.45/2020/85 दिनांक 13.08.2021 से खननपट्टाधारियों को जारी कन्सेन्ट टू ऑपरेट को रिवोक करने के सम्बन्ध में विधिक निर्णय लिया जाने हेतु लिखा गया।

राजस्थान राज्य प्रदूषण नियंत्रण मण्डल, मुख्यालय (जयपुर) द्वारा उनके पत्र क्रमांक F.12(CC-130)/RPCB/Gr.MINES/ 884 DATED:-29-09-2021 से खननपट्टा संख्या 121/2004 पट्टाधारी श्री प्रेम कुमार खण्डेलवाल निकट ग्राम -बलदेवगढ, तहसील-राजगढ में खनन कार्य बंद (पूर्व से ही बन्द) कराने हेतु निर्देशित किया गया है।

अतः उक्त वर्णित आदेशों की अनुपालना में इस कार्यालय क्षेत्राधिकार के अन्तर्गत ग्राम बलदेवगढ तहसील राजगढ जिला अलवर में स्थित खननपट्टा संख्या 121/2004 क्षेत्रफल 4.00 हैक्टर वास्ते खनिज मार्बल निकट ग्राम बलदेवगढ श्री प्रेम कुमार खण्डेलवाल के पक्ष में स्वीकृत/धृत में अग्रिम आदेशों तक खनन कार्य प्रतिबंधित रखा जावे।

भवदीय

(राजेन्द्र सिंह)

खनि अभियन्ता, अलवर

दिनांक:- 1.10.2021

क्रमांक:- खअ/अल/ओ.ए.नं./45/2020/ 457-474
प्रतिलिपि:- निम्न को आवश्यक कार्यवाही एवं सूचनार्थ प्रेषित है:-

1. श्रीमान जिला कलक्टर अलवर।
2. वन संरक्षक एवं क्षेत्र निदेशक, सरिस्का बाघ परियोजना अलवर।
3. उप वन संरक्षक बाघ परियोजना सरिस्का अलवर।
4. उप वन संरक्षक अलवर।
5. राजस्थान स्टेट पॉल्यूशन कन्ट्रोल बोर्ड अलवर।
6. श्रीमान अधीक्षण खनि अभियन्ता, जयपुर वृत्त जयपुर को दी जाकर निवेदन है कि उक्त खनन पट्टा के ऑन लाईन ई-रवन्ना बंद कराने का श्रम करावे।
7. संबंधित खनन पट्टाधारी एम. एल. नं. 121/2004 श्री प्रेम कुमार खण्डेलवाल पुत्र श्री मंगंतु राम खण्डेलवाल निवासी ई-120, चमेली देवी पाटोदिया मार्ग, शास्त्री नगर, जयपुर को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करे।
8. खनि कार्य देशक/सर्वेयर कार्यालय हाजा को दी जाकर लेख है कि उक्त आदेश की पालना सुनिश्चित करा पालना रिपोर्ट पेश करें।
9. संगणक/अधिगणक निर्धारण शाखा/मानचित्रकार/मांगलिपिक/लेखा शाखा/रोकडपाल/सहा. प्रशा.अधि. /रियायती शाखा/ सूचना सहायक/ऑनलाईन शाखा कार्यालय हाजा।
10. रक्षित पत्रावली।

खनि अभियन्ता, अलवर

S.NO.	ML.NO.	NAME OF LESSEE	MINERAL	AREA IN (HECT.)	DATE OF INITIAL GARNT	NEAR VILLAGE /TEHSIL	EC GRANT No AND DATE	EC GRANTIN G AUTHORITY	PRESENT STATUS	DISTANC E FROM BOUNDARY OF SANCTUARY (KM.)	CTO VALIDITY AND CAPACITY	Cluster Area Name
1	67/97	DEEPAK MINING COMPNY	MARBLE	1	13-04-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 220 /2016-2017/1961-9/7/16	DEIAA	WORKING	2.299KM..	13.04.18 to 31.03.2023 125270 TPA	KHO, RAJGARH
2	.2/96	M/S RAJSTHAN MINERAL & TRADERS	MARBLE	1	10-02-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt214 /2016-2017/1889-9/7/16	DEIAA	WORKING	2.625KM.	01.10.17 to 30.09.2022 84160 TPA	KHO, RAJGARH
3	98/07	SMT.SUSH MA GOYAL	MARBLE	1	31-05-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 212 /2016-2017/1865-9/7/16	DEIAA	NON WORKING	2.390KM..	09.09.16 to 31.08.2021 42598 TPA expired	KHO, RAJGARH
4	64/97	M/S KHNIJ UDHYOG	MARBLE	1	02-06-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 194 /2016-2017/172-9/7/16	DEIAA	NON WORKING	2.722KM.	26.07.16 to 30.06.2019 100000 TPA expired	KHO, RAJGARH
5	40/97	SH.PARMO D GOYAL	MARBLE	1	02-04-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 80 /2016-2017/683-9/7/16	DEIAA	WORKING	2.315KM.	01.09.17 to 31.08.2022 48000 TPA	KHO, RAJGARH

6	.7/2007	SH.PARMO D GOYAL	MARBLE	1	02-4-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 211 /2016- 2017/1853- 9/7/16	DEIAA	NON WORKING	2.204KM.	01.04.16 to 31.03.2019 39999 TPA expired	KHO, RAJGARH
7	1158/91	M/S RAM NARAYAN BROTHERS	MARBLE	1	01-9-2001 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt197 /2016- 2017/1757- 9/7/16	DEIAA	NON WORKING	2.667KM.	26.07.16 to 30.06.2021 100000 TPA Epried	KHO, RAJGARH
8	17/97	M/S RAM NARAYAN BROTHERS	MARBLE	1.88	28-9-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 200 /2016- 2017/1769- 9/7/16	DEIAA	NON WORKING	2.859KM.	07.10.16 to 30.09.2021 110540 TPA Expired	KHO, RAJGARH
9	55/97(187/0 2)	M/S MARBLE MINING COMPANY	MARBLE	4.3789	14-5-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 205 /2016- 2017/1781- 9/7/16	DEIAA	NON WORKING	3.147KM.	05.10.16 to 30.09.2021 307170 TPA Expired	KHO, RAJGARH
10	34/97	SMT.SUSH MA GOYAL	MARBLE	1.3198	30-3-1998 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt213 /2016- 2017/1877- 9/7/16	DEIAA	NON WORKING	2.579KM.	09.09.16 to 31.08.2021 45511 TPA Expired	KHO, RAJGARH
11	32/96	SH.BHAGIR ATH MEENA	MARBLE	1.0492	30-9-1997 TO 50 YEAR	KHO, RAJGARH	DEIAA/AW R/FILE NOt 229 /2016- 2017/2069- 9/7/16	DEIAA	NON WORKING	2.727KM.	26.09.16 to 31.08.2021 65910 TPA Expired	KHO, RAJGARH
12	35/97	SH. DWARKA PARSAD MEENA	MARBLE	0.6347	31-12-1998 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AW R/FILE NOt 227 /2016- 2017/2047- 9/7/16	DEIAA	WORKING	2.514KM.	01.03.17 to 28.02.2022 45376 TPA	Palpur, Rajgarh

13	33/96	SH. RAMKESH MEENA	MARBLE	1.188	30-9-1997 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt228 /2016-2017/2057-9/7/16	DEIAA	WORKING	2.172.KM.	27.05.17 to 30.04.2022 7500 TPA	Palpur, Rajgarh
14	51/96	ABHISHKE SHARMA	MARBLE	0.8625	28-10-1997 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt 219 /2016-2017/1949-9/7/16	DEIAA	WORKING	2.393KM.	01.07.17 to 30.06.2022 45000 TPA	Palpur, Rajgarh
15	18/2001	M/S RNB MARBLE	MARBLE	2.25	16-7-2001 TO 50 YEAR	DUNDHPU RI RAJGARH	DEIAA/AWR/FILE NOt 206 /2016-2017/1793-9/7/16	DEIAA	NON WORKING	2.516KM..	26.01.16 to 30.05.2021 100000 TPA Expired	Scattered Mine
16	79/97	M/S SHRUTI MARMO PVT. LTD.	MARBLE	2.25	06-10-1997 TO 50 YEAR	DUNDHPU RI RAJGARH	DEIAA/AWR/FILE NOt 242 /2016-2017/1913-9/7/16	DEIAA	NON WORKING	2.552KM.	01.09.16 to 31.08.2021 388430 TPA Expired	Scattered Mine
17	80/97	M/S SHRUTI MARMO PVT. LTD.	MARBLE	2.25	06-10-1997 TO 50 YEAR	DUNDHPU RI RAJGARH	DEIAA/AWR/FILE NOt239 /2016-2017/1925-9/7/16	DEIAA	NON WORKING	2.701KM.	01.09.16 to 31.08.2021 320580 TPA Expired	Scattered Mine
18	114/2000	SH. NEERAJ PUROHIT	MARBLE	2.065	16-5-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FILE NOt 44 /2016-2017/623-30/5/16	DEIAA	NON WORKING	3.171KM.	05.07.16 to 15.05.2021 113100 TPA Expired	Mallana, Rajgarh
19	106/01	M/S K R MARBLES	MARBLE	1.48	19-12-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FILE NOt 71 /2016-2017/647-30/5/16	DEIAA	NON WORKING	3.431KM.	01.04.16 to 31.03.2019 42670 TPA Expired	Mallana, Rajgarh

20	104/01	SH.B.L.ME ENA	MARBLE	4.263	21-12-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AW R/FILE NOt 68 /2016- 2017/1031- 30/5/16	DEIAA	WORKING	3.721M	27.11.17 to 31.10.2022 302380 TPA	Mallana, Rajgarh
21	38/99	M/S RAMA MARBLE	MARBLE	1.94	16-7-1999 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AW R/FILE NOt 165 /2016- 2017/1307- 31/05/16	DEIAA	NON WORKING	4.168KM.	28.03.17 to 15.07.2019 76700 TPA expired	Goverdha npura, Rajgarh
22	66/96	M/S VISHV MARBLE COMPANY PVT. LTD.	MARBLE	1	23-7-1987 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AW R/FILE NOt 67 /2016- 2017/803- 30/5/16	DEIAA	WORKING	4.409KM.	02.05.17 to 30.04.2022 39310 TPA	Goverdha npura, Rajgarh
23	38/98	SH.BHAGW AN DAS MANGAL	MARBLE	1	12-4-1989 TO 50 YEAR	TILWAD RAJGARH	DEIAA/AW R/FILE NOt 123 /2016- 2017/671- 30/5/16	DEIAA	NON WORKING	1.548KM.	05.07.16 to 30.06.2021 110900 TPA Expired	Tilwad- Tilwadi, Rajgarh
24	472/03	SH. RAMPYARI MEENA	MARBLE	1	18-10-2004 TO 50 YEAR	TODARAI SHINGH PURA	F.1(4)/SEIA A/SEAC- Raj/Sectt/Cat /projectCat.1 (A)B2(EC)1 4-15Jaipur- 4/1/16	SEIAA	NON WORKING	6.422KM.	15.02.16 to 31.01.2019 65520 TPA expired	Scattered Mine
25	121/04	SH. PREM KUMAR KHANDEL WAL	MARBLE	4	07-1-2005 TO 50 YEAR	BALDEVG HRD	F.1(4)/SEIA A/SEAC- Raj/Sectt/Cat /project.Cat. 1(A)B2(EC) 14-15Jaipur- 28/03/16	SEIAA	NON WORKING	7.205KM.	01.05.16 to 30.04.2019 150000 TPA expired	Baldevgar h, Rajgarh

26	114/02	SH. PARDEEP CHOHAN	MARBLE	4	20-1-2005 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 223 /2016-2017/1997-9/7/16	DEIAA	WORKING	1.880M	01.03.17 to 28.02.2022 150000 TPA	Baldevgar h, Rajgarh
27	133/04	SH. MANJU SHARMA	MARBLE	4	24-1-2005 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt 230 /2016-2017/2081-9/7/16	DEIAA	WORKING	2.511KM.	01.03.17 to 28.02.2022 163500 TPA	Palpur, Rajgarh
28	167/02	SH. BEENA MEENA	MARBLE	1.46	20-4-2005 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FILE NOt 164 /2016-2017/1379-31/05/16	DEIAA	NOT WORKING	3.330KM.	3.11.16 to 31.10.2021 81120 TPA	Mallana, Rajgarh
29	500/03	SH. JAGDISH PARSAD MEENA	MARBLE	4	15-6-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 225 /2016-2017/2021-9/7/16	DEIAA	NOT WORKING	2.202KM.	23.01.17 to 31.12.2021 214500 TPA	KHO, RAJGARH
30	96/02	MALTI GUNAWAT	MARBLE	4	30-7-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 226 /2016-2017/2032-9/7/16	DEIAA	NON WORKING	1.677KM.	18.01.17 to 31.12.2020 75000 TPA Expired	KHO, RAJGARH
31	118/02	SH. CHAGAN LAL AACHARY	MARBLE	4	30-07-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 224 /2016-2017/2009-9/7/16	DEIAA	NON WORKING	2.338KM.	14.07.16 to 31.05.2019 187900 TPA expired	KHO, RAJGARH
32	54/02	M/S PALPUR MINING COMPNY	MARBLE	4	08-1-2003 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 209 /2016-2017/1829-9/7/16	DEIAA	WORKING	1.999KM.	01.06.18 to 31.05.2023 40000 TPA	KHO, RAJGARH

33	56/02	M/S PALPUR MINING COMPNY	MARBLE	4	08-1-2003 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt210 /2016-2017/1841-9/7/16	DEIAA	WORKING	1.949KM.	01.06.18 to 31.05.2023 40000 TPA	KHO, RAJGARH
34	261/06	SH. MAAN SHINGH MEENA	MARBLE	1.24	12-12-2007 TO 50 YEAR	TILWAD RAJGARH	F.1(4)/SEIAA/SEAC-Raj/Sectt/Cat./project.Cat.1(A)B2(EC)14-15Jaipur-19/05/16	SEIAA/DEIAA	WORKING	1.867KM.	16.08.17 to 31.07.2022 250000 TPA	Tilwad-Tilwadi, Rajgarh
35	73/06	SH. NARESH KUMAR VASHISHT H	MARBLE	1.06	24-08-2007 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt 129 /2016-2017/1319	DEIAA	NON WORKING	3.645KM.	14.09.16 to 31.08.2021 110060 TPA Expired	Goverdha npura, Rajgarh
36	59/07	SH. RAJBALA JAIN	MARBLE	4	22-10-2008 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt231 /2016-2017/2093-9/7/16	DEIAA	NOT WORKING	1.803KM.	05.11.16 to 31.10.2021 79230 TPA	KHO, RAJGARH
37	120/07	SH. RANJIT SHINGH	MARBLE	0.8	03-9-2008 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FILE NOt 70 /2016-2017/ 1043-30/5/16	DEIAA	WORKING	3.835KM.	01.09.17 to 31.08.2022 34430 TPA	Mallana, Rajgarh
38	335/09	SH.MOOLC HAND MEENA	MARBLE	1	21-7-2017 TO 50 YEAR	TODA JAISHING PURA RAJGARH	F.1(4)/SEIAA/SEAC-Raj/Sectt/Cat./projectCat.1(A)B2(EC)14-15Jaipur	SEIAA	WORKING	6.435KM.	01.04.19 to 30.06.2022 75920 TPA	Scattered Mine

39	39/99	RADHEY KRISHNA GRANITE AND MARBLES	MARBLE	1	14-7-1999 TO 50 YEAR	KALWAD RAJGARH	DEIAA/AWR/FILE NOt 119 /2016-2017/995-30/5/16	DEIAA	WORKING	1.483KM.	06.03.17 to 28.02.2022 104900 TPA	Scattered Mine
40	53/2002	SH.MAHEN DRA SHING	MARBLE	4	05-3-2005 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 233 /2016-2017/2117-9/7/16	DEIAA	NON WORKING	2.1KM..	- 04.08.16 to 3.07.2021 119340 TPA Expired	KHO, RAJGARH
41	267/88	SH.ASHOK GUPTA	MARBLE	1	01&4&1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 218 /2016-2017/1937-9/7/16	DEIAA	WORKING	2.276M	- 22.04.17 to 31.03.2022 54000 TPA	KHO, RAJGARH
42	199/86	RAJESH SHARMA	MARBLE	1	25&4&1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 222 /2016-2017/1985	DEIAA	WORKING	2.518KM.	08.06.17 to 31.05.2022 113260 TPA	KHO, RAJGARH
43	208/84	M/S YASH MARBLE	MARBLE	4.3625	20-2-19855 TO 31-3-2025 rd	KHO, RAJGARH	DEIAA/AWR/FILE NOt215 /2016-2017/1901-9/7/16	DEIAA	WORKING	3.223KM.	20.04.17 to 31.03.2022 154900 TPA	KHO, RAJGARH
44	922/88	SMT MAYA GAOYAL	MARBLE	1	31-5-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 208 /2016-2017/1817-9/7/16	DEIAA	WORKING	2.406KM.	- 17.04.17 to 31.03.2022 30000 TPA	KHO, RAJGARH
45	46/88	M/S RAM NARAYAN & BROTHERS	MARBLE	1	12-5-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 196 /2016-2017/	DEIAA	WORKING	2.307KM.	03.05.17 to 30.04.2022 100000 TPA	KHO, RAJGARH

46	19/88	NAMAN SHARMA	MARBLE	1	09-8-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 221 /2016-2017/1973-9/7/16	DEIAA	NON WORKING	2.227KM.	07.02.17 to 08.08.2019 106080 TPA expired	KHO, RAJGARH
47	923/88	SH. SANTOSH SHARMA	MARBLE	1.7	31-5-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 234 /2016-2017/2291-9/7/16	DEIAA	WORKING	2.294KM.	01.04.17 to 31.03.2022 104186 TPA	KHO, RAJGARH
48	246/85	M/S SHREE RAM MINERAL	MARBLE	1	10-2-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 102 /2016-2017/815-30/5/16	DEIAA	WORKING	2.605KM.	01.05.17 to 30.04.2022 100000 TPA	KHO, RAJGARH
49	217/86	SH. RADHY SHYAM GUPTA	MARBLE	1	25-9-1987 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt 72 /2016-2017/2528-24/08/17	DEIAA	WORKING	4.681KM.	27.04.17 to 31.03.2022 60000 TPA	Goverdha npura, Rajgarh
50	49/86	SH. SAMPTRA M CHOUDHRY	MARBLE	1	3-6-1986 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt262 /2016-2017/2516-24/08/17	DEIAA	WORKING	4483KM.	01.05.17 to 30.04.2022 90000 TPA	Goverdha npura, Rajgarh
51	341/87	SH. ASHOK AJMERA	MARBLE	1	01-9-1988 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 174 /2016-2017/1624-9/7/2016	DEIAA	WORKING	7.556KM.	03.05.17 to 30.04.2022 100000 TPA	Baldevgar h, Rajgarh
52	376/87	SH.ANIL SHARM	MARBLE	1	27-5-1988 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 266/2016-2017/2685	DEIAA	WORKING	7.362KM.	10.04.17 to 31.03.2022 115991 TPA	Baldevgar h, Rajgarh

53	278/88	SMT. NIRMALA SHRAMA	MARBLE	1	11-8-1988 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 178 /2016-2017/1673-9/7/16	DEIAA	WORKING	7.036KM.	03.04.17 to 31.03.2022 100000 TPA	Baldevgarh, Rajgarh
54	160/87	SH. MANOJ KUMAR SHARMA	MARBLE	1	23-4-1988 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 175 /2016-2017/1661-9/7/16	DEIAA	WORKING	6.905KM.	03.04.17 to 31.03.2022 90000 TPA	Baldevgarh, Rajgarh
55	342/87	SH. VINOD KUMAR AJMERA	MARBLE	1	01-9-1988 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 177 /2016-2017/1637-9/7/16	DEIAA	WORKING	7.653KM.	19.04.17 to 31.03.2022 100000 TPA	Baldevgarh, Rajgarh
56	148/85	SH. PARDEEP PARIK	MARBLE	1	05-5-1987 TO 50 YEAR	TILWAD RAJGARH	DEIAA/AWR/FILE NOt 176 /2016-2017/2661	DEIAA	WORKING	1.332KM.	06.05.17 to 30.04.2022 126520 TPA	Tilwad-Tilwadi, Rajgarh
57	167/88	M/S SS MARBLE	MARBLE	0.5238	25-04-1988 TO 50 YEAR	BALDEVG HRDRAJGARH	DEIAA/AWR/FILE NOt 176 /2016-2017/1649-9/7/16	DEIAA	WORKING	6.747KM.	17.04.17 to 31.03.2022 5700 TPA	Baldevgarh, Rajgarh
58	Jul-87	SH. SUBESHING	MARBLE	1	8-3-88 TO 50 YEAR	GOVERDHANPURA	DEIAA/AWR/FILE NOt 277 /2016-2017/3018	DEIAA	WORKING	4.277KM.	20.08.18 TO 31.07.2023 122304 TPA	Goverdhanpura, Rajgarh
59	34/96	M/S ARPIT PVT. LTD.	MARBLE	1	5&8&87 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FILE NOt 260 /2016-2017/2189-9/7/16	DEIAA	WORKING	5.214KM.	15.02.17 to 31.01.2022 160000 TPA	Jhiri, Thanagazi

60	35/96	M/S ARPIT PVT. LTD.	MARBLE	1	5&8&87 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FILE NOt 259 /2016-2017/2177-9/7/16	DEIAA	WORKING	5.257KM.	15.02.17 to 31.01.2022 170000 TPA	Jhiri, Thanagazi
61	158/81 (9/93)	SH. CHANDRA SHEKHAR GUPTA	MARBLE	1.7779	28&7&93 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FILE NOt 235 /2016-2017/2153-	DEIAA	WORKING	7.416KM.	05.03.2018 to 28.02.2023 82730 TPA	Kalsi Kala Gwada, Thanagazi
62	218/89	M/S C S MINES PVT. LTD.	MARBLE	4.645	19&2&70 TO 50 YEAR	JHIRI THANAGAJI	F.1(4)/SEIAA/SEAC-Raj/Sectt/project Cat.1(a)B2(E C)14-15Jaipur-9/5/16	SE IAA	NON WORKING	5.665KM.	17.09.16 to 31.08.2021 110000 TPA Expired	Jhiri, Thanagazi
63	815/88	M/S DIKSHIT MARBLE	MARBLE	1	7&1&89 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FILE NOt 236 /2016-2017/2611-	DEIAA	WORKING	5.938KM.	01.11.17 to 31.10.2022 43500 TPA	Jhiri, Thanagazi
64	258/89	M/S OM SHUBHAM HOUSING AND CONST. COMPANY	MARBLE	10.186	13&3&80 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	F.1(4)/SEIAA/SEAC-Raj/Sectt/projectCat.1(a)B2(EC)14-15Jaipur date -22-08-16	-	NON WORKING	7.970KM.	01.01.17 to 12.03.2020 150000 TPA expired	Kalsi Kala Gwada, Thanagazi
65	881/88	SH. PRITHVI	MARBLE	1	27-7-92 TO 50 o"k	KALSI KALA GWADA THANAGAJI	F.1(4)/SEIAA/SEAC-Raj/Sectt/project Cat.1(a)B2(E C)14-15Jaipur-9/5/16	SEIAA	NON WORKING	5.296KM.	10.08.16 to 30.11.2018 95340 TPA expired	Kalsi Kala Gwada, Thanagazi

66	87/97	M/S MANSI MINERAL	MARBLE	1	5&8&97 TO 50 YEAR	JHIRI THANAGAJ I	F.1(4)/SEIA A/SEAC-Raj/Sectt/project	SEIAA	WORKING	5.483KM.	27.04.2018 to 31.03.2023 36000 TPA	Jhiri, Thanagazi
67	30/96	ANDHI MINERAL AND MARBLE	MARBLE	1	14&7&87 TO 50 YEAR	JHIRI THANAGAJ I	DEIAA/AWR/FILE NOt 258 /2016-2017/2165-9/7/16	DEIAA	WORKING	5.553KM.	06.03.17 to 28.02.2022 18000 TPA	Jhiri, Thanagazi
68	596/88(156/08)	M/S NARUKA MARBLE	MARBLE	1	2&5&89 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	F.1(4)/SEIA A/SEAC-Raj/Sectt/project Cat.1(a)B2(E C)14-15Jaipur -	SEIAA	NON WORKING	7.200KM.	07.10.2016 TO 27-02-2019 50000 TPA expired	Kalsi Kala Gwada, Thanagazi
69	1767/91	SH. RAKESH MEENA	MARBLE	1	15&10&97 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt247 /2016-2017/2237-9/7/16	DEIAA	WORKING	6.158KM.	14.03.17 to 28.02.2022 160000 TPA	Kalsi Kala Gwada, Thanagazi
70	1770/91	SH. RAKESH MEENA	MARBLE	1	15-10-97 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt 254 /2016-2017/2225-9/7/16	DEIAA	WORKING	6.115KM.	14.03.17 to 28.02.2022 168000 TPA	Kalsi Kala Gwada, Thanagazi
71	327/88	SHARMA MARBLE AND MINERAL	MARBLE	1	8&9&88 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	F.1(4)/SEIA A/SEAC-Raj/Sectt/project Cat.1(a)B2(E C)14-15Jaipur	SEIAA	WORKING	7.202KM.	09.08-17 to 31.07.2022 54920 TPA	Kalsi Kala Gwada, Thanagazi
72	39/96	SH. KELASH CHANDRA GUPTA	MARBLE	1	31&8&97 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt 255 /2016-2017/2213-9/7/16	DEIAA	WORKING	5.400KM.	01.12.17 to 30.11.2022 20000 TPA	Kalsi Kala Gwada, Thanagazi

73	43/94	SITARAM SAINI	MARBLE	1	28&6&85 TO 50 YEAR	DHANI NIJRA THANAGAJI	DEIAA/AWR/FILE NOt./DEIAA /276/2016-2017/2999	DEIAA	WORKING	2.481KM	22.02.17 to 30.06.2022 108888 TPA	Scattered Mine
74	361/88	SH. ROHIT KUMAR	MARBLE	1	23&5&89 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FILE NOt 252 /2016-2017/2249-9/7/16	DEIAA	NON WORKING	5.254KM.	09.09.16 to 22.05.2019 59805 TPA expired	Jhiri, Thanagazi
75	112/04	DIXIT MARBLE STONE	MARBLE	0.71	25-07-07 TO 50 YEAR	JHIRI THANAGAJI	DEIAA/AWR/FILE NOt 237 /2016-2017/2623	DEIAA	NON WORKING	5.215KM.	26.10.16 to 30.09.2021 44000 TPA Expired	Jhiri, Thanagazi
76	103/01	AMBIKA MARBLE	MARBLE	0.56	14-12-01 TO 50 YEAR	SAMRA THANAGAJI	DEIAA/AWR/FILE NOt 81 /2016-2017/1685-9/7/16	DEIAA	WORKING	4.953KM.	01.07.17 to 31.03.2022 10000 TPA	Scattered Mine
77	834/88	MAHEHWARI KNWAR	MARBLE	1	2&5&89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FILE NOt	DEIAA	WORKING	6.631KM.	12.06.18 to 31.05.2023 96967 TPA	Kalsi Kala Gwada, Thanagazi
78	Dec-85	SH. RAMAVTAR KUMHAR	MARBLE	1	11&8&86 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FILE NOt250 /2016-2017/2273-9/7/16	DEIAA	WORKING	7.263KM.	16.10.17 to 30.9.2022 63390 TPA	Kalsi Kala Gwada, Thanagazi
79	837/88	M/S AGRWAL MINES	MARBLE	1	25-04-89 TO 50 YEAR	KALSI KALA GWADA THANAGAJI	DEIAA/AWR/FILE NOt 241 /2016-2017/2129-9/7/16	DEIAA	NON WORKING	6.746KM.	25.08.16 to 24.04.2019 58920 TPA expired	Kalsi Kala Gwada, Thanagazi

80	91/98	TEZ RAM SAINI	MASONARY STONE	1	21&8&99 TO 50 YEAR	NARAYAN PUR THANA GAJI	DEIAA/AWR/FILE NOt 20 /2016-2017/92-30/5/16	DEIAA	WORKING	7.580KM.	01.05.18 to 30.04.2023 54000 TPA	Scattered Mine
81	92/98	TEZ RAM SAINI	MASONARY STONE	1	21&8&99 TO 50 YEAR	NARAYAN PUR THANA GAJI	DEIAA/AWR/FILE NOt 01 /2016-2017/104-30/5/16	DEIAA	WORKING	7.380KM.	01.05.18 to 30.04.2023 54000 TPA	Scattered Mine
82	109/04	SH. VISHNU PARSAD	MASONARY STONE	1	13&7&05 TO 50 YEAR	NITATA THANAGAJI	DEIAA/AWR/FILE NOt186 /2016-2017/2504-31/05/16	DEIAA	NON WORKING	1.173KM.	01.08.13 to 31.07.2016 6210 TPA expired	Scattered Mine
83	108/09	NEHRA BILDURS AND DEVLOPER S PVT LTD.	MASONARY STONE	1	9-11-2011 TO 50 YEAR	BHANGDOLI THANAGAJI	DEIAA/AWR/FILE NOt 131 /2016-2017/1511-31/05/16	DEIAA	NON WORKING	2.427KM.	01.07.2015 to 30.06.2018 100000 TPA expired	Scattered Mine
84	109/09	NEHRA BILDURS AND DEVLOPER S PVT LTD.	MASONARY STONE	1	9-11-2011 TO 50 YEAR	BHANGDOLI THANAGAJI	DEIAA/AWR/FILE NOt 130 /2016-2017/1523-31/05/16	DEIAA	NON WORKING	2.370KM.	01.07.2015 to 30.06.2018 100000 TPA expired	Scattered Mine

42 mine lease with valid Consent to Operate as on 31.12.2021

S. N O.	ML.NO.	NAME OF LESSEE	MINERAL	AREA IN (HECT.)	DATE OF INITIAL GARNT	NEAR VILLAGE /TEHSIL	EC GRANT No AND DATE	EC GRANTIN G AUTHORITY	DISTANC E FROM BOUNDA RY OF SANCTUARY (KM.)	CTO VALIDITY AND CAPACITY	Cluster Area Name
1	67/97	DEEPAK MINING COMPNY	MARBLE	1	13-04-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 220 /2016-2017/1961-9/7/16	DEIAA	2.299KM..	13.04.18 to 31.03.2023 125270 TPA	KHO, RAJGARH
2	.2/96	M/S RAJSTHAN MINERAL & TRADERS	MARBLE	1	10-02-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt214 /2016-2017/1889-9/7/16	DEIAA	2.625KM.	01.10.17 to 30.09.2022 84160 TPA	KHO, RAJGARH
3	40/97	SH.PARMO D GOYAL	MARBLE	1	02-04-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 80 /2016-2017/683-9/7/16	DEIAA	2.315KM.	01.09.17 to 31.08.2022 48000 TPA	KHO, RAJGARH
4	35/97	SH. DWARKA PARSAD MEENA	MARBLE	0.6347	31-12-1998 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt 227 /2016-2017/2047-9/7/16	DEIAA	2.514KM.	01.03.17 to 28.02.2022 45376 TPA	Palpur, Rajgarh
5	33/96	SH. RAMKESH MEENA	MARBLE	1.188	30-9-1997 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt228 /2016-2017/2057-9/7/16	DEIAA	2.172.KM.	27.05.17 to 30.04.2022 7500 TPA	Palpur, Rajgarh
6	51/96	ABHISHKE SHARMA	MARBLE	0.8625	28-10-1997 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt 219 /2016-2017/1949-9/7/16	DEIAA	2.393KM.	01.07.17 to 30.06.2022 45000 TPA	Palpur, Rajgarh
7	104/01	SH.B.L.ME ENA	MARBLE	4.263	21-12-2001 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FILE NOt 68 /2016-2017/1031-30/5/16	DEIAA	3.721M	27.11.17 to 31.10.2022 302380 TPA	Mallana, Rajgarh
8	66/96	M/S VISHV MARBLE COMPANY PVT. LTD.	MARBLE	1	23-7-1987 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt 67 /2016-2017/803-30/5/16	DEIAA	4.409KM.	02.05.17 to 30.04.2022 39310 TPA	Goverdhanpu ra, Rajgarh

9	133/04	SH. MANJU SHARMA	MARBLE	4	24-1-2005 TO 50 YEAR	PALPUR RAJGARH	DEIAA/AWR/FILE NOt 230 /2016-2017/2081-9/7/16	DEIAA	2.511KM.	01.03.17 to 28.02.2022 163500 TPA	Palpur, Rajgarh
10	54/02	M/S PALPUR MINING COMPNY	MARBLE	4	08-1-2003 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 209 /2016-2017/1829-9/7/16	DEIAA	1.999KM.	01.06.18 to 31.05.2023 40000 TPA	KHO, RAJGARH
11	56/02	M/S PALPUR MINING COMPNY	MARBLE	4	08-1-2003 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt210 /2016-2017/1841-9/7/16	DEIAA	1.949KM.	01.06.18 to 31.05.2023 40000 TPA	KHO, RAJGARH
12	261/06	SH. MAAN SHINGH MEENA	MARBLE	1.24	12-12-2007 TO 50 YEAR	TILWAD RAJGARH	F.1(4)/SEIAA/SEAC-Raj/Sectt/Cat-/project.Cat.1(A)B2(EC)14-15Jaipur-19/05/16	SEIAA/DEI AA	1.867KM.	16.08.17 to 31.07.2022 250000 TPA	Tilwad-Tilwadi, Rajgarh
13	120/07	SH. RANJIT SHINGH	MARBLE	0.8	03-9-2008 TO 50 YEAR	MALLANA RAJGARH	DEIAA/AWR/FILE NOt 70 /2016-2017/1043-30/5/16	DEIAA	3.835KM.	01.09.17 to 31.08.2022 34430 TPA	Mallana, Rajgarh
14	335/09	SH.MOOLC HAND MEENA	MARBLE	1	21-7-2017 TO 50 YEAR	TODA JAISHING PURA RAJGARH	F.1(4)/SEIAA/SEAC-Raj/Sectt/Cat-/projectCat.1(A)B2(EC)14-15Jaipur	SEIAA	6.435KM.	01.04.19 to 30.06.2022 75920 TPA	Scattered Mine
15	39/99	RADHEY KRISHNA GRANITE AND MARBLES	MARBLE	1	14-7-1999 TO 50 YEAR	KALWAD RAJGARH	DEIAA/AWR/FILE NOt 119 /2016-2017/995-30/5/16	DEIAA	1.483KM.	06.03.17 to 28.02.2022 104900 TPA	Scattered Mine
16	267/88	SH.ASHOK GUPTA	MARBLE	1	01&4&1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 218 /2016-2017/1937-9/7/16	DEIAA	2.276M	- 22.04.17 to 31.03.2022 54000 TPA	KHO, RAJGARH
17	199/86	RAJESH SHARMA	MARBLE	1	25&4&1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 222 /2016-2017/1985	DEIAA	2.518KM.	08.06.17 to 31.05.2022 113260 TPA	KHO, RAJGARH
18	208/84	M/S YASH MARBLE	MARBLE	4.3625	20-2-19855 TO 31-3-2025 rd	KHO, RAJGARH	DEIAA/AWR/FILE NOt215 /2016-2017/1901-9/7/16	DEIAA	3.223KM.	20.04.17 to 31.03.2022 154900 TPA	KHO, RAJGARH

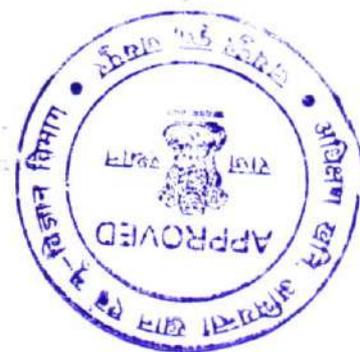
19	922/88	SMT MAYA GAOYAL	MARBLE	1	31-5-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 208 /2016- 2017/1817-9/7/16	DEIAA	2.406KM.	- 17.04.17 to 31.03.2022 30000 TPA	KHO, RAJGARH
20	46/88	M/S RAM NARAYAN & BROTHERS	MARBLE	1	12-5-1988 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 196 /2016-2017/	DEIAA	2.307KM.	03.05.17 to 30.04.2022 100000 TPA	KHO, RAJGARH
21	923/88	SH. SANTOSH SHARMA	MARBLE	1.7	31-5-1989 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 234 /2016- 2017/2291-9/7/16	DEIAA	2.294KM.	01.04.17 to 31.03.2022 104186 TPA	KHO, RAJGARH
22	246/85	M/S SHREE RAM MINERAL	MARBLE	1	10-2-1987 TO 50 YEAR	KHO, RAJGARH	DEIAA/AWR/FILE NOt 102 /2016- 2017/815-30/5/16	DEIAA	2.605KM.	01.05.17 to 30.04.2022 100000 TPA	KHO, RAJGARH
23	217/86	SH. RADHY SHYAM GUPTA	MARBLE	1	25-9-1987 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt 72 /2016- 2017/2528-24/08/17	DEIAA	4.681KM.	27.04.17 to 31.03.2022 60000 TPA	Goverdhanpu ra, Rajgarh
24	49/86	SH. SAMPTRA M CHOUHR Y	MARBLE	1	3-6-1986 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt262 /2016- 2017/2516-24/08/17	DEIAA	4483KM.	01.05.17 to 30.04.2022 90000 TPA	Goverdhanpu ra, Rajgarh
25	148/85	SH. PARDEEP PARIK	MARBLE	1	05-5-1987 TO 50 YEAR	TILWAD RAJGARH	DEIAA/AWR/FILE NOt 176 /2016- 2017/2661	DEIAA	1.332KM.	06.05.17 to 30.04.2022 126520 TPA	Tilwad- Tilwadi, Rajgarh
26	Jul-87	SH. SUBE SHING	MARBLE	1	8-3-88 TO 50 YEAR	GOVERDH ANPURA	DEIAA/AWR/FILE NOt 277 /2016- 2017/3018	DEIAA	4.277KM.	20.08.18 TO 31.07.2023 122304 TPA	Goverdhanpu ra, Rajgarh
27	34/96	M/S ARPIT PVT. LTD.	MARBLE	1	5&8&87 TO 50 YEAR	JHIRI THANAGAJ I	DEIAA/AWR/FILE NOt 260 /2016- 2017/2189-9/7/16	DEIAA	5.214KM.	15.02.17 to 31.01.2022 160000 TPA	Jhiri, Thanagazi
28	35/96	M/S ARPIT PVT. LTD.	MARBLE	1	5&8&87 TO 50 YEAR	JHIRI THANAGAJ I	DEIAA/AWR/FILE NOt 259 /2016- 2017/2177-9/7/16	DEIAA	5.257KM.	15.02.17 to 31.01.2022 170000 TPA	Jhiri, Thanagazi

29	158/81 (9/93)	SH. CHANDRA SHEKHAR GUPTA	MARBLE	1.7779	28&7&93 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt 235 /2016- 2017/2153-	DEIAA	7.416KM.	05.03.2018 to 28.02.2023 82730 TPA	Kalsi Kala Gwada, Thanagazi
30	815/88	M/S DIKSHIT MARBLE	MARBLE	1	7&1&89 TO 50 YEAR	JHIRI THANAGAJ I	DEIAA/AWR/FILE NOt 236 /2016- 2017/2611-	DEIAA	5.938KM.	01.11.17 to 31.10.2022 43500 TPA	Jhiri, Thanagazi
31	87/97	M/S MANSI MINERAL	MARBLE	1	5&8&97 TO 50 YEAR	JHIRI THANAGAJ I	F.1(4)/SEIAA/SEAC- Raj/Sectt/ project	SEIAA	5.483KM.	27.04.2018 to 31.03.2023	Jhiri, Thanagazi
32	30/96	ANDHI MINERAL AND MARBLE	MARBLE	1	14&7&87 TO 50 YEAR	JHIRI THANAGAJ I	DEIAA/AWR/FILE NOt 258 /2016- 2017/2165-9/7/16	DEIAA	5.553KM.	06.03.17 to 28.02.2022 18000 TPA	Jhiri, Thanagazi
33	1767/91	SH. RAKESH MEENA	MARBLE	1	15&10&97 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt247 /2016- 2017/2237-9/7/16	DEIAA	6.158KM.	14.03.17 to 28.02.2022 160000 TPA	Kalsi Kala Gwada, Thanagazi
34	1770/91	SH. RAKESH MEENA	MARBLE	1	15-10-97 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt 254 /2016- 2017/2225-9/7/16	DEIAA	6.115KM.	14.03.17 to 28.02.2022 168000 TPA	Kalsi Kala Gwada, Thanagazi
35	327/88	SHARMA MARBLE AND MINERAL	MARBLE	1	8&9&88 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	F.1(4)/SEIAA/SEAC- Raj/Sectt/ project Cat.1(a)B2(EC)14- 15Jaipur	SEIAA	7.202KM.	09.08-17 to 31.07.2022 54920 TPA	Kalsi Kala Gwada, Thanagazi
36	39/96	SH. KELASH CHANDRA GUPTA	MARBLE	1	31&8&97 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt 255 /2016- 2017/2213-9/7/16	DEIAA	5.400KM.	01.12.17 to 30.11.2022 20000 TPA	Kalsi Kala Gwada, Thanagazi
37	43/94	SITARAM SAINI	MARBLE	1	28&6&85 TO 50 YEAR	DHANI NIJRA THANAGAJ I	DEIAA/AWR/FILE NOt./DEIAA/276/2016- 2017/2999	DEIAA	2.481KM	22.02.17 to 30.06.2022 108888 TPA	Scattered Mine

38	103/01	AMBIKA MARBLE	MARBLE	0.56	14-12-01 TO 50 YEAR	SAMRA THANAGAJ I	DEIAA/AWR/FILE NOt 81 /2016- 2017/1685-9/7/16	DEIAA	4.953KM.	01.07.17 to 31.03.2022 10000 TPA	Scattered Mine
39	834/88	MAHEHWA RI KNWAR	MARBLE	1	2&5&89 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt	DEIAA	6.631KM.	12.06.18 to 31.05.2023 96967 TPA	Kalsi Kala Gwada, Thanagazi
40	Dec-85	SH. RAMAVTA R KUMHAR	MARBLE	1	11&8&86 TO 50 YEAR	KALSI KALA GWADA THANAGAJ I	DEIAA/AWR/FILE NOt250 /2016- 2017/2273-9/7/16	DEIAA	7.263KM.	16.10.17 to 30.9.2022 63390 TPA	Kalsi Kala Gwada, Thanagazi
41	91/98	TEZ RAM SAINI	MASONAR Y STONE	1	21&8&99 TO 50 YEAR	NARAYAN PUR THANA GAJI	DEIAA/AWR/FILE NOt 20 /2016-2017/92- 30/5/16	DEIAA	7.580KM.	01.05.18 to 30.04.2023 54000 TPA	Scattered Mine
42	92/98	TEZ RAM SAINI	MASONAR Y STONE	1	21&8&99 TO 50 YEAR	NARAYAN PUR THANA GAJI	DEIAA/AWR/FILE NOt 01 /2016- 2017/104-30/5/16	DEIAA	7.380KM.	01.05.18 to 30.04.2023 54000 TPA	Scattered Mine

List of Chapters

CHAPTER	TITLE OF TEXT	PAGE
1	GENERAL	1
2	LOCATION AND ACCESSIBILITY	4
3	DETAILS OF APPROVED MINING SCHEME	6
4	GEOLOGY AND RESERVES	7
5	MINING	13
6	MINE DRAINAGE	20
7	STACKING OF MINERAL REJECTS/SUB GRADE MATERIAL AND DISPOSAL OF WASTE	21
8	USE OF MINERAL AND MINERAL REJECTS	22
9	PROCESSING OF ROM AND MINERAL REJECTS	23
10	OTHERS	24
11	PROGRESSIVE MINE CLOSURE PLAN	25-33



List of Annexure

Annexure No.	TITLE
1	LOI
2	Plan and Demarcation report
3	Joint Demarcation report
4	Khasra details
5	On Line Scrutiny
6	RQP Registration certificate
7	Documents of M.L 104/01
8	Documents of M.L. 105/01



List of Plates

Number	TITLE
1	LOCATION PLAN
2	KEY PLAN
3	ENVIRONMENT PLAN
4	REVENUE MAP
5	SURFACE GEOLOGICAL PLAN & SECTIONS
6	COMPOSIT PLAN & YEARWISE SECTIONS
7	CONCEPTUAL PLAN



B. L. MEENA

**VILLAGE- MALLANA,
TEHSIL- RAJGARH
DISTRICT-ALWAR (RAJASTHAN)
PINCODE- 301408
PHONE- 94133 04070**

**CONSENT LETTER/UNDERTAKING/CERTIFICATE FROM THE
LESSEE**

01. The Modified Mining Plan with PMCP in respect of Marble Mine, over an area of 4.2630 ha, in village- Mallana, Tehsil- Rajgarh, district- Alwar of Rajasthan State, under rule 19 of MCDR 2002 & rule 29 (5) (6) of RMMCR 2017 has been prepared by RQP Shri Govind Singh (RQP/AJM/009/87/A).

This is to request the Superintending Mining Engineer, Jaipur Circle, Jaipur, to make any further correspondence regarding any correction of the Modified Mining Plan with PMCP with the said recognized person at his address below:

Shri Govind Singh
RQP/AJM/009/87/A
Khachariyawas House
D-88, Meera Marg, Bani Park,
Jaipur-302016
e.mail:naruka.consultancy@gmail.com
Mobile: 9414071070

I hereby undertake that all modification/ updating as made in the Modified Mining Plan with PMCP by the said recognized person be deemed to have been made with our knowledge and consent and shall be acceptable on us and binding in all respects.

02. It is certified that the CCOM Circular no 2/2010 will be implemented and complied with when an authorized agency is approved by the State Government.

03. It is certified that the progressive Mine Closure Plan of Marble Mine Mallana of B.L. Meena over an area of 4.2630 ha complies with all statutory rules, regulations, Orders made by Central or State Government, Statuary organization, Court etc which have been taken into consideration and wherever any specific permission is required the lessee will approach the concerned authorities.

The information furnished in the Progressive Mine Closure Plan is true and correct to the best of our kind knowledge and records.

04 "The provisions of Mines Act, Rules and Regulations made there under have been observed in the Modified Mining Plan with PMCP over an area of 4.2630 ha in Alwar district of Rajasthan State belonging to Marble Mine Mallana and where specific permissions are required, the applicant will approach the DGMS. Further, standards prescribed by D.G.M.S. in respect of miner's health will be strictly implemented."

Place: Jaipur
Dated: 24.02.2017


B.L. Meena
Lessee

वरिष्ठ भू-वैज्ञानिक
ज्ञान एवं भू-विज्ञान विभाग
अलवर (राज.)



GOVIND SINGH

RQP/AJM/009/87/A
Khachariyawas House
D/88, Meera Marg, Bani Park
Jaipur, Pin 302 016
e-mail naruka_consultancy@gmail.com

JAIPUR(O) 0141- 4021611
Mobile: 94140 71070

CERTIFICATE

The provisions of **Marble Conservation and Development Rules 2002** and RMMCR 2017 have been observed in the preparation of the Modified Mining Plan with PMCP for Mallana Marble Mine, over an area of 4.2630 ha of Shri B. L. Meena in village- Mallana Tehsil- Rajgarh, district- Alwar of State Rajasthan and whenever specific permission are required, the lessee will approach the concerned authorities of Department of Mines and Geology.

The information furnished in the Modified Mining Plan with PMCP is true and correct to the best of my knowledge.

Place- Jaipur
Dated- March 07, 2017


Govind Singh
RQP/AJM/009/87/A
Valid up to August 4, 2021



1.0 INTRODUCTION

Lessee:-

The lessee Shri B. L. Meena, Lessee of this M.L. 104/01 (area 2.24 ha) and M.L. 105/01 (area 2.023 ha) engaged in mining since long with the both mining leases. Now the both leases M.L. 104/01 and M.L. 105/01 are amalgamated and named as M.L. 104/01, area 4.2630 ha (refer annexure-1). The leases are for marble and located near village- Mallana, tehsil- Rajgarh of Alwar district (Rajasthan).

Lease details:-**The lease is for mineral Marble**

Lessee	Shri B. L. Meena
M.L. 105/01	2.023hectare- up to 20.12.2021
M.L. 104/01	2.24 hectares- up to 20.12.2021
Amalgamated leases 104/01 and 105/01	Now known as M.L. 104/01
Lease period	Up to 20.12.2021
M.L.	104/01
Lease area	4.2630 ha
Amalgamation	M.L. 104/01 and M.L. 105/01
Reason for modified mining plan	As the lease area of M.L. 104/01 is increased up to 4.2630 ha thus the modified mining plan is prepared as per rule 19 of MCDR 2002, rule 37 F (1)(2) of RMMCR 1986 with Progressive Mine Closure Plan under rule 37 E(vi) of RMMCR 1986.

For preparation of the Modified Mining Plan with PMCP the lessee approached the RQP and authorized the RQP for preparation of Modified Mining Plan with Progressive Mine Closure Plan.

The survey work was conducted on Second week of March 2017 and the plan with progressive mine closure plan has been prepared. This Modified Mining Plan with Progressive Mine Closure Plan has been prepared as per the new guide lines provided by the approving authorities and circulars issued time to time.

Approach:

The route is as follows:

Route	Road	Distance in kilometres
Alwar- Rajgarh	NH 8A	36
Rajgarh to Mine Site	SH-29A	30
Jaipur to Mine Site	NH-11, NH 8A, and SH 29A	96



Lease history**M.L. 104/01 and 105/01**

M.L. 104/01	Sanction	Agreement	Registration	Period
Original M.L. 104/01 Shri B. L. Meena Area 2.24 hectares			21.12.2001	20 year w. e. f. 21.12.2001 i.e. up to 20.12.2021
M.L. 105/01				
Original M.L. 105/01 Shri B. L. Meena Area 2.023 hectares			21.12.2001	20 year w. e.f. 21.12.2001 i.e. up to 20.12.2021

Now both the two leases are in favour of Shri B. L. Meena of village- Mallana, Tehsil- Rajgarh of Alwar district (Rajasthan).

The lease period is up to 21.12.2021 for amalgamated lease as M.L. 104/01.

The lessee applied for amalgamation of both leases 104/01 and 105/01 with joint plan and description reports for total 4.2630 hectares. After demarcation the total lease area comes as 4.2630 hectares.

The documents found satisfactory. The demarcation made by Mines Foreman and showed satisfaction about plan and description report. As per patwari the area falls in private khasra numbers 166, 167, 167/850, 168, 169, 237, 238, 239, 240, 241, 230, & 231 of Mallana village of Rajgarh tehsil, Alwar.

The letter of the Mining Engineer Alwar about amalgamation of both leases are enclosed as annexure-1.



1.1 GENERAL

a) Name of lessee rule 45 Registration Number

Name:

Shri B. L. Meena

S/O Shri Gyarsi Lal Meena

Village- Mallana,

Tehsil- Rajgarh

District- Alwar

(Rajasthan)

Pin Code: 301408

Mobile: 9413304070

b) Status of Lessee:

Private Individual.

c) Mineral which are included in prospecting license:

Not applicable.

d) Mineral which are included in the letter of Intent/ lease deed

Marble.

e) Mineral which lessee intends to mine

Marble.

f) Name of Recognized Person under rule 22C of MCR 1960 who prepare the mining plan/ scheme

Name:

Govind Singh

Address:

Khachariyawas House

D/88, Meera Marg, Bani Park

Jaipur-302016

Phone: 0141-4021611

Mobile: 9314071068

Fax- 0141-4021611

Registration Number:

RQP/AJM/009/87/A

Date of Grant- August 4, 1987

Valid up to August 4, 2021



LOCATION AND ACCESSIBILITY**a) Lease details****Name of the mine:**

Marble Mine Mallana

N/V- Mallana Tehsil- Rajgarh, District- Alwar

FRP well of Shri Ram Karan Meena**Latitude: 27°12'55.6" Longitude: 76°24'40.9"****Lease period – up to December 20, 2021****b) Name of Lessee:****Shri B. L. Meena**

S/O Shri Gyarsi Lal Meena

Village- Mallana,

Tehsil- Rajgarh

District- Alwar

(Rajasthan)

Pin Code: 301408

Mobile: 9413304070

c) Details of lease area with location plan**Location plan is enclosed as Plate-1.**

Forest		Non Forest	
Not applicable	Not applicable	Private Land of Khasra numbers 166, 167, 167/850, 168, 169, 237, 238, 239, 240, 241, 230, & 231 of Mallana village of Rajgarh tehsil, Alwar	Lease area is 4.263 hectare

The lease area of 4.2630 hectares is a part of survey of Indian G.T. Sheet No. 54 A/8.

Total lease area is 4.263 ha

District- Alwar, State- Rajasthan

Taluka- Rajgarh, Village- Mallana

Weather the area falls under coastal Regulation Zone (CRZ)

No



Existence of public road/ railway line

Route	Road	Distance in kilometres
Alwar – Rajgarh	NH 8A	36
Rajgarh to Mine Site	SH 29A	30
The lease area is near the road and connected by kacha rasta		
SH- State Highway, NH- National Highway		
Nearest Railway Station is Rajgarh RS---- 30 kilometres from the lease area		
Nearest Irrigation rest house---Mallana around 1 kilometres away		
Nearest PWD rest house is at Rajgarh around 30 kilometres away		
Market, school,hospital facilities etc are available at Tehla 4 kilometres away		
Water will be brought from nearby tube wells in the villages		
Electric power is available along the tar road and at the mine office		

- e) The Location Plan (not to scale) is enclosed (plate-1) showing the access routes with a Key plan (Plate-2) on GT Sheet Map in 1 cm= 500 metres showing access up to the Mine Site.

Pillars of the lease area:**FRP well of shri Ram Karan Meena**

Latitude: 27°12'55.6" **Longitude:** 76°24'40.9"

From	To	Bearing	Distance (metres)
FRP	A	100°30'	144.00
A	B	138°30'	125.00
B	C	211°30'	027.00
C	D	295°00'	075.00
D	E	210°30'	108.43
E	F	297°30'	095.20
F	G	301°15'	139.50
G	H	087°15'	025.00
H	I	307°45'	017.50
I	J	351°00'	028.00
J	K	001°30'	039.00
K	L	019°00'	037.7111
L	M	102°23'55.25"	159.8624
M	A	102°18'18.87"	083.7262
Lease area 4.2630 hectares			

The lease area forms the part of Survey of India G.T. Sheet number 54 A/8 (refer plate-2 parts of G.T. Sheets number 54 A/8).



3.0 DETAILS OF APPROVED MINING PLAN/SCHEME OF MINING

3.1	<p>Date and reference of earlier approved mining plan/ scheme</p> <p>Now the lease area is 4.2630 ha and it is by amalgamation of two leases of 2.24 ha, 2.023 ha. No mining plan scheme is approved previously for 4.2630 ha area. Previous approvals were for separate leases.</p>
3.2	<p>Details of last modification if any (for the previous approved period) of approved mining plan/ scheme indicating date of approval, reason for modification.</p> <p>No modification carried out.</p>
3.3	<p>Give review of earlier approved proposals (if any) in respect of exploration, excavation and reclamation etc.</p> <p>Not applicable</p> <p>Reclamation: Proposed Not applicable</p> <p>Waste Disposal Proposed: Not applicable</p> <p>Plantation Proposed: Not applicable</p>
3.5	<p>Indicate and give details of any suspension / closure/ prohibitory order issued by any Government agency under any rule or court of law</p> <p>The mine is in operation.</p>
3.6	<p>In case the MP/SOM submitted under rules 18 of the MCDR 2002 or under rule 19 of MCDR 2002 for approval of modification, specify reason and justification under these rules.</p> <p>Not applicable</p>



PART-A

4.0 GEOLOGY AND RESERVES

- a. Brief describe the topographic, drainage pattern, vegetation, climate , rainfall data of the area applied/ mining lease area

The lease area is almost flat terrain. The general altitude of the area is 335mRL.

Drainage in the lease area is along westerly and southerly. General drainage in the five kilometers periphery is almost southerly by non perennial nalah. One Mallana Dam is located towards NE side of the lease area around 1.2 kms away. The dam is towards higher side. No other river etc observed in the area and nearby the area.

Small shrubs, bushes and trees planted by the lessee are observed in the lease area.

Climate of the area is semi arid zone type. The average rain fall remains around 300mm per year. The maximum, mean and lowest temperature remain around 44°C, 24°C and 4°C. Maximum precipitation takes place during month of July and August.

- b) Regional Geology

REGIONAL STRATIGRAPHIC SUCCESSION

The regional stratigraphic succession of rocks is as follows:

(Source district resource map of Alwar)

Recent		soil
Post Delhi, Intrusive		Amphibolite, aplite, Granite, Pegmatite, quartz veins
Delhi Super Group	Ajabgarh Group	Carbonaceous Phyllite and minor quartzite, Phyllite interbedded by quartzite, Schist and marble, Ferruginous, spongy quartzite
	Alwar Group	Massive Quartzite, Schist, Phyllite, Flaggy quartzite, pebbly, arkosic grit with iron bands
-----unconformity-----		
Delhi Super Group	Railo Group	Intertrappean quartzite, conglomerate, intertrappean schist, Basic Flow, Quartzite with thin bands of conglomerate, Dolomitic marble
-----unconformity-----		
Bhilwara Super Group	Mangalwar Complex	Granite and pegmatite, Schist, Marble and quartzite



Local Geology

Recent		Soil
Post Delhi		Absent
Delhi Super Group	Ajabgarh Group	Phyllite
	Alwar Group	Absent
	Railo Group	Marble

c. Detailed description of geology

Lithology:

The marble is exposed in the lease area. The amphibolites observed in small pockets. The amphibolite is exhausted at depth. No other rock is exposed in the lease area.

STRUCTURE

No fault, fold or any other geological disturbances encounter in the lease area as the area is covered with gneisses and pegmatite.

The trend of the rocks is almost N10°W- S10°E and dip is 80° due westerly.

Nature of wall rocks

The marble is fractured at surface. The cracks observed up to 3 metres from the surface and it is useable as khanda. The block marble is observed in the working pit at depth and mining is going on for block and khanda. The amphibolite is of brownish in colour. The quality of marble is increased at depth. Block mining is going on in this lease area.

EFFECT OF WEATHERING

The cracks and joints in upper layer of marble are due to weathering.

NATURE OF WALL ROCKS

The phyllite is exposed between the marble in thin band. It is black to dark brown in colour. It observed in thin band and exhausted at depth. The phyllite is soft and flakey.

OCCURRENCE

Marble in this area occurs in Railo group of Delhi Super Group.



Recovery

Recovery of marble seems 80% in this deposit including khanda, laffer and block. The recovery may increase or decrease as per availability of market for khanda. The block recovery is poor and depends on crack less thadi for block mining. The mining plan is not the base for calculation of excavated material as the excavation is included overburden, inter-burden and mineral and these are not remaining same.

Physical and chemical characteristics

Physically the marble is off white in colour. Hardness is good. The marble take good polish. The bulk density is 2.6 tonnes per cu. metres. Marble market depends on size of block, free from minor cracks and polishing quality. The khanda market depends on colour and quality.

- d. Name of prospecting agency
It is an existing mine of Marble. No Prospecting agency was involved.

- e. Details of prospecting/ exploration already carried out:
Dimensions are in metres

Pit number	Length	width	Top of pit	Bottom of pit
Pit-1	150	120	336mRL	300mRL

The grade is same in the pits.

- f. Surface cum surface Geological Plan is provided as plat-5.
- g Surface Geological Plan is provided as plate-5.
- h Geological sections are provided on plate-5
- l Future program of exploration:
The prospecting is not required as maximum area will be excavated during the mining of next five years.
- j Reserves and Resources as per UNFC (as per recent survey in November 2015)

The reserves are estimated by following formula:

Volume of mineral = Area of section X Sectional influence length

Mineral in tonnes = Volume of mineral × Recovery percentage x Bulk density 2.6 tonnes per cu. Metre).

The reserves are computed for proved, probable and possible categories.

The details are as follows:

The sections are prepared at 50 meters interval.



Proved category (111+211):

The mineral is exposed up to 300mRL in the lease area and below 300mRL in nearby lease area. Thus proved category reserves are computed up to 290mRL as shown on plate-5. The surface limits are shown on plan and sections.

As per UNFC considering economical viability, feasibility study and Geological study the proved category reserves are considered under code 111 and 211 of UNFC.

Probable category (121+ 222):

The mineral is exposed in the area and in pit and is continuing in depth and in sides. Thus considering the continuity in depth the probable category reserves are computed for 30 metres thickness as per the continuity of minerals in depth. Thus probable category reserves are computed between 290mRL and 260mRL. The other limits are considered same as considered for proved category.

As per UNFC considering economic viability, feasibility study and Geological study the probable category reserves are considered under code 121+221 of UNFC.

Possible category (333):

Considering the possibility of continuing the deposit beyond the probable category limit in depth the possible category reserves are considered for 10 meters in depth vertically beyond the probable category reserves limit. Considering these aspects the possible category reserves are computed between 260 to 250mRL. The other limits are considered same as considered for proved category reserves.

As per UNFC considering economically viability, feasibility study and Geological study the possible category reserves are considered under code 333 of UNFC.



Reserve Calculations

CALCULATIONS**Proved Category (111+211)**

Section	Area of section M ²	Sectional Influence length M	Volume of Marble M ³	Volume of Useable Marble 80% M ³	Mineral in tonnes V x 2.6
AA'	1840	50	92500	74000	192400
BB'	4820	50	241000	192800	501280
CC'	4340	50	217000	173600	451360
DD'	5720	50	286000	228800	594880
EE'	5630	50	281500	225200	585520
Total					232440
Reserves in nearest tens					23,25,440

Probable Category (211+221)

Section	Area of section M ²	Sectional Influence length M	Volume of Marble M ³	Volume of Useable Marble 80% M ³	Mineral in tonnes V x 2.6
AA'	1320	50	132050	105640	274664
BB'	5220	50	261000	208800	542880
CC'	5160	50	258000	206400	536640
DD'	4740	50	237000	189600	492960
EE'	4200	50	210000	168000	436800
Total					2283944
Reserves in nearest tens					22,83,940

Possible Category (333)

Section	Area of section M ²	Sectional Influence length M	Volume of Marble M ³	Volume of Useable Marble 80% M ³	Mineral in tonnes V x 2.6
AA'	440	50	22000	17600	45760
BB'	1740	50	87000	69600	180960
CC'	1720	50	86000	68800	178880
DD'	1580	50	79000	63200	164320
EE'	1420	50	71000	56800	147680
Total					717600
Reserves in nearest tens					7,17,600



L Mineral Reserves/ Resources: Marble

Quantity is in tonnes

A Total Mineral Reserves	UNFC Code	Marble
Proved Mineral Reserves	111	18,60,350
Probable Mineral Reserves	121 and 122	15,98,800
B Total Remaining Resources		
Feasibility Mineral Resources	211	4,65,090
Pre-feasible Mineral resources	221+222	6,85,140
Measured mineral resources	331	
Indicated Mineral resources	332	
Inferred mineral resources	333	7,17,600
Reconnaissance mineral resources	334	

Total mineable reserves= 34, 59, 150 tonnes

MINEABLE RESERVES AND ANTICIPATED LIFE OF THE MINE

The mineable reserves of marble is of the order of 34,59,150 tonnes. Around 10,58,130 tonnes of mineral will be excavate during the period of this modified mining plan and after with a target 2,41,900 tonne per year these reserves will gave a life of around 9.37 years or say 10years to the mine. The life is as per present reserves and the life will be increased after completion of next five years of work or if lessee not excavates the target of production.



5. MINING

Briefly describe the existing and proposed method for excavation:

Existing Mining:

Presently the mining is going on in the lease area by semi mechanized method of opencast mining. The excavation of waste is by hydraulic excavators. The blocks are excavating by wire saw machines. The long hole drills are uses for making holes to put the diamond wire of wire saw for separating the block from thadi. The transportation of waste from face to dump site is by dumpers and transportation of block and khanda from the face to stock site is by dumpers and trucks. The blocks are lifted from face to stock site at surface by derrick cranes. From stock the mineral is dispatched to the consumers by lessee's vehicle and by hired vehicles. The site services are available in and near the lease area as shown on Environment plan. All the requisite facilities are available at site.

Proposed Mining:

The existing opencast semi mechanized method of mining is proposed to continue in future for excavation of mineral and waste and for loading the same. The bench height is proposed 6 metres and width will be 6 metres or more as required for movement of vehicles. Approach roads are available in the lease area and will be provided in future as required time to time. Blasting will be done as and when required if hard overburden come across, otherwise blasting is not required as the mining is for blocks. Excavation of mineral and waste will be by hydraulic machineries. Derrick cranes are available for raising the blocks etc and will also provided as required time to time. The present practice of mining will be continuing in future.

The fencing will be provided around the pits to check the inadvertent entry of human and livestock.

The soil which comes across during mining will be scraped and stacked separately to be used for plantation during monsoon.

Drinking water is being brought from nearby tube well and stored in water pitchers for drinking purpose and in cement tanks for other purpose.



Indicate Year-wise tentative excavation in cubic metres
The development is proposed from 2017-18 to 2021-22

1. Insitu Tentative Excavation

Year	Bench	Total tentative excavation (Cum)	Top Soil (Cu m)	OB/SB IB (Cu m)	ROM Cu m		Mineral reject	ROM/Waste Ratio
					Ore Cu m	Mineral reject Cu m		
2017-18	330	30000	1000	12000	8000	00	00	1:0.27
	326	31000	-	9900	21700	00	00	
	320	45000	-	9000	360009	00	00	
	302	11700	-	2340	9360	0	00	
2018--19	314	50800	00	10160	40640	00	00	1:0.25
	308	45400	00	9080	36320	00	00	
2019-20	302	65800	00	13160	52640	00	00	1:0.23
	326	12600	00	3780	8820	00	00	
	320	12400	00	2480	9920	00	00	
	314	12500	00	2500	10000	00	00	
2020-21	308	12100	00	2420	9680	00	00	1:0.25
	302	12000	00	2400	9600	00	00	
	296	76500	00	15300	61200	00	00	
2021-22	290	65300	00	13060	52240	00	00	1:0.25
	284	51000	00	10200	40800	00	00	

Year wise production in tones is as follows:

Year	Tentative excavation in tones (ROM) excluding soil	Waste useable marble tonnes	not as in	Mineral in tonnes	Soil in tones * excluded from ROM
2017-18	2,27,800	32640		1,95,160	20000
2018--19	2,50,120	50020		2,00,100	00
2019-20	2,59,870	48150		2,11,720	00
2020-21	2,61,560	52310		2,09,250	00
2021-22	3,02,380	60480		2,41,900	00
Total	13,01,730	2,43,600		10,58,130	20,000



II Dump rehandling (for the purpose of recovery of mineral)

The lessee will recover the mineral from the old dumps/ stacks located in the lease area towards southern side of the deposit. This recovery will be as follows:

Year	Mineral Khanda recovery from old dump
2017-18	5,000
2018--19	5,000
2019-20	5,000
2020-21	5,000
2021-22	5,000
Total	25,000

The recovery from old dump is additional to the production.

a) Enclose Individual year-wise development plans and sections

It will be a semi mechanized mine. The development plan and year wise sections are enclosed as Plate-5 in scale 1 cm = 10 metres showing all requisite details.

b) Describe briefly giving salient features of the proposed method of workings indicating Category of Mine

The mining in this lease is being carried out by semi mechanized method by using hydraulic machineries and wire saw. This method is adopted considering the nature of mineral, nature of deposit and production of mineral and generation of waste.

Considering the national, state and local holidays, around 300 working days are proposed in a year.

The bench height is proposed 6 meters or as per the height of the thadi. The width will also 6 metres or may be up to 8 metres.

Haul roads are available up to the faces and will be maintained in future up to the proposed workings for movements of labourers and vehicles.

Face slope will be maintained 85 °, whereas ultimate pit slope is proposed 45°. Controlled Blasting is proposed for easy excavation of rocks as per approved mining plan.

The overall layout of workings and other mining activities has been illustrated on plate 6.



The proposed mining will be as follows:

i) **Drilling:**

Drilling for blasting (if required in overburden) is proposed by jack hammers using 32mm diameter TC bits. The length of hole is proposed 1.5 meters. Spacing and burden is proposed 1 and 0.8 meters respectively. Drilling the holes for putting the wire garland for cutting the block is proposed by drill roads of 32mm diameter by jack hammers and up to 102mm diameter and required depth of hole by long hole drill machines. Direct drilling by long hole drill machine is proposed for drilling the holes for wire garland of wire saw machines.

ii) **Cutting of Blocks from thadi:**

Cutting of block by wire saw: The marble deposit in the bottom/ in sides of the pit which is able for block mining is known as thadi. The blocks have to mined out from the thadi. The separation of block from thadi is proposed by wire saw. Two holes are proposed to drill. One is vertical and other is horizontal. Both holes are proposed to connect with each other. The wire garland with diamond bits are proposed to penetrate through these holes and the pulley of wire saw machine. This wire saw machine by the action of diamond bits cuts the block. For bottom cutting both holes may be drill horizontal. Total three wire saw machines are proposed out of which two for work and one is standby.

iii) **Separating the required size block from big block:**

For separating the required size block from big block, the drill holes are proposed at the line of required size. Either the holes are proposed at 15 cms apart. The V shaped chisel is proposed to put on the holes and than by hammering action the required size block is separates out. The required size block will also develop by wire saw machines.

iv) **Lifting of minerals and material:**

The block, laffer from the face or bottom raised up to surface by derrick cranes. khanda from the pit bottom is being transported by trucks/ tippers of 10 tonne to 20 tonne capacity and this method of transport is being carried out in future. The block and laffer are proposed to lifted by cranes of 42 HP having capacity of 15 to 20 tonnes or more. Considering the quantity of mineral and waste to handle per day towards maximum one or two crane are sufficient for this purpose.

v) **Loading of mineral and material**

Loading of mineral, khanda and waste is proposed by hydraulic loaders, JCB 3D (capacity 0.3 cu. meter) and L & T Poclain- 90 capacity, 1.1 cu. meter are proposed.



vi) **Transportation of Material:**

Transportation of waste material from surface/ bottom to dump site will be by tippers of 10- 20 tonnes capacities. Transportation of khand, block and laffer from stock to consumers will be by hired trucks as per present practice. Considering the quantity of waste to handle per day towards maximum two tippers are sufficient. From pit bottom to destination the mineral is proposed to dispatch in hired trucks. The road is available for this purpose.

vii) **Dewatering**

The monsoon water collects in the mine. Presently the mine water is being dewatered through a sump to check the silt. From sump the dewatering is being done in nearby nalah . The water is good and the agriculturist of nearby fields uses this water for their crops. This water is also used for plantation. The garland drain with parapet wall will be provided around the pit to check the entry of monsoon water in the working pit.

viii) **Beneficiation:**

The marble block/ laffer will be dispatched to the cutting units khand is being dispatched to the grinding units. No beneficiation is required at site and none is proposed at site.

ix) **Employment potential:**

One Mines Manager and one Mining Mate are proposed for supervision at site and for daily supervision. All the machineries will be operated by skilled and qualified laborers. Thus total 10 skilled labourers are proposed.

As helper of the skilled persons around 10 semi skilled persons are proposed.

For other works 20 laborers are proposed to engage.

Face slope is proposed 85 °, whereas ultimate pit slope is proposed 60°.

c **EXTENT OF MECHANIZATION**

The following machineries are proposed (as per MCDR 2002):

Item	Quantity
Compressor of 120 psi	One or two mobile/ tractor mounted or stable
Jack hammer and other pneumatic or hydraulic drill, long hole drill	As required
Mobile crane 15 to 20 tonne capacity	One or as needed
Derrick cranes	Two or as required
Hydraulic excavator with rock breaker arrangement	Four or as needed
Wagon drill	One or as needed



Slot Liners	As needed
Line drilling machines	As needed
Diamond Wire Saw	As needed
Chain Saws or diamond belt saws	As needed
Hydraulic Jack	As needed
Tractor with water tank	One
Tippers	As needed
Other machineries	As needed

d CONCEPTUAL PLAN

ULTIMATE EXTENT & SIZE OF THE PIT

The ultimate extent and size of the workings will be as follows:

Dimensions of workings are given below

Dimension	Deposit
Length	290
Width	18 -150
Depth	250mRL 85 meters

THE FINAL SLOPE ANGLE ADOPTED

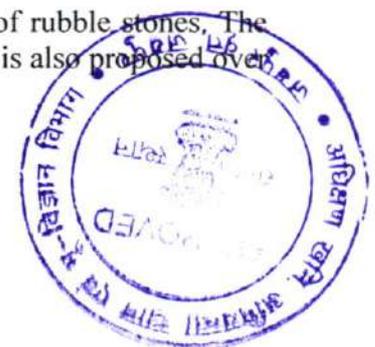
Considering the stability of rocks the final slope angle or says ultimate pit slope is proposed 45° from vertical. This slope angle will remain quite safe for these deposits.

ULTIMATE CAPACITY OF DUMPS

Total waste will be of 2, 43,600 tonnes. The dump site is located in the lease area and towards western side in the lease area. The khanda will be sorted from the dumps located in the lease area. The rest waste is dumped towards southern side of the lease area covering the existing dumps. The lessees will also sale the waste after taking permission from the department. The soil will be stacked in 0.01 ha area. The soil will be used for plantation in each monsoon and for spreading over the agriculture land. The waste dump will be stabilized by retaining walls of rubble stone. Parapet wall and drain will also construct towards lower altitude side to check the wash off during monsoon.

STABILIZATION OF DUMPS

The waste dump is proposed to stabilize by retaining wall of rubble stones. The wall is proposed towards lower altitude side. The plantation is also proposed over the matured dumps for stabilization.



ULTIMATE PIT LIMIT

The section has been prepared and ultimate slope is drawn over the sections from end bottom point of possible reserves with ultimate slope (refer plate-4). The upper points of these slopes have been projected over the plan. By joining these points the ultimate pit limit has been drawn, which is shown on Conceptual Plan.

RECLAMATION

No reclamation is proposed during the period of this mining plan. The excavated area will be used as water reservoir.

Land Use pattern

S.No	Item	As on date	End of 5th year	End of lease
1	Area to be excavated	2.10	2.70	3.10
2	Storage of top soil	0.02	0.01	0.0
3	Overburden dump	0.24	0.30	0.30
4	Mineral/Sub-grade stack	0.02	0.02	0.00
5	Infrastructure	0.02	0.02	0.02
6	Roads	0.20	0.20	0.20
7	Green belt	0.10	0.20	0.40
8	Reclamation	0.00	0.0	0.0
9	Others	0.00	0.00	0.00
	Total Disturbed land	2.70	3.45	4.00



6.0 MINE DRAINAGE

a) Minimum and Maximum depth of water table based on observations from nearby wells and water bodies:

In five kms periphery:

General ground level is 340mRL in nearby area

Minimum depth of water table is 90mbgl i.e.at 250mRL (as per tube well in nearby area)

b) Indicate minimum and maximum depth of workings

Minimum depth of workings- 284mRL

Maximum depth of workings – 260mRL up to probable category reserves

c) Quality and quantity of water likely to be encountered, the pumping arrangements and places where the mine water is finally proposed to be discharged

There is a sufficient gap between proposed workings up to conceptual and level of ground water table, thus ground water will not encountered in the workings at any stage.

d) Describe regional and local drainage pattern with annuli rain fall, catchment area, and likely quantity of rain water to flow through the lease area, arrangement to arresting the solid wash off etc.

The water comes across in the workings during monsoon. The water will fill in the working pits. This water has to dewater during and after the monsoon.

The monsoon water which directly precipitates over the working will fill in the pit and rest water which precipitates outside the pit will flow down towards lower altitude side by slope of the area. The rainfall remains around 300mm per year towards maximum. The water accumulate in the working pit is being dewatered by 10 HP diesel operated pumps/ electric motor and this practice will be continued in future. The water will fill in the non working pits for use for plantation and also dewatered in nearby nalahs. The rubble stone walls are constructed towards lower side of the dumps to check the wash off during monsoon.



7.0

**STACKING OF MINERL REJECTS/ SUB GRADE MATERIAL
AND DISPOSAL OF WASTE**

- a) **Indicate briefly the nature and quantity of top soil, overburden/waste and mineral rejects to be disposed off.**

No separate soil observed on the proposed mining site and thus not come across during mining. The soil which comes across will be stacked separately to be used for plantation. The rest soil will spread over the agriculture land of the lessee. During mining the soil stack is proposed in 0.01 ha area. The mineral rejects not come across during mining.

The waste dump management is discussed in the mining chapter in conceptual plan.

- b) **The proposed dumping ground within the lease area be proved for presence or absence of mineral and be outside the UPL unless simultaneous backfilling is proposed or purely temporary dumping for a short period is proposed in mineralized area with technical constraints and justification**

The details are given in Conceptual Mining Plan.

- c) **Attach a note indicating the manner of disposal of waste, configuration and sequence of year wise build up of dumps along with the proposals for protective measures**

The waste is proposed to dump in the area as described above. The dumps are shown on plate-5. The stone walls will be provided time to time towards lower altitude side of the dumps to arrest the solid wash off. Plantation will also provide along both side of the dump.



8.0 USE OF MINERAL AND MINERAL REJECTS

- a) **Describe briefly the requirement of end use industry specially in terms of physical and chemical compositions;**

The marble is uses for converting into slabs and powder.

The blocks are uses for cutting purpose. The slabs are separates by gang saw machines. The industries located in the district and in state uses the blocks.

The lumps, small pieces of marble known as khanda of good quality are uses for manufacturing of powder in the grinding units. The industries located in the district and in state are the main consumers. The grinding units are located at Rajgarh and Alwar. The blocks are dispatches to the cutting units for cutting purpose for decorative stone. The units are located at Alwar, Jaipur and Kishangarh.

- b) **Give brief requirement of intermediate industries involved in upgradation of mineral before end use.**

Not required.

- c) **Give details requirement for other industries, captive consumption export associated industrial use**

Not applicable

- d) **Indicated precious physical and chemical specification stipulated by buyers**

Only the good quality blocks are marketable and dispatches to cutting units. Rest marble in small pieces is uses for grinding purpose and dispatches as khanda.

- e) **Give details of processes adopted to upgrade the ROM to suit the user requirement**

The lessee dispatches the ROM mineral to the consumers in form of Khanda, Laffer and Block. The blocks are excavating by wire saw machines.



9.0

POCESSING OF ROM AND MINERAL REJECTS

No process takes place at mine site and none is required.
The ROM mineral is being dispatched to the consumers.

- a) **If processing/ beneficiation of the ROM or Mineral Rejects is planned to be conducted, briefly describe nature of processing/ beneficiation.**

Not Applicable.

- b) **Give a material balance chart with a flow sheet or schematic diagram of the processing procedure indicating feed, product, recovery and its grade at each stage of processing**

Not applicable.

- c) **Explain the disposal method for tailings or reject from the processing plant**

Not applicable

- d) **Quantity and quality of tailing/ rejects proposed to be disposed**

Not applicable.

- e) **Specify quantity and type of chemicals if any to be used in the processing plant**

Not applicable

- f) **Specify quantity and type of chemicals to be stored**

Not applicable

- g) **Indicate quantity (Cu. M per day) of water required for mining and processing and sources of supply of water, disposal of water and extent of recycling.**

Around 8 Cu. M. water required for mining for drinking and other purpose. The water is brought from tube wells located near the tar road.



10.0

OTHERS**a) Site services**

The site office, workshop, rest shelters, kitchen etc are available in and near the lease area as shown on plate-5.

b) Employment Potential

The following employment is proposed:

Highly Skilled: nil
 Skilled: 10
 Semi Skilled: 10
 Un Skilled: 20 (as per semi mechanization)

The following supervisory personnel are proposed with management chart:

Mining Engineer (Degree Holder) + Geologist

Mines Manager (Certificate Holder)

Mining Mate clerk Watchman

Mine labourer

B. Personal Protective Equipments

1. **Safety Helmet-** Uses for the safety of head
2. **Safety Goggles-** Uses for the safety of Eyes from sun, welding and other flying rock particles.
3. **Dust Respirators:** Uses for dust free air at dusty areas in the mine.
4. **Ear Plugs:** Uses for protection of air from unwanted sound i.e. noise pollution.
5. **Safety Belts with Rope-** For safety of body which may fall from high faces.
6. **Hand Gloves-** for protection of hand during welding or other hot things/articles.
7. **Safety Boots-** For protection of foot from fall of stone and for safety from injury.

C. Other requisite requirements for labourers:

1. WC (Latrines and Urinals) one for each and up to 50 labourers. Separate for Male and Females (Rule 20 Mines Act, 33 of Mines Rules).
2. Rest Shelter for labourers for taking rest during off hours (Rule 62 of Mines Rules).
3. Water hut for storing of cold water for labourers (at least 2 liters for each labour for drinking purpose) (Rule 19 Mines Act, 30 of Mines Rules).
4. First Aid Boxes in sufficient numbers (Rule 21 of Mines Act).



11.0 PROGRESSIVE MINE CLOSURE PLAN UNDER RULE 29 (5) (6) OF RMMCR 2017.

11.1 Environment Base Line Information's:

The lease area is non forest land. The lease area is 4.2630 hectares. The pits, dumps, roads, infrastructure etc are observed in the lease area. The present degradation of land is as follows:

S.No	Item	As on date
1	Area to be excavated	2.10
2	Storage of top soil	0.02
3	Overburden dump	0.24
4	Mineral/Sub-grade stack	0.02
5	Infrastructure	0.02
6	Roads	0.20
7	Green belt	0.10
8	Reclamation	0.00
9	Others	0.00
	Total Disturbed land	2.70

Water Regime:

No water reservoir or perennial stream etc observed in the lease area and around 500 metres periphery of the lease area. The local water reservoir observed in five kilometers periphery as shown on plate-2. These reservoirs are on higher side and thus not get adverse impact from this mining activity.

Quality of air:

The lease area is away from the habitation, the present workings are semi mechanized and proposed workings are semi mechanized. Blasting is not needed in block mining. It may be required some time in overburden in very small scale. Thus the present air pollution is within the prescribed limit.

Ambient Noise Level:

The noise level in the lease area is within the prescribed limit as the workings are towards lower side and workings are by hydraulic machineries.

Flora:

In the lease area the main flora is shrubs and bushes. The trees planted by lessee observed in the lease area.



Climatic Conditions:

Climate of the area is semi arid zone type. The average rain fall remains around 300mm per year. The maximum, mean and lowest temperature remain around 44°C, 24°C and 4°C. Maximum precipitation takes place during month of July and August. The hottest months are May and June and coldest are of December and January.

Human Settlement:

No human settlement observed in the lease area. Nearest village is Mallana towards SEE side of the lease area. The habitants belong to ST, SC, Minority, OBC and general categories. The main vocation of the habitants is agriculture. The habitants also has job at nearby mines and nearby towns like Rajgarh and Dausa. The population of villages observed in five kilometers periphery of the lease area is as follows:

As per CENSUS 2011 the population details is as follows:

S.No.	Village	Population	Male	Female	Literate
1.	Palpur	796	403	393	440
2.	Tilwar	1587	828	759	901
3.	Tilwari	234	116	118	117
4.	Tehla	4624	2434	2190	2926
5.	Gordhanpura	2044	1083	961	1160
6.	Rupbas	693	373	320	410
7.	Dabla	865	459	406	509
8.	Rajdoli	1058	558	500	376
9.	Khoh	4671	2374	2297	2629
10.	Sitwat	1388	733	655	695
11.	Kalwar	584	318	266	237
12.	Mallana	1359	714	645	759
13.	Berli	151	74	77	68
14.	Thana	1311	691	620	650
15.	Doondpuri	1453	756	697	611
	Total	22818	11914	10904	12488
	Percentage	100%	52.22%	47.78%	54.72%

Public building, place of worship and monuments

No such things are observed in and around the lease area. The other things observed in five kilometers periphery is illustrated on plate-2

Indicate any sanctuary is located in the vicinity of leasehold

No any sanctuary etc observed in the vicinity of the lease area.



11.2 Impact Assessment:

The land of the lease area will degrade by excavation, dumps and roads.

- i) The infrastructure, waste dump, roads, existing workings etc are already in existence. Thus a little fresh area will degrade by proposed workings as the proposed workings envisages extension of present workings in sides and in depth.

In this mining the area will degrade by excavation only. Rest area is already degraded by dump, infrastructure and roads etc.

S.No	Item	As on date	End of 5th year
1	Area to be excavated	2.10	2.70
2	Storage of top soil	0.02	0.01
3	Overburden dump	0.24	0.30
4	Mineral/Sub-grade stack	0.02	0.02
5	Infrastructure	0.02	0.02
6	Roads	0.20	0.20
7	Green belt	0.10	0.20
8	Reclamation	0.00	0.0
9	Others	0.00	0.00
	Total Disturbed land	2.70	3.45

ii) Air Quality:

The quality of air is likely to be effected by drilling and transportation of mineral and waste. The drilling will be by wet process for wire saw machines. The lessees will use rock brokers for excavation of mineral and waste.

Water spray is being used over the haul/ approach roads time to time and this practice is proposed to continue in future.

iii) Water Quality:

The quality of water is affected by mining if ground water comes across in mining or by having any toxic mineral in the lease area.

There is a high gap between the level of ground water and the depth of proposed deepest workings thus ground water will not intersect the workings at any stage. In absence of toxic mineral the quality of water will not get any adverse impact.

If ground water will intersect the lessee will get necessary permission.



iv) Noise Level

The diesel operated machineries and blasting will create noise in the mining.

The following measures are proposed:

The high quality silencers will be provided to the diesel operated machineries uses for excavation and loading of mineral and waste and water pump etc. The approach roads will be provided smooth and wide.

v) Vibration level (due t Blasting)

Blasting is not a regular practice and if needed it will be on small scale thus no measures are called for. Thus no ground vibration comes across.

vi) Water Regime:

No perennial water regime is observed in and near the lease area in 500 metres periphery. No toxic mineral is observed in and near the lease area. The dam is located towards higher side thus no adverse impact will be anticipated. Thus water regime will not disturbed by proposed mining activities.

vii) Acid Mine Drainage

Not applicable in this mine.

viii) Surface subsidence

It is an opencast mining and no such subsidence will come across in past by mining and none is expected by future mining.

ix) Socio- Economic

The socio economic conditions of an area will gate +ve impact by having and economic activity near by the habitation. The local habitants will get permanent extra income from the source of employment near the villages.

x) Historical Monuments etc

In absence of such monuments in and around the lease area no impact will be anticipated.



11.3 PROGRESSIVE RECLAMATION PLAN

The mining is from top to bottom side and extension of existing workings in sides and in depth, which reduces the height of the ground by excavation. The waste will use for construction and maintenance of approach roads time to time. The maximum quantity of waste is sailable and the lessee sale the waste after taking Short Term Permit from the department. Thus reclamation of excavated land is not proposed. The excavated land (deep cuttings) will be used as water reservoir. The water will be useful for nearby crops, plants and live stock.

11.3.1 MINED OUT LAND

S.No	Item	As on date	End of 5th year	End of lease
1	Area to be excavated	2.10	2.70	3.10
2	Storage of top soil	0.02	0.01	0.0
3	Overburden dump	0.24	0.30	0.30
4	Mineral/Sub-grade stack	0.02	0.02	0.00
5	Infrastructure	0.02	0.02	0.02
6	Roads	0.20	0.20	0.20
7	Green belt	0.10	0.20	0.40
8	Reclamation	0.00	0.0	0.0
9	Others	0.00	0.00	0.00
	Total Disturbed land	2.70	3.45	4.00

11.3.2 TOP SOIL MANAGEMENT

The soil come across during mining will be scraped and stacked separately in 0.01 ha area as shown on plate-5. The soil will uses for plantation in each monsoon.

11.3.3 TAILING DAM MANAGEMENT

In absence of such tailing dams in the lease area and nearby no measures are called for.

11.3.4 ACID MINE DRAINAGE

In absence of acid mine drainage no management will be anticipated.

11.3.5 SURFACE SUBSIDENCE

Surface subsidence mitigation measures though backfilling of mine voids or by any other means and its monitoring *mechanism*



Item	Details	Proposed	Actual	Remarks
Dump Management	Area afforested(ha)	00	00	-
	No of saplings planted	00	00	-
	Cumulative no of plants	Nil	Nil	-
	Cost including watch and care during the year	Nil	Nil	-
Management of worked out benches	Area available for rehabilitation (ha)	Nil	Nil	-
	Afforestation done (ha)	Nil	Nil	-
	No of sapling planted in the year	Nil	Nil	-
	Cumulative no of plants	Nil	Nil	-
	Any other method of rehabilitation (specify)	Nil	Nil	-
	Cost including watch and care during the year	Nil	Nil	-
Reclamation and rehabilitation by back filling	Void available for back filling (L x B x D) pit wise/ stop wise	Nil	Nil	
	Void filled by waste/ tailing	Nil	Nil	
	Afforestation on back filled area	Nil	Nil	
	Rehabilitation by making water reservoir	Nil	Nil	
	Any other means (specify)			
Rehabilitation of waste land within the lease	Area available	020	0.20	Reclaimed
	Area rehabilitated	0.20	0.20	Reclaimed
	Method of rehabilitation	By plantation	By plantation	-
Other (specify)		Nil	Nil	

No such things are proposed in this progressive mine closure plan.

The cost required for plantation (with watering, fencing and survival) and waste dump management etc is given below.

No reclamation etc proposed in this Progressive Mine Closure Plan.

The retaining wall is proposed to construct during next five years. The fencing by waste blocks and wire is already in existence. The fencing will be provided in non fenced area. Around 10 metres retaining wall is proposed to construct each year. The cost is given below in table.



YEARWISE PROPOSALS FOR ITEM NO 6 & 7 OF PMCP

ITEM	DETAILS	AREA (HECT)	QUANTITY	EXPENDITURE	REMARKS
(A) RECLAMATION AND REHABILITATION OF MINES OUT LAND/AREA	(i) Backfilling	Nil	NA	NA	NA
	(ii) afforestation on backfilled area	Nil	NA	NA	NA
	(iii) Others (please Specify) eg. Afforestation on exhausted benches	Nil	NA	NA	NA
	(iv) Pisciculture	Nil	NA	NA	NA
	(v) converting into water reservoir	Nil	NA	NA	NA
	(vi) Picnic Spot	Nil	NA	NA	NA
(B) STABILIZATION & REHABILITATION OF DUMPS (Within Lease)	(i) Terracing	One	-	-	-
	(ii) Pitching	Nil	NA	NA	NA
	(iii) Construction of parapet wall /retaining wall at toe of dump	10 running metre Per year	10 running metre Per year	Rs 2000/-	Toe of dump
	(iv) Construction of checkdams along slope of vallies etc	Nil	NA	NA	NA
	(v) Construction of settling ponds (Garland drains etc)	Nil	NA	NA	NA
	(vi) Desilting of settling ponds, channels	Nil	NA	NA	NA
	(vii) Afforestation on dumps	Nil	NA	NA	NA
	(vii) Others (please specify)				
(C) REHABILITATION OF BARREND AREA (Within Lease)	(i) Afforestation (Greenbelt building)	0.05 ha Per year	50 trees	10000/-	Along lease boundary and along road
	(ii) Others (Please Specify) Wire Fencing	10 metre Per year	10 running metre per year	3000/-	Around the excavation
(D) ENVIRONMENTAL MONITORING (Core Zone & Buffer Zone separately)	(i) Ambient air quality	Lease area	2 sample	5000/-	From lease area
	(ii) Water quality	well	1 sample	2500/-/-	From nearby well
	(iii) Noise Level Survey	Lease area	2 measurements	2000/-	Near working pits and hydraulic machineries
	(iv) Ground Vibration)	Nil	NA	NA	NA
	(v) Others (Specify)	Nil	NA	NA	



	Total	0.05 ha per year total 0.25 ha	10 meter parapet wall 10meter wire fencing 5 samples of air, water and noise	215,500/- per year including all	
--	-------	---	--	-------------------------------------	--

11.4 DISASTER MANAGEMENT PLAN

No landslide and inundation like disaster were come across in this area and nearby the area in past. The workings are proposed from top to bottom by forming proper benching. The proposed workings will be by opencast mining method. Underground mining is not proposed. Face height will maintain safe. No tailing dam is proposed. Thus high -risk accidents like land slide, subsidence, flood, inundation, fire, seismic activities etc. not come across.

Small accidents like fire, explosion in explosive and accident and fall of face like disaster may come across.

A fire fighting station (sand filled buckets) is proposed at site in the supervision of mines manager and mate. After receiving the information, the officials will reach up to site and will remove men and machineries from the site.

Magazine approved is proposed for storing the explosive and approved boxes are proposed for handling the explosive from magazine to site. Any person, who notices any explosion or accident, should immediately take steps to give warning by suitable mean and at the same time take necessary action for withdrawal of men from the site. He shall also inform the mines manager and other officials without any delay. The persons should be trained properly to handle the situation.

Detailed warning system, implementation procedure, emergency control center, shall be maintained at the mine with names of trained persons. Proper arrangements should be made for treatment of injured persons. Fiore fighting arrangements should be provided at all the prone sites. All the safety equipments should be available at mine site. A vehicle should always remain at site (vehicles remain available on road passes through the area. The lessee is capable to meet any type of risk. The fire stations are available at Rajgarh and Dausa. Hospital is located at Rajgarh. Dispensary is available at Rajgarh.

The responsible person is as follows:

Shri B. L. Meena

Village- Mallana, Tehsil- Rajgarh

District- Alwar

Lessee



11.5 CARE AND MAINTENANCE DURING TEMPORARY DISCONTINUENCE:

No mining operation is proposed to temporary discontinuance during the period of this progressive mine closure plan. During any discontinuance the mining workings will be in the watch of a watchman. Before re-open of the mine the maintenance will be provided to all the machineries deployed at mine. Before entering the labourers into mine the workings are proposed to inspect by manager for safety purpose as per Mines Act.

11.6 FINANCIAL ASSURANCE

The financial assurance is provided to the Mining Engineer Alwar.

Table indicating the break-up of areas in the Mining Lease for calculation of Financial Assurance

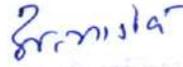
Sl.No	Head	Area put on use at start of plan (A)	Additional requirement during plan period(B)	Total C=A+B	Area considered as fully reclaimed & rehabilitated (D)	Net area considered for calculation E=C-D
1	Area under mining	2.10	0.60	2.70	0.00	2.70
2	Storage of top soil	0.02	0.01	0.01	0.00	0.01
3	Waste dump site	0.24	0.06	0.30	0.00	0.30
4	Mineral storage	0.02	0.00	0.02	0.00	0.02
5	Infrastructure (workshop, administrative building etc)	0.02	0.00	0.02	0.00	0.02
6	Roads	0.20	0.00	0.20	0.00	0.20
7	Railways	0.00	0.0	0.0	0.00	0.0
8	Tailing pond	0.00	0.0	0.0	0.00	0.0
9	Effluent treatment plan	0.00	0.0	0.0	0.00	0.0
10	Mineral separation plant Cement plant and quarters	0.00	0.00	0.00	0.00	0.00
11	Township area	0.00	0.0	0.0	0.00	0.0
12	Others area considered or break up	0.00	0.00	0.00	0.00	0.00
13	Green belt	0.10	0.10	0.20		0.20
Total	Grand Total	2.70	0.75	3.45	0.00	3.45

The lessee will submit the financial assurance to the Mining Engineer Alwar at the rate of Rupees 15,000/- per hectare as per rule 37J of RMMCR.

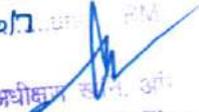

B.L. Meena ✓
Lessee


Govind Singh
RQP/AJM/009/87/A


स. स्वनि अमियन्ता
स्वान एवं भूविज्ञान विभाग
अलवर (राज०)


स. स्वनि अमियन्ता
स्वान एवं भूविज्ञान विभाग
अलवर (राज०)

This stamp is valid only for the purpose of
vide Order No. 5187/1 dated 28/17
dated 27.03.2017


अधीक्षक स्वी. अ. वि.
जयपुर कृ. सं.

राजस्थान सरकार

Government of Rajasthan

निदेशालय, खान एवं भू विज्ञान विभाग

DIRECTORATE OF MINES & GEOLOGY,

खनिज भवन / Khanij Bhawan, उदयपुर / Udaipur-313001.

दूरभाष / Phones: 2415091-95, फेक्स / Fax: (0294)-2410526

क्रमांक: निदे/प-2(एच.1)अल/2017/232

प्रेषित:-

दिनांक: 06-03-2017

श्री बी.एल. मीणा
पुत्र श्री ग्यारसी लाल मीणा
निवासी ग्राम मल्लाना
तहसील राजगढ़ जिला अलवर(राज.)।

विषय:- राजस्थान अप्रधान खनिज रियायत नियमावली, 1986 के नियम-76 के अन्तर्गत खनन पट्टा खनिज मार्बल एमएल नम्बर-104/01 में एमएल नम्बर-105/01 निकट ग्राम मल्लाना तहसील राजगढ़ जिला अलवर के खनन पट्टे का अमलगमेशन करने बाबत।

महोदय,

उपरोक्त विषयान्तर्गत मामले में निर्देशानुसार लेख है कि आपके पक्ष में निकट ग्राम मल्लाना में खनिज मार्बल के स्वीकृत खनन पट्टा संख्या 104/01 का खनन पट्टा संख्या-105/01 में एकल खनन पट्टा चाहा गया। जिसके क्रम में खनि अभियन्ता, अलवर ने आपके पक्ष में स्वीकृत उक्त खनन पट्टों का एकल खनन पट्टा बनाये जाने हेतु अपनी अनुशंषा प्रेषित की है।

खनि अभियन्ता, अलवर द्वारा की गई अनुशंषा/प्रस्ताव अनुसार आपके पक्ष में स्वीकृत उक्त खनन पट्टों का एकल खनन पट्टा स्वीकृत किये जाने हेतु मंशा जारी की जाती है।

अतः इस संबंध में लेख है कि निम्नांकित दस्तावेज छः माह में आवश्यक रूप से खनि अभियन्ता, कार्यालय अलवर एवं निदेशालय, उदयपुर को प्रस्तुत करें ताकि एकल खनन पट्टा की स्वीकृति जारी की जा सकें :-

1. राजस्थान अप्रधान खनिज रियायत नियम-1986 के अनुसार माईनिंग प्लान तथा प्रोग्रेसिव माईनिंग क्लोजर प्लान का अनुमोदन अधीक्षण खनि अभियन्ता, जयपुर-वृत्त, जयपुर से करा प्रस्तुत करें।
2. नियमानुसार पर्यावरण क्लीयरेंस (E.C.) प्राप्त कर प्रस्तुत करें।

नोट:- राज्य सरकार/केन्द्र सरकार के समय-समय पर जारी परिपत्रों/नोटिफिकेशनों की पालना आप द्वारा सुनिश्चित की जावेगी।

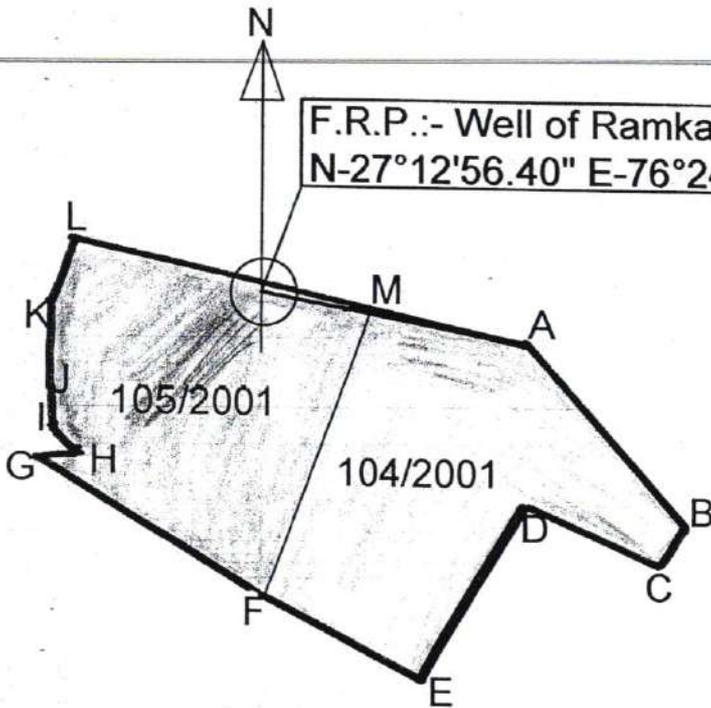


क्रमांक: निदे/प-2(एच.1)अल/2017/233-236

प्रतिलिपि निम्न को सूचनार्थ एवं आवश्यक कार्यवाही हेतु :-

1. अतिरिक्त निदेशक (खान) जयपुर जोन, जयपुर।
2. अधीक्षण खनि अभियन्ता, जयपुर-वृत्त, जयपुर।
3. खनि अभियन्ता, अलवर को पत्र क्रमांक: 43 दिनांक 31-01-17 के संदर्भ में।

MAP SHOWING AREA APPLIED FOR AMALGAMATION OF EXISTING M.L. 104/2001 AND ML ¹⁰⁵/₀₁ (ON ML ¹⁰⁴/₀₁) FOR MINERAL MARBLE NEAR VILLAGE MALLANA TEHSIL RAJGARH DISTRICT ALWAR IN FAVOUR OF SHRI. B.L. MEENA.
SCALE:- 1CM. = 40 METRE



F.R.P.:- Well of Ramkaran meena
N-27°12'56.40" E-76°24'36.78"

DESCRIPTION REPORT OF EXISTING M.L. 105/2001
FRP :well of ramkaran meena
N-27°12'56.40" E-76°24'36.78"

FROM	TO	BEARING	DISTANCE
F.R.P.	p	98-0-0	59 MTS.
p	q	200-30-0	162.55 MTS.
q	r'	301-15-0	139.5 MTS.
r'	v	87-15-0	25 MTS.
v	s'	307-45-0	17.5MTS.
s'	w	351-0-0	28 MTS.
w	t'	1-30-0	39 MTS.
t'	u'	19-0-0	40 MTS.
u'	p	103-0-0	159MTS.

AREA 2.023HECT

DESCRIPTION REPORT OF EXISTING M.L. 104/2001
FRP :well of ramkaran meena
N-27°12'56.40" E-76°24'36.78"

FROM	TO	BEARING	DISTANCE
F.R.P.	a	100-30-0	144 MTS.
a	b	138-30-0	125 MTS.
b	c	211-30-0	27 MTS.
c	d	295-0-0	75 MTS.
d	e	210-30-0	108.43 MTS.
e	f	297-30-0	95.2 MTS.
f	g	20-30-0	162.55 MTS.
g	a	102-30-0	85.7MTS.

AREA- 2.24 HECT

DESCRIPTION REPORT OF AREA AFTER
AMALGAMATION OF EXISTING M.L.104/2001, 105/2001

F.R.P.:-well of ramkaran meena
N-27°12'56.40" E-76°24'36.78"

FROM	TO	BERING	DISTANCE
FRP	A	100-30-0	144 MTS.
A	B	138-30-0	125 MTS.
B	C	211-30-0	27 MTS.
C	D	295-0-0	75MTS.
D	E	210-30-0	108.43 MTS
E	F	297-30-0	95.200 MTS.
F	G	301-15-0	139.50 MTS.
G	H	87-15-0	25 MTS.
H	I	307-45	17.5 MTS
I	J	351-0-0	28 MTS.
J	K	1-30-0	39MTS.
K	L	19-0-0	37.7111 MTS.
L	M	102-23-55.25	159.8624MTS.
M	A	102-18-18.87	83.7262 MTS.,

AREA 4.2630 HECT

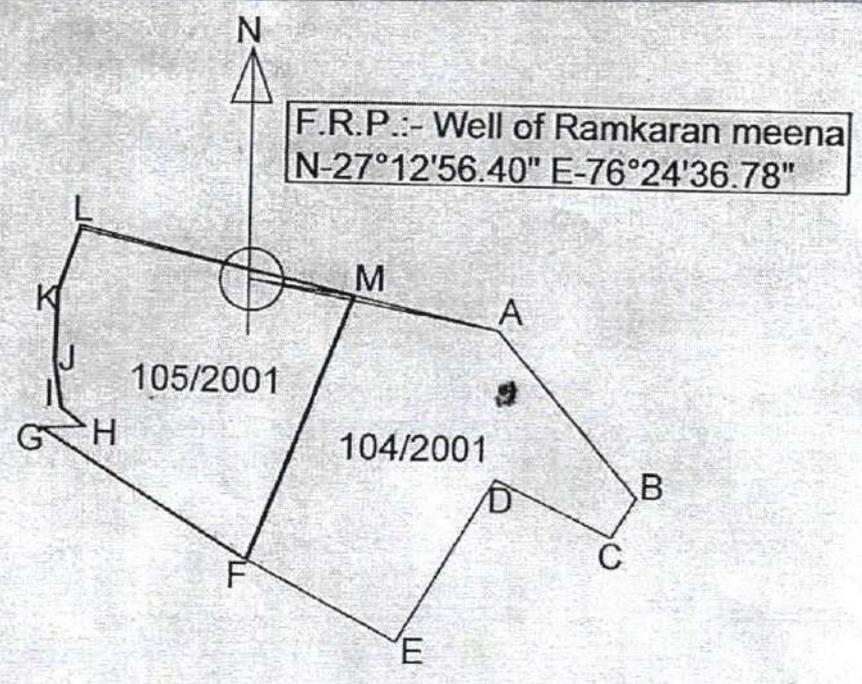
INDEX-

-  EXISITING ML 104/2001 FOR MARBLE
-  EXISITING ML 105/2001 FOR MARBLE
-  AREA APPLIED FOR AMALGAMATION
(ML ¹⁰⁴/₂₀₀₁, ¹⁰⁵/₂₀₀₁)



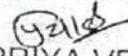
SIGN. LESSEE

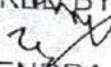
MAP SHOWING AREA PROPOSED FOR AMALGAMATION OF EXISTING M.L. 104/2001 AND ML ¹⁰⁵/₀₁ (ON ML ¹⁰⁴/₀₁) FOR MINERAL MARBLE NEAR VILLAGE MALLANA TEHSIL RAJGARH DISTRICT ALWAR IN FAVOUR OF SHRI. B.L. MEENA. SCALE:- 1CM.= 40 METRE



INDEX

-  EXISTING ML.104/01, SH. B.L. MEENA, AREA-2.24 HECT.ACCORDING TO DESCRIPTION REPORT
-  EXISTING ML 105/01, SH. B.L. MEENA, AREA-2.023 HECT. ACCORDING TO DESCRIPTION REPORT
-  PROPOSED AREA FOR AMALGAMATION ON ML 104/01 SH. B.L. MEENA AREA -4.2630 HECT.

PREPARED BY-

(PRIYA VED)
JR.DRAUGHTSMAN

CHECKED BY-

(DEVENDRA SHARMA)
JR.DRAUGHTSMAN




MINING ENGINEER
ALWAR

LIST OF CHAPTERS

CHAPTER	TITLE OF TEXT	PAGE
1	<i>General Information about lease</i>	1
2	<i>Details of mining lease</i>	3
3	<i>Geology and Reserves</i>	5
4	<i>Details of Production and Dispatch</i>	10
5	<i>Physical and Geological characteristics</i>	10
6	<i>Details of mining machinery deployed or to be deployed</i>	10
7	<i>Method of Mining</i>	11
8	<i>Yearwise annual program of mining for next five years</i>	21
9	<i>Details of employment</i>	22
10	<i>Measures taken and to be taken for land restoration reclamation and plantation in/or nearby lease area</i>	24
11	<i>Measures taken and to be taken for protection of the environment in and around mining lease area</i>	25
12	<i>Measures taken and to be taken for dumping of overburden, stacking of top soil and utilization of top soil</i>	27
13	<i>Measures taken and to be taken for control of water, noise and air pollution</i>	28
14	<i>Contribution regarding the social development of nearby residents</i>	30
15	<i>Progressive Mine Closure Plan</i>	31-36

0



LIST OF ANNEXURE

NUMBER	TITLE
1.	<i>Copy of letter of extension of time and agreement</i>
2.	<i>Copy of Transfer Agreement</i>
3.	<i>Plan of area</i>
4.	<i>Demarcation report</i>
5.	<i>On Line Scrutiny</i>
6.	<i>Jamabandi</i>
7.	<i>Copy of RQP Certificate</i>



LIST OF PLATES

PLATES	TITLE
1	LOCATION PLAN
2	KEY PLAN
3	ENVIRONMENT PLAN
4	REVENUE MAP
5	SURFACE GEOLOGICAL PLAN & SECTIONS
6	COMPOSIT PLAN AND YEARWISE SECTIONS
7	CONCEPTUAL PLAN



Pramod Kumar Goyal

4-17, Malviya Nagar
Alwar (Rajasthan)
Pin Code: 301001
Mobile: 9829097764

CONSENT LETTER/UNDERTAKING/CERTIFICATE FROM THE LESSEE

01. The Mining Scheme in respect of Marble Mine, over an area of 1.00 ha, in village- Kho, Tehsil- Rajgarh, District- Alwar of Rajasthan State, under rule 18(2) of MCDR 2002 has been prepared by Shri Govind Singh RQP. AJM 009/87/A, Khachariyawas House, Jaipur.

This is to request the Superintending Mining Engineer, Jaipur Circle, Jaipur, to make any further correspondence regarding any correction of the Mining Scheme with the said recognized person at his address below:

Shri Govind Singh
RQP/AJM/009/87/A
Khachariyawas House
D-88, Meera Marg, Bani Park,
Jaipur-302016
e.mail: pinkcitymining@gmail.com
Mobile: 9414071070, 9314071068

I hereby undertake that all modification/ updating as made in the said mining scheme by the above said person be deemed to have been made with our knowledge and consent and shall be acceptable on us and binding in all respects.

02 It is certified that the CCOM Circular no 2/2010 will be implemented and complied with when an authorized agency is approved by the State Government.

The information furnished in the Mining Scheme is true and correct to the best of our kind knowledge and records.

04 "The provisions of Mines Act, Rules and Regulations made there under have been observed in the Mining Scheme over an area of 1.00 ha in Alwar district of Rajasthan State belonging to Marble Mine Kho and where specific permissions are required, the applicant will approach the DGMS. Further, standards prescribed by D.G.M.S. in respect of miner's health will be strictly implemented."

Place: Jaipur
Dated 10.11.2017



GOVIND SINGH

RQP/AJM/009/87/A

Khachariyawas House

D/88, Meera Marg, Bani Park

Jaipur, Pin 302 016

e-mail- naruka.consultancy@gmail.com

JAIPUR (O) 0141- 5101611

Mobile- 94140 71070

CERTIFICATE

The provisions of RMMCR 2017 & Marble Development and Conservation Rules 2002 have been observed in the preparation of the Mining Scheme for Marble Mine M.L.7/07, over an area of 1.00 ha of Shri Pramod Kumar Goyal in village Kho, Tehsil- Rajgarh of District- Alwar of State Rajasthan and whenever specific permission are required, the lessee will approach the concerned authorities of Department of Mines and Geology.

The information furnished in the Mining Scheme is true and correct to the best of my knowledge.

Place- Jaipur

Dated- November 20, 2018


Govind Singh
(RQP/AJM/009/87/A)



MINING SCHEME

GORDHANPURA--- RAJGARH---ALWAR

SUBMISSION UNDER RULE 29(10) & 29(13)(1) OF RMMCR 2017
& Rule 18(2) of MCDR 2002

1.0 GENERAL INFORMATION ABOUT LEASE

NAME	Shri Pramod Kumar Goyal
MINERAL	Marble
M.L. Number	07/07
LEASE AREA	1.00 hectare
NEAR VILLAGE	Kho
TEHSIL	Rajgarh
DISTRICT	Alwar
STATE	Rajasthan
Lease Sanction Date	29.02.1988
Date of registration	02.04.1988
Lease period	10 years w. e. f. 02.04.1988
Period extended for 20 years	20 years by order dated 19.09.1998
Lease period	02.04.1988 to 01.04.2008
Lease period extended under rule 9(2) of RMMCR 2017	50 years w. e. f. 02.04.1988 i.e. up to 01.04.2038.
Agreement executed on Mining Scheme approved	17.04.2017 the previous mining scheme approved vide order dated 24.12.2013 for the period of up to 2018-19.
This mining scheme	submitted under rule 29(10) and 29(13)(1) of RMMCR 2017 and Rule 18(2) of MCDR 2002.

For preparation of the Simplified Mining Scheme under rule 29(10) with Progressive Mine Closure Plan MCP under rule 29(13)(1) of RMMCR 2017 and rule 18(2) of MCDR 2002 the lessee approached the RQP and authorized the RQP for preparation of Mining Scheme with Progressive Mine Closure Plan.

The survey work was conducted in November 2018 and the scheme with progressive mine closure plan has been prepared. This scheme with Progressive Mine Closure Plan has been prepared as per the new guide lines provided by the approving authorities and circulars issued time to time.



"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

Approach:

Route	Road	Distance in kilometres
Mine Site to Tar Road SH 29A	KR	0.6
Mine Site to Tehla	KR + SH	10
Mine site to Rajgarh	KR +SH	36
Mine Site to Alwar	KR +SH + NH	76
Mine site to Dausa	KR +SH + NH	46
Mine site to Jiapur	KR +SH + NH	102

KR- Kacha Rasta, SH- State Highway, NH- National Highway

1.1	PARTICULAR	DETAILS
A	Name and Address	Shri Pramod Kumar Goyal B-10, Malviya Nagar Alwar (Rajasthan)
	Pin code	301001
	Mobile	
B	Status of Lessee	The lessee is a private individual busy in treading and mining of mineral marble
C	Mineral which the lessee intends to mine	The lessee is doing mining for marble
D	Period for lease is required	It is an existing mining lease and the period is upto 18.06.2039
E	Name and address of recognized person	Govind Singh Khachariyawas House D-88, Meera Marg, Bani Park, Jaipur (Rajasthaan)
	Pin Code	302016
	Mobile	9414071070
	Email	Naruka.consultancy@gmail.com
	Registration number	RQP/AJM/009/87/A Valid up to August 4,2021
F	Reference number and date of consent from state	It is an existing mining lease. This mining scheme is in continuance of the previous approved mining scheme.



2.0

DETAILS OF MINING LEASE**2.1 M.L. NO**

M.L. is 7/07

2.2 DESCRIPTION REPORT OF THE MINING LEASE WITH PLAN

FRP : Well of Shri Khairati Meena

The description report is as follows

Latitude: 27°11'51.22603" Longitude: 76°23'02.51075"

From	To	Bearing	Distance (meters)	Longitude	Latitude
FRP	A	141°30'	272.0	76°23'08.77"	27°11'44.26"
A	B	060°00'	100.0	76°23'11.93"	27°11'45.86"
B	C	150°00'	100.0	76°23'13.72"	27°11'43.02"
C	D	240°00'	100.0	76°23'10.55"	27°11'41.43"
D	A	330°00'	100.0	76°23'08.77"	27°11'44.26"
Lease area 1.0 hectares					

Area is 10,000 sq. meter or 1.00 hectare.

Plan is enclosed in annexure.

2.3 KEY PLAN OF THE AREA

Key plan in a scale of 1 cm = 500 meter is enclosed as plate 2.

2.4 LOCATION MAP

Location map showing the details of the approached roads is enclosed as plate 1.

2.5 DETAILS OF THE MINING LEASE

The 1.00 hectare of lease area is located near village Kho of Rajgarh tehsil of Alwar district. The lease is existing lease. Copy enclosed as annexure-1. The revenue details are as follows:

Near Village	Tehsil	District & State	Khasra	Status of land	Area	Period
Revenue village Kho/palpur	Rajgarh	Alwar	302, 320, 319,302/475	Barani Govt. Land	1.00 hectares	The lease period is up to 30.05.2039

2.6 REVENUE MAP

Revenue map enclosed as plate 4.



2.7 INFRASTRUCTURE

RAILWAY:

Nearest railway station is Rajgarh located on Delhi- Jaipur Broad Gauge line of western railway. This station is around 35 kms away from Mine Site.

POLICE STATION:

Nearest police station is Tehla about 8 kms away.

COMMUNICATION:

Nearest post and telegraph facility available at village Tilwar around 1 Kilometers away.

MEDICAL:

Nearest dispensary is located at nearby prominent villages and hospital at Rajgarh (35kms) and Tehla 8 kms and nearby villages

WATER:

Source of drinking water is well and hand pump located in the nearby area and nearby villegs. Drinking water is brought in tractor tankers.

ELECTRICITY:

Electric power lines are available near the lease area towards southern side along the tar road and at the office of nearby mine towards southern side.

EDUCATION:

Education facilities are available as follows:

Primary school- at all prominent villages

Secondary school- Tehla (8kms), College at Rajgarh (36 Kms).

TRANSPORT:

The tar road is available about 0.5 kms away from the lease area.

Nearest Irrigation rest house is located at Mallana around 4 kms away.

PWD rest house is available at Rajgarh (36 kms) away. Market facility is available at Tehla and Rajgarh. Machine maintenance shops are available in near by area on tar road. Considering the aforesaid aspect it concluded that the area has reasonably good infrastructure facilities.



3.0 GEOLOGY AND RESERVES

3.01 LOCATION

The lease area of 1.00 hectares form the parts of Survey of India G. T. Sheets No 54 A/8 and located towards northern side of the SH 29 (Rajgarh- Dausa).

3.1 PHYSIOGRAPHY

The lease area is almost flat terrain. The drainage in the area is towards southerly. Drainage in nearby area is by non-perennial nalah with southerly to southeasterly flow. The nalah flows during peak rains only. The general drainage within 5 kms periphery is illustrated on plate-2.

The general level in the lease area is 321mRL.

Marble exposed in the pit and on surface in the lease area.

The land is government land. No PWD road passes through the area.

3.2 GEOLOGY

As per geological and mineral atlas of India sheet no 14, miscellaneous bulletin no-30 and as per DRM of GSI the area belongs to Railo Group of Delhi Super Group. The stratigraphic succession of rocks is as follows.

REGIONAL GEOLOGY

Recent		Soil
Post Delhi		Granite. intrusive
Delhi Super Group	Ajabgarh Group	Phyllite, Amphibolite, Quartzite, Minor marble, Schist
	Alwar Group	Quartzite, Schist, Conglomerate, Quartzite with basic flow
	Railo Group	Marble, Dolomite, Soapstone, Feldspathic quartzite, Conglomerate

IN APPLIED AREA (LOCAL GEOLOGY)

Recent		Soil
Post Delhi		Absent
Delhi Super Group	Railo Group	Marble



"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

LITHOLOGY

The marble rocks are exposed in the lease area is pit and on surface. The scree soil cover varies from 0.5 to 1 meter on the marble rock. No other rock is exposed within the lease area so far.

STRUCTURE

The strike of the deposit is N10°W – S10°E and dip is 75° due westerly.

The joints are observed in the area along and across the strike.

NATURE OF MINERALISATION

The deposit of marble is a massive deposit and continuing in sides and in depth. Marble rocks having miner foreign intrusions etc. exposed in the lease area in pit and on surface.

The marble is proved for about 35 meters in the pit at bottom of the pit.

No other rock unit exposed in the area so far.

The upper layer of 0.5 to 1 meter part has scree/soil and weathered, fractured marble. The fractures and joints are observed in upper layers and below this the block ability is observed. The marble continuity is observed in almost whole lease area.

Present mining is for block and the crack part and intrusive part not suitable for block is uses as khanda.

EFFECT OF WEATHERING

In the upper part the fracture and scree present due to weathering effect.

NATURE OF WALL ROCKS

Wall rock is not exposed in this lease area.

OCCURRENCE

Marble in this area occurs in Railo group of Delhi Super Group.

Marble in this region often forms whole blocks or are inter-bedded with amphibolite. In this lease area amphibolite etc not encounter on surface. It is a hydrothermal deposit. When dolomitize lime stones are reworked by hydrothermal solutions, these gives rise to coarse-crystalline masses of dolomite known as marble.

RECOVERY

The recovery of marble in the lease area seems 80% as per present situation (not related with past). The mining is for block and the block recovery seems around 25% in the deposit and rest is uses as khanda. The ratio of recovery of block and khanda may vary at places and in depth depends on availability of healthy thadi.



PHYSICAL CHARACTERISTICS

The marble of this area is white and light bluish in colour. Grain size varies from medium to fine. Bulk density is 2.6. Lustre is vitreous. Hardness is around 3.8.

3.3 DETAILS OF EXPLORATION

(A) ALREADY CARRIED OUT IN THE AREA

One pit is observed in the lease area. The pit is around 100 metres in length and 95 metres in width towards maximum. The depth seems around 35 metres. The ground water is not come across in the lease. The pit is shown on plte-5.

B PROPOSED TO BE CARRIED OUT

The marble is exposed in the pit and maximum area will be exposed by proposed mining of next five years. To know the quality at depth a bore hole of 15 meters depth is proposed to develop at bottom of the pit. This work is proposed to complete within first two years.

3.4 METHOD OF ESTIMATION OF RESERVES

The reserves are calculated by the following formula:

Volume of mineral = Area of section x Sectional influence length

Mineral in tonnes = Volume of mineral X bulk density.

The bulk density of the mineral is 2.6 tonnes per cu. meter.

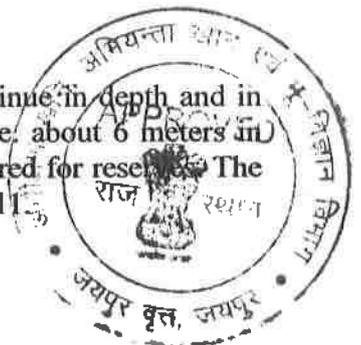
The reserves are computed for Proved, Probable and possible categories. Geological sections have been prepared at 30 meters interval.

PROVED CATEGORY RESERVES (111+211)

The marble is exposed up to 294mRL in the pit and is continue in depth and in sides. Thus proved reserves are computed up to 290mRL i.e. about 6 meters in depth from existing exposed limit. The whole area is considered for reserves. The proved reserves are computed under UNFC code 111 AND 211.

PROBABLE CATEGORY RESERVES (121+222)

The marble is continuing in depth and considering its continuity in depth as per adjacent mines, the probable category reserves are computed for 25 meters in thickness vertically beyond the proved reserves limit. Thus considering these aspects the Probable category reserves are computed for around 25 meters in thickness i.e. between 280mRL and 255mRL. The whole lease area is considered for reserves. The area is calculated excluding the upper weathered part and soil cover. These reserves are computed under code 121 and 222 of UNFC.



PROBABLE CATEGORY RESERVES (121+222)

The marble is continuing in depth and considering its continuity in depth as per adjacent mines, the probable category reserves are computed for 25 meters in thickness vertically beyond the proved reserves limit. Thus considering these aspects the Probable category reserves are computed for around 25 meters in thickness i.e. between 280mRL and 255mRL. The whole lease area is considered for reserves. The area is calculated excluding the upper weathered part and soil cover. These reserves are computed under code 121 and 222 of UNFC.

POSSIBLE CATEGORY RESERVES (333)

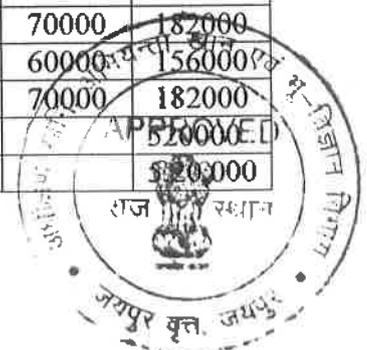
As per geological study of the area and nearby area and considering the possibility of continuing the marble rocks beyond the probable category reserve limit the possible category reserves are computed for 10 meter in thickness vertically beyond the probable reserves limit. These reserves are computed between 255mRL and 245mRL. The other limits are considered same as considered for probable category limit. These reserves are computed under code 333 of UNFC.

Reserve Calculations**PROVED CATEGORY (111+211)****Table -2**

Section	Area of section in sq. meter	Sectional influence length in meter	Volume of ROM mineral in cu. Meter	Volume of mineral 80%	Mineral in tonne V x 2.6
AA'	2720	35	95200	76160	198016
BB'	2350	30	70500	56400	146640
CC'	3260	35	114100	91280	237328
Total					581984
Total proved category reserves in nearest tens					5,81,980

PROBABLE CATEGORY (121+222)**Table -3**

Section	Area of section in sq. meter	Sectional influence length in meter	Volume of ROM mineral in cu. Meter	Volume of mineral 80%	Mineral in tonne V x 2.6
AA'	2500	35	87500	70000	182000
BB'	2500	30	75000	60000	156000
CC'	2500	35	87500	70000	182000
Total					520000
Total probable category reserves in nearest tens					5,20,000



A Geological Reserves				
i Geological reserves 331				Table 3
Section	Area of section Sq. meter	Sectional influence length (meter)	Volume of ROM mineral in (cu. meter)	Minerals in tonne (vx 2.6)
AA'	2720	35	95200	247520
BB'	2350	30	70500	183300
CC'	3260	35	114100	296660
Total				727480
Total reserves in nearest tens 331				7,27,480

ii Geological reserves 332				Table 4
Section	Area of section Sq. meter	Sectional influence length (meter)	Volume of ROM mineral in (cu. meter)	Minerals in tonne (vx 2.6)
AA'	2500	35	87500	227500
BB'	2500	30	75000	195000
CC'	2500	35	87500	227500
Total				6,50,000
Total reserves in nearest tens 332				6,50,000

iii Geological reserves 333				Table 5
Section	Area of section Sq. meter	Sectional influence length (meter)	Volume of ROM mineral in (cu. Meter)	Minerals in one (vx 2.6)
AA'	1000	35	35000	91000
BB'	1000	30	30000	78000
CC'	1000	35	35000	91000
Total				2,60,000
				2,60,000

3.5 Mineable Reserves

The mineral reserves as per UNFC are as follows:

Total Mineable reserves = Demonstrated reserves (Proved + Probable) - Reserves in boundary barrier, 7.5 meter barrier etc (Proved + Probable)

Reserves of Marble

Total Mineral Resources (A+B)	Code	Reserves
A Mineral Reserves		
1. Proved Mineral Reserves	111	5,81,980 tonne
2. Probable Mineral Reserves	121	5,20,000 tonne
B. Remaining Mineral		Lease barrier + locked in UPL
1. Feasibility Mineral Resources	211	00
2. Prefeasibility Mineral Resources	221	00
3. Measured Mineral Resources	331	7,27,480 tonnes
4. Indicated Mineral Resources	332	6,50,000 tonnes
5. Inferred Mineral Resources	333	2,60,000 tonnes
6. Reconnaissance mineral resources	334	



4.0 DETAILS OF PRODUCTION AND DISPATCH

The production and dispatch of previous years are as follows:

Year	Production in tonnes		Dispatch in tonnes	
	Block	Khanda	Block	Khanda
2013-14	5775.00	29375.00	5741.10	29374.40
2014-15	5500.00	34410.00	5421.73	34226.30
2015-16	3900.00	36070.00	3933.74	35670.90
2016-17	6700.00	33560.00	4349.20	30839.90
2017-18	650.00	27050.00	2870.34	21968.22

5.0 PHYSICAL AND GEOLOGICAL CHARACTERISTICS

The marble of this area is white and light bluish to white in colour. Grain size varies from medium to fine. Bulk density is 2.6. Hardness is around 3.8.

6.0 DETAILS OF MINING MACHINERY DEPLOYED OR TO BE DPLOYED

The following machineries are proposed as per Marble Conservation and Development Rules 2002:

Item	Quantity
Compressor of 120 psi or any other suitable	One tractor mounted
Jack hammer and other pneumatic or hydraulic drill, long hole drill	One or as needed
Mobile Crain 15 to 20 tonne capacity	One or as needed
Hydraulic excavator with rock breaker arrangement	One or as needed
Wagon drill	As needed
Slot Liners	As needed
Line drilling machines	As needed
Diamond Wire Saw	As needed
Chain Saws or diamond belt saws	As needed
Hydraulic Jack	As needed
Tractor with water tank	One
Tippers	As needed
Other machineries	As needed

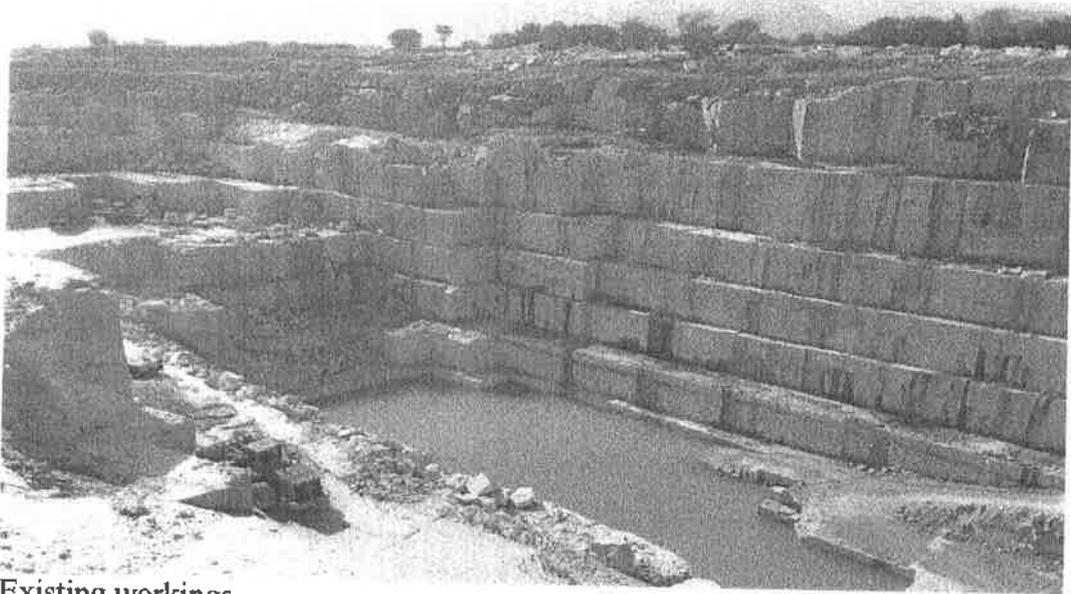
All necessary machines are available at mine site. The mobile crane, excavators, loader, wire saw machines, tippers etc and other machineries are available in sufficient numbers.



7.0 METHOD OF MINING

The mining is proposed by opencast method of semi-mechanized method.

It is an **existing opencast** mine for marble. Numbers of marble mines are running in this zone of Kho, Palpur, Tilwar, Tilwari, Mallana etc. It is a massive deposit for marble of dolomatic base. Present mining is for Block and khanda. The excavation is by hydraulic excavators and wire saw machines and loading is by loaders as well as by manually. The raising of blocks at surface is by cranes.



Existing workings

“the mining leases of 1 hectare area are adjacent to each other. The lessee will take permission under rule 111 MMR 1961 for change of mine boundary i.e. to use common roads etc and thus 7.5 metre barrier on common boundary of lease in not required.” The present working is common working.

The haul road is available up to the bottom of the working pit in the lease area from the nearest tar road. The haul rod is also available up to the different site services, cranes, site office, site of dumps etc from the nearest tar road. The mining will be for block and khanda. The mining for upper benches will be for khanda and lower benches will be for khanda and block. Percentage of recovery will change at depth and in sides as per actual workings.. The transportation of block and khanda From mine to consumers is by hired trucks. Loading of mineral is proposed by crane as well as by manual means.



“Naruka Consultants”
D-88, Meera Marg, Banipark, Jaipur (Raj.)

The production and dispatch of last five years is as follows:

Year	Production in tonnes		Dispatch in tones	
	Block	Khanda	Block	Khanda
2013-14	5775.00	29375.00	5741.10	29374.40
2014-15	5500.00	34410.00	5421.73	34226.30
2015-16	3900.00	36070.00	3933.74	35670.90
2016-17	6700.00	33560.00	4349.20	30839.90
2017-18	650.00	27050.00	2870.34	21968.22

The dumps are proposed outside the lease area as shown on environment plan at common site. Rest shelter is available in nearby area of the lease. All the requisite infrastructural facilities are available near the site offices located nearby the lease area. A water hut for drinking water is proposed to provide near working faces and in the rest shelter.

It is proposed to install the Crain at safe place and proper work will be done for its stability. The working is proposed for recovering the block and the stone not useable as block will be sale as khanda (converted into khanda). Block recovery will depend on availability of healthy thadi suitable for block mining.

The fencing will be carried out around the pit boundary to check the inadvertent entry of human and live stock.

Garland drain with parapet wall will be provided around the pit to prevent the entry of monsoon water in the pit.

7.1 YEARWISE DEVELOPMENT PROPOSED FOR FIRST FIVE YEARS

General:

1. The barbed wire fencing will be provided around the proposed and existing workings to check the inadvertent entry of human and livestock in mining zone.
2. The soil which may come across during mining in patches or in cavities will be scraper and stacked separately to be used for plantation ion monsoon.
3. The proper plantation will be done in the lease area and nearby the lease area in each monsoon and will report to the department with photographs.
4. Garland drains with parapet walls will be provided around the pit to check the entry of monsoon flowing water towards working pit.
5. Drinking water will brought from nearby tube wells and stored in water pitchers for drinking purpose and in cement tanks for other purpose
6. The workings will be done by maintaining the proper benches.
7. The waste will be dumped at one place outside the lease area on existing dump in the lessee's land. It is also proposed to dump towards eastern side in the lease area.
8. The excavation/excavated area will be fenced during the mining.
9. Rest shelter etc are already in existence near the lease area.



"Naruka Consultants"
D-88, Meera Marg, Banipark, Jaipur (Raj.)

The workings are common for a group of mines of the company and Sister Company and thus development and approach roads are common for all mines.

The Development year wise is proposed from year 2019-20 to 2022-23.

In the period of this mining scheme the lessee will develop seven benches i.e. from 328mRL, 322mRL, 316mRL, 310mRL and 304mR. The benches will be from top to bottom side. The approach will be in round shape from top to bottom. The approach will be in round shape from top to bottom. Derrick crane is also proposed to lift the mineral and waste. The development is shown on plate-6. The development of benches will be as per requirement of marble stone i. e. towards higher side or towards lower side but benches will be developed as proposed in this mining scheme during the period of five years. Thus lessee will develop the benches as per requirement of stone. The bench height and width are proposed 6 metres but the lessee may take permission from DGMS for bench height more than 6 metres.

The bench slope will be providing 85°. The loading will be from bottom of the pit as per present practice.

The lessee will work as per proper benches and develop the benches as required but in the manner as proposed and as shown on plate-6. The length and width of workings are as per the situation at field.

Year wise production in tones is as follows:

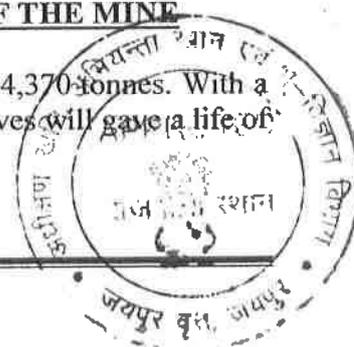
Year	Tentative excavation in tones (ROM)	Soil in tonnes	Waste / sub-grade i.e not useable as marble in tonnes	Mineral Marble in tones Block and Khanda
2018-19	50,000	00	10,000	40,000
2019-20	50,000	00	10,000	40,000
2020-21	50,000	00	10,000	40,000
2021-22	50,000	00	10,000	40,000
2022-23	50,000	00	10,000	40,000
Total	2,50,000	00	50,000	2,00,000

7.2 PROPOSED RATE OF PRODUCTION WHEN MINE IS FULLY DEVELOPED

The production as proposed in table above is proposed to achieve during each year as proposed.

7.3 MINEABLE RESERVES AND ANTICIPATED LIFE OF THE MINE

As per paragraph 3.5 the mine-able reserve of marble is 8,54,370 tonnes. With a production target of around 40,000 tones per year these reserves will give a life of around 21.369 years or say 22 years to the mine.



7.4 METHOD OF MINING

The mining in this lease area is being done by opencast method. The present mining is for Block and Khanda. Thus this planning is proposed considering the block mining. The future mining will be by semi-mechanized method and it is for block and khanda. Blasting should be avoided as it creates cracks in the blocks. Considering the national, state and local holidays, around 300 working days are proposed in a year.

a Drilling:

Drilling for blasting (if required) is proposed by jack hammers using 32mm diameter TC bits. The length of hole is proposed 1.5 meters. Spacing and burden is proposed 1 and 0.8 meters respectively. Drilling the holes for putting the wire garland for cutting the block is proposed by drill roads of 32mm diameter and up to 102mm diameter and length of hole is proposed as required. Direct drilling LD-4 modal is proposed for drilling the holes for wire garland of wire saw machines.

b Cutting of Blocks from thadi:

Cutting of block by wire saw: The marble in the bottom of the pit is known as thadi. The separation of block from thadi is proposed by wire saw. Two holes are proposed to drill. One is vertical and other is horizontal. Both holes are proposed to connect with each other. The wire garland with diamond bits are proposed to penetrate through these holes and the pulley of wire saw machine. This wire saw machine by the action of diamond bits cuts the block. For bottom cutting both holes may be drill horizontal. Total three wire saw machines are proposed considered the daily cut of blocks.

c Separating the required size block from big block:

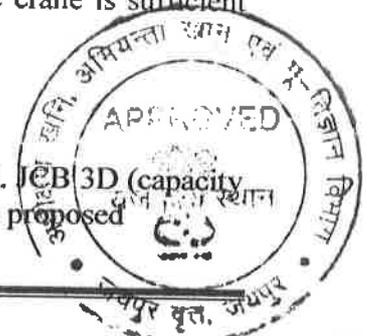
For separating the required size block from big block, the drill holes are proposed at the line of required size. The holes are proposed at 15 cms apart. The V shaped chisel is proposed to put on the holes and than by hammering action the required size block is separates out.

d Lifting of minerals and material:

The khanda from the pit bottom is being transported by trucks/ tippers of 10 tonne to 20 tonne capacity and this method of transport is being carried out in future. The block and laffer if come across from pit bottom are proposed to lifted by cranes of 42 HP having capacity of 15 to 20 tonnes. Considering the quantity of mineral and waste to handle per day towards maximum. One crane is sufficient for this purpose.

e Loading of mineral and material

Loading of mineral and waste is proposed by hydraulic loaders. JCB 3D (capacity 0.3 cu. meter) and L & T Poclain- 90 capacity 0.9 cu. meter are proposed



f **Transportation of Material:**

Transportation of waste material from surface and from bottom i.e. from the loading point to waste dump site will be done by tippers of 10 tone, 20 tonne capacity. Considering the quantity of waste to handle per day towards maximum two tippers are sufficient. From pit bottom to destination the mineral is proposed to dispatch in hired trucks. The road is available for this purpose.

g **Dewatering**

Presently the mine water is being dewatered through a sump to check the silt. From sump the dewatering is being done in near by nalah and river. The monsoon water is also used for plantation. The garland drain with parapet wall will be provided around the pit to check the entry of monsoon water in the working pit.

h **Beneficiation:**

The marble block will be dispatched to the cutting units and grinding units in form of block and khanda. The ladders will also dispatch to the cutting units. Khanda will be dispatch to the grinding units or in other industries in form of lumps. No beneficiation is required at site and none is proposed at site.

i **Employment potential:**

One Mines Manager and one Mining Mate are proposed for supervision at site and for daily supervision. All the machineries will be operated by skilled and qualified laborers. Thus total 5 skilled labourers are proposed.

As helper of the skilled persons around 5 semi skilled persons are proposed.

For other works 20 laborers are proposed to engage.

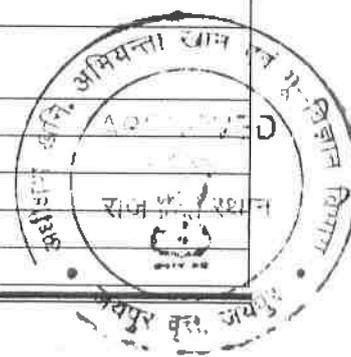
Face slope is proposed 85 °, whereas ultimate pit slope is proposed 60°.

j **EXTENT OF MECHANIZATION**

The following machineries are proposed (as per MCDR 2002):

Item	Quantity
Compressor of 120 psi or any other suitable	One tractor mounted
Jack hammer and other pneumatic or hydraulic drill, long hole drill	One or as needed
Mobile crane 15 to 20 tonne capacity	One or as needed
Hydraulic excavator with rock breaker arrangement	One or as needed
Wagon drill	As needed
Slot Liners	As needed
Line drilling machines	As needed
Diamond Wire Saw	As needed
Chain Saws or diamond belt saws	As needed

"Naruka Consultants"
D-88, Meera Marg, Banipark, Jaipur (Raj.)



Hydraulic Jack	As needed
Tractor with water tank	One
Tippers	As needed
Other machineries	As needed

7.5 CONCEPTUAL MINING PLAN

Conceptual Mining Plan is necessary to know the ultimate limit if the pit crust when whole reserves will be exhausted. The ultimate pit limit is limit of pit at surface at the end of mining. It is also necessary to select the sites for waste dump, site service, plantation etc. in such a place that these sites should not get any disturbance during the life of the mine. Considering the aforesaid aspects the Conceptual Mining Plan is proposed as follows:

a) ULTIMATE EXTENT & SIZE OF THE PIT

The ultimate extent and size of the pit will be as follows:

Length of the working 100 meter already exposed
 Width of the working 95 meter already exposed
 Depth of working 80 meter (group of mines)

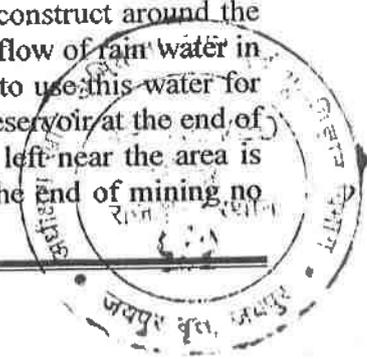
b) THE FINAL SLOPE ANGLE ADOPTED

Considering the stability of rocks the final slope angle or say ultimate pit slope is proposed 45°. This slope angle will remain quite safe for these deposits.

c) ULTIMATE CAPACITY OF DUMPS

The mining will be in already degraded land as well as in some fresh land also. Maximum area is degraded by mining activities. The waste comes across as overburden and side burden. The waste is proposed to dump towards eastern to northeastern side outside the lease area in own land of the lessee. The dumps will be on existing dumps. The height of the dump will be increased. No separate soil will come across during mining. The soil in little amount if come across is proposed to scrape and stacked at separate place to use for plantation during monsoon. The retaining wall will be constructed in lower altitude side of the dumps to check the wash off during rainy season. The dumps will be properly sloped, so that rainwater may flow smoothly down the dumps. No waste dump will be remained in existence at the end of mining. The lessee may also recover the khanda from old dumps after taking permission from the Department.

At the end of mining a one meter wide wall is proposed to construct around the excavated land leaving a gate towards higher altitude side to flow of rain water in side the workings. One gate is proposed towards road entry to use this water for livestock etc. Thus the excavated land is proposed as water reservoir at the end of mining. The monsoon water collects in the pit. The waste left near the area is proposed to fill in 1/8th part of the excavated pit. Thus at the end of mining, no waste left at site and nearby.



d) STABILIZATION OF DUMPS

During mining the dumps are proposed to stabilize by retaining wall of rubble stone to be constructed towards lower altitude side. The retaining wall is proposed of 1 meter in height and 1 meter in width.

e) ULTIMATE PIT LIMIT

The ultimate pit limit is considered 7.5 meters from the lease boundary in side the lease. The limit is illustrated on plate-5.

7.5 SITE SERVICES

Source of **drinking water** is well and hand pump located in the nearby area and hand pumps located in near by villages. Drinking water is supplied by the tankers. The RO for purification of water is available at mine office with water cooler. The drinking water is also available at mine site in water pitchers and in cement tanks for other purpose. The water hut is proposed near the site services as shown on plate-6.

Rest shelter is required for taking rest and lunch for the labourers during off hours. The rest shelter is available near the lease area.

Site office is required for keeping the records and for the supervisory staff. The sites are available near the lease area. The kitchen etc and all other site services are available near the lease in office premises.



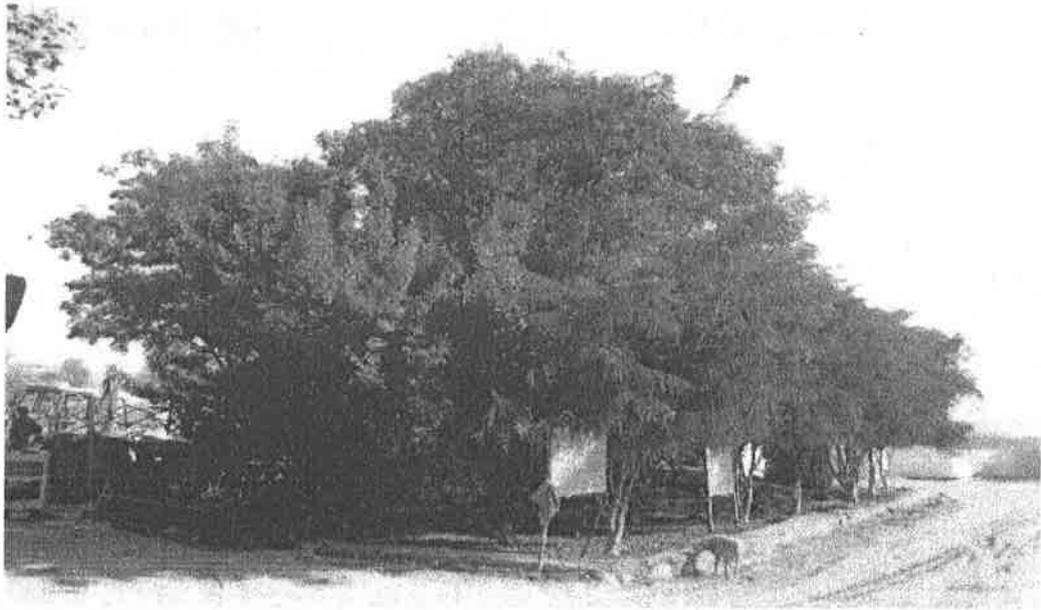
Office surrounded by plantation

7.5.1 PLANTATION



The lessee planted trees near the office. Around more than 1000 trees are in existence near the site office. Around 20 trees will be planted in each monsoon in the lease area for increasing the aesthetic beauty of the lease area and along the

approach roads to improve the aesthetic Environment



t.
In front of office



Behind the office

"Naruka Consultants"
D-88, Meera Marg, Banipark, Jaipur (Raj.)



7.6 BLASTING

The blasting if required necessary is proposed to excavate the upper layer of weathered portion in weathered strata. Blasting is proposed with low charge of explosive to loosen the rocks only. Blasting is not proposed in block mining. The blasting is proposed as follows:

A BROAD BLASTING PARAMETERS

Deep Hole Blasting	
Deep Hole Drill road	6 meters effective length
Deep Hole Drill machine	Down the hole drill
Burden	3 meter
Spacing	4 meter
Hole Diameter	110mm
Short Hole	
Drill road	1.5 meters effective length
Drill machine	Jack Hammer
Burden	0.8 meter
Spacing	1.0 meter
Hole Diameter	32 mm

B EXPLOSIVE USED

Blasting will be done by various types of explosives. Generally the following conventional types of explosives are used in the mine.

Slurry explosive (AN based) viz. power gel, Acquadyne, Superdyne etc.

Booster is proposed as Packaged Slurry Explosive, Emulsion explosives available in 100gms to 500 gms cartridge. The Raj Gel, Raj Power explosive cartridge of RECL Dholpur, and other suitable explosive may also use.

Initiation is proposed by half second delay detonators.

C POWDER FACTOR

Deep Hole:

Charges per hole is 0.125 kg of booster, 6 kg per metres of explosive and One detonator (as inquired by Mines Manager).

Powder Factor = $\frac{\text{Effective Depth of hole} \times \text{Burden} \times \text{Spacing} \times \text{Bulk Density}}{\text{Total charge in Kg}}$

Powder factor = $\frac{6 \times 3 \times 4 \times 2.6}{0.125 + 36}$

$= \frac{187.2}{36.125} = 5.18$ tones of rock/kg of explosive



"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

Short Hole:

Charges per hole is 0.125 kg of booster, 0.5 kg of explosive and One detonator.

Powder Factor = $\frac{\text{Effective Depth of hole} \times \text{Burden} \times \text{Spacing} \times \text{Bulk Density}}{\text{Total charge in Kg}}$

$$\text{Powder factor} = \frac{1.5 \times 0.8 \times 1 \times 2.6}{0.125 + 0.5}$$

$$= 3.12/0.625 = 4.992 \text{ tones of rock/kg of explosive}$$

The drilling will be by wet process.

D Secondary Blasting
Secondary blasting will not needed

E Storage of explosive

Considering the consumption of explosive a 500 kg portable magazine is proposed for storing the explosive. ANFO mixing shed is proposed for manufacture of ANFO. A room will provide for storage of Ammonium Nitrate.

It is advised to lessee that he should apply for explosive magazine for 100 kg capacity to the competent authority and for ANFO mixing shed to the competent authority. It is expected that the lessee should try to get the license within six month.

7.7 MINE DRAINAGE

General ground level in five kilometers periphery is around 320mRL (outside the area) whereas level of ground water table is around 80 meters below from general ground level Thus ground water table in the area is at around 240mRL. This level fluctuates around 3 metres in dry and wet season. In dry season it lowered around 3metres. Proposed deepest working is up to 250mRL up to conceptual. Thus ground water will not come across in mining during first five years. Monsoon water collects in the pit during monsoon. The rainwater of direct precipitation over the workings will have to be dewatered. A 10HP diesel operated water pump is proposed for this purpose. The dewatering is proposed through a sump made in the pit and during dewatering the water is proposed to discharge in nearby nalah to avoid the silt contamination in the agriculture land.

7.8 PLAN AND SECTION

The plan and sections of the applied lease area is given in plate-5. The development and mining for first five years is illustrated in plate no-6.

7.9 SOIL STACK

Soil is observed in the area in thin layer. The soil which comes across during mining will be scraped and stacked separately in 0.01 hectare area as shown on plate-6.



8.0 YEARWISE ANNUAL PROGRAM OF MINING FOR NEXT FIVE YEARS

Year wise annual program of mining is discussed in paragraph 7.0 and illustrated on plate 6. The year-wise production and generation of waste is given below:

Year	Tentative excavation in tones (ROM)	Soil in tonnes	Waste / sub-grade i.e not useable as marble in tonnes	Mineral Marble in tones Block and Khanda
2018-19	50,000	00	10,000	40,000
2019-20	50,000	00	10,000	40,000
2020-21	50,000	00	10,000	40,000
2021-22	50,000	00	10,000	40,000
2022-23	50,000	00	10,000	40,000
Total	2,50,000	00	50,000	2,00,000



9.0 DETAILS OF EMPLOYMENT

A MANAGERIAL AND SUPERVISORY STAFF

The following supervisory personnel are proposed with management chart:

Mining Engineer (Degree Holder)

|

Mines Manager (Certificate Holder)

|

 | Mining Mate | Store Keeper | Timekeeper | Drivers | Watchman

|

Mine labourer

B Labourers, skilled, semi-skilled and un-skilled

The following labourers are proposed:

Skilled	5
Semi-Skilled	5
Unskilled	20

C Medical Insurance of workers:

The medical insurance of all the workers will be provided as per law.

The personal protective appliances like safety boots, helmet, safety belt etc will be provided to the labourers.

B. Personal Protective Equipments (PPE will be provided)(already provided)

- 1. Safety Helmet-** Uses for the safety of head
- 2. Safety Goggles-** Uses for the safety of Eyes from sun, welding and other flying rock particles.
- 3. Dust Respirators:** Uses for dust free air at dusty areas in the mine.
- 4. Ear Plugs:** Uses for protection of air from unwanted sound i.e. noise pollution.
- 5. Safety Belts with Rope-** For safety of body which may fall from high faces.
- 6. Hand Gloves-** for protection of hand during welding or other hot things/articles.
- 7. Safety Boots-** For protection of foot from fall of stone and for safety from injury.



- D . **Other requisite requirements for labourers:**
1. WC (Latrines and Urinals) one for each and up to 50 labourers. Separate for Male and Females (Rule 20 Mines Act, 33 of Mines Rules).
 2. Rest Shelter for labourers for taking rest during off hours (Rule 62 of Mines Rules).
 3. Water hut for storing of cold water for labourers (at least 2 liters for each labour for drinking purpose) (Rule 19 Mines Act, 30 of Mines Rules).
 4. First Aid Boxes in sufficient numbers (Rule 21 of Mines Act).

9.01 CONTRIBUTION REGARDING THE SOCIAL DEVELOPMENT OF ARE BY RESIDENTS

There is no impact of mining on local residents of the area. All the persons will be employed from nearby villages. The local residents will away from the lease area and never posed any problem in other nearby area in which mining is going on. The villagers may use the waste free of cost. The lessee also helps in maintenance of village kuchha roads with request of local Panchayat Samiti. The lessee will provide maximum assistant to local body on their request.

The mine owner is member of "Arpan Sansthan (Ek Vikas Dhara) at village Mallana, tehsil- Rajgarh in Alwar district. This organization is registered under Societies Act and has been formed by the mine owners themselves with the primary objective of Social development of people of nearby villages. The funds are contributed by every member lessee and are used only for the social development of the people in the field of Education, medical, financial aid etc. The society is also involved in the work of plantation in villages and on roads.



10.0 MEASURES TAKEN AND TO BE TAKEN FOR LAND RESTORATION, RECLAMATION AND PLANTATION IN/OR NEARBY LEASE AREA

No mining is observed in the applied area. The present land use pattern is given below.

The life of the mine is beyond this planning; therefore, measures for reclamation are not given in this planning. The khanda has market and some waste will be uses for construction and maintenance of haul roads after each monsoon. Some waste will be used by local habitants. Thus it will not be possible to reclaim the mined out area fully. Thus at the end of mining the waste is proposed to push in around 1/8th part of the pit. The rest pit will be converted into water reservoir at the end of life of the mine. The water reservoir will recharge the ground water table and is helpful for plantation and agriculture in near by area.

It is proposed to grow 20 trees per year in the lease area as shown on plate 6 to improve the aesthetic beauty of the area and to minimize the environmental ill. The year wise plantation has been shown on development plan plate no-6. Land Use Pattern. Present plantation is in good number.



11.0 MEASURES TAKEN AND TO BE TAKEN FOR PROTECTION OF THE ENVIRONMENT IN AND AROUND MINING LEASE AREA

In opencast mining, the top crust is completely removed to assess the underneath minerals. The opencast mining involves extraction of underneath minerals, dumping of waste along with vehicular movement, blasting, running of mine machineries etc. These operations affect the ecosystem in various ways, such as change of a landscape, displacement of flora and fauna of the area, change of surface drainage pattern, change in air and water and noise quality of the area. Any development activity having adverse impact on environment may defeat the object as it may create problem for future generation. However, socio-economic benefits can be maximized, if environmental concerns are integrated in mine planning during development of the project i.e., by eco-friendly mining. The environmental patterns likely to be affected are as follows:

- 1 Land environment
- 2 Water, air and noise environment
- 3 Socio-economic environment

1. LAND ENVIRONMENT

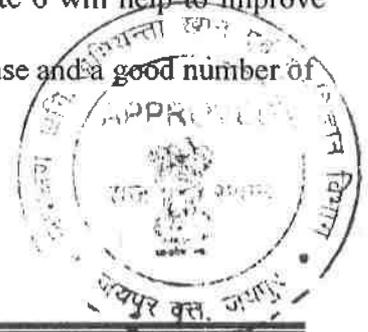
(A) Land Use Pattern

The land use pattern of the area will change by the land, which will be used in actual mining and waste dumping. The mining is proposed in excavated area as well as in some fresh area, thus additional land will also be broken by proposed mining of next five years. The dumps are proposed towards northwestern side in the lease area as shown on plate-6. Around 0.95 hectares of total land is already degraded by the mining activity and same will be degrading in next five years i.e. by excavation. As the life of the mine is more than the period of this planning, hence no measures are called for during the period of this planning. The measures proposed for land use at the end of mining has been discussed in paragraph 10.0.

(B) Vegetation

More than 500 trees are observed near the site office. Twenty trees will be planted in each monsoon in 7.5 meter zone along the lease boundary and some more trees should be planted outside the lease area on both sides of approach road. The trees guards, proper watering arrangements will be provided for achieving the good survival rate of trees. The proposed plantation as per plate 6 will help to improve the vegetation in the lease area.

The plantation is done near the site office of the nearby lease and a good number of plantation is in existence.



(C) Agriculture Land

No impact will be anticipated on agriculture land as the lease area is in government land and crops not grown in this land.

(D) Forest Land

The lease area is away from forest land therefore no measures are needed.

(E) Public, Building and Monument

These things are not exists in the lease area and near the area, which effect from mining therefore, measures are not required.

2. WATER, AIR AND NOISE ENVIRONMENT

The protective measures for control of water, air and noise pollution has been discussed in paragraph 13.0.

Water for drinking and other purpose will be brought by tankers from nearby tube wells and wells. The water for washing and other purpose should be providing in cement tanks with sufficient numbers of water taps. The clean and cold drinking water in sufficient quantity is proposed to store in water pitchers. The water pitchers should be clean, hygienic and should be re-filled daily.

Air pollution is observed in permissible limits.
The noise found within permissible limit.

3. SOCIO-ECONOMIC ENVIRONMENT**(A) Social and Demographic Profile**

The impact of mining on social demographic profile is always positive, because all the persons have been employed from nearby villages. Apart from indirect employment, some persons get satellite occupation like tea stall, shops and small workshops due to mining activities in the area. Thus the mining has raised the economic status of nearby villagers.



(B) Human Settlement

As per CENSUS 2011 (latest available) the population details is as follows:
Table -10

Village	Population	Male	Female	Literate	Workers
Rampura	1625	883	742	1090	729
Kalwan	584	318	266	237	281
Gordhanpura	2044	1083	961	1060	621
Dundpuri	1453	756	697	611	757
Thana	4497	2366	2131	2764	1932
Dabla Meo	640	332	308	387	284
Khoh	4671	2374	2297	2629	1893
Palpur	796	403	395	440	266
Mallana	1359	714	645	759	493
Tilwar	1587	828	759	901	539
Tilwari	234	116	118	117	103
Sitawat	1388	733	655	695	684
Tehla	4624	2434	2190	2926	1698
Jaisinghpura	1656	875	781	916	776
Berli	151	74	77	68	67
Total					
Percentage	100%	52.33%	47.67%	56.85%	40.62%

The impact of mining on human settlement is not anticipated as the lease area is away from human settlement. The nearest village is Kho as shown on plate-2.

(C) Occupational Health and Safety

The health and safety hazards will be anticipated to affect the persons employed in the mine. The persons may get injury by fall of rocks or may suffer from professional diseases while working in the mine. The mining in the area will be done under the supervision of qualified person. Safety boots, hats, safety belts will be provided to the employed persons. A first-aid box will be kept at the mine. The dust respirators will be provided to the labourers who engaged near dust creating points. The ear plugs will be provided to the labourers who engaged near noise generating points.

12.0 MEASURES TAKEN OR TO BE TAKEN FOR DUMPING OF OVERBURDEN, STACKING OF TOP SOIL AND UTILIZATION OF TOP SOIL

The mining will be in already degraded land as well as in some fresh land also. Maximum area is degraded by mining activities. The waste comes across as overburden and side burden. The waste is proposed to dump towards eastern to northeastern side outside the lease area in own land of the lessee. The dumps will be on existing dumps. The height of the dump will be increased. No separate soil will come across during mining. The soil in little amount if come across is proposed to scrape and stacked at separate place to use for plantation during monsoon. The retaining wall will be constructed in lower altitude side of the dumps to check the wash off during rainy season. The dumps will be properly sloped, so that rainwater may flow smoothly down the dumps. No waste dump will be remained in existence

"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

at the end of mining. The lessee may also recover the khanda from old dumps after taking permission from the Department.

13.0 MEASURES TAKEN AND TAKEN TO BE CONTROL OF WATER, NOISE AND AIR POLLUTION

(A) WATER ENVIRONMENT

1. Surface Water

The rainwater of monsoon season may be polluted by wash off from the dumps or from the water, which have to dewater during monsoon. The following measures are taken to check impact on surface water:

- a Garland drain will be made towards higher altitude side of the working pit to check the entry of rain water in the workings. The rainwater flowing outside the lease area is diverted into natural water channels.
- b The water taken out from the mine is diverted into water channels without obstruction. The dewatering is proposed through a sump made in the bottom of the pit to check the silt.
- c Retaining wall will be constructed in lower altitude side of the dumps to check wash off during rainy season.

2. Ground Water

The ground water will not come across in the workings during the period of this mining scheme. Thus no adverse impact on ground water will encounter in the workings during the period of this planning. The ground water table may goes down due to use of water for domestic and other purpose by local habitants and uses by lessees for marble mining. This water table is automatically raises during wet season due to porosity of rocks and water reservoirs. The monsoon water of direct precipitation may come across in the workings during monsoon.

3. Water Quality

The impact on water quality is not anticipated as the marble and waste dumps are inert, which will not generated toxic substances at any stage. No toxic mineral will generate and no tailing pond is proposed, hence the quality of water is not expected to pollute by mining activity in this area.

(B) NOISE ENVIRONMENT

The following measures are taken to minimize noise generated during drilling and by running of mine machineries and movement of transport vehicles.

- a Drilling is being done with sharp drill bits.
- b All the machineries including transport vehicles are properly maintained. All the diesel engines are provided adequate silencers to minimize generation of noise.



(C) AIR ENVIRONMENT

The magnitude of air pollution in mining is machineries with method of mining, type of mineral and level of mechanization. The marble is compact and therefore chances of generation of dust will be very less. The sources of gaseous and dust pollution are due to emissions from diesel engines of mine machineries, transport vehicles and during drilling, blasting.

a Gaseous Pollution

The source of gaseous pollution is emission of gas from diesel engines of mine machineries and transport vehicles. These emissions are minimized by proper maintenance of all the diesel engines. Good quality lubricants are used in engines.

b Control of Dust Pollution

The main sources of dust pollution are during drilling and removal of overburden and movement of transport vehicles. The following measures are taken to minimize air pollution during different operations.

1. During Drilling

- (i) Sharp drill bits are used
- (ii) Jackhammers are operated with water spraying system

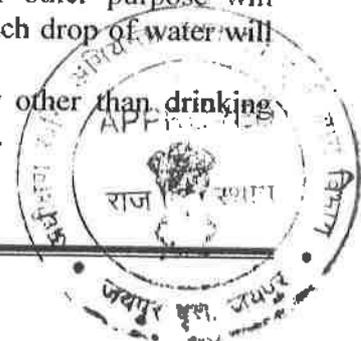
2. During Transport Operation

- (i) All the haul roads in the lease area are kept wide, leveled and compact. Water spraying will be done on haul road to prevent generation of dust by movement of vehicles and other machinery during summer season.
- (ii) Monitoring will be done to check the quality of air in mining area once in a year.
- (iii) The lease will take consent to establish and operate from RPCB Alwar.

C Plantation

It is proposed to collect the monsoon water in non working pits if available or in cement tanks. The cement tank use for storing the water for other than drinking purpose for the labourers should be towards higher altitude side. The drain should be developed from tank to lower side along contours. The plantation should be done near or say adjacent to the drain. The labourers use the water for washing and for other purpose will automatically goes to plants by the drain and thus each drop of water will be used.

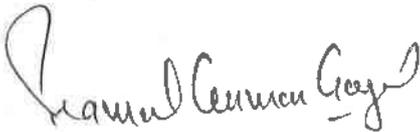
In other case it is advised that the used water for other than drinking purpose will be diverted towards plantation by drains.



14.0. CONTRIBUTION REGARDING THE SOCIAL DEVELOPMENT OF NEARBY RESIDENTS

There is no impact of mining on local residents of the area. All the persons will be employed from nearby villages. The local residents will away from the lease area and never posed any problem in other nearby area in which mining is going on. The villagers may use the waste free of cost. The lessee also helps in maintenance of village kuchha roads with request of local Panchayat Samiti. The lessee will provide maximum assistant to local body on their request.

The mine owner is member of "Arpan Sansthan (Ek Vikas Dhara) at village Mallana, tehsil- Rajgarh in Alwar district. This organization is registered under Societies Act and has been formed by the mine owners themselves with the primary objective of Social development of people of nearby villages. The funds are contributed by every member lessee and are used only for the social development of the people in the field of Education, medical, financial aid etc. The society is also involved in the work of plantation in villages and on roads.



Lessee



Govind Singh
RQP/AJM/009/87/A



15 PROGRESSIVE MINE CLOSURE PLAN

UNDER RULE 29 (13) (1) OF RMMCR 2017 (Lease area up to 1.00 ha area).

15.1 Environment Base Line Information's:

The lease area is non forest land. The lease area is 1.00 hectares.

The pits, dumps, roads, infrastructure etc are observed in the lease area. The present degradation of land is as follows:

S. No.	Item	As on date
1	Area to be excavated	0.75
2	Storage of top soil	0.00
3	Overburden dump	0.00
4	Sub-grade/mineral stack	0.00
5	Infrastructure	0.00
6	Roads	0.00
7	Green belt	0.00
8	Reclamation	0.00
9	Total Disturbed	0.75

Water Regime:

No water reservoir or perennial stream etc observed in the lease area and around 500 metres periphery of the lease area. The local water reservoir observed in five kilometers periphery as shown on plate-2.

Quality of air:

The lease area is away from the habitation, the present workings are semi mechanized and towards lower side thus the air pollution observed is within limits. Blasting is also carried out in the area and the noise from blasting is momentarily. Thus the present air pollution is within the prescribed limit.

Ambient Noise Level:

The noise level in the lease area is within the prescribed limit.

Flora:

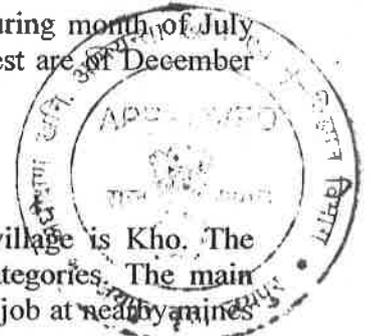
In the lease area the main flora is shrubs and bushes. The trees planted by lessee observed in the lease area.

Climatic Conditions:

Climate of the area is semi arid zone type. The average rain fall remains around 300mm per year. The maximum, mean and lowest temperature remain around 44°C, 24°C and 4°C. Maximum precipitation takes place during month of July and August. The hottest months are May and June and coldest are of December and January.

Human Settlement:

No human settlement observed in the lease area. Nearest village is Kho. The habitants belong to ST, SC, Minority, OBC and general categories. The main vocation of the habitants is agriculture. The habitants also has job at nearby mines.



"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

and nearby towns like Rajgarh and Dausa. The population details are given in plate-2 and in Simplified Mining Scheme.

Public building, place of worship and monuments

No such things are observed in and around the lease area. The other things observed in five kilometers periphery is illustrated on plate-2

Indicate any sanctuary is located in the vicinity of leasehold

No any sanctuary etc observed in the vicinity of the lease area and in 5 kms periphery.

15.2 Impact Assessment and Management:

The land of the lease area will degrade by excavation, dumps and roads.

- i) The infrastructure, waste dump, roads, existing workings etc are already in existence. The land degraded by proposed mining activities is given below in the table.

S. No.	Item	As on date	End of the Scheme
1	Area to be excavated	0.75	0.90
2	Storage of top soil	0.00	0.00
3	Overburden dump	0.00	0.00
4	Sub-grade/mineral stack	0.00	0.00
5	Infrastructure	0.00	0.00
6	Roads	0.00	0.00
7	Green belt	0.00	0.10
8	Reclamation	0.00	0.00
9	Total Disturbed	0.75	1.00

ii) Air Quality:

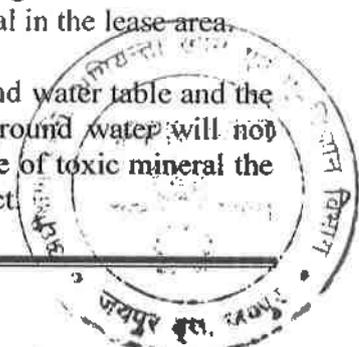
The quality of air is likely to be effected by drilling, Blasting and transportation of mineral and waste.

The drilling will be by wet process. Water spray is being used over the haul/ approach roads time to time and this practice is proposed to continue in future.

iii) Water Quality:

The quality of water is affected by mining if ground water comes across in mining or by having any toxic mineral in the lease area.

There is a high gap between the level of ground water table and the depth of proposed deepest workings thus ground water will not intersect the workings at any stage. In absence of toxic mineral the quality of water will not get any adverse impact.



if ground water will intersect the lessee will get necessary permission.

iv) Noise Level

The diesel operated machineries, Blasting and vehicular movement will creates the noise pollution.

The following measures are proposed:

The high quality silencers will be provided to the diesel operated machineries uses for excavation and loading of mineral and waste and water pump etc. The noise from blasting will be momentarily. The approach roads will be provided smooth and wide.

v) Vibration level (due t Blasting)

Heavy blasting may create vibration.

The blasting in the area is towards lower side and thus vibration from blasting is not very much significant.

vi) Water Regime:

The water regime may disturb by waste dump, obstruction of nalah etc.

No such things are located in the lease area and around 500 meters of the lease area, thus no measures are called for.

vii) Acid Mine Drainage

Not applicable in this mine.

viii) Surface subsidence

It is an opencast mining and no such subsidence will come across in past by mining and none is expected by future mining.

ix) Socio- Economic

The socio economic conditions of an area will gate positive impact by having and economic activity near by the habitation. The local habitants will get permanent extra income from the source of employment near the villages.

x) Historical Monuments etc

In absence of such monuments in and around the lease area no impact will be anticipated.



"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

15.3

PROGRESSIVE RECLAMATION PLAN

The mining is from top to bottom side and extension of existing workings in sides and in depth, which reduces the height of the ground by excavation. The generation of waste is towards very lower side and it will be used for construction and maintenance of approach roads time to time. Thus reclamation of excavated land is not proposed. The excavated land (deep cuttings) will be used as water reservoir. The water will be useful for nearby crops, plants and live stock.

15.3.1 MINED OUT LAND

S. No.	Item	As on date	End of the Scheme	End of the mining
1	Area to be excavated	0.75	0.90	0.90
2	Storage of top soil	0.00	0.00	00
3	Overburden dump	0.00	0.00	00
4	Sub-grade/mineral stack	0.00	0.00	00
5	Infrastructure	0.00	0.00	00
6	Roads	0.00	0.00	00
7	Green belt	0.00	0.10	0.10
8	Reclamation	0.00	0.00	00
9	Total Disturbed	0.75	1.00	1.0

15.3.2 TOP SOIL MANAGEMENT

The soil come across during mining will be scraped and stacked separately. The soil will uses for plantation in each monsoon.

15.3.3 TAILING DAM MANAGEMENT

No such tailing dams are present and none is proposed in the lease area and nearby thus no measures are called for.

15.3.4 ACID MINE DRAINAGE

In absence of acid mine drainage no management will be anticipated.

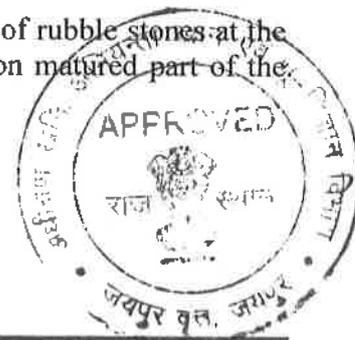
15.3.5 SURFACE SUBSIDENCE

Surface subsidence mitigation measures though backfilling of mine voids or by any other means and its monitoring mechanism.

It is an opencast mining and no subsidence will take place. Thus no measures are called for.

15.3.6 WASTE MANAGEMENT:

The waste dump will stabilized by retaining walls of rubble stones at the lower altitude side. Plantation will also provide on matured part of the dump.



"Naruka Consultants"

D-88, Meera Marg, Banipark, Jaipur (Raj.)

15.4 DISASTER MANAGEMENT PLAN

No landslide and inundation like disaster were come across in this area and nearby the area in past. The workings are proposed from top to bottom by forming proper benching. The proposed workings will be by opencast mining method. Underground mining is not proposed. Face height will maintain safe. No tailing dam is proposed. Thus high -risk accidents like land slide, subsidence, flood, inundation, fire, seismic activities etc. not come across.

Small accidents like fire, explosion in explosive and accident and fall of face like disaster may come across.

A fire fighting station (sand filled buckets) is proposed at site in the supervision of mines manager and mate. After receiving the information, the officials will reach up to site and will remove men and machineries from the site.

Magazine approved is proposed for storing the explosive and approved boxes are proposed for handling the explosive from magazine to site. Any person, who notices any explosion or accident, should immediately take steps to give warning by suitable mean and at the same time take necessary action for withdrawal of men from the site. He shall also inform the mines manager and other officials without any delay. The persons should be trained properly to handle the situation.

Detailed warning system, implementation procedure, emergency control center, shall be maintained at the mine with names of trained persons. Proper arrangements should be made for treatment of injured persons. Fiore fighting arrangements should be provided at all the prone sites. All the safety equipments should be available at mine site. A vehicle should always remain at site (vehicles remain available on road passes through the area. The lessee is capable to meet any type of risk. The fire stations are available at Rajgarh and Dausa. Hospital is located at Rajgarh. Dispensary is available at Kho.

The responsible person is as follows:

Pramod Kumar Goyal



15.5 CARE AND MAINTENANCE DURING TEMPORARY DISCONTINUENCE:

No mining operation is proposed to temporary discontinuance during the period of this progressive mine closure plan. During any discontinuance the mining workings will be in the watch of a watchman. Before re-open of the mine the maintenance will be provided to all the machineries deployed at mine. Before entering the labourers into mine the workings are proposed to inspect by manager for safety purpose as per Mines Act.

15.6 FINANCIAL ASSURANCE

As per rule 29(XV) of RMMCR 2017 the lessee have to deposit the financial assurance for PMCP at the rate of Rs. 15,000/ per hectares to the Mining Engineer, Alwar

Pramod Kumar Goyal

Pramod Kumar Goyal
Lessee

Govind Singh

Govind Singh
RQP/AJM/009/87/A

Hu y
परिष्ठा भूवैज्ञानिक
अलवर

खनि अभियन्ता

खनि अभियन्ता
खान एवं भूविज्ञान विभाग
अलवर (राज0)

This Mining Plan has been approved
vide Order No. SME/IP/MP..656/18
Dated...9/4/19... under RMMCR

P. D.
अधीक्षक खनि अभियन्ता
जयपुर वृत्त, जयपुर





राजस्थान RAJASTHAN

E 869904

S. No. 395
 17 APR 2017 पूरक संविदा 17 APR 2017 ON'S
 ML No 07/2007(R)

यह गैर न्यायिक स्टाम्प पेपर रूपये 500/- वास्ते पूरक संविदा मूल खनन पट्टा सं. 123/88 वास्ते खनिज मार्बल क्षेत्र 1.00 है० निकट ग्राम खोह तहसील राजगढ जिला अलवर का जो श्री प्रमोद कुमार गोयल पुत्र श्री जगदीश प्रसाद गोयल निवासी तातपुर एन्टरप्राइजेज, हीरादास, भरतपुर (राज.) के पक्ष में कार्यालय आदेश क्रमांक खअ/अल/अखप/123/88(8)/164 दिनांक 29.2.1988 से स्थिरभाटक 6500/- सालाना पर संविदा पंजियन तिथि 02.4.1988 से 10 वर्ष हेतु स्वीकृत/धृत है। कार्यालय आदेश क्रमांक 578-85 दिनांक 19.9.1998 से खनन पट्टा की MMCR, 1986 के नियम 16(2) के तहत अवधि 10 के स्थान पर 20 वर्ष अर्थात् संशोधित की गई। खनन पट्टे का प्रथम नवीनीकरण अतिरिक्त निदेशक(खान)जयपुर के आदेश क्रमांक अनिखा/जय/अल/एम.एल.123/88 /नवी/07/07/290 दिनांक 05.4.2007 से अवधि दिनांक 02.4.2008 से 20 वर्ष हेतु स्वीकृत किया गया जिसका दिनांक 01.4.2018 तक वार्षिक स्थिरभाटक रूपये 2,85,557/- देय है।

राजस्थान अप्रधान खनिज रियायत नियम, 2017 के नियम 09 (2) के अनुसार स्वीकृत खनन पट्टे की अवधि 50 वर्ष हो जाने से इस कार्यालय के पत्र क्रमांक 764 दिनांक 10.4.2017 से खनन पट्टा की अवधि दिनांक 02.4.2038 तक बढ़ा दी गई है। उपरोक्त खनन पट्टा में अन्य की पूर्ण सभी शर्तें एवं प्रतिबन्ध यथावत रहेगे। अतः बढी हुई अवधि के सम्बन्ध में पूरक संविदा का निष्पादन भाज दिनांक 17/4/17 को किया गया।

Pranav Kumar Singh
 (प्रमोद कुमार गोयल)
 खनन पट्टाधारी



M. S. J. S.
 (के०सी०गोयल)
 खनि अभियन्ता, अलवर
 (राज्यपाल महोदय की तरफ से)

IDENTIFIED BY

साक्षी - *M. S. J. S.*
 1. *...*
 2. *...*
 मरेश कुमार *...*
 जयपुर

NOTARY A. W. A.
 17 APR 2017

राजस्थान सरकार

कार्यालय सचिव अभियन्ता, खान एवं भू विज्ञान विभाग, जयपुर
 क्रम/अन/असप/ 123/88/88/

दिनांक -----

कार्यालय आदेश

श्री श्री प्रमोद कुमार शोषल पुत्र श्री जगदीश प्रसाद शोषल निवासी भरतपुर

ने राजस्थान अध्यापन विधि विधायक नियम 1986 के नियम 5 के तहत खनन पट्टा चाहने हेतु आवेदन पत्र प्रस्तुत किया है, तथा इस कार्यालय के समक्ष आवेदनकर्ता को खनन पट्टा दिया जाता उचित समझा गया है।

अतः श्रुति क्षेत्र जिसके लिये पट्टा आवेक्षित किया गया है वह रिक्त है। अतः नियम 8 के अन्तर्गत निम्न शर्तों पर आवेदनकर्ता को खनन पट्टा अनुदान किया जाता है :-

- नाम खान : निकट नाम सीधे तः राजपुर जिना अमवर ।
- क्षेत्र : 100x100 मी० खसरा नम्बर 80 में बाटा है ।
- खनन : मातृभूत
- मवधि पट्टा : इस वर्ष विधि पंजीयन संविदा से ।
- स्थिर भाटक : र० 6500/- साताना (र०) र० राजा पांच मी भूख जो क्षेत्र एवं परचात पुनः निर्धारित किया जावेगा ।
- अधि भुक्त की दर : 1 र० 12-50 प्रतिटन ता से हानने चिपस व पाउडर ।
 80/- प्रतिटन वा से बनाम जास ।
 2 र० 40/- प्रतिटन वा से असमान जा से या से जो जिसका 40 सेमी में क्षेत्र का आयाम म की है ।
 3 र० 1625/- राष्ट्रीय बचत पत्र के रूप में ।
- प्रतिभूति की राशि : राजस्व विभाग के अनुसार ।
- मूलन भाटक : राजस्थान सरकार के नियमानुसार ।
- अन्य कर : राज० अध्यापन खनिज विधायक नियम 1986 एवं उसमें समय समय पर हुए संशोधनानुसार ।
- अन्य शर्तें

टिप्पणी :- 1. आज्ञा बिना पूर्व नोटिस के संपिद्ध मानो जावेगी यदि आवेदक द्वारा आदेश जारी होने की तिथि से तीन माह की अवधि में संविदा निष्पादन नहीं कराया जावे ।
 2. आवेदक क्षेत्र में खनन कार्य नहीं करेगा, जब तक कि संविदा का पंजीयन नहीं करा लेवे अथवा राज्य सरकार की विशेष आज्ञा ना हो ।
 3. क्षेत्र का सीमांकन 15 दिवस की अवधि में कराया जावे तथा सीमांकन से पूर्व सीमांकन, व्यय आदि का आयाम म की राशि र० 150/- जमा करावे ।

सचिव अभियन्ता, अमवर



क्रमांक : क्रम/अन/असप/ 123/88/88/ 116

दिनांक 21-2-2023

- प्रतिलिपि निम्न को वांछे सूचना एवं आवश्यक कार्यावाही हेतु प्रेषित है :
- अधीक्षण सचिव अभियन्ता, भरतपुर वृत भरतपुर ।
 - सचिव अभियन्ता (उपनदस्ता) भरतपुर ।
 - श्री श्री प्रमोद कुमार शोषल पुत्र श्री जगदीश प्रसाद शोषल निवासी भरतपुर से है कि वे निम्न पृथिवी आदेश जारी होने की दिनांक से 45 दिवस की अवधि समाप्ती से पूर्व पूरी कर लिखित सूचना इस कार्यालय में प्रस्तुत करें :- 1. अग्रिम स्थिर भाटक किस्त के र० 1625/- 2. प्रतिभूति राशि के र० 1625/- 3. तीन जूडिसियल स्टाम्प र० 1250/- 4. नवशः फीस र० 30/-
 - जिनाधीश महोदय, अमवर को मय एक अतिरिक्त प्रति के । 5. व० सचिव वामं देवक/सर्वेयर को भेजकर देस है कि वक्त सीमांकन मोके पर हल्का पटवारी से स्वीकृत क्षेत्र के पार्टी द्वारा प्रस्तुत खसरा सूचना में ही पढने की प्रमाणिकता प्राप्त की जाकर सीमांकन प्रतिवेदन के साथ पेश करे ।
 - क० मानचित्रकार ।



True Copy
 Arun Kumar Yadav
 RQP/AJM/242/2003/A
 d: upto-21 May, 2023

कार्यालय आदेश

चूंकि श्री प्रमोद कुमार गोयल पुत्र श्री जगदीश प्रसाद गोयल, निवासी-भरतपुर के पक्ष में खनन पट्टा खनिज मार्बल, क्षेत्र 100 X 100 मी० निकट ग्राम- खोह, तहसील राजगढ़, जिला-अलवर में खनि अभियंता अलवर के आदेश क्र० खअ/अल/अखप-123/188/578 दिनांक 29.02.88 द्वारा अवधि दिनांक 02.04.88 से 01.04.98 तक स्थिरभाटक रू० 6,500/- वार्षिक पर स्वीकृत किया गया, जिसकी संविदा का निष्पादन होकर पंजीयन तिथि 02.04.88 से 10 वर्ष हेतु पंजीबद्ध हुआ एवं शेष अवधि 02.04.93 से 01.04.98 तक के लिए स्थिरभाटक रू० 74,332/- वार्षिक पर निर्धारित किया गया। खनन पट्टे की अवधि राजस्थान अप्रधान खनिज रियायत नियमावली, 1986 के नियम 16(2) के प्रावधान के अन्तर्गत खनन पट्टे की अवधि 10 से 20 वर्ष के लिए खनि अभियंता अलवर के समसंख्यक संशोधित आदेश दिनांक 29.02.88 द्वारा संशोधित किया गया। जिसकी पूरक संविदा का निष्पादन दिनांक 27.09.98 एवं पंजीयन दिनांक 26.10.98 को उप पंजीयक राजगढ़, अलवर के यहाँ पंजीबद्ध होकर खनन पट्टा 01.04.2008 तक के लिए प्रभावशील है। खनन पट्टे का वर्तमान स्थिरभाटक 02.4.03 से 01.04.08 तक के लिए रू० 1.45,691/- है।



और चूंकि श्री प्रमोद कुमार गोयल द्वारा उक्त खनन पट्टे का प्रथम नवीनीकरण आवेदन पत्र दिनांक 31.01.07 को आगामी अवधि 20 वर्ष हेतु आवेदन शुल्क रू० 5000/- जरिये डी.डी. स० 427382 दिनांक 31.01.07 से कार्यालय खनि अभियंता अलवर में प्रस्तुत किया गया। आवेदित रिनीवल क्षेत्र की सूक्ष्म जाँच कराए जाने पर आवेदित क्षेत्र पूर्व घृत खनन पट्टा 123/88 के अनुरूप ही पाया गया। रिनीवल आवेदित क्षेत्र का संयुक्त सर्वे दिनांक 28.02.07 को वरिष्ठ सर्वेयर एवं हल्का पटवारी तिलवाड, राजगढ़ द्वारा किया गया। जिसके अनुसार आवेदित क्षेत्र ग्राम पालपुर के खसरा स० 302, 320, 302/475 एवं 319 क्रमशः बंजड एवं बरानी सोयम में आना प्रमाणित किया गया। आवेदित क्षेत्र की किस्म भूमि पर पर्यावरण एवं वन मंत्रालय भारत सरकार नई-दिल्ली की अधिसूचना दिनांक 07.05.92 व दिनांक 29.11.99 के प्रावधानों के तहत पर्यावरण अनुमति की आवश्यकता नहीं रहती है। खसरा स० 320 की खातेदारी व खसरा स० 302/475 के खातेदार द्वारा श्री प्रमोद गोयल के पक्ष में पंजीकृत सहमति की प्रति प्रस्तुत की गई है। आवेदित क्षेत्र सरिस्का बाघ परियोजना के 866 वर्ग०कि०मी० क्षेत्र से बाहर है। मार्बल कन्जर्वेशन एवं डवलपमेंट रूल्स 2002 के प्रावधानों के तहत अनुमोदित माईनिंग प्लान प्रस्तुत कर दिया गया है। शासन के परिपत्र दिनांक 29.03.03 के संदर्भ में पार्टी द्वारा प्रस्तुत ईको फ्रेण्डली माईनिंग प्लान का निरीक्षण कर प्रस्तुत कर दिया गया है। खनन पट्टे की वर्तमान में किसी प्रकार की बकाया अवशिष्ट नहीं है। पट्टेधारी श्री प्रमोद गोयल व उनकी पत्नी श्रीमती सुषमा गोयल के पक्ष में खनि अभियंता अलवर द्वारा बकाया नहीं के दो अलग-अलग प्रमाण पत्र दिनांक 24.02.07 को जारी किए जा चुके हैं। खनि अभियंता अलवर के पत्र क्रमांक: खअ/अल/अखप/नवीनी.07/07/317 दिनांक 04.04.07 के अनुसार नवीनीकरण बाबत आवेदित क्षेत्र अरावली हिल्स की श्रेणी में नहीं आता है। खनि अभियंता अलवर ने उपरोक्तानुसार निम्न शर्तों एवं प्रतिबंधों पर उक्त खनन पट्टे का नवीनीकरण स्वीकृति हेतु कार्यालय को प्रथम नवीनीकरण हेतु प्रस्तावित किया है, जिससे यह कार्यालय सहमत है। अतः राजस्थान अप्रधान खनिज रियायत नियमावली 1986 के नियम 17(ग) के अंतर्गत खनन पट्टे का नवीनीकरण निम्न शर्तों एवं प्रतिबंधों के आधार पर पट्टेधारी के पक्ष में अनुदान करने की एतद् द्वारा स्वीकृति प्रदान की जाती है:-



1. खनिज मार्बल
2. क्षेत्र 100 मी० X 100 मी० निकट ग्राम-खोह, तहसील राजगढ़, जिला-अलवर (मूल खनन पट्टा संख्या 123/88 रीभांकन अनुसार तथा ग्राम पालपुर के आराजी: खसरा स० 302, 319, 320 व 302/475 क्रमशः किस्म भूमि सि०च०० बरानी सोयम में स्थित है।)
3. अवधि 02.04.2008 से 01.04.2008 तक

Arun Kumar Yadav
RO/IAJM/242/2003/A
Valid upto-21-May-2013

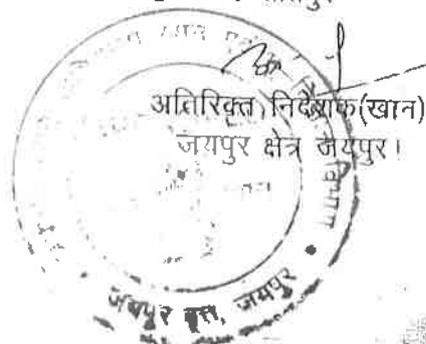
4. वार्षिक स्थिरभाटक : रूपये 2,03,969/- (अक्षरे दो लाख तीन हजार नौ सौ उनहत्तर मात्र) किन्तु प्रत्येक 5 वर्ष पर स्थिरभाटक का पुनर्निर्धारण किया जावेगा।
5. प्रतिभूति राशि : वार्षिक स्थिरभाटक की एक चौथान राशि राष्ट्रीय बचत पत्र / राष्ट्रीयकृत बैंक की सावधि जमा रसीद / नकद जमा के बैंक चालान के रूप में।
6. अधिशुल्क दर : राज0अप्रधान खनिज रियायत नियमावली 1986 के शिड्यूल प्रथम एवं इसमें समय-समय पर होने वाले संशोधनानुसार।
7. भूतल भाटक : जैसा कि राजस्व अधिकारी तय करें।
8. अन्य कर : राज्य सरकार व केन्द्र सरकार के नियमानुसार।
9. अन्य शर्तें : (1) राजस्थान अप्रधान खनिज रियायत नियमावली 1986 इसमें समय-समय पर होने वाले संशोधनों के अनुसार।
(2) मार्बल नीति 2002 मार्बल कन्जर्वेशन एवं डवलपमेंट रूल्स 2002 एवं खनिज नीति 1994 के प्रावधानों की पूर्ण पालना करनी होगी।
(3) अनुमोदित माईनिंग प्लान एवं ईको फ्रैण्डली माईनिंग प्लान अनुसार खनन कार्य करना होगा।
(4) खनन पट्टा क्षेत्र में निकलने वाले ऑवरबर्डन एवं टॉप सोयल को यथा स्थान संग्रहित कर उस पर वृक्षारोपण कराया जावेगा, साथ ही खनन पट्टा क्षेत्र के आस-पास व एंग्रोच रोड के दोनों ओर समुचित वृक्षारोपण कराना होगा।
(5) माननीय सर्वोच्च न्यायालय, उच्च न्यायालयों एवं अधिनस्थ न्यायालयों द्वारा समय-समय पर जारी आदेशों की पूर्ण पालना करनी होगी।
(6) केन्द्र सरकार व राज्य सरकार द्वारा समय-समय पर जारी विभिन्न आदेशों की तदानुसार पालना करनी होगी।
(7) संविदा का निष्पादन इस आदेश के जारी होने के 3 माह की अवधि में कराया जाना आवश्यक होगा।



अतिरिक्त निदेशक(खान)
जयपुर क्षेत्र जयपुर।
दिनांक: 05/4/07

क्रमांक:समसंख्यक/ 291
प्रतिलिपि निम्न को सूचनार्थ एवं आवश्यक कार्यवाही हेतु:-

1. कलेक्टर अलवर
2. अधीक्षण खनि अभियंत भरतपुर वृत भरतपुर।
3. उप वन संरक्षक अलवर।
4. उप पंजीयक, राजगढ, (अलवर)।
5. निदेशक, खान सुरक्षा अजमेर।
6. खनि अभियंता अलवर को उनके प्रस्ताव क्र0 294 दिनांक 23.03.07 के संदर्भ में भेजकर लेख है कि संविदा निष्पादन पश्चात संविदा की एक प्रति इस कार्यालय को भिजावे।
7. श्री प्रमोद कुमार गोयल पुत्र श्री जगदीश प्रसाद गोयल द्वारा मै0 तांतपुर एण्टरप्राइजेज, हीरादासा, भरतपुर।
8. रक्षित पत्रावली।



True Copy

Atul Kumar Yada
2007/AJM/242/2007

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/220274437>

Determination of the emission rate from various opencast mining operations

Article in *Environmental Modelling and Software* · December 2002

DOI: 10.1016/S1364-8152(02)00010-5 · Source: DBLP

CITATIONS

80

READS

2,417

6 authors, including:



M. Ahmad

Central Institute of Mining and Fuel Research

15 PUBLICATIONS 168 CITATIONS

[SEE PROFILE](#)



Raj S. Singh

Central Institute of Mining and Fuel Research

153 PUBLICATIONS 2,607 CITATIONS

[SEE PROFILE](#)



D. Pal

10 PUBLICATIONS 133 CITATIONS

[SEE PROFILE](#)



C. Bandopadhyay

2 PUBLICATIONS 89 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Conservation of medicinal plant [View project](#)



Development of feasibility assessment model for adaption of Underground Coal Gasification technology in North East region of India [View project](#)

DEVELOPMENT OF EMPIRICAL FORMULAE TO DETERMINE EMISSION RATE FROM VARIOUS OPENCAST COAL MINING OPERATIONS

S. K. CHAULYA*, M. K. CHAKRABORTY, M. AHMAD, R. S. SINGH, C. BONDYOPADHAY, G. C. MONDAL and D. PAL
Central Mining Research Institute, Barwa Road, Dhanbad – 826 0001, India
(* author for correspondence, e-mail: dhanbad@yahoo.com; fax 91 326202429)

(Received 2 May 2000; accepted 18 July 2001)

Abstract. All major mining activities, particularly opencast coal mining, directly or indirectly contribute to the problem of air pollution. Therefore, air quality assessment and prediction are required to prevent and minimize the air quality deterioration due to various opencast coal mining operations. Determination of emission rates for these activities is the first and foremost concern. In view of the above, this study was undertaken to determinate emission rates and to develop empirical formulae to calculate emission rates of various opencast coal mining activities. To achieve the objectives, seven coal mining sites were selected to generate site-specific emission data by considering mining practices, method of working, geographical location, accessibility and above all resource availability. The study covers various mining activities and locations including drilling, overburden loading and unloading, coal loading and unloading, the coal handling plant, the exposed overburden dump, the stock yard, the workshop, the exposed pit surface roads and haul roads. Based on the study, a set of twelve empirical formulae have been developed for calculation of suspended particulate matter (SPM) emission rates from various opencast coal mining activities. The emission of gaseous pollutants (sulphur dioxide and nitrogen oxide) has been found negligible for various mining activities. Therefore, observation for gaseous pollutants has been considered for overall mine activities and empirical formulae have subsequently been developed. The developed empirical formulae were calculated by a field study at another coal mine. The measured and calculated values of emission rate were compared for each activity. Average correlation between the measured and calculated values for different activities was estimated to be 85.6–99.9%, which indicates fairly good accuracy. Validation of the study was also carried out by means of the fugitive dust model (FDM) using the calculated emission rate data from the empirical formulae for each mining activity of a mine, meteorological data and other details as input. The average accuracy between measured and predicted values of concentration of SPM at certain receptor locations was found to be 79%. A user-friendly emission software called 'EmissCalc' was developed to calculate emission rate, which can be used as input for different air quality models.

Keywords: air pollution, dispersion modelling, emission rate, opencast coal mine

1. Introduction

Coal is the most abundant fossil fuel resource in India, which currently stands eighth in terms of total world coal resources, whereas it is fourth when identified reserves are considered. The challenge of increasing coal production to meet the ever-growing needs of the country has been admirably met by increasing coal



Water, Air, and Soil Pollution **140**: 21–55, 2002.
© 2002 Kluwer Academic Publishers. Printed in the Netherlands.

production from opencast mines. India has reached the forefront of the world coal scene, as it ranks fourth in total coal production and is the third largest coal producer from opencast mines (Chaulya and Chakraborty, 1995).

Coal mining is one of the core industries in India and plays a positive role in the economic development of the country. Its environmental impact cannot be ignored and, to some extent, is unavoidable as is evident in some other industries (Huchabee *et al.*, 1983; Wahid *et al.*, 1995; Singh *et al.*, 1996; Tichy, 1996). Most of the major mining activities contribute emissions of air pollutants leading directly or indirectly to the problem of air pollution at all points in the process, from exploration to exploitation and mineral processing (Sinha and Banerjee, 1994; CMRI, 1998). Therefore, a detailed study of emission sources (to determine the emission rates for various mining activities) and quantification of pollutant concentrations (by means of a dispersion model) is required to assess the environmental impact of a proposed opencast site (Perkins, 1974; Jones, 1993; Rao, 1996; CMRI, 1998; Chaulya *et al.*, 2001). Determination of emission rates by various mining activities, all of which have their own distinct characteristics, will help practicing mine environmental engineers and mine managers to gain advance information about the likely impact on air quality. On the basis of the predicted increments in air pollutant concentrations, effective mitigative measures, including green belt design, can be devised for sensitive areas (Kapoor and Gupta, 1984; NEERI, 1993; Shannigrahi and Agarwal, 1996; Sharma and Roy, 1977; Chaulya *et al.*, 2001).

Zeller *et al.* (1979), Cowherd (1982), USEPA (1995a) and Australia EPA (1996) have derived empirical formulae for the determination of emission rates for western surface coal mining activities. However, the emission rates in Indian mines are different from those in the US due to differences in the nature of mining, site practices and mitigation measures, and geological and climatic conditions (CMRI, 1998). Due to additional activities in Indian coal mines and these mines being different from coal mines of western countries, similar emission rates cannot be attributed to Indian mines. In India, limited studies have been conducted on the characteristics of dust from opencast mines by such researchers as Kumar *et al.* (1994), Sinha and Banerjee (1994), Sinha (1995), Sinha and Banerjee (1997), and Soni and Agarwal (1997). Subsequently, a detailed study was taken up by the Central Mining Research Institute, Dhanbad to determine emission rates from different opencast mining operations and to develop empirical formulae for each activity, along with user-friendly software.

This project was sanctioned by the Indian Ministry of Environment and Forest (MOEF) in 1997 and the work was completed in 1998. The Environmental Management group of the Central Mining Research Institute, Dhanbad, India performed a comprehensive field study and synthesized the results of this important field study in the laboratory. The investigations led to a set of empirical formulae and user-friendly programmes to calculate the emission rate of each activity. This is of great interest to mining environmental engineers working in the field of air pollution research and scientists studying air quality. A comprehensive description of the

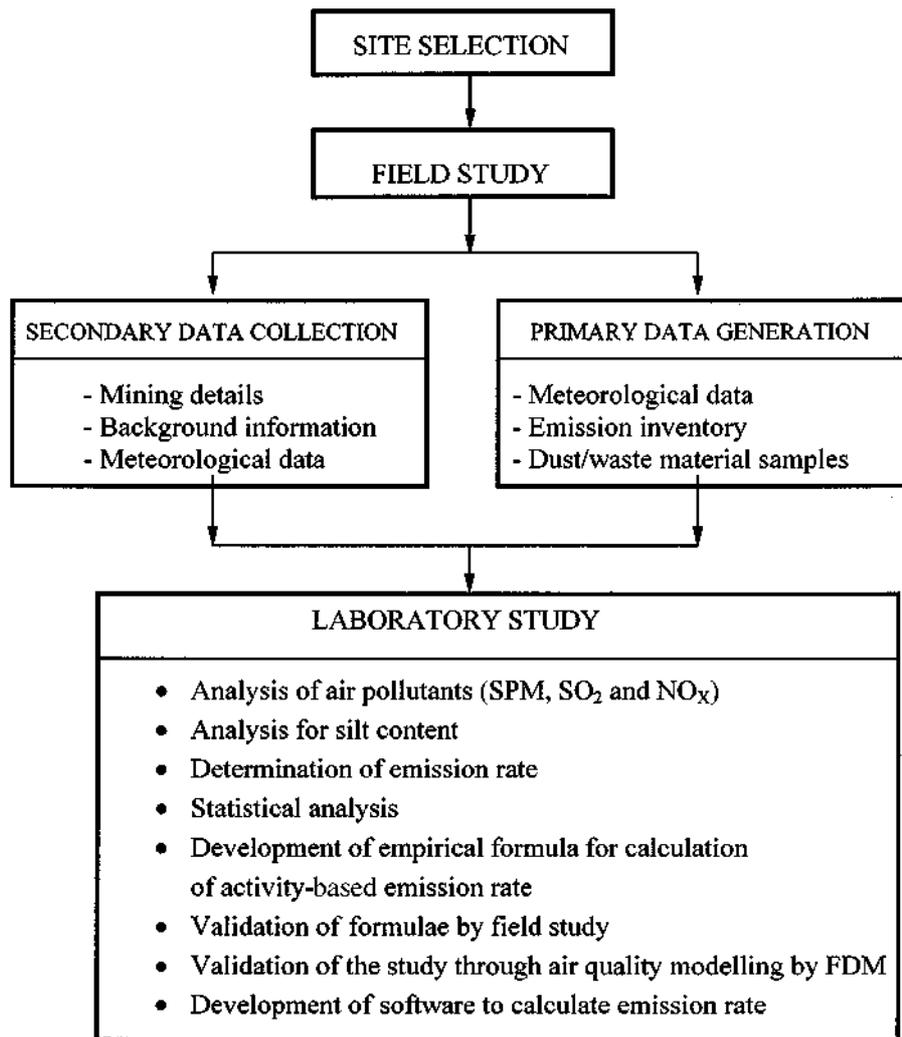


Figure 1. Schematic diagram of emission sources for Rajpura mine.

study sites, a detailed discussion of the methodology use in the study and results are all presented in this paper.

2. Methodology

2.1. APPROACH

The field-monitoring, laboratory-analysis and modelling procedures used to achieve the objectives of this study are outlined in the flow chart shown in Figure 1.

TABLE I
Air pollutant analysis methods

Parameter	Method	Instruments
SPM	Measurement of weight	High Volume Sampler (HVS) with an average flow rate more than $1.1 \text{ m}^3 \text{ min}^{-1}$
SO ₂	Improved West and Gaeke Method	HVS with gaseous sampling arrangement and spectrophotometer
NO _x	Jacob and Hochheiser modified method	HVS with sampling arrangement and spectrophotometer

Site selection: Study sites were selected on the basis of mining practice, method of working, location, accessibility and above all resource availability. A total of seven opencast coal mines were selected for development of activity-based empirical formulae, while another opencast coal mine was used in a validation study.

Secondary data collection: The secondary data regarding mining details, geology, meteorological data, etc. were collected from various sources, such as the mine plan, environmental management plan report and mine management personnel of the respective mine.

Primary data generation: Primary data for this project can be broadly categorised under three major sub-heading, namely, micro-meteorological data, emission inventory data and finally dust or waste material quality data (for parameters like silt content, moisture content, etc.). The study was conducted during the winter season (1997–98) to evaluate the worst possible scenario for air pollution.

Micro-meteorological data was generated for such parameters as wind speed, wind direction, ambient air temperature, relative humidity, total rainfall and barometric pressure. Emission data was generated for each and every type of mining activity as per the USEPA methodology (one high volume sampler at upwind direction and two at downwind direction at appropriate distances depending upon site accessibility). The mining activities and locations covered were drilling, overburden loading, coal loading, haul road, transport road, unloading of overburden, unloading of coal, stock yard exposed overburden dumps, coal handling plant, exposed pit face and workshop. Background air quality concentration of the respective mine (one high volume sampler at upwind and two at downwind directions of the mine) were monitored. Haul road dust and other samples were also collected and analysed for silt content. Moisture content analysis was carried out at the respective site.

2.2. MICRO-METEOROLOGICAL PARAMETERS

Hourly micro-meteorological parameters were generated by installing automatic weather monitoring stations at the respective study sites during the studied period (winter season). Long term meteorological data were also collected from the nearest meteorological station of the Indian Meteorological Department at the respective areas. A doppler Sound Detection And Ranging (SODAR) instrument was installed to generate detailed micro-meteorological data (including mixing height) at the Rajpura mine to validate air quality data. From these data, a windrose diagram was prepared with stability classes, including calms (defined as a wind speed less than 0.6 m s^{-1}). Atmospheric stability classes (Pasquill-Gifford) were computed using the Turner classification scheme (Hanna *et al.*, 1982; Viswanathan *et al.*, 1995; Hermann and Gottfried, 1997).

2.3. AIR QUALITY PARAMETERS

Air quality was measured by means of high volume samplers recording an average flow rate greater than $1.1 \text{ m}^3 \text{ min}^{-1}$. The parameters considered for field monitoring were Suspended Particulate Matter (SPM), Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NO_x). Twenty-four-hour mean samples of SPM, SO_2 and NO_x were obtained following the national ambient air quality standard (NAAQS) protocol. Analysis was carried out by the standard methods indicated in Table I (Stern, 1968); Monitoring at each point was triplicated and the average of the three readings was considered for the study. During the field study, it was found that SPM is the major source of emission from various opencast mining activities; whereas emission of SO_2 and NO_x were negligible. Therefore, SO_2 and NO_x emissions were measured on the basis of the total mine as a whole and not for each activity of the mine.

2.4. EMISSION INVENTORY

An emission inventory study was conducted to evaluate the amount of different pollutants contributed by each mining activity. The study was carried out for all the mining activities and locations e.g. drilling, haul road and transport road, loading, unloading, handling etc. Blasting was not taken into consideration, as it is an instantaneous source. The concentration of air pollutants with respect to different mining activities were collected in both upwind and downwind (two locations) directions. Difference in concentrations between the downwind (maximum of the two readings) and upwind directions was used to determine the emission rate for the respective mining operation. Emission rates from line and area sources were calculated by dividing emissions by the respective influencing zone for an activity involved in the field measurement. The following modified Pasquill and Gifford

formula for ground level emission was used to calculate the emission rate (Peavy *et al.*, 1985):

$$C_{x,0} = \frac{Q}{\pi u \sigma_y \sigma_z}$$

Where,

- $C_{x,0}$ = difference in pollutant concentration (downwind value – upwind value), g m^{-3}
- Q = pollutant emission rate, g s^{-1}
- π = pi. 3.14159
- u = mean wind speed, m s^{-1}
- σ_y = standard deviation of horizontal plume concentration, evaluated in terms of downwind distance x , m
- σ_z = standard deviation of vertical plume concentration, evaluated in terms of downwind distance x , m

To calculate activity-based emission rate, values of $C_{x,0}$ and u were generated by field monitoring in the respective mine. However, values of σ_y and σ_z were taken from the graph (relation of σ_y and σ_z with downwind distance from source), prepared by Peavy *et al.* (1985).

2.5. DEVELOPMENT OF EMPIRICAL FORMULAE

The emission rates calculated for different mining activities along with the key influencing parameters for seven mines were statistically analysed according to the procedures established by Snedecor and Cochran (1967). Regression analysis was carried out utilising different sets of variables. Empirical formulae were developed to calculate emission rates from various mining activities by considering the major influencing parameters for individual activities. The following steps were followed in sequential order to derive the empirical formulae:

- i) The data set with regards to each activity was segregated and tabulated, keeping in mind the different major parameters influencing the emission rate due to that particular activity.
- ii) Each data set was scanned to find out the degree of bias for the respective set, keeping in mind the boundary conditions of the parameters. The set of data, not confirming to the boundary conditions, was rejected.
- iii) Boundary conditions for each parameter were decided in a rational manner and correspondingly probable equation sets for each parameter were selected. It may be worth mentioning here that, for the purpose of simplicity, only those equations were considered which are either linear in nature or reducible to linear form. For all these equations, A and B are empirical constants. Some of the examples are given in Table II.

TABLE II
Examples of empirical equations considered for the evaluation

Parameters	Boundary conditions	Equations considered to satisfy boundary conditions
m = Moisture content (%) E = Emission rate	m = 0, E = α m = 100, E = 0	E = A {in(101)/in(m + 1) - 1} E = A[e ^{B(100-m)/m} - 1] E = A {(100-m)/m} ^B
S = Silt content (%) E = Emission rate	s = 0, E = 0 S = 100, E = α	E = A {in(101)/in(101 - s) - 1} E = A[e ^{B.s/(100-s)} - 1] E = A {s/(100-s)} ^B
Other parameters whose curves on X-Y passes through origin	X = 0, y = 0 X = α , y = α	y = A x ^B y = x/(A + Bx)
Parameters having multiplicative effect	x = 0, y = 0 x = α , y = α	y = A in(x + 1) y = A (e ^{Bx} - 1) y = A x ^B y = x/(A + Bx)
Parameters having additive effect	x = 0, y = A x = α , y = α	y = A e ^{Bx} y = A + Bx

- iv) Permutation and combination of all equations for each of the parameters involved in a particular activity were used to arrive at the best fit equation, by means of an indigenously developed statistical software. For example, an activity having only three parameters, like moisture content, silt content and wind speed; $3 \times 3 \times 4 = 36$ various combination of equations have been tried and the best fit of these 36 combinations has been accepted.
- v) Finally, the accepted values of the empirical constants (up to two places of decimal) of the best fit equations were evaluated based on the actual data used in the research method. In case of power constants, the values were restricted to a single place after decimal because that was sufficient to arrive at a correlation coefficient of more than 0.9 between the actual measured value and predicted value generated by the empirical equations.

2.6. VALIDATION STUDY

To validate the developed empirical formula for each mining activity emission inventory, the study was carried out at the Rajpura opencast coal mine according to

the above mentioned methodology. The emission rates measured for different mining activities has been compared with the calculated value derived from empirical formula for each activity. The results have been statistically analysed to validate the accuracy of the developed formulae (Snedecor and Cochran, 1967).

Similarly, modelling exercise was carried out for the mine by applying the calculated emission rate from a derived empirical formula for each mining activity as input for the model along with micro-meteorological parameters and other details. The predicted concentration of SPM at the selected receptor locations has been compared with the measured data at the field for validation study. Various models have been developed by USEPA for air quality modelling. Different models are applicable for different types of sources and different topographic features, characterising different needs like short and long term predictions and local or regional predictions. The present study sites are almost level and activities are localised but all three types of sources namely point, area and line are present. Therefore, FDM model has been used for the validation study.

Baseline monitoring data was generated for the winter season and modelling was carried out for this season, to validate the developed empirical formulae for emission rate. FDM is a computerized Gaussian plume dispersion model, specifically developed by the United States Environmental Protection Agency (USEPA) for the estimation of particulate concentrations (USEPA, 1995). The basic model incorporates a detailed deposition routine based on the equations of Ermak (1977). The sources may be point, line or area. The model can process up to 1200 receptors and 121 sources. The line source and area source algorithms are based on algorithms in the CALINE3 Model (California Department of Transportation, 1979). FDM employs an advanced gradient transfer particle deposition algorithm (Horst, 1977; Hanna *et al.*, 1981).

An average of winter season hourly micro-meteorological parameters over 24 hrs were assigned as an input for the model. Utilising the mine plan of the Rajpura mine (for locating different activities), activity-based emission rates and meteorological data as input, FDM was run. Emission sources were placed in three categories: point, line and area sources. All these sources are numbered and shown in Figure 2. Numbers 1–48 represent line sources (1–26 transport roads and 27–48 haul roads), 49–56 area sources (49–50 exposed overburden dumps, 51 stock yard, 52 workshop and 53–56 exposed pit faces) and 57–63 point sources (57–58 drilling points, 59 coal handling point, 60 coal unloading point, 61 overburden loading point and 62–63 overburden unloading points). Therefore, a total of 7 point sources, 48 line sources and 8 area sources were defined as input for the model. Line sources were broken into small segments to convert the curvilinear source to line sources and area sources were broken into small area sources to avoid exceeding the maximum width-length ratio of 1:5. An emission rate was assigned to each activity as calculated by the developed empirical formulae for each mining activity. A total of 9 receptor locations (A1-A9, as indicated in Figure 2) were selected, ground level SPM concentration predicted for each of them and also actual field measurements

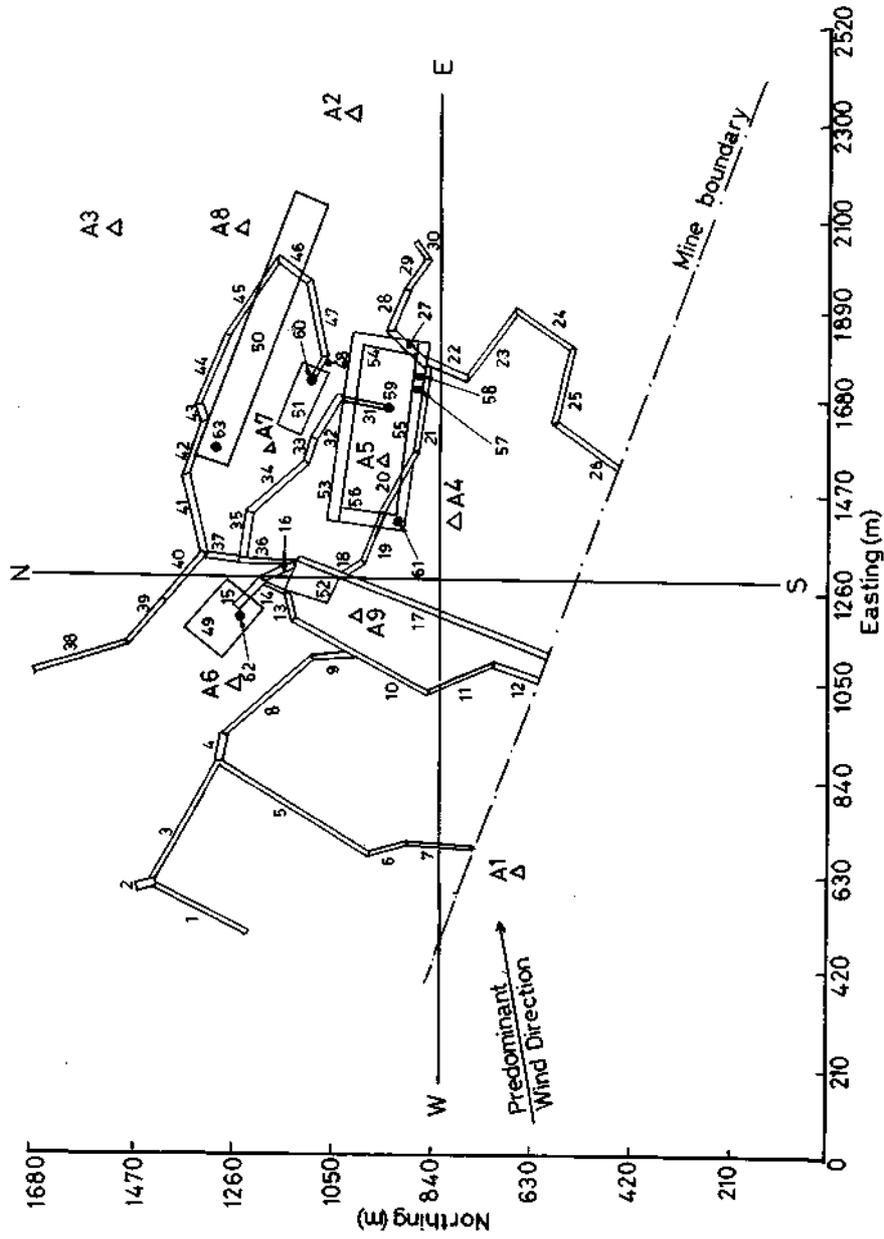


Figure 2. Approach for the study.

TABLE III
Brief location data of the study sites

Sl.	Name of the mine	Location			Coalfield	Company
		District	State	Latitude (N)		
1.	Sasti	Chandrapur	Maharastra	18°48'05"	79°18'25"	Wardha Valley WCL
2.	Lakhanpur	Jharsuguda	Orissa	21°45'15"	83°50'38"	Ib Valley MCL
3.	Belpahar	Jharsuguda	Orissa	21°46'10"	83°51'52"	Ib Valley MCL
4.	Ananta	Angul	Orissa	20°59'13"	85°09'05"	Talcher MCL
5.	Jagannath	Dhenkanal	Orissa	20°56'20"	85°08'10"	Talcher MCL
6.	Block II	Dhanbad	Bihar	23°46'05"	86°12'31"	Jharia BCCL
7.	Kusunda	Dhanbad	Bihar	23°47'25"	86°14'15"	Jharia BCCL
8.	Rajpura	Burdwan	West Bengal	23°46'55"	86°43'45"	Raniganj ECL

Key: WCL – Western Coalfields Limited, MCL – Mahanadi Coalfields Limited, BCCL – Bharat Coking Coal Limited, ECL – Eastern Coalfields Limited.

TABLE IV
Background information of the study sites

Sl.	Name of the mine	Surface reduced level (m)	Climate		Mining details		
			Annual rainfall (mm)	% of calm	Leasehold area (ha)	Annual production (Mt)	Striping ratio ($\text{m}^3 \text{t}^{-1}$)
1.	Sasti	270–282	1250	34.8	653.9	1.0	3.70
2.	Lakhanpur	198–250	1400	38.4	1260.0	1.0	1.01
3.	Belpahar	199–251	1400	38.4	1601.0	2.0	2.31
4.	Ananta	95–125	1200	40.0	572.0	4.0	0.51
5.	Jagannath	102–127	1150	38.3	793.2	4.0	0.60
6.	Block II	176–240	1375	39.1	755.5	2.5	4.49
7.	Kusunda	160–226	1400	38.4	235.3	1.5	3.20
8.	Rajpura	93–127	1450	32.7	174.0	1.0	2.30

were made. The model predicts the pollutant concentration at the selected receptor locations and these values are compared with the measured values generated during the field study at that particular site.

2.7. LIMITATIONS AND ASSUMPTIONS

An emission inventory study was carried out only during the winter season (1997–98) to determine the worst possible emission rate. This emission rate would be

TABLE V
Activity-based SPM emission inventory at Sasti mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1410	1805	1261	544	2.0	14	8	g s^{-1}	0.3825
Overburden loading	1202	1596	1100	496	2.4	14	8	g s^{-1}	0.4186
Coal loading	1798	2166	1712	554	2.5	14	8	g s^{-1}	0.4872
Haul road	2041	2615	1369	1246	3.0	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0132
Transport road	2184	2747	1496	1251	3.2	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0140
Overburden unloading	1078	1552	902	650	1.7	20	16	g s^{-1}	1.1103
Coal unloading	1454	1950	1203	747	2.9	14	8	g s^{-1}	0.7618
Exposed overburden dump	1069	1440	1021	419	2.4	24	16	$\text{g s}^{-1} \text{m}^{-2}$	0.00003675
Stock yard	1465	1903	1011	892	2.7	14	8	$\text{g s}^{-1} \text{m}^{-2}$	0.0002066
Coal handling plant	3099	3906	1815	2091	2.2	14	8	$\text{g s}^{-1} \text{m}^{-2}$	0.000647
Workshop	1272	1548	1052	496	1.9	25	15	$\text{g s}^{-1} \text{m}^{-2}$	0.000111
Exposed pit surface	981	1258	920	338	1.2	15	32	$\text{g s}^{-1} \text{m}^{-2}$	0.00001528
Overall mine	452	692	338	354	3.2	110	58	g s^{-1}	21.984425

useful to predict the maximum concentration of pollutants by modelling, and the data may also be used for greenbelt designs and air pollution management. Input data on emission rates from various activities were calculated based on the assumption that one activity in a mine does not influence other activities. The empirical formula developed for each activity is based on field studies at seven opencast coal mines and the averages of three readings at each monitoring station. The sink potentials of the pollutants in the field, resulting from forests, green cover, etc. and obstructions by buildings, dumps, etc. could not be taken into account in the developed empirical formulae and also during air quality modelling. The FDM model used for air quality modelling cannot include terrain features, and the model can be used only for local scale predictions (USEPA, 1995). However, this model offers improved performance over both the Industrial Source Complex Model (USEPA, 1995) and also the Point, Area and Line (PAL 2) source model (CMRI, 1998). Emissions of SPM from combustion of diesel fuel and blasting was not quantified nor modelled.

TABLE VI
Activity-based SPM emission inventory at Lakhanpur mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1235	1663	1048	615	1.5	18	12	g s^{-1}	0.6257
Overburden loading	1368	1706	1080	626	21.9	14	8	g s^{-1}	0.4176
Coal loading	1430	1814	1162	652	2.6	14	8	g s^{-1}	0.5733
Haul road	1741	2120	1098	1032	2.3	14	8	$\text{g s}^{-1} \text{ m}^{-1}$	0.0085
Transport road	1592	1984	1024	960	2.5	14	8	$\text{g s}^{-1} \text{ m}^{-1}$	0.00844
Overburden unloading	1281	1693	1041	652	2.6	20	12	g s^{-1}	1.2775
Coal unloading	1420	1895	1133	762	2.3	14	8	g s^{-1}	0.6164
Exposed overburden dump	932	1178	848	330	2.8	30	20	$\text{g s}^{-1} \text{ m}^{-2}$	0.0000387
Stock yard	1198	1612	975	637	1.5	18	12	$\text{g s}^{-1} \text{ m}^{-2}$	0.000160
Coal handling plant	1810	2243	1015	1228	2.0	14	8	$\text{g s}^{-1} \text{ m}^{-2}$	0.000432
Workshop	1040	1258	866	392	1.6	26	16	$\text{g s}^{-1} \text{ m}^{-2}$	0.000082
Exposed pit surface	976	1205	890	315	1.5	26	16	$\text{g s}^{-1} \text{ m}^{-2}$	0.0000154
Overall mine	510	730	395	335	2.5	120	65	g s^{-1}	20.5121

3. Study sites

To generate site-specific emission data for various opencast mining activities, different study sites were selected as discussed earlier. Sasti, Lakhanpur, Belpahar, Ananta, Jagannath, Block II and Kusunda mines were selected as the sites used in developing activity-based empirical formulae, and the Rajpura mine was chosen for the validation study. Therefore, a total of eight opencast coal mines have been studied in the present work. Brief data for all eight sites are given in Table III, while summaries of topography, climate and mining details are included in Table IV.

4. Results and Discussion

4.1. EMISSION INVENTORY

Activity-based emission inventory data for the eight opencast coal mines are presented in Tables V-XII. SPM concentrations were measured at three locations viz.

TABLE VII
Activity-based SPM emission inventory at Belpahar mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1319	1604	997	607	2.3	14	8	g s^{-1}	0.4910
Overburden loading	1276	1752	1165	587	1.3	18	12	g s^{-1}	0.5176
Coal loading	1384	1715	1114	637	1.3	18	12	g s^{-1}	0.5617
Haul road	1548	2045	980	1065	2.4	148	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0090
Transport road	1680	2017	1075	942	1.8	18	12	$\text{g s}^{-1} \text{m}^{-1}$	0.0115
Overburden unloading	1238	1605	1003	602	2.7	20	12	g s^{-1}	1.2249
Coal unloading	1424	1862	1075	787	2.1	14	8	g s^{-1}	1.1500
Exposed overburden dump	1030	1304	865	439	1.9	15	32	$\text{g s}^{-1} \text{m}^{-2}$	0.0000393
Stock yard	1165	1580	942	638	2.0	14	8	$\text{g s}^{-1} \text{m}^{-2}$	0.0001869
Coal handling plant	2054	2410	1114	1296	1.7	18	12	$\text{g s}^{-1} \text{m}^{-2}$	0.000428
Workshop	968	1332	872	460	1.4	25	15	$\text{g s}^{-1} \text{m}^{-2}$	0.0000628
Exposed pit surface	1004	1238	829	409	1.1	15	32	$\text{g s}^{-1} \text{m}^{-2}$	0.0000160
Overall mine	524	742	380	362	2.9	120	65	g s^{-1}	25.7117

one upwind and two downwind from each mine (DN1 and DN2, minimum and maximum SPM concentration in the downwind direction, respectively). The value of horizontal (σ_y) and vertical (σ_z) dispersion co-efficients, calculated according to methodology described earlier are also included in the tables. Maximum possible emission rates for different activities were calculated as the difference in measured values of SPM concentration ($C_{x,0}$) between downwind (maximum concentration) and upwind directions (UP). As mentioned earlier, activity-based emissions of SO_2 and NO_x are negligible. Therefore, emission rates for SO_2 and NO_x have been calculated for the whole mine. The summary of these results are shown in Tables XIII and XIV, for SO_2 and NO_x respectively. Various parameters affecting the emission rate of each respective activity were collected or measured in the field over the study day, and the average value of all the influencing parameters is given in Table XV for all activities. The moisture content of different materials was determined along with the emission rate measurements made in the field, and average values are given in Table XV. Similarly, the silt contents of different materials were obtained by analysis in the laboratory, and average values for the

TABLE VIII
Activity-based SPM emission inventory at Ananta mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1232	1708	943	765	2.2	14	8	g s^{-1}	0.5919
Overburden loading	1741	2228	1290	938	1.5	8	12	g s^{-1}	0.4241
Coal loading	1492	1905	1207	698	2.4	14	8	g s^{-1}	0.5891
Haul road	1758	2095	1108	987	2.7	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0094
Transport road	1824	2216	1134	1082	2.8	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0106
Overburden unloading	1364	1778	1106	640	2.6	20	12	g s^{-1}	1.254
Coal unloading	1534	1958	1220	738	2.0	14	8	g s^{-1}	0.5192
Exposed overburden dump	1018	1372	890	482	1.4	15	32	$\text{g s}^{-1} \text{m}^{-2}$	0.0000363
Stock yard	1243	1665	951	704	1.9	18	12	$\text{g s}^{-1} \text{m}^{-2}$	0.000216
Coal handling plant	2212	2708	1287	1421	1.6	18	12	$\text{g s}^{-1} \text{m}^{-2}$	0.000514
Workshop	934	1224	759	465	1.6	25	15	$\text{g s}^{-1} \text{m}^{-2}$	0.0000100
Exposed pit surface	884	1175	763	412	2.5	18	8	$\text{g s}^{-1} \text{m}^{-2}$	0.0000149
Overall mine	578	770	372	398	2.1	114	68	g s^{-1}	20.3444

respective samples collected during the study day are also presented in Table XV. It has been observed that the coal handling plant (CHP), haul road and transport roads are the major sources of emission from the mines. Due to occasional rain during the study period at almost all the mines, variation in the moisture and silt contents of different materials and thereby emission rates for various activities were observed. These key influencing parameters and measured emission rates for each mining activity were utilised to construct empirical formulae.

4.2. DEVELOPMENT OF EMPIRICAL FORMULAE

Based on the procedure described above, a set of twelve different empirical formulae were finalized to calculate activity-based the SPM emission rates from coal mining activities (Table XVI). The formulae have developed for the following opencast coal mining activities and locations:

- i) Drilling.
- ii) Overburden (OB) loading.
- iii) Coal loading.

TABLE IX
Activity-based SPM emission inventory at Jagannath mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1224	1678	946	732	1.1	18	12	g s^{-1}	0.5461
Overburden loading	964	1485	780	705	2.3	14	8	g s^{-1}	0.5702
Coal loading	1531	1828	1156	672	2.5	14	8	g s^{-1}	0.5908
Haul road	1762	2186	1080	1106	2.5	14	8	$\text{g s}^{-1} \text{ m}^{-1}$	0.00973
Transport road	1834	2181	1146	1035	2.7	14	8	$\text{g s}^{-1} \text{ m}^{-1}$	0.00983
Overburden unloading	1048	1509	769	740	2.5	20	12	g s^{-1}	1.3940
Coal unloading	1467	1872	1147	725	2.1	14	8	g s^{-1}	0.5354
Exposed overburden dump	1055	1336	871	465	1.3	15	32	$\text{g s}^{-1} \text{ m}^{-2}$	0.0000365
Stock yard	1229	1608	953	655	1.5	18	12	$\text{g s}^{-1} \text{ m}^{-2}$	0.000238
Coal handling plant	2090	2632	1254	1378	1.7	18	12	$\text{g s}^{-1} \text{ m}^{-2}$	0.0005295
Workshop	884	1178	668	510	1.9	28	18	$\text{g s}^{-1} \text{ m}^{-2}$	0.000051
Exposed pit surface	780	1080	622	458	2.1	18	8	$\text{g s}^{-1} \text{ m}^{-2}$	0.0000134
Overall mine	560	745	320	425	2.4	95	60	g s^{-1}	18.2560

- iv) Haul road.
- v) Transport road.
- vi) Overburden loading.
- vii) Coal unloading.
- viii) Exposed overburden dump.
- ix) Stock yard.
- x) Coal handling plant.
- xi) Workshop, and
- xii) Exposed pit surface.

An Empirical formula was also developed for the SPM emission rate for the whole mine. It has already been mentioned that emission of gaseous pollutants (SO_2 and NO_x) was found to be negligible for the individual activities involved. Therefore, empirical formulae for overall mine only were developed for SO_2 and NO_x emissions as shown in Tables XVII and XVIII.

TABLE X
Activity-based SPM emission inventory at Block II mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1362	1812	997	815	1.2	18	8	g s^{-1}	0.4422
Overburden loading	1408	1753	1061	692	2.0	14	8	g s^{-1}	0.4867
Coal loading	1628	2192	1477	715	2.3	14	8	g s^{-1}	0.5783
Haul road	1852	2484	1306	1178	1.8	18	12	$\text{g s}^{-1} \text{m}^{-1}$	0.0144
Transport road	2240	2768	1471	1293	3.2	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0146
Overburden unloading	1284	1673	1086	587	1.8	24	16	g s^{-1}	1.2740
Coal unloading	1552	2073	1271	802	2.6	14	8	g s^{-1}	0.7333
Exposed overburden dump	1128	1475	1043	432	2.1	24	16	$\text{g s}^{-1} \text{m}^{-2}$	0.0000377
Stock yard	1592	2015	1078	937	1.9	18	12	$\text{g s}^{-1} \text{m}^{-2}$	0.000237
Coal handling plant	3088	3740	1819	1921	2.2	14	8	$\text{g s}^{-1} \text{m}^{-2}$	0.000572
Workshop	1276	1624	1096	528	2.1	18	8	$\text{g s}^{-1} \text{m}^{-2}$	0.000100
Exposed pit surface	915	1192	872	320	0.8	15	32	$\text{g s}^{-1} \text{m}^{-2}$	0.0000129
Overall mine	462	703	348	365	2.8	114	68	g s^{-1}	24.8768

4.3. VALIDATION

Field measurements: For Rajpura mine, field measured and calculated values are listed in Table XIX. The accuracy between field measurement value and calculated value from empirical formulae was found to vary between 85.6 and 99.0% which indicated fairly good accuracy.

Air pollution modelling: Hourly micro-meteorological data for the winter season (1997–98), i.e. during the study period, are represented in the Table XX. All the data represented are average values for the study period. In the modelling exercise, SPM concentration at 9 receptor locations was predicted. The predicted values at receptor locations were added to the regional background level (i.e. $365 \mu\text{g m}^{-3}$) to get the total predicted 24-hr average SPM concentration. Regional background SPM concentration is the minimum of the 24-hr average monitored data in the upwind direction. The predicted and observed SPM concentrations at the receptor locations for different mines are listed in Table XXI.

TABLE XI
Activity-based SPM emission inventory at Kusunda mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate	
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value
Drilling	1276	1585	973	612	1.0	18	12	g s^{-1}	0.4151
Overburden loading	1124	1581	965	616	1.1	18	12	g s^{-1}	0.4596
Coal loading	1516	1928	1160	768	2.0	14	8	g s^{-1}	0.5402
Haul road	2032	2528	1256	1272	2.5	14	8	$\text{g s}^{-1} \text{ m}^{-1}$	0.0112
Transport road	1978	2678	1475	1203	2.8	14	8	$\text{g s}^{-1} \text{ m}^{-1}$	0.0119
Overburden unloading	1334	1705	1061	644	1.9	18	12	g s^{-1}	0.8299
Coal unloading	1468	1894	1182	712	1.2	18	12	g s^{-1}	0.5795
Exposed overburden dump	1015	1362	922	440	2.0	24	16	$\text{g s}^{-1} \text{ m}^{-2}$	0.0000354
Stock yard	1476	1974	1029	945	1.1	18	12	$\text{g s}^{-1} \text{ m}^{-2}$	0.0001763
Coal handling plant				Not present				$\text{g s}^{-1} \text{ m}^{-2}$	–
Workshop	1349	1632	1124	508	2.3	18	8	$\text{g s}^{-1} \text{ m}^{-2}$	0.000088
Exposed pit surface	1028	1264	914	350	1.1	15	32	$\text{g s}^{-1} \text{ m}^{-2}$	0.0000155
Overall mine	472	744	360	384	2.1	110	58	g s^{-1}	16.15478

The performance of the FDM model was evaluated using a set of statistical parameters. The various statistical parameters calculated were correlation coefficients, regression coefficients and index of agreement. Correlation coefficients provide an idea how far the measured values are related to predicted values. Regression coefficients represent the status of the best fit line between measured and predicted values. The index of agreement shows the degree to which the model predictions are error free.

The value of the correlation coefficient for FDM was calculated as 0.894, which shows a fairly good agreement between measured and predicted values. Linear regression coefficients a and b were calculated to be 0.963 and 51.957, respectively. The values of the index of agreement show the extent to which the model performs correctly. Here, the average index of agreement value for FDM has been calculated as 0.79 which indicates that the predictions by FDM model is 79% accurate. The variation between measured and predicted values may be due to non-accountable emissions from various other mining and non-mining sources and activities, like blasting, domestic use of fuels, transportation network, etc. Overlapping of emis-

TABLE XII
Activity-based SPM emission inventory at Rajpura mine

Activity	SPM conc. ($\mu\text{g m}^{-3}$)				Wind vel., u (m s^{-1})	Diffusion coefficient		Emission rate		
	DN1 (Min.)	DN2 (Max.)	UP	$C_{x,0}$ (DN2 -UP)		σ_y	σ_z	Unit	Value	
Drilling	1340	1758	1233	525	2.1	14	8	g s^{-1}	0.3877	
Overburden loading	1234	1660	1108	552	2.4	14	8	g s^{-1}	0.4659	
Coal loading	1648	2092	1377	715	2.1	14	8	g s^{-1}	0.5281	
Haul road	1963	2498	1336	1162	3.1	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0127	
Transport road	2015	2605	1387	1218	3.1	14	8	$\text{g s}^{-1} \text{m}^{-1}$	0.0132	
Overburden unloading	1195	1605	942	663	1.9	18	12	g s^{-1}	0.8544	
Coal unloading	1438	1897	1135	762	2.0	14	8	g s^{-1}	0.5360	
Exposed overburden dump	1030	1387	1002	385	2.5	24	16	$\text{g s}^{-1} \text{m}^{-2}$	0.0000363	
Stock yard	1482	1872	1027	845	1.8	14	8	$\text{g s}^{-1} \text{m}^{-2}$	0.0001981	
Coal handling plant			Not present						$\text{g s}^{-1} \text{m}^{-2}$	–
Workshop	1062	1478	1040	438	1.7	25	15	$\text{g s}^{-1} \text{m}^{-2}$	0.0000878	
Exposed pit surface	1015	1357	985	372	1.0	15	32	$\text{g s}^{-1} \text{m}^{-2}$	0.0000160	
Overall mine	469	713	365	348	2.7	95	60	g s^{-1}	16.81695	

sion rates for different activities, and failure to consider obstructions like buildings, dumps, etc.; protection measures like water sprinkling, dust arrestors, etc.: and sink potential from vegetation, forests, on green belt are also major causes for differences between predicted and measured values of SPM concentrations (Hosker, 1974; Slinn, 1982).

4.4. SOFTWARE

A user-friendly and totally menu-driven software named 'EmissCalc' was developed on the 'Dbase' platform to calculate emission rates for various mining activities. The software generates the expected emission loads from the different opencast coal mining operations on receipt of data related to various influential parameters such as those as mentioned earlier. Figure 3 illustrates the flow chart of the software.

The opening menu of the software receives information about the emission types e.g. particulate or gaseous. In the next sub-level, the menu selection decides the particular operation for the emission rate to be generated, in case of particulate

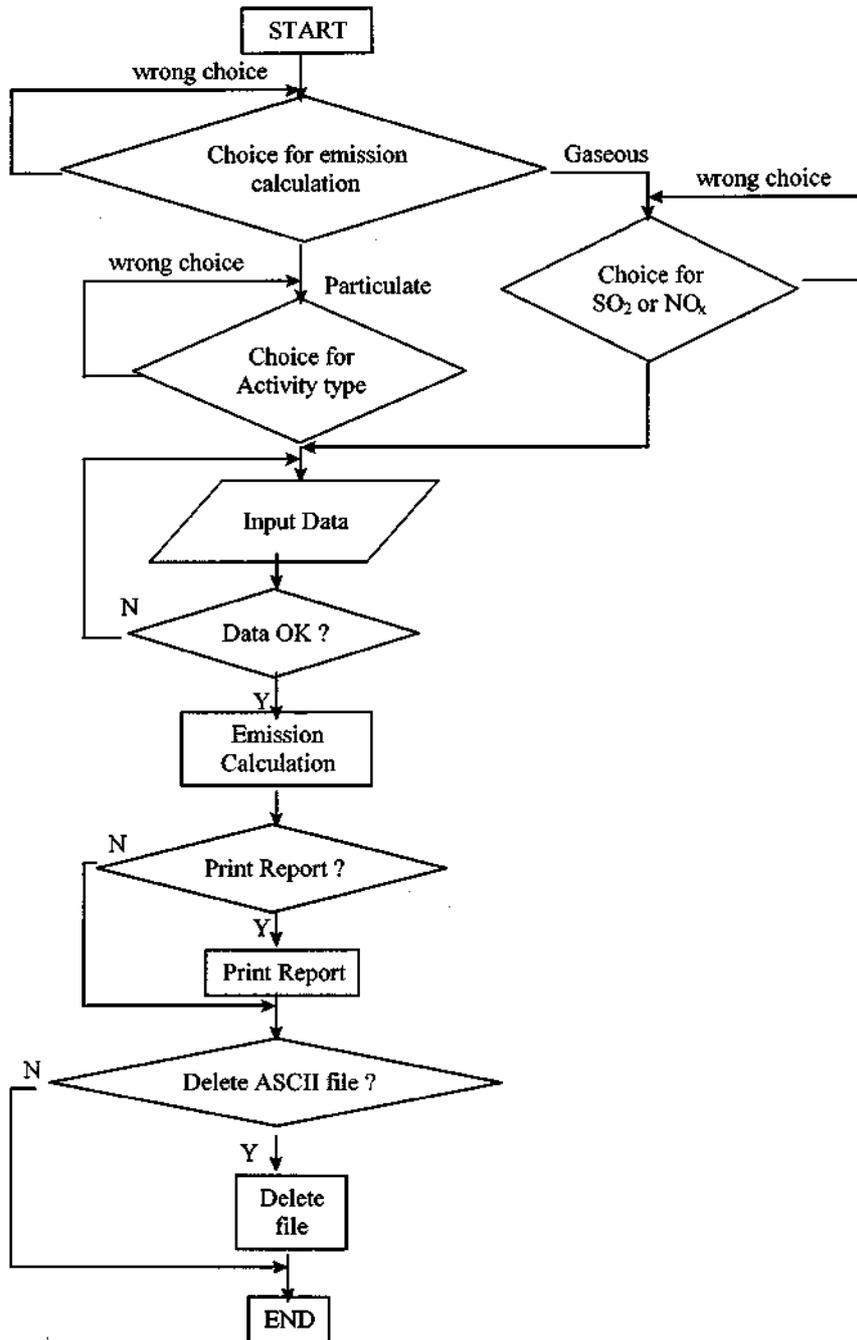


Figure 3. Flow diagram for emission calculation using 'EmissCalc'.

TABLE XIII
SO₂ emission inventory for different mines

Name of the mine	SO ₂ concentration ($\mu\text{g m}^{-3}$)				Wind speed u (m s^{-1})	Dispersion coefficient		Emission rate (g s^{-1})
	DN1 (Min.)	DN2 (Max.)	UP	C _{x,0} (DN2 -UP)		σ_y	σ_z	
Sasti	45	48	35	13	3.2	110	58	0.8334
Block II	58	62	42	20	2.8	114	68	1.3631
Kusunda	48	55	34	21	2.1	110	58	0.8835
Lakhanpur	52	59	37	22	2.5	120	65	1.3471
Belpahar	49	54	36	18	2.9	120	65	1.2785
Ananta	56	60	37	23	2.1	114	68	1.1757
Jagannath	52	57	35	22	2.4	95	60	0.9450
Rajpura	50	54	38	16	2.7	95	60	0.7732

TABLE XIV
NO_x emission inventory for different mines

Name of the mine	SO ₂ concentration ($\mu\text{g m}^{-3}$)				Wind speed u (m s^{-1})	Dispersion coefficient		Emission rate (g s^{-1})
	DN1 (Min.)	DN2 (Max.)	UP	C _{x,0} (DN2 -UP)		σ_y	σ_z	
Sasti	49	52	43	9	3.2	110	58	0.5770
Block II	54	58	48	10	2.8	114	68	0.6816
Kusunda	52	57	44	13	2.1	110	58	0.5469
Lakhanpur	56	60	46	14	2.5	120	65	0.8572
Belpahar	52	56	45	11	2.9	120	65	0.7813
Ananta	51	54	40	14	2.1	114	68	0.7156
Jagannath	57	61	45	16	2.4	95	60	0.6873
Rajpura	44	48	41	7	2.7	95	60	0.3383

emission. In case of gaseous emission, it will allow the user to select emissions generated for either SO₂ or NO_x. On receipt of all the input parameters and subsequent confirmation about the accuracy of the data; the emission load is generated and all the input as well as the generated data are stored in the databases. The data can be printed only upon expressed request by the user. Thereafter an ASCII (*.txt)

TABLE XV
Activity-based SPM emission inventory of the study sites

Activity	Source type	Parameters	Unit	Name of the mine								
				Sasti	Block II	Kusunda	Lakhanpur	Belpahar	Ananta	Jagannath Rajpura		
Drilling	Point	Moisture content	%	8.9	7.4	7.6	7.2	7.8	7.6	7.8	8.3	
		Silt content of cuttings	%	34	38	38.8	39.2	36.5	38.8	36.2	36.2	36
		Wind speed	m s ⁻¹	2	1.2	1	1.5	2.3	2.2	1.1	1.1	2.1
		Hole diameter	mm	150	200	160	160	150	200	200	200	150
		Frequency of drilling	No. of holes day ⁻¹	11	17	17	57	23	27	27	27	11
Emission rate				0.3825	0.4422	0.4151	0.6257	0.4910	0.5919	0.5461	0.3877	
Overburden loading	Point	Moisture content	%	8.6	7.6	7.8	8.7	7.4	8.5	7.3	8	
		Silt content of loading materials	%	13.2	13.6	13.8	13.5	14.5	14.6	14.6	14.6	13.0
		Wind speed	m s ⁻¹	2.4	2	1.1	1.9	1.3	1.5	2.3	2.3	2.4
		Drop height	m	1.5	1.4	1.5	1.6	1.6	1.4	1.5	1.5	1.3
		Size of loader	m ³	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
		Frequency of loading	no. h ⁻¹	22	23	22	24	24	24	24	24	23
Emission rate				0.4186	0.4867	0.4596	0.4176	0.5176	0.4241	0.5702	0.4659	
Coal loading	Point	Moisture content	%	8.7	8.1	8.0	8.2	8.4	8.3	7.4	7.9	
		Silt content of loading materials	%	9.0	10.9	10.6	10.5	10.2	12.1	11.4	11.4	9.2
		Wind speed	m s ⁻¹	2.5	2.3	2.0	2.6	1.3	2.4	2.5	2.5	2.1
		Drop height	m	1.0	0.9	0.8	0.9	1.0	0.8	0.9	0.9	0.8
		Size of loader	m ³	2.0	4.6	4.6	4.6	2.0	4.6	4.6	4.6	4.6
		Frequency of loading	no. h ⁻¹	28	23	22	24	30	24	24	24	22
Emission rate				0.4872	0.5783	0.5402	0.5733	0.5617	0.5891	0.5908	0.5281	

TABLE XV
continued

Activity	Source type	Parameters	Unit	Name of the mine								
				Sasti	Block II	Kusunda	Lakhanpur	Belpahar	Ananta	Jagannath	Rajpura	
Haul road	Line	Moisture content of haul road dust	%	15.2	12.4	18.4	22.3	22.0	20.9	20.6	18.5	
		Silt content of haul road	%	32.0	34.5	30.0	29.0	30.6	32.4	31.5	32.0	
	Dust	Wind speed	m s ⁻¹	3.0	1.8	2.5	2.3	2.4	2.7	2.5	2.5	3.1
		Average vehicle speed	m s ⁻¹	2.7	2.6	2.5	2.7	2.7	2.7	2.7	2.6	2.5
		Frequency of vehicle movement	no. h ⁻¹	12	18	16	22	15	16	17	17	11
		Capacity of dumpers	t	35	35	35	35	35	35	35	35	35
Transport road	Line	Emission rate	g s ⁻¹ m ⁻¹	0.0132	0.0144	0.0112	0.0085	0.0090	0.0094	0.0097	0.0127	
		Moisture content of transport road dust	%	10.5	09.8	17.0	20.2	19.2	19.8	19.9	16.1	
	road	Silt content of haul road dust	%	29.9	30.0	27.5	26.0	27.3	28.8	28.6	30.8	
		Wind speed	m s ⁻¹	3.2	3.2	2.8	2.5	1.8	2.8	2.7	3.1	
		Average vehicle speed	m s ⁻¹	10	10	10	11	11	10	11	10	
		Frequency of vehicle movement	no. h ⁻¹	18	27	24	28	22	24	26	16	
Emission rate	g s ⁻¹ m ⁻¹	0.0140	0.0146	0.0119	0.0084	0.0115	0.0106	0.0098	0.0132			

TABLE XV
continued

Activity	Source type	Parameters	Unit	Name of the mine								
				Sasti	Block II	Kusunda	Lakhampur	Belpahar	Ananta	Jagannath	Rajpura	
Overburden unloading	Point	Moisture content of unloading material	%	8.2	7.2	7.8	7.8	7.3	7.9	7.2	8.0	
		Silt content of unloading materials	%	14.5	14.2	14.0	14.5	14.5	15.3	15.2	14.3	
	Point	Wind speed	m s ⁻¹	1.7	1.8	1.9	2.6	2.7	2.6	2.5	1.9	
		Drop height	m	12.5	14.3	13.4	15.0	12.8	12.0	15.2	12.5	
	Point	Capacity of unloader	t	35	35	35	35	35	35	35	35	35
		Frequency of unloading	no. h ⁻¹	9	10	10	14	12	10	11	8	
		Emission rate	g s ⁻¹	1.1103	1.2740	0.8299	1.2775	1.2249	1.2540	1.3940	0.8544	
Coal unloading	Point	Moisture content of unloading material	%	8.2	8.0	7.8	8.0	7.8	8.0	7.2	7.8	
		Silt content of unloading material	%	10.4	11.2	10.9	10.8	11.5	12.5	11.9	9.8	
	Point	Wind speed	m s ⁻¹	2.9	2.6	1.2	2.3	2.1	2.0	2.1	2.0	
		Drop height	m	2.9	2.5	2.6	2.6	3.0	2.7	2.8	2.5	
	Point	Capacity of dumper	t	35	35	35	35	35	35	35	35	
		Frequency of unloading	no. h ⁻¹	8	7	7	11	12	7	9	6	
		Emission rate	g s ⁻¹	0.7618	0.7333	0.5795	0.6164	1.1500	0.5191	0.5354	0.5360	

TABLE XV
continued

Activity	Source type	Parameters	Unit	Name of the mine							
				Sasti	Block II	Kusunda	Lakhampur	Belpahar	Ananta	Jagamath	Rajpura
Exposed overburden dump	Area	Moisture content of dump material	%	7.8	7.4	8.9	7.1	6.9	8.6	8.5	9.1
		Silt content of dump materials	%	8.0	8.2	7.5	8.5	8.8	7.8	7.9	7.2
		Wind speed	m s ⁻¹	2.4	2.1	2.0	2.8	1.9	1.4	1.3	2.5
		Area of active dump	Sq.Km	0.033	0.029	0.030	0.045	0.032	0.028	0.025	0.032
		Emission rate	g s ⁻¹ m ⁻²	0.0000368	0.0000377	0.0000354	0.0000387	0.0000393	0.0000363	0.0000365	0.0000363
Stock yard	Area	Moisture content of material	%	7.2	6.6	7.8	8.4	8.3	7.0	6.5	7.6
		Silt content of materials	%	10.8	12.5	12.8	10.0	9.9	11.9	13.6	12.0
		Wind speed	m s ⁻¹	2.7	1.9	1.1	1.5	2.0	1.9	1.5	1.8
		Capacity of unloader	t	35	35	35	35	35	35	35	35
		Size of loader	m ⁻³	4.6	4.6	4.6	5.0	2.0	5.0	4.6	4.6
		Frequency of unloading	no. h ⁻¹	3.0	4.0	4.0	5.0	4.0	4	5	3.0
		Frequency of loading	no. h ⁻¹	12.0	15.0	15.0	20.0	15.0	15.0	20.0	12.0
		Emission rate	g s ⁻¹ m ⁻²	0.0002066	0.0002370	0.0001763	0.000160	0.0001869	0.000216	0.000238	0.0001981
Coal handling plant (CHP)	Area	Moisture content of coal in the coal handling plant	%	6.0	7.3	NO CHP	7.8	7.2	6.8	6.5	NO CHP

TABLE XV
continued

Activity	Source Parameters type	Unit	Name of the mine							
			Sasti	Block II	Kusunda	Lakhanpur	Belpahar	Ananta	Jagannath	Rajpura
	Silt content of material	%	15.2	12.5	12.8	13.0	14.2	14.4	15.6	14.4
	Wind speed	m s ⁻¹	2.2	2.2	2.0	2.0	1.7	1.6	1.7	1.7
	Area	Sq. Km	0.0025	0.0026	0.0020	0.0030	0.0030	0.0030	0.0030	0.0030
	Emission rate	g s ⁻¹ m ⁻²	0.000647	0.000572	–	0.000432	0.000498	0.000514	0.000530	–
Workshop	Area									
	Moisture content of ground surface dust	%	11.8	12.4	12.8	14.4	15.4	12.2	15.9	13.0
	Silt content of ground surface dust	%	34.2	31.8	33.5	30.0	28.9	30.2	28.0	32.0
	Wind speed	m s ⁻¹	1.9	1.0	1.9	1.6	1.4	1.5	1.9	1.7
	Area	m ²	10000	5000	6000	10000	12050	8750	7500	10000
	Emission rate	g s ⁻¹ m ⁻²	0.0001110	0.00001000	0.0000880	0.0000820	0.0000628	0.00001000	0.0000510	0.0000875
Exposed pit surface	Area									
	Moisture content of surface	%	7.4	8.1	6.9	7.1	6.8	7.5	7.8	6.6
	Silt content of surface material	%	8.2	7.8	8.2	7.9	8.5	6.9	7.4	8.8
	Wind speed	m s ⁻¹	1.2	0.8	1.1	1.5	1.1	2.5	2.1	1.0
	Area	Sq. Km	0.0400	0.0300	0.0375	0.0400	0.0425	0.0313	0.0325	0.0350
	Emission Rate	g s ⁻¹ m ⁻²	0.0000153	0.0000129	0.0000155	0.0000154	0.0000160	0.0000149	0.0000134	0.0000160
Overall mine	Area									
	Wind speed	m s ⁻¹	2.5	2.3	2.1	2.2	2.3	2.1	1.4	2.4
	Coal production	Mt yr ⁻¹	1.0	2.5	1.5	5.0	2.0	4.0	4.0	1.0
	OB handling	Mm ³ yr ⁻¹	3.7	11.225	6.0	12.6	4.62	2.04	2.4	3.5
	Leasehold area	Sq. Km	6.534	7.555	2.353	5.055	16.010	8.100	7.932	1.74
	Emission rate	g s ⁻¹	21.9844	24.8768	16.1548	20.5121	25.7117	20.3444	18.2560	16.8170

TABLE XVI
Activity-wise empirical formula for emission rate

Activity	Source type	Parameters		Empirical equation
		Symb.	Name	
Drilling	Point	m	Moisture content	$E = 0.0325 \left[\frac{\{(100-m)su\}}{\{(100-s)m\}} \right]^{0.1} (df)^{0.3}$
		s	Silt content of cuttings	
		u	Wind speed	
		d	Hole diameter	
		f	Frequency of drilling	
		E	Emission rate	
Overburden loading	Point	m	Moisture content	$E = [0.018 \{(100-m)/m\}^{1.4} \{s/(100-s)\} (uhf)^{0.4}]$
		s	Silt content of loading materials	
		u	Wind speed	
		h	Drop height	
		l	Size of loader	
		f	Frequency of loading	
E	Emission rate			
Coal loading	Point	m	Moisture content	$E = \left[\frac{\{(100-m)/m\}^{0.1} m \{s/(100-s)\}^{0.3} h^{0.2}}{\{u/(0.2+1.05u)\} \{f(15.4+0.87f)\}} \right]$
		s	Silt content of loading materials	
		u	Wind speed	
		h	Drop height	
		l	Size of loader	
		f	Frequency of loading	
E	Emission rate			

TABLE XVI
continued

Activity	Source type	Parameters		Empirical equation
		Symb.	Name	
Haul road	Line	m	Moisture content of haul road dust	%
		s	Silt content of haul road dust	%
		u	Wind speed	m s ⁻¹
		v	Average vehicle speed	m s ⁻¹
		f	Frequency of vehicle movement	No. h ⁻¹
		c	Capacity of dumpers	t
		E	Emission rate	g s ⁻¹ m ⁻¹
				$E = \left[\frac{(100-m)}{m} \right]^{0.8} \left[\frac{s}{u(100-s)} \right]^{0.1} u^{0.3} \{2663+0.1(v+fc)\} 10^{-6}$
Transport road	Line	m	Moisture content of transport road dust	%
		s	Silt content of transport road dust	%
		u	Wind speed	m s ⁻¹
		v	Average vehicle speed	m s ⁻¹
		f	Frequency of vehicle movement	No. h ⁻¹
		E	Emission rate	g s ⁻¹ m ⁻¹
Overburden unloading	Point	m	Moisture content of unloading material	%
		s	Silt content of unloading materials	%
		u	Wind speed	m s ⁻¹
		h	Drop height	m
		c	Capacity of unloader	t
		f	Frequency of unloading	No. h ⁻¹
		E	Emission rate	g s ⁻¹
				$E = [1.76 \sqrt{h} + \{(100-m)/m\}^{0.2} \{s/(100-s)\}^2 u^{0.8} (cf)^{0.1}]$

TABLE XVI
continued

Activity	Source type	Parameters		Empirical equation
		Symb.	Name	
Coal unloading	Point	m	Moisture content of unloading material	%
		s	Silt content of unloading material	%
	u	Wind speed	$m s^{-1}$	
	h	Drop height	m	
	c	Capacity of dumper	t	
	f	Frequency of unloading	$No. h^{-1}$	
	E	Emission rate	$g s^{-1}$	
Exposed overburden dump	Area	m	Moisture content of dump material	%
		s	Silt content of dump materials	%
	u	Wind speed	$m s^{-1}$	
	a	Area of active dump	Sq. Km	
	E	Emission rate	$g s^{-1} m^{-2}$	
				$E = \{[(100-m)/m]^{0.2} \{s/(100-s)\}^{0.1} \{u/(2.6+120u)\} \{a/(0.2+276.5a)\}]\}$
Stock yard	Area	m	Moisture content of material	%
		s	Silt content of materials	%
	u	Wind speed	$m s^{-1}$	
	c	Capacity of unloader	t	
	l	Size of loader	m^3	
	f	Frequency of unloading	$No. h^{-1}$	
	d	Frequency of loading	$No. h^{-1}$	
	E	Emission rate	$g s^{-1} m^{-2}$	
			$E = \{[(100-m)/m]^{0.1} \{u/(71+43u)\} \{cf/(329+7.6cf)\} + \{ld/(30+900 ld)\}]\}$	

TABLE XVI
continued

Activity	Source type	Parameters		Empirical equation
		Symb.	Name	
Coal handling plant	Area	m	Moisture content of coal in the handling plant	%
		s	Silt content of material	%
	u	Wind speed	$m\ s^{-1}$	
	a	Area	Sq. Km	
	E	Emission rate	$g\ s^{-1}\ m^{-2}$	
				$E = \{[(100-m)/m]^{0.4} \{a^2 s / (100-s)\}^{0.3} \{u / (160 + 3.7u)\}]\}$
Workshop	Area	m	Moisture content of ground surface dust	%
		s	Silt content of ground surface dust	%
	u	Wind speed	$m\ s^{-1}$	
	a	Area	m^2	
	E	Emission rate	$g\ s^{-1}\ m^{-2}$	
				$E = [0.064 \{(100-m)/m\}^{1.8} \{as / (100-s)\}^{0.1} \{u / (0.01 + 5u)\} 10^{-4}]$
Exposed pit surface	Area	m	Moisture content of surface	%
		s	Silt content of surface material	%
	u	Wind speed	$m\ s^{-1}$	
	a	Area	Sq. Km	
	E	Emission rate	$g\ s^{-1}\ m^{-2}$	
				$E = [2.4 \{(100-m)/m\}^{0.8} \{as / (100-s)\}^{0.1} \{u / (4 + 66u)\} 10^{-4}]$
Overall mine	Area	u	Wind speed	$m\ s^{-1}$
		c	Coal production	$Mt\ yr^{-1}$
	b	OB handling	$Mm^3\ yr^{-1}$	
	a	Leasehold area	Sq. Km	
	E	Emission rate	$g\ s^{-1}$	
				$E = [u^{0.4} a^{0.2} \{9.7 + 0.01c + b / (4 + 0.3b)\}]$

TABLE XVII
Empirical formula for SO₂ emission rate of overall mine

Activity	Source type	Parameters			Empirical equation
		Symb.	Name	Unit	
Overall mine	Area	u	Wind speed	m s ⁻¹	E = a ^{0.14} {u/(1.83+0.93u)}[{c/(0.48+0.57c)} + {b/(14.37+1.15b)}]
		c	Coal production	Mt yr ⁻¹	
		b	OB handling	Mm ³ yr ⁻¹	
		a	Leasehold area	Sq. Km	
		E	Emission rate	g s ⁻¹	

TABLE XVIII
Empirical formula for NO_x emission rate of overall mine

Activity	Source type	Parameters			Empirical equation
		Symb.	Name	Unit	
Overall mine	Area	u	Wind speed	m s ⁻¹	E = a ^{0.25} {u/(4.3+32.5u)}[1.5 ^c + {b/(0.06+0.08b)}]
		c	Coal production	Mt yr ⁻¹	
		b	OB handling	Mm ³ yr ⁻¹	
		a	Leasehold area	Sq. Km	
		E	Emission rate	g s ⁻¹	

data file is created from the data base which is automatically emptied. The ASCII file can be retained or deleted as the user chooses.

It may be noted here the database is automatically initialized every time in order to save precious system resources. The option to retain the ASCII file has been provided, so that the user may be able to use the same data for some other purpose. In case the user wishes to retain the ASCII file then care must be taken to delete all such files before using the software once again, otherwise the current set of data will be appended at the bottom of the old file.

5. Conclusions

The study at eight opencast coal mines have indicated that suspended particulate matter is the major source of emission, whereas emissions of SO₂ and NO_x from most of the mining activities are negligible. A set of twelve empirical formulae were developed to calculate activity-based SPM emission rates from opencast coal mining activities by considering the major influential parameters. Empirical formulae were also developed for SPM, SO₂ and NO_x emission rates for the whole

TABLE XIX
Comparison of activity-based measured and calculated emission rates for Rajpura mine

Activity	Unit	Measured value	Calculated value	Accuracy (%)
Drilling	g s^{-1}	0.3877	0.3879	99.9
Overburden loading	g s^{-1}	0.4659	0.4591	98.5
Coal loading	g s^{-1}	0.5281	0.5255	99.5
Haul road	$\text{g s}^{-1} \text{m}^{-1}$	0.0127	0.0115	90.0
Transport road	$\text{g s}^{-1} \text{m}^{-1}$	0.0132	0.0126	95.4
Overburden unloading	g s^{-1}	0.8544	0.8305	97.2
Coal unloading	g s^{-1}	0.5360	0.4983	93.0
Exposed OB dump	$\text{g s}^{-1} \text{m}^{-2}$	0.0000363	0.0000359	98.9
Stock yard	$\text{g s}^{-1} \text{m}^{-2}$	0.0001981	0.0002002	98.5
Workshop	$\text{g s}^{-1} \text{m}^{-2}$	0.0000875	0.0000912	95.9
Exposed pit surface	$\text{g s}^{-1} \text{m}^{-2}$	0.0000160	0.0000162	98.8
Overall mine (SPM)	g s^{-1}	16.8170	16.4951	98.0
Overall mine (SO ₂)	g s^{-1}	0.7732	0.7296	94.4
Overall mine (NO _x)	g s^{-1}	0.3383	0.3950	85.6

mine. User-friendly software to calculate emission rate was also developed. To find out the accuracy of the developed formulae, the correlation coefficient between the measured and calculated values for the Rajpura mine was determined. The correlation coefficient was found to vary from 85.6–99.9%, which shows a fairly good level of accuracy.

The variations between field-measured and FDM-predicted values were determined for the Rajpura mine. The average accuracy of 79% was observed using FDM. This is because, in actual conditions there may be emissions from other activities like blasting, barren areas, non-mining sources viz. domestic, nearby transportation network, other industry, etc. In addition there were obstructions and sink potentials in the area. Therefore, site specific emission rate is to be calculated considering the above factors and incorporated into the model as input leading to better predictions of air quality. The empirical formulae were developed based on emission inventory for the winter season to predict the worst possible maximum concentration of total suspended particulate matters around mining activities using the air pollution model and thereby facilitate the design of a green belt to control air pollution. Therefore, the developed formulae cannot be used to calculate annual average emission rates or to determine emission rates of fine particles. The present study was conducted for opencast coal mines only. Therefore, similar studies should be conducted for other mining operations also to determine than emission factor and to construct empirical models.

TABLE XX
Hourly micro-meteorological data for model input

Hour (IST)	Wind direction (from) (deg.)	Average wind speed at 10 m height (m s^{-1})	Stability class (Pasquill-Gifford)	Mixing height (m)	Temperature ($^{\circ}\text{K}$)
00	236	0.3833	F (6)	48	288.77
01	225	0.4028	F (6)	44	288.08
02	229	0.3750	F (3)	60	287.67
03	227	0.3750	F (4)	49	287.67
04	220	0.3528	C (3)	65	287.04
05	222	0.3528	B (2)	76	287.30
06	216	0.4722	B (2)	58	289.71
07	201	0.7556	B (2)	61	292.42
08	186	0.9583	B (2)	109	294.49
09	193	1.0722	B (2)	261	296.01
10	191	1.2694	A (1)	424	297.07
11	205	1.3306	A (1)	425	297.84
12	206	1.2667	A (1)	405	298.23
13	202	1.2083	A (1)	428	298.23
14	218	1.0222	A (1)	448	297.70
15	221	0.6861	A (1)	322	275.64
16	237	0.5222	A (1)	473	293.60
17	246	0.5306	B (2)	238	292.33
18	254	0.3694	F (6)	45	288.37
19	256	0.4944	C (3)	307	291.55
20	255	0.5111	D (4)	139	290.97
21	242	0.4194	E (5)	77	290.35
22	239	0.4139	E (5)	63	289.66
23	235	0.3028	F (6)	59	289.06

With the development of the empirical formulae to calculate activity-based emission rates, the prediction of air pollution is possible even before the commencement of any mining project, and effective mitigative measures can be designed at the planning stage. Therefore, these results may also be utilised to visualise future environmental scenarios and to assist local level decision concerning the environment when granting permission to mine coal.

TABLE XXI
Predicted and observed values of SPM by FDM model for Rajpura mine

Receptor location code	Measured SPM concentration ($\mu\text{g m}^{-3}$)	Predicted SPM concentration ($\mu\text{g m}^{-3}$)
A1	469	502
A2	713	663
A3	365	459
A4	985	863
A5	1015	1122
A6	942	811
A7	1002	1147
A8	1030	905
A9	1040	894

Acknowledgment

Authors are grateful to the Director, Central Mining Research Institute (CMRI), Dhanbad for giving permission to publish this paper. Authors are thankful to the scientists of the Environmental Management Group of CMRI for their help during field monitoring. Authors are also thankful to the mine management of Mahanadi Coalfields Limited, Eastern Coalfields Limited, Bharat Cooking Coal Limited and Western Coalfields Limited for providing the necessary facilities and cooperation during the field study. Finally, thanks to Mr. B.S. Attri, Director, Dr. I.K. Kamboj, Additional Director and Mrs. Sujata Khaparde, Deputy Director of Ministry of Environment and Forests, Government of India for their keen interest and encouraging suggestions during the course of the study, as well as their financial support.

References

- Australia EPA: 1996, *Emissions Estimation Techniques Report*, Volume 1, National Pollutant Inventory Taskforce, 40 Blackall Street, Barton ACT 2600, Australia.
- California Department of Transportation: 1979, *CALNINE3-A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets*, Office of Transportation Laboratory Department of Transportation, State of California, Sacraments, California 95807, No. FAWA/CA/TL-79/23, U.S.A.
- Central Mining Research Institute (CMRI): 1998, 'Determination of Emission Factor for Various Opencast Mining Activities', GAP/9/EMG/MOEF/09, Environmental Management Group, Dhanbad, India.
- Chaulya, S. K. and Chakraborty, M. K.: 1995, 'Perspective of New National Policy and Environmental Control for Mineral Sector', in G. S. Khuntia (ed.), *Proceedings of National Seminar on Status of Mineral Exploitation in India*, New Delhi, India, pp. 114–123.

- Chaulya, S. K., Chakraborty, M. K. and Singh, R. S.: 2001, 'Air Pollution Modelling for a Proposed Limestone Quarry', *Water, Air, and Soil Pollution* **126**, 171–191.
- Cowherd, D., Jr.: 1982, 'Fugitive Emission Factor Update for AP-42 Final Report', Research Triangle Park, NC: US Environmental Protection Agency, Industrial Research Laboratory.
- Ermak, D. L.: 1977, 'An Analytical Model for Air Pollutant Transport and Deposition from a Point Source', *Atmos. Env.* **11**, 231–237.
- Hanna, S. R., Briggs, G. A. and Hosker, R. P., Jr.: 1982, *Handbook on Atmospheric Diffusion*, DOE/TIC-11223, Technical Information Center, U.S. Department of Energy, pp. 101.
- Hermann, P. and Gottfried, H.: 1997, 'Winter Time Optical Properties of Atmospheric Particle and Weather', *Atmos. Env.* **31**(24), 4053–4062.
- Horst, T. W.: 1977, 'A Surface Depletion Model for Deposition from a Gaussian Plane', *Atmos. Env.* **11**, 41–46.
- Hosker, R. P., Jr.: 1974, 'Estimation of Dry Deposition and Plume Depletion Over Forests and Grassland', in *Proceedings of International Atomic Energy Association on the Physical Behaviour of Radioactive Contaminants in the Atmosphere*, Vienna, pp. 291–309.
- Huchabee, J. W., Sanz Diaz, F., Janzen, S. A. and Solomon, J.: 1983, 'Distribution of Mercury in Vegetation of Almaden, Spain', *Env. Pollut.* **30**, 211–224.
- Jones, T.: 1993, 'The Role of Environmental Impact Assessment in Coal Production and Utilisation', *Nat. Res. Forum* **17**(3), 170–180.
- Kapoor, R. K. and Gupta, V. K.: 1984, 'A Pollution Attenuation Coefficient Concept for Optimization of Green Belt', *Atmos. Env.* **18**(6), 1107–1117.
- Kumar, C. S. S., Kumar, P., Deshpande, V. P. and Badrinath, S. D.: 1994, 'Fugitive Dust Emission Estimation and Validation of Air Quality Model in Bauxite Mines', in G. S. Khuntia (ed.), *Proceedings of International Conference on Environmental Issues in Minerals and Energy Industry*, New Delhi, India, pp. 77–81.
- National Environmental Engineering Research Institute (NEERI): 1993, *Workshop on Computer Aided EIA of Industrial Project*, Nagpur, India.
- Peavy, H. S., Rowe, D. R. and Tchobanoglous, G.: 1985, *Environmental Engineering*, McGraw-Hill, New York.
- Perkins, H. C.: 1974, *Air Pollution*, McGraw-Hill, New York.
- Rao, C. C. V.: 196, 'Air Quality Modelling – Research Needs', in B. B. Dhar, M. K. Chakraborty, S. K. Chaulya and R. S. Singh (eds.), *Proceedings of Workshop on Air Quality Modelling and Atmospheric Acidification*, Commonwealth Science Council, Dhanbad, India, pp. 1–27.
- Shannigrahi, A. S. and Agrawal, K. M.: 1996, 'An Overview on Optimal Green Belt Development Around Industrial Project', *Indian J. Env. Protect.* **17**(4), 253–261.
- Sharma, S. C. and Roy, R. K.: 1997, 'Green Belt – an Effective Means of Mitigating Industrial Pollution', *Indian J. Env. Protect.* **17**(10), 724–727.
- Singh, R. S., Chaulya, S. K., Tewary, B. K. and Dhar, B. B.: 1996, 'Restoration of a Coal Mine Overburden Dump – a Case Study', *Coal International*, March, 88–90.
- Sinha, S. and Banerjee, S. P.: 1994, 'A Method for Estimating Fugitive Particulate Emission from Haul Roads in Opencast Coal Mines and Mitigative Measures', in S. P. Banerjee (ed.), *Proceedings of Second National Seminar on Minerals and Ecology*, Dhanbad, India, pp. 217–227.
- Sinha, S. and Banerjee, S. P.: 1997, 'Characterisation of Haul Road in Indian Open Cast Iron Ore Mine', *Atmos. Env.* **31**(17), 2809–2814.
- Sinha, S.: 1995, 'Quantification of Fugitive Particle Emission From Line Source in Surface Coal Mine – An Approach', *Indian J. Env. Protect.* **15**(5), 339–343.
- Slinn, W. G. N.: 1982, 'Predictions for Particle Deposition to Vegetative Canopies', *Atmos. Env.* **16**, 1785–1794.
- Snedecor, G. W. and Cochran, W. G.: 1967, *Statistical Methods*, Oxford and IBH Publishing Co., New Delhi, India.

- Soni, D. K. and Agarwal, A.: 1997, 'Characterisation of Dust Emission in Coal Mining Activities – Case Study', *Indian J. Env. Protect.* **17**(11), 80–814.
- Stern, A. C.: 1968, *Air Pollution*, Vol. II. Analysis, Monitoring and Surveying, Second Edition, Academic Press, New York, London,
- Tichy, J.: 1996, 'Impact of Atmospheric Deposition on the Status of Planted Norway Spruce Stands: a Comparative Study Between Sites in Southern Sweden and the North Eastern Czech Republic', *Env. Pollut.* **93**, 303–312.
- USEPA: 1995, *User's Guide for the Fugitive Dust Model (FDM)*, Vol. I, User's Instruction, Region 10, 1200 sixth Avenue, Seattle, Washington, U.S.A.
- USEPA: 1995a, *Compilation of Air Pollution Emission Factors*, Vol. I, Stationary Point and Area Sources, 5th Ed., Research Triangle Park, North Carolina, U.S.A.
- Viswanathan, D. V., Mishra, S. and Satyanarayana, A. N. V.: 1995, 'Climatological Atmospheric Dilution Over India', *Indian J. Env. Protect.* **15**(10), 734–738.
- Wahid, A., Maggs, R., Shamsi, S. R. A., Bell, J. N. B. and Ashmore, M. R.: 1995, 'Air Pollution and its Impacts on Wheat Yield in Pakistan Punjab', *Env. Pollut.* **88**(2), 147–154.
- Zeller, K. F., Fox, G. F. and Marlate, W. E.: 1979, *Estimating Dust Production from Surface Mining*, Report No. EPA-600/7-79-182. Research Triangle Park, Ne, U.S. Environmental Protection Agency, Industrial Research Laboratory.

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/226594623>

Air Pollution Modelling for a Proposed Limestone Quarry

Article in *Water Air and Soil Pollution* · February 2001

DOI: 10.1023/A:1005279819145

CITATIONS

47

READS

1,336

3 authors, including:



S. K. Chaulya

95 PUBLICATIONS 1,119 CITATIONS

[SEE PROFILE](#)



Raj S. Singh

Central Institute of Mining and Fuel Research

153 PUBLICATIONS 2,607 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Carbon sequestration through revegetated mine wasteland. [View project](#)



Impact of Underground Mine Subsidence on Forest Cover and Hydrology. [View project](#)

AIR POLLUTION MODELLING FOR A PROPOSED LIMESTONE QUARRY

S. K. CHAULYA*, M. K. CHAKRABORTY and R. S. SINGH

Central Mining Research Institute, Barwa Road, Dhanbad, 826 001, India

(* author for correspondence, e-mail: dhanbad@yahoo.com; fax: 91 326202429)

(Received 26 July 1999; accepted 17 February 2000)

Abstract. Predictions of the air pollution impact of a proposed opencast limestone quarry have been made using meteorological data, information on various quarrying activities and their associated emission factors, baseline air quality and a validated model conditions. Results have indicated that the haul routes and ore processing plant are the major sources of suspended particulate matter (SPM) emissions. The emission rates of other air pollutants are insignificant. It has been predicted that 24-hr average SPM concentrations due to quarrying activities would be around $360 \mu\text{g m}^{-3}$ in the work zone and less than $130 \mu\text{g m}^{-3}$ beyond the site boundary. The total 24-hr average SPM concentration beyond the site boundary would be below $500 \mu\text{g m}^{-3}$, which is the national air quality standard for SPM in an industrial area. Therefore, the impact of opencast extraction on the local air quality would be acceptable. However, implementation of a green belt comprising of various tree species which will act as a dust attenuator of 40 m width around the site boundary, along with efficient control measures at source, would effectively mitigate and minimize pollution impacts from the quarry. The effectiveness of the green belt around the quarry site has been assessed and a sensitivity analysis has been carried out for different parameters, namely, tree height, width of green belt, and distance of receptor from the source. The technique for designing a green belt around a quarry site has also been described.

Keywords: air pollution, dispersion modelling, green belt, opencast

1. Introduction

Quarrying is one of the core industries in India and plays a positive role in the economic development of the country. Its environmental impact cannot be ignored and, to some extent, is unavoidable as is evident in some other industries (Huchabee *et al.*, 1983; Wahid *et al.*, 1995; Singh *et al.*, 1996; Trichy, 1996). India has extensive deposits of limestone in many states, particularly, Madhya Pradesh, Rajasthan, Tamil Nadu, Andhra Pradesh, Himachal Pradesh, Uttar Pradesh, Bihar, Assam, Mizoram, Meghalaya and Orissa (Chaulya and Chakraborty, 1995). Due to the increasing demand for limestone, quarrying and extraction of this mineral by opencast methods have been intensified in many parts of the country in recent years.

However, opencast extraction activities like drilling, blasting, material handling and transport are a potential source of air pollution (Sinha and Banerjee, 1994; CMRI, 1998). Therefore, a detailed study on emission sources and quantification



Water, Air, and Soil Pollution **126**: 171–191, 2001.

© 2001 Kluwer Academic Publishers. Printed in the Netherlands.

of pollutant concentrations (by means of dispersion modelling) is required to assess the environmental impact of a proposed opencast site (Jones, 1993; Rao, 1996; CMRI, 1998). On the basis of the predicted increments to air pollutant concentrations, an effective mitigation and environmental management plan can be devised for sensitive areas. A new approach has been adopted in recent years, to grow green plants around quarry site. The capacity of plants to reduce air pollution is well known and has been reported in the literature (Slinn, 1982; Peavy, 19985; NEERI, 1993; Sharma and Roy, 1997). To limit the dispersion of such air pollution emitted from opencast activities, it is recommended that a green belt be grown around a quarry site. The present study describes the prediction of air quality impact for a proposed opencast limestone quarry in India, including the state-of-the-art in developing a green belt around a quarry site.

2. Study Site

2.1. LOCATION AND TOPOGRAPHY

The proposed Rawan-Jhipan limestone quarry is located in the Raipur district of Madhya Pradesh state in India. The area extends between 21°31'N and 21°35'N latitude, and 81° 58'E and 82°E longitude. The topography of the area is almost flat and mean reduced level (R.L.) varies between 263 and 282 m (Figure 1). The leasehold area of the quarry comprises grazing land.

2.2. GEOLOGY

The limestone exposed on the surface is grey and chocolate in colour and the deposit is horizontal in nature. The order of superposition in the area is (i) overburden, (ii) yellow buff shale, (iii) grey limestone and (iv) chocolate limestone. The average thickness of overburden is 3.7 m. It is estimated that for exploitation of 63 Mt of cement grade limestone (CaO > 45%) and sub-marginal grade limestone (CaO 42–45%), an additional 34 and 48 Mt of low grade limestone (CaO 36–42%) and waste respectively will need to be removed.

2.3. QUARRYING DETAILS

The total leasehold area of the Rawan-Jhipan limestone quarry is 10.624 km². This captive quarry has the potential to produce 1.6 Mt of limestone annually. The total estimated life of the quarry is 40 yr. The area is divided into two zones: Zone I (1.685 km²) and Zone II (1.3 km²). The quarry is designed to exploit limestone in Zone II during the first 5 yr with three benches, each of 9 m height. It is estimated that the total amount of cement and sub marginal grade limestone which will be exploited during the first 5 yr will be 0.24 and 12.2 Mt, respectively. A total of 3.87 Mt of low grade limestone and 4.1 Mt waste will have to be disposed of

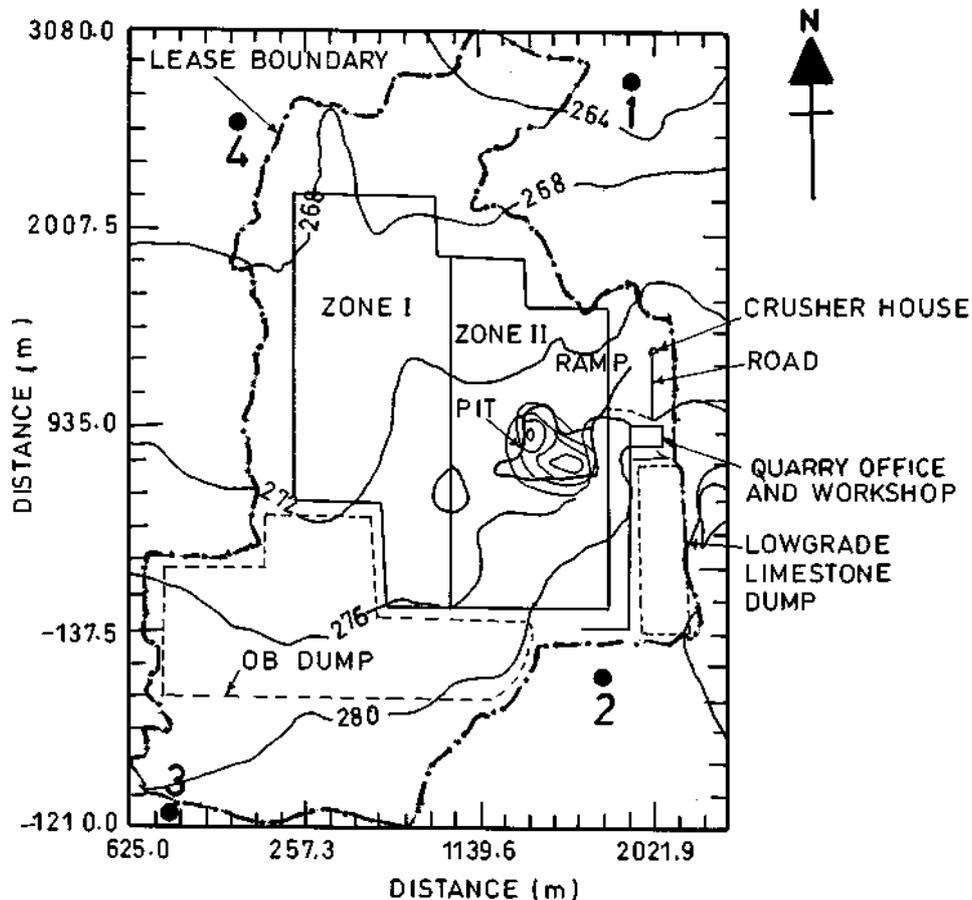


Figure 1. Surface plan of the quarry along with air monitoring stations.

separately off-site. The proposed configuration of the quarry extraction area and waste and low grade limestone dumps during 5 yr of extraction are presented in Figure 1, with the surface R.L. contours in metres.

2.4. CLIMATE

The climate of the area is dry and tropical. There are three seasons, namely summer (March to June), monsoon (July to October) and winter (November to February). The maximum temperature varies from 42 to 48 °C in May and the minimum temperature can go down to 15 °C in December. Wind speeds are light to moderate in the summer and winter seasons, though they can increase towards the end of summer and become moderate to heavy during the monsoon season. The predominant wind direction in summer is towards the south, and that during the winter is towards the south-west. The annual average rainfall in the area varies from 1000 to

1200 mm, and the relative humidity is usually above 50%. The monthly variation in rainfall for a duration of 10 yr (1988–97) is presented in Figure 2.

3. Methodology

The methodology adopted for this study is described in Figure 3. Various relevant meteorological parameters covering one complete year (1997) have been measured at the nearest meteorological station, Raipur. However, for air quality modelling, only the summer season meteorological data have been used, since the baseline monitoring data for suspended particulate matter (SPM) has been obtained for this period. From these data, a windrose diagram has been prepared with stability classes, including calms (defined as a wind speed less than 0.6 m s^{-1}). Atmospheric stability classes (Pasquill-Gifford) have been computed using the Turner classification scheme (Hanna *et al.*, 1982). Baseline air quality has been measured by means of high volume samplers with an average flow rate greater than $1.1 \text{ m}^3 \text{ min}^{-1}$ at four locations near the site boundary. 24-hr mean samples of SPM were obtained following the national ambient air quality standard (NAAQS) protocol. Locations of the four sampling stations are shown in Figure 1.

Various activities which would contribute to ambient air quality during the first five years of extraction (according to the phasing plan prepared by Associated Cement Company*) have been considered for determination of source emission rates. The emission rate for each activity has been estimated from the Central Mining Research Institute's study (CMRI, 1998) of ten opencast quarries in India (sponsored by the Ministry of Environment and Forests, Government of India, New Delhi).

During a field study on air quality and related parameters (CMRI, 1998; Kumar *et al.*, 1994) it was concluded that the main air pollutant generated by opencast quarrying was SPM, and that the impact of other air pollutants was not significant. Therefore, for the purpose of the current study, only SPM has been considered. Using meteorological data, information on proposed site activities and their respective emission rates as input parameters, dispersion modelling has been carried out using the Fugitive Dust Model (FDM) to predict SPM concentrations at various selected receptor locations in and around the quarry during the first five years of quarry development. Receptor locations have been selected using a $200 \times 200 \text{ m}$ grid. An isopleth map of 24-hr average SPM concentrations contributed by quarry activities has been prepared by the Kriging method of extrapolation (Davis, 1973). Then, the background 24-hr average concentration of SPM has been added to the predicted values, to estimate the total 24-hr mean SPM concentration in and around the quarry during the first 5 yr of quarrying. Using these predicted SPM concentrations at different locations, a green belt model has been prepared, based on the filtering effect of trees and the deposition rate of the SPM (Perkins, 1974; Horst, 1977).

* Research and Development Wing, Thane, Mumbai, India.

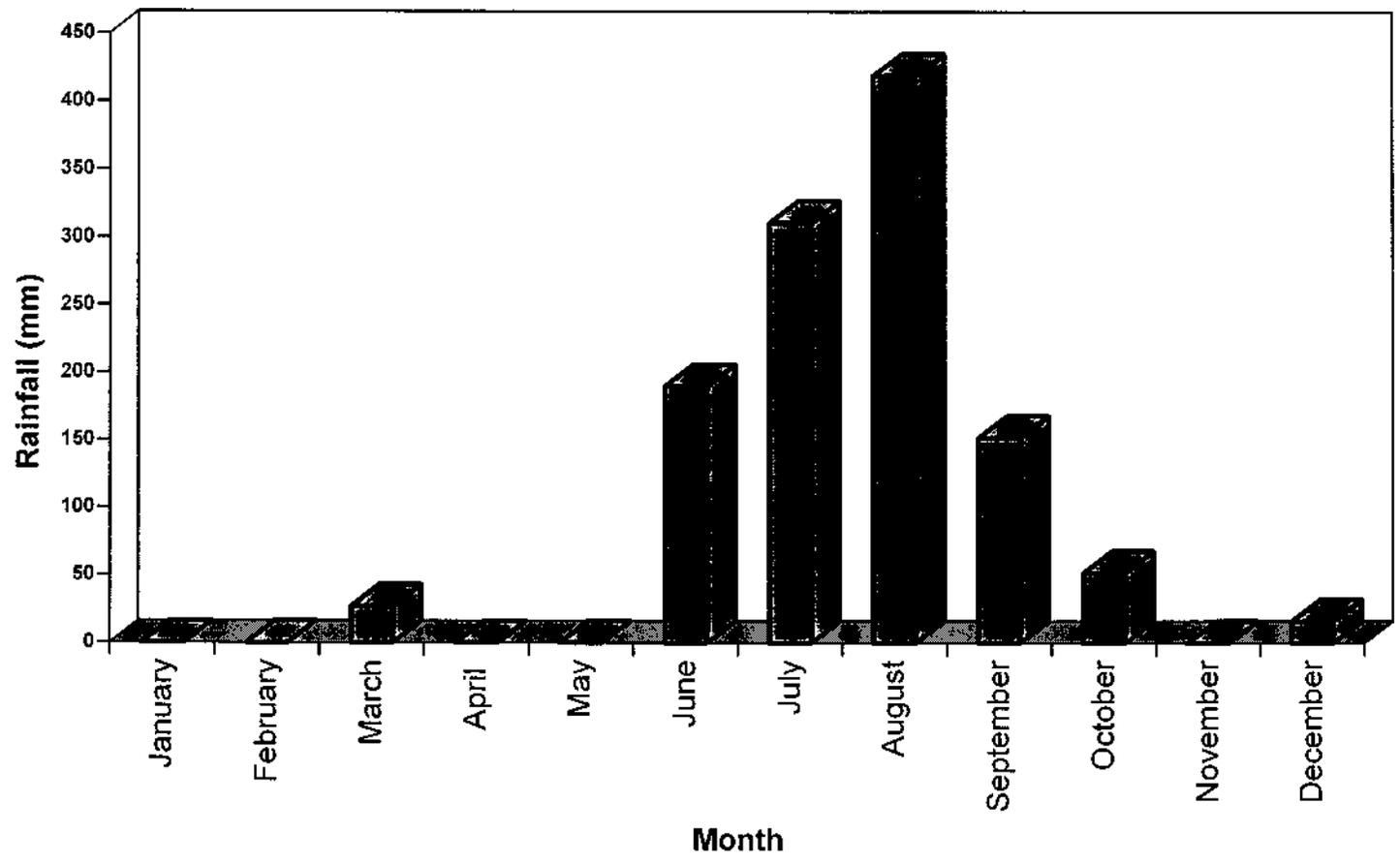


Figure 2. Monthly rainfall in the study area.

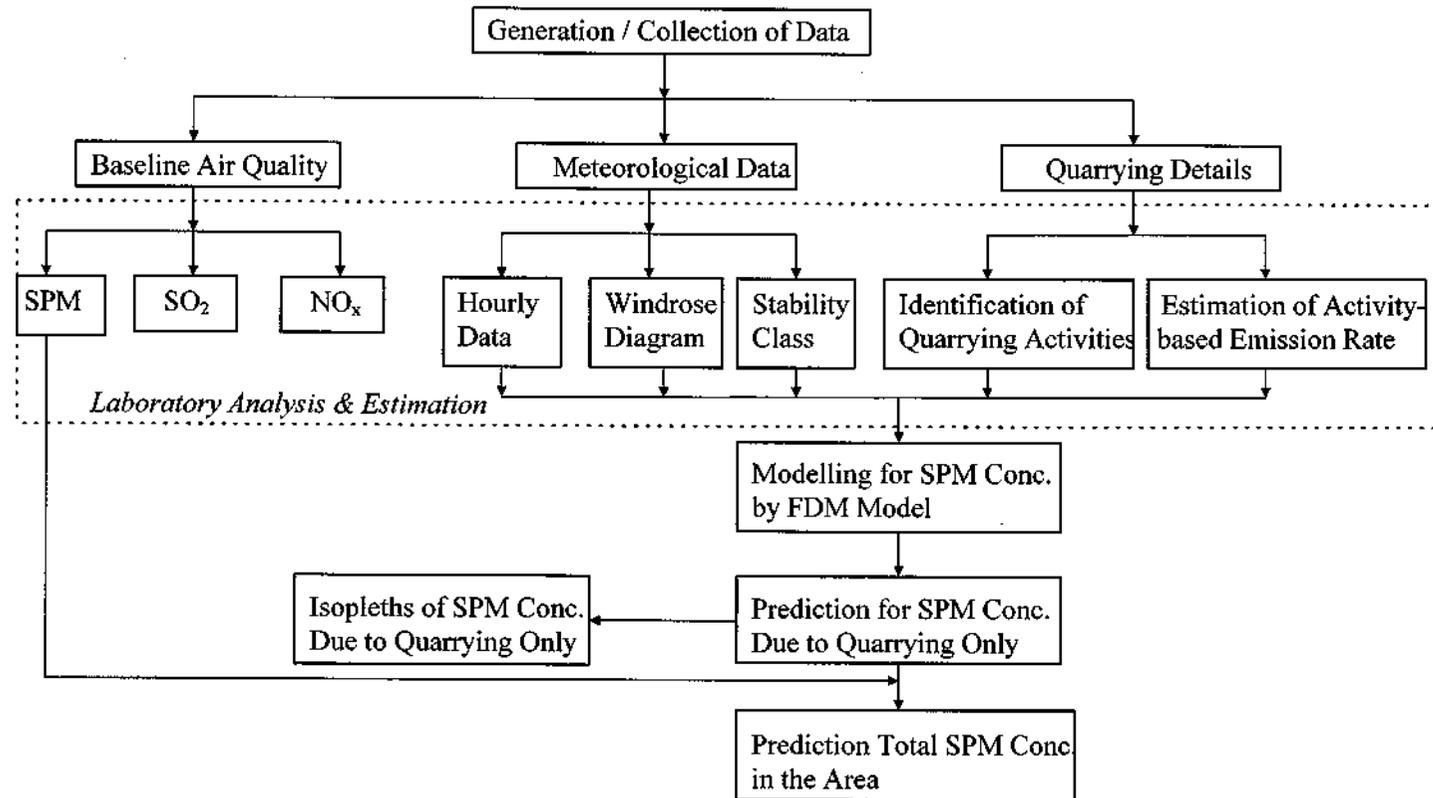


Figure 3. Methodology adopted for the study.

3.1. EMISSION INVENTORY

Different quarrying activities have different SPM emission rates, and the determination of the emission factor for each activity is a crucial part of the calculations. To evaluate the air quality impact, an inventory has been compiled with a view to identifying the major sources of SPM.

- (a) *Drilling*: Blast holes would be drilled in overburden and limestone with the help of two drill machines (150 mm diameter). In dry condition, this drilling operation would generate dust. These may be treated as point sources.
- (b) *Blasting*: This may be treated as an instantaneous point source for SPM.
- (c) *Handling of limestone*: Once the limestone mass has been loosened by blasting, it would be loaded into dumper trucks (35 t capacity) by hydraulic excavators (3.9 m³). Two such loaders would be used for the limestone handling at the proposed site. A total of 8 dumpers would be used per day. Dumper trucks will have six wheels. An average distance of 6 km would be travelled by each dumper trucks per hour. The loading and movement of dumper trucks on haul routes would generate SPM.
- (d) *Ore processing*: There would be a need for crushing the limestone into small sizes. A loader (6 m³ capacity) and a gyratory crusher would be used for crushing the limestone. The crushing of ore and transferring it to a belt conveyor would be a potential source of dust generation.
- (e) *Overburden handling*: Overburden loosened by blasting would be loaded into dumper trucks. These dumper trucks would carry the overburden to a mound at a distance of 1–1.5 km as shown in Figure 1. Two loaders of 3.9 m³ capacity and 6 dumper trucks of 35 t capacity each would be used for loading and transportation of overburden. Loading may be treated as a point source and transportation on haul routes may be considered as line sources.
- (f) *Mound formation*: Overburden material and low grade limestone would be used to form separate mounds of predetermined geometrical shape and size, graded and leveled by bulldozers. Operation of dumpers, dozers and graders would generate SPM. These may be treated as point sources.
- (g) *Mounds (OB and low grade limestone)*: The bare surface of the mounds would generate dust due to wind erosion. The emission rate is directly proportional to wind speed (CMRI, 1998) and calculated based on average wind speed of the area as an input to the FDM model. These may be treated as area sources.
- (h) *Movement of vehicles*: Movement of vehicles like dumper trucks, dozers, tankers, explosives van, mobile van etc. would generate dust from the passage of wheels over unpaved surface. These may be taken as line sources.

3.2. FUGITIVE DUST MODEL

As described earlier, the Fugitive Dust Model (FDM) has been used to predict the ground level SPM concentration in and around the quarry during the first five years of operation. Since a detailed year-by-year quarry operational plan was not available, an average five year quarry plan has been considered with an average emission rate for respective activity. Baseline monitoring data have been generated for the summer season and modelling has been carried out for the summer season, to assess the worst-case scenario. FDM is a computerized Gaussian plume dispersion model, specifically developed by the United State Environmental Protection Agency (USEPA) for the estimation of particulate concentrations (USEPA, 1995). The basic model incorporates a detailed deposition routine based on the equations of Ermak (1977). The sources may be point, line or area sources. The model can process up to 1200 receptors and upto 121 sources. The line source and area source algorithms are based on algorithms in the CALINE3 Model (California Department of Transportation, 1979). FDM employs an advanced gradient transfer particle deposition algorithm (Horst, 1977; Hanna *et al.*, 1982).

The accuracy of FDM in Indian quarrying conditions has been found to be 68–80% (CMRI, 1998). Therefore, a calibration has been carried out for the predicted SPM concentration in the present study. FDM cannot include terrain features, and the model can be used only for local scale predictions (USEPA, 1995). However, this model offers improved performance over the Industrial Source Complex Model (USEPA, 1995) and also the Point, Area and Line (PAL 2) source model (CMRI, 1998). Input data on emission rates from various activities have been calculated based on the assumption that one activity in a quarry does not influence other activities (CMRI, 1998). Emissions of SPM from combustion of diesel fuel has not been quantified nor modelled. The emission rates used are based on a case study at ten opencast quarries, and not on the actual site of the proposed quarry. For the present study, 10 point sources, 54 line sources and 27 area sources have been defined for input to the model. Line sources have been broken into small segments to convert the curvilinear source to line sources and areas sources have been broken into small area sources to avoid exceeding the maximum width-length ratio of 1:5. A total of 200 receptor locations have been selected, at which ground level SPM concentration has been predicted.

3.3. GREEN BELT DESIGN

A green belt is the mass planting of pollution-tolerant trees (evergreen and deciduous) for the purpose of mitigating the air pollution in an effective manner by filtering, intercepting and absorbing pollutants (Sharma and Roy, 1997). Optimum green belt development, including factors such as distance of green belt from source, width of green belt and height of green belt, may be achieved using the green belt attenuation model developed by Kapoor and Gupta (1984). The effectiveness of a green belt in attenuating the pollution is given by the attenuation factor

(A_f), which is defined as the ratio of mass flux reaching a distance in the absence of the green belt, to the mass flux reaching the same distance in the presence of the green belt. The selection of tree species which can be grown around a quarry site is a very important issue. Plants differ considerably with reference to their responses towards pollutants, some being highly sensitive and others hardy and tolerant. On the basis of an air pollution tolerance index (APTI) and some relevant phyto-socio-economic characters, expected performance index (EPI) of plant species are used for green belt development.

3.3.1. Modelling Concept

The Pollution Attenuation Model developed by Kapoor and Gupta (1984) is a 'state-of-the-art' model for estimating the pollution attenuation factor of a green belt for ground level pollution sources. Subsequently, Shannigrahi and Agrawal (1996) have also studied the different aspects of green belt design and development. The pollution attenuation factor (A_f) is estimated using:

$$A_f = [FD(X_1 + X_2)]/FD(X_1)[erf\{h_e/\sqrt{2\sigma_z(X_1)}\}e_2^{-\lambda X} + \operatorname{erfc}\{h_e/\sqrt{2\sigma_z(X_1)}\}F'D(X_2)], \quad (1)$$

where X_2 is width of green belt (m), h_e is effective height of green belt (m), λ is pollution attenuation coefficient (m^{-1}), σ_z is vertical dispersion coefficient, erf is error function, erfc is complementary error function and X_1 is separation distance between the green belt and pollution source (m). $FD(X_1 + X_2)$ and $FD(X_1)$ are plume depletion factor due to dry deposition of pollutant on natural surface for downwind distances $X_1 + X_2$ and X_1 , respectively for a point source. $F'D(X_2)$ is the plume depletion factor for distance X_2 above the green belt. Since the portion of plume above the green belt has a finite size, $F'D(X_2)$ is calculated assuming that this size of the plume would be obtained if it has travelled over an imaginary distance X_1 . The size of the plume at the edge of the green belt is obtained from the following relationship:

$$\sigma_z(X_1) = \sigma_z(X_1) - h_e \quad (2)$$

and $F'D(X_2)$ is obtained as follows:

$$F'D(X_2) = \{FD(X_1 + X_2)\}/\{FD(X_1)\} \quad (3)$$

where $FD(X_1 + X_2)$ and $FD(X_1)$ are the plume depletion factors due to dry deposition over $X_1 + X_2$ and X_1 distances, respectively. The plume depletion factor $FD(X)$ for any distance X is calculated using:

$$FD(X) = [\exp \int_0^X (1/\sigma_z) \exp(H^2/2\sigma_z) dz]^{-\sqrt{(2/\pi)}V_d/u} \quad (4)$$

where H is release height (m) (it is zero in the present case), σ_z is standard deviation of concentration distribution in vertical (m) at downwind distance X , V_d is dry deposition velocity (m s^{-1}), and u is mean wind speed (m s^{-1}). The value of $FD(X)$ is calculated by evaluating the above integral using Simpson's rule.

The distribution parameter σ_z is a function of downwind distance X and atmospheric stability category and can be computed using the scheme given by Hosker (1974) as it has the advantage of considering ground roughness length (Z_o) in the computation of σ_z . The concept of effective height h_e (which is less than the physical height of green belt, h) is introduced to account for the reduced wind speed in the green belt region. The value of h_e is computed from the following relationship:

$$\int_0^{h_e} u(z)dz = hU_c \quad (5)$$

where $u(z)$ is the wind speed profile outside the green belt and U_c is the average wind speed (m s^{-1}) inside the green belt. The pollution attenuation coefficient λ (m^{-1}) of the green belt is given by:

$$\lambda = K P_t V_{dp} / V_{dg} \quad (6)$$

where P_t is foliage surface area density of a single tree ($\text{m}^2 \text{m}^{-3}$), V_{dg} is the dry deposition velocity of pollutants on natural surface (m s^{-1}), V_{dp} is the dry deposition velocity of pollutants on vegetation (m s^{-1}) and K is P_c/P_t , where P_c is the average foliage surface area density of the green belt ($\text{m}^2 \text{m}^{-3}$). The constant K depends upon the spacing of the trees in the green belt. For an ideal green belt the value of K is unity.

3.3.2. Selection of Species

Adequate information is required regarding climate, soil and human interactions to select plant species for establishing the green belt. In any green belt development, monoculture is not advisable due to its climatic factor and other environmental constraints. A green belt with a variety of native species is preferable to maintain species diversity, rational utilisation of nutrients and for maintaining the health of the trees. Air pollution tolerance indices (APTI) and the expected performance indices (EPI) of plant species are the important parameters for selection of species (Shannigrahi and Agarawal, 1996). Air pollution tolerance indices of tree species may be calculated by means of the formula proposed by Singh and Rao (1983):

$$APTI = [A(T+P)+R]/10 \quad (7)$$

where A is the ascorbic acid content in mg g^{-1} of dry weight, T is total chlorophyll in mg g^{-1} fresh weight, P is pH of leaf extract, and R is relative water content (%). On the basis of the air pollution tolerance index and some relevant phyto-socio-economic characters, performance index (EPI) of plant species may be calculated. Trees may be graded as best, excellent, very good, good, moderate, poor and very

TABLE I
Average hourly meteorological data for the area during the summer season

Hour (IST)	Wind direction (from)	Wind speed at 9 m height (m s^{-1})	Stability class (Pasquill-Gifford)	Mixing height (m)	Temperature ($^{\circ}\text{K}$)
0100	E	2.0	6	300	303.1
0200	S	2.7	6	300	302.1
0300	SE	2.7	6	300	301.4
0400	E	2.8	6	300	301.1
0500	S	2.5	6	300	300.4
0600	W	2.3	5	450	300.1
0700	ESE	1.5	4	550	302.1
0800	SW	1.7	4	600	303.1
0900	NNE	1.8	3	800	307.5
1000	W	2.0	3	850	308.1
1100	N	2.2	3	900	313.4
1200	WNW	2.4	2	1100	313.1
1300	N	2.1	1	1300	314.5
1400	N	2.5	1	1300	314.0
1500	N	3.5	1	1400	313.8
1600	N	2.4	2	1200	312.1
1700	S	2.4	2	1100	311.1
1800	S	2.1	3	800	310.1
1900	N	0.6	4	700	309.1
2000	NNE	0.5	5	600	308.1
2100	N	1.0	5	600	309.1
2200	WNW	1.0	6	500	308.1
2300	N	1.1	6	500	305.1
2400	E	1.8	6	300	304.1

poor categories. Species belonging to the first 4 categories may be recommended for planting. Categories are given in Tables II and III.

4. Results and Discussion

4.1. METEOROLOGY

The local meteorology during the study period (summer season, March to June) is

TABLE II
Grading pattern of trees for green belt development

Grading character	Pattern of assessment	Grade allotted
Air pollution tolerance index	7.0–8.5	1
	8.6–9.5	2
	9.6–10.5	3
	10.6–11.5	4
	11.6–12.5	5
Tree habit	Small	0
	Medium	1
	Large	2
Canopy structure	Sparse/irregular/globular	0
	Spreading crown/open/semidense	1
	Spreading dense	2
Type of tree	Deciduous	0
	Evergreen	1
Laminar characters		
(a) Size	Small	0
	Medium	1
	Large	2
(b) Texture	Smooth	0
	Coriaceous	1
Hardiness	Delieate	0
	Heady	1
Economic value	Less then three uses	0
	Three or four uses	1
	Five or more uses	2

Maximum grades that can be scored by a plant = 16.

summarized in Table I. The data represent hourly averages of all the parameters for the period of four months at a height of 9 m from ground. The diurnal variations of mixing height was between 300 m (during night time) and 1400 m (during day time). Wind speed varied between 0.5 and 3.5 m s⁻¹. Calms (wind speed <0.6 m s⁻¹) during the study period occurred around 7% of the time (Figure 4). The predominant wind direction was towards the south (i.e. wind was blowing from the north). All the stability classes (Pasquill-Gifford) occurred during the summer season.

TABLE III
Expected performance index of different tree species

Grade	Scores (%)	Assessment
0	upto 30	Not recommended for plantation
1	31–40	Very poor
2	41–50	Poor
3	51–60	Moderate
4	61–70	Good
5	71–80	Very good
6	81–90	Excellent
7	91–100	Best plus plant

TABLE IV
Baseline air quality data for the area ($1 \pm$ S.E.)

Sampling station no.	Direction from the centre of the proposed quarry	Distance from site boundary (m)	24-hr average SPM concentration ($\mu\text{g m}^{-3}$)
1	North-East	250	164 \pm 16
2	South-East	195	178 \pm 18
3	South-West	50	166 \pm 19
4	North-West	200	152 \pm 12

4.2. BASELINE AIR QUALITY

Four sampling stations were established around the boundary of the proposed quarry. Monitoring data from the four sampling stations are presented in Table IV. The mean value of the 24-hr average SPM concentration varied between 152 and 178 $\mu\text{g m}^{-3}$.

4.3. EMISSION RATE

Emission rates for different quarrying activities during the first five years of operation have been calculated based on the study by CMRI (1998) and are summarized in Table V. Emission rates have been calculated based on average wind speed, moisture and silt content of materials, capacity/size of equipment and frequency of respective operation (CMRI, 1998). This emission rate assumes no mitigative measures at the site. It is note worthy that the main sources of SPM emissions

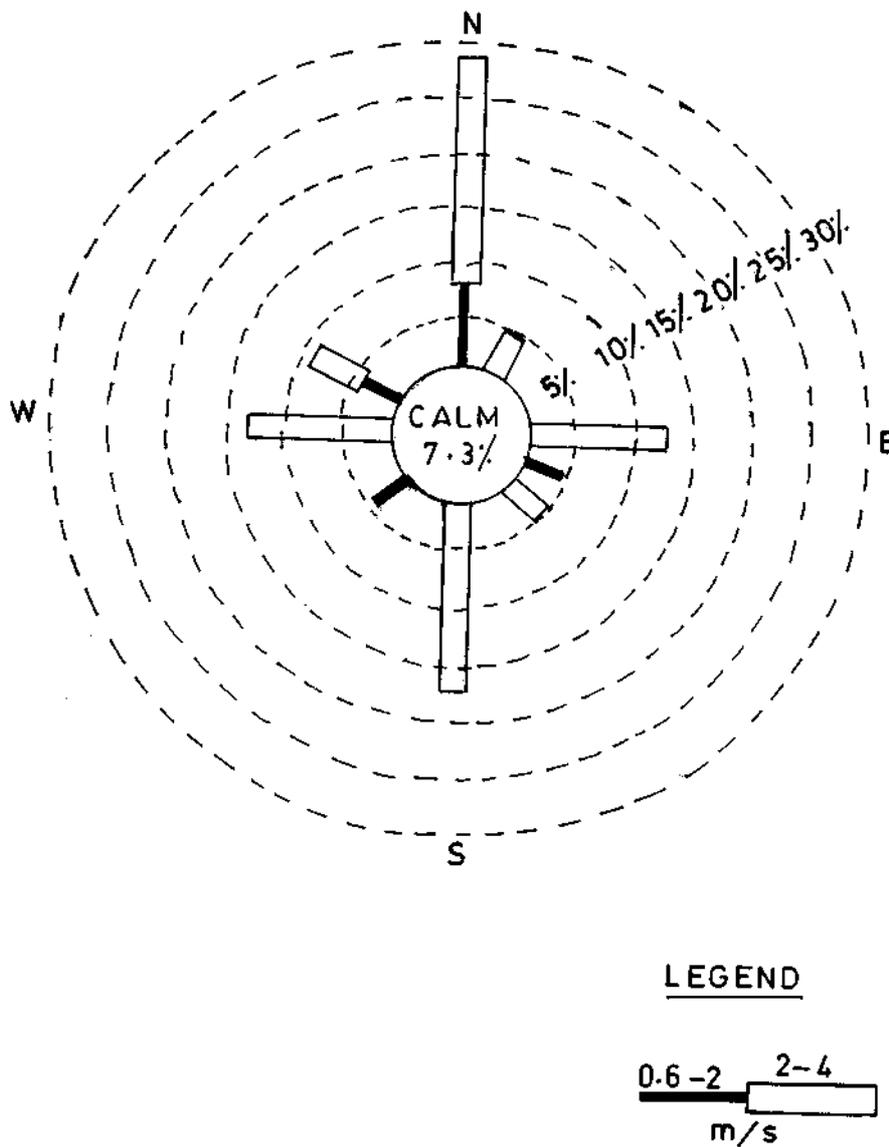


Figure 4. Windrose of the area during summer season.

are the haul routes and ore processing plant. Emission rates for point, line and area sources are given in g s^{-1} , $\text{g s}^{-1} \text{m}^{-1}$ and $\text{g s}^{-1} \text{m}^{-2}$, respectively. Zeller *et al.* (1979), Cowherd (1982), USEPA (1995a) and Australia EPA (1996) have also derived empirical formulae for the determination of emission rates for western surface coal mining activities. However, the emission rates from Indian quarries are different from US quarrying activities due to differences in the nature of quarrying, site practices and mitigation measures, and geological and climatic conditions

TABLE V
SPM emission rate for different activities

Sl. no.	Activity	Category of source	Emission rate	
			Unit	Value
1	Drilling	Point	g s^{-1}	1.2103
2	Overburden loading	Point	g s^{-1}	1.1964
3	Limestone loading	Point	g s^{-1}	0.7850
4	Haul road	Line	$\text{g s}^{-1} \text{m}^{-1}$	0.0312
5	Transport road	Line	$\text{g s}^{-1} \text{m}^{-1}$	0.0250
6	Overburden unloading	Point	g s^{-1}	2.6114
7	Limestone unloading	Point	g s^{-1}	2.0472
8	Exposed overburden dump	Area	$\text{g s}^{-1} \text{m}^{-2}$	0.0001085
9	Stock yard	Area	$\text{g s}^{-1} \text{m}^{-2}$	0.0005774
10	Screening plant	Area	$\text{g s}^{-1} \text{m}^{-2}$	0.001506
11	Workshop	Area	$\text{g s}^{-1} \text{m}^{-2}$	0.000203
12	Exposed pit face	Area	$\text{g s}^{-1} \text{m}^{-2}$	0.0000456

(CMRI, 1998). Due to additional activities at Indian quarries and the difference from coal mines, comparison of emission rates is not possible against USEPA and Australia EPA data. CMRI (1998) has given a detailed procedure for emission rate calculations along with the formulae for each activity.

4.4. PREDICTED AIR QUALITY

The maximum 24-hr mean SPM concentration due to quarrying activities only are presented in Figure 5. The modelling shows that SPM concentrations within the site boundary would be around $360 \mu\text{g m}^{-3}$ (excluding background SPM concentrations) and the dispersion of pollutants would be towards the south, as the predominant wind direction in the area is from the north during the summer season.

Increments to 24-hr mean SPM concentrations beyond the site boundary would be less than $130 \mu\text{g m}^{-3}$. The total 24-hr mean SPM concentration beyond the boundary would be around $330 \mu\text{g m}^{-3}$ during the first five years of quarrying, assuming a maximum background average of $200 \mu\text{g m}^{-3}$ as shown by the measurements during summer season. This is well below the national permissible limit of $500 \mu\text{g m}^{-3}$ for 24-hr mean SPM concentrations (including background concentration) for an industrial area. Therefore, it may be concluded that the impact on local air quality from the operation of Rawan-Jhipan limestone quarry would be acceptable.

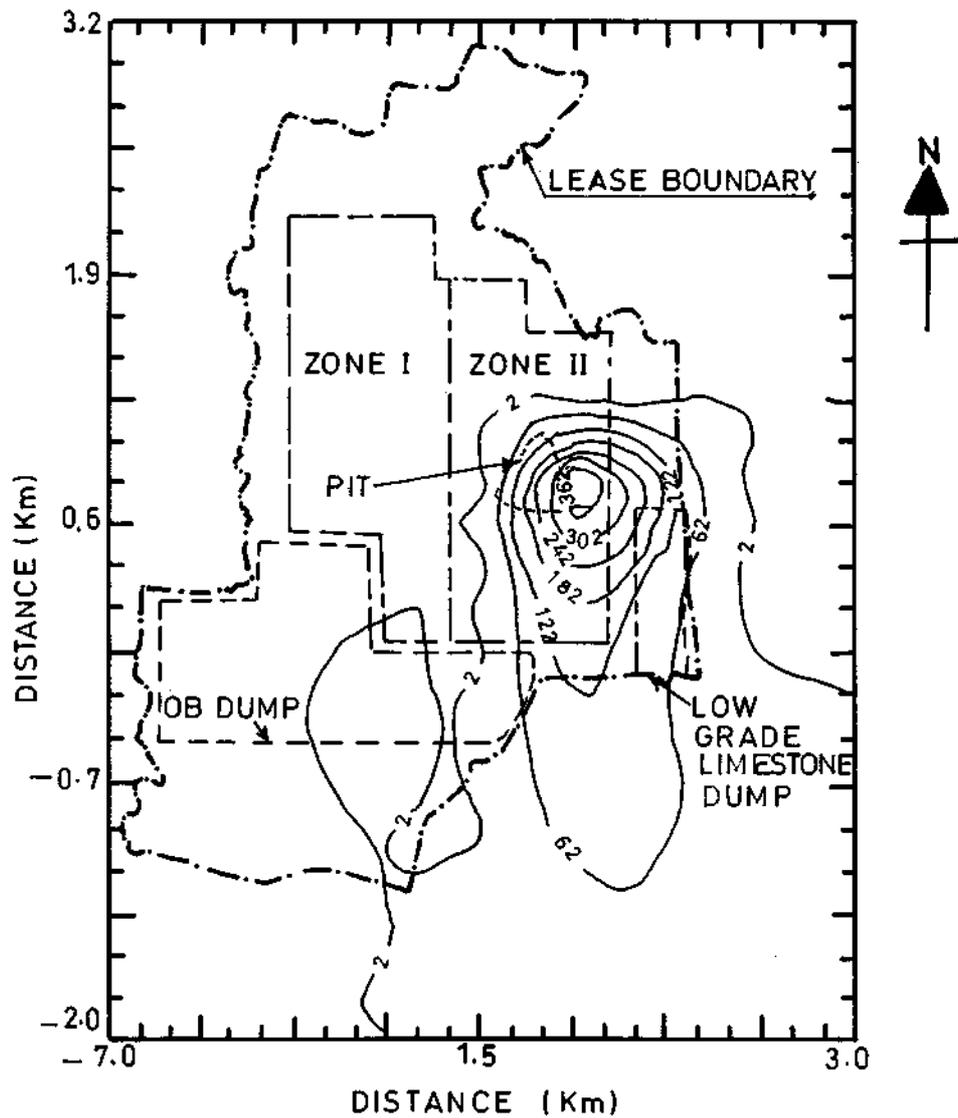


Figure 5. Isoleth of ground level 24-hr mean SPM concentration ($\mu\text{g m}^{-3}$) contributed by quarrying activities.

4.5. GREEN BELT DEVELOPMENT

4.5.1. Recommended Plant Species

Plant species selected for planting are listed in Table VI following the methodology described earlier. Plant species having an expected performance index (EPI) more than 60% have been selected to include the following characteristics:

TABLE VI
Suggested plant species for green belt development

Species name	Family	Local name of plant	Evergreen (E) or deciduous (D)	Expected performance index (%)
<i>Azadirachta indica</i>	Meliaceae	Neem	E	63
<i>Dalbergia sisoo</i>	Leguminosae	Shisam	D	81
<i>Mangifera indica</i>	Myrtaceae	Aam	E	81
<i>Shorea robusta</i>	Dipterocarpaceae	Sal	D	81
<i>Terminalia arjuna</i>	Combretaceae	Arjun	D	75
<i>Teetona grandis</i>	Verbenaceae	Teak	D	81
<i>Tamarindus indica</i>	Leguminosae	Imple	D	63
<i>Holarrhena antidysentrica</i>	Apocynaceae	Dudhli	D	63
<i>Adina cordifolia</i>	Rubiaceae	Holdu	D	69
<i>Bridelia retusa</i>	Euphorbiaceae	Kesri	D	75
<i>Buchanania lanzan</i>	Anacardiaceae	Achar	D	75
<i>Madhuca indica</i>	Sapotaceae	Mahua	E	81
<i>Polyalthia longifolia</i>	Anonaceae	Ashoka	E	69
<i>Syzygium cumini</i>	Myrtaceae	Jamun	E	75

- Native in nature to sustain in the micro-climatic, soil and human interaction.
- Trees growing up to 10 m or more in height with thick perennial foliage.
- Fast growing plant species which can attain their full height in a short period of time (i.e. 5–6 yr).
- Green belt should be implemented after the planning stage and would be able to grow considerably within the development stage of the quarry.

4.5.2. Design of Green Belt

Due to site specific characteristics of the quarry, the development of green belt is possible only along the site boundary. Distances of emission sources from the green belt vary at different locations on the site boundary. The pollution attenuation factor (λ), U_c and U_z will remain the same for the particular recommended species, design parameters, implementation technique of green belt and micro-climatic conditions of the area. Therefore, X_1 , X_2 and h are the critical parameters for optimization of the green belt for the present case.

During the first five years of quarrying, the height of plant species would vary between 5 and 8 m. The distance of the pollution source to green belt would vary between 100 and 2000 m. Therefore, for optimum design of the green belt, a sensit-

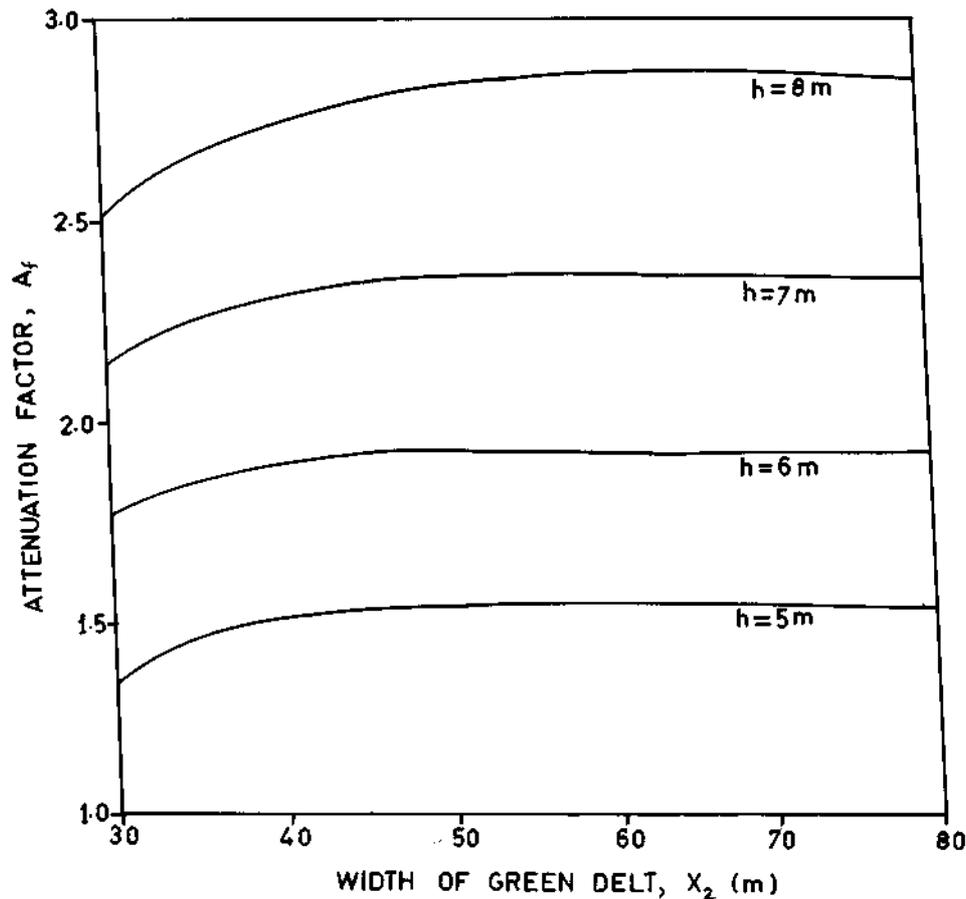


Figure 6. Variation of A_f with width of green belt.

ivity analysis has been carried out with respect to width of green belt (X_2), distance between source and inner edge of green belt (X_1) and height of trees (h).

Figure 6 shows the variation of A_f with X_2 for four different tree height, when $\lambda = 0.02 \text{ m}^{-1}$, $V_{dp} = 0.0156 \text{ m s}^{-1}$, $V_{dg} = 0.0468 \text{ m s}^{-1}$, $U_o = 0.5 \text{ m s}^{-1}$, $U_z = 2.0 \text{ m s}^{-1}$, $X_1 = 100 \text{ m}$ and stability class = A. It can be seen that value of A_f increases with increase in X_2 only up to 40 m and then remains practically independent of X_2 . This suggests that 40 m is the optimum width of the green belt, beyond which the value of A_f practically ceases to increase.

The variation of A_f with X_1 for four different tree heights is presented in Figure 7, when $\lambda = 0.02 \text{ m}^{-1}$, $V_{dp} = 0.0156 \text{ m s}^{-1}$, $V_{dg} = 0.0468 \text{ m s}^{-1}$, $U_c = 2.0 \text{ m s}^{-1}$, $U_z = 0.5 \text{ m s}^{-1}$, $X_2 = 40 \text{ m}$ and stability class = A. It is seen that A_f decreases with increasing value of X_1 , and increases of h cause A_f to increase. The value of A_f varies significantly for smaller X_1 , and A_f is practically the same for all four values of h .

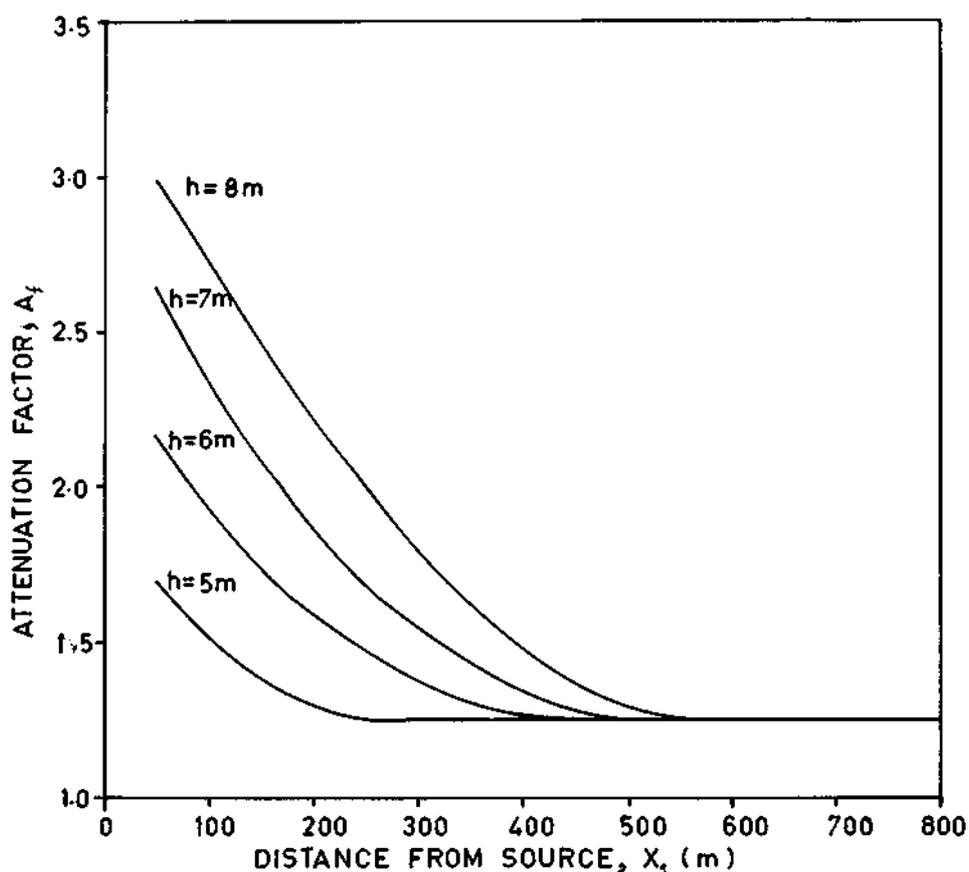


Figure 7. Variation of A_f with distance from source to inner edge of green belt.

4.5.3. Planting Technique

For planting of small plants, digging of pits is very important for preparing the soil environment near the roots of the plants. The size of the pit should be such as to supply the required nutrients to the roots of the plants. The usual method is to dig a pit of required size 3 to 4 month before planting of species, which is generally done at the break of the monsoon. Pits of $45 \times 45 \times 45$ cm size may be used for planting trees. Planting of trees should be done in eleven rows along the site boundary in staggered rows to prevent horizontal pollution dispersion. The soils should be mixed with one third farm-yard manure before refilling about a week prior to planting.

Effective control measures at the processing plant, excavation area and overburden mounds should also be implemented to mitigate the SPM emission at source.

5. Conclusions

For the site under investigation limestone quarrying operations do not have a significant impact on airborne levels of suspended particulate matter, both within the site boundary and beyond the site boundary. Nevertheless, a green belt development around the site boundary with the suggested plant species would reduce the pollutant dispersion.

Atmospheric dispersion modelling is a useful tool for predicting airborne concentrations contributed by a proposed quarrying project, using two basic input parameters viz. meteorological data and pollutant emission rates. Such an analysis is possible before commencement of any quarrying activity and effective mitigative measures (if required) can be included at the planning stage. Therefore, this technique may also be used for investigating future operational scenarios and thereby aiding decision making for the granting of permission to exploit minerals. This will help in maintaining eco-friendly quarrying and sustainable development for the quarrying areas.

Acknowledgements

Authors are grateful to the Director, Central Mining Research Institute (CMRI), Dhanbad for giving permission to publish this article. The help rendered by Mr. A.K. Chowdhury for preparation of the manuscript is sincerely acknowledged. Authors are also thankful to the scientists of Environmental Management Group of CMRI for their help during field monitoring. Grateful acknowledgment is also due to M/s Bhagwati Design Pvt. Ltd, Mumbai for sponsoring this research work. Finally, the necessary help and facilities extended by the Management of Rawanjhipan limestone quarry during the field study is gratefully acknowledged.

References

- Australia EPA: 1996, *Emissions Estimation Techniques Report*, Vol. 1, National Pollutant Inventory Taskforce, 40 Blackall Street, Barton ACT 2600, Australia.
- California Department of Transportation: 1979, *CALINE3-A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets*, Office of Transportation Laboratory Department of Transportation, State of California, Sacramento, California 95807, No. FAWA/CA/TL-79/23, U.S.A.
- Central Mining Research Institute (CMRI): 1998, 'Determination of Emission Factor for Various Opencast Mining Activities', GAP/9/EMG/MOEF/97, Environmental Management Group, Dhanbad, India.
- Chaulya, S. K. and Chakraborty, M. K.: 1995, 'Perspective of New National Mineral Policy and Environmental Control for Mineral Sector', in G. S. Khuntia (ed.), *Proceedings of National Seminar on Status of Mineral Exploitation in India*, New Delhi, India, pp. 114-123.
- Cowherd Jr., D.: 1982, 'Fugitive Emission Factor Update for AP-42 Final Report', Research Triangle Park, NC: U.S. Environmental Protection Agency, Industrial Research Laboratory.

- Davis, J. C.: 1973, *Statistic and Data Analysis in Geology*, John Wiley & Sons, New York.
- Ermak, D. L.: 1977, *Atmospheric Environment* **11**, 231.
- Hanna, S. R., Briggs, G. A. and Hosker Jr., R. P.: 1982, *Handbook on Atmospheric Diffusion*, DOE/TIC-11223, Technical Information Center, U.S. Department of Energy, pp. 101.
- Horst, T. W.: 1977, *Atmospheric Environment* **11**, 41.
- Hosker Jr., R. P.: 1974, 'Estimation of Dry Deposition and Plume Depletion Over Forests and Grassland', in *Proceedings of International Atomic Energy Association on the Physical Behaviour of Radioactive Contaminants in the Atmosphere*, Vienna, pp. 291–309.
- Huchabee, J. W., Sanz Diaz, F., Janzen, S. A. and Solomon, J.: 1983, *Environmental Pollution* **30**, 211.
- Jones, T.: 1993, *Natural Resource Forum* **17**(3), 170.
- Kapoor, R. K. and Gupta, V. K.: 1984, *Atmospheric Environment* **18**(6), 1107.
- Kumar, C. S. S., Kumar, P., Deshpande, V. P. and Badrinath, S. D.: 1994, 'Fugitive Dust Emission Estimation and Validation of Air Quality Model in Bauxite Mines', in G. S. Khuntia (ed.), *Proceedings of International Conference on Environmental Issues in Minerals and Energy Industry*, New Delhi, India, pp. 77–81.
- National Environmental Engineering Research Institute (NEERI): 1993, *Workshop on Computer Aided EIA of Industrial Project*, Nagpur, India.
- Peavy, H. S., Rowe, D. R. and Tchobanoglous, G.: 1985, *Environmental Engineering*, McGraw-Hill, New York.
- Perkins, H. C.: 1974, *Air Pollution*, McGraw-Hill, New York.
- Rao, C. C. V.: 1996, 'Air Quality Modelling – Research Needs', in B. B. Dhar, M. K. Chakraborty, S. K. Chaulya and R. S. Singh (eds.), *Proceedings of Workshop on Air Quality Modelling and Atmospheric Acidification*, Commonwealth Science Council, Dhanbad, India, pp. 1–27.
- Shannigrahi, A. S. and Agrawal, K. M.: 1996, *Indian J. Environmental Protection* **17**(4), 253.
- Sharma, S. C. and Roy, R. K.: 1997, *Indian J. Environmental Protection* **17**(10), 724.
- Singh, R. S., Chaulya, S. K., Tewary, B. K. and Dhar, B. B.: 1996, 'Restoration of a Coal Quarry Overburden Dump – A Case Study', *Coal International March*, 88–90.
- Singh, S. and Roa, D. N.: 1983, 'Evaluation of Plants for their Tolerance to Air Pollution', in A. K. Singh (ed.), *Proceedings on Air Pollution Control*, New Delhi, India, pp. 218–224.
- Sinha, S. and Banerjee, S. P.: 1994, 'A Method for Estimating Fugitive Particulate Emission from Haul Roads in Opencast Coal Mines and Mitigative Measures', in S. P. Banerjee (ed.), *Proceedings of Second National Seminar on Minerals and Ecology*, Dhanbad, India, pp. 217–227.
- Slinn, W. G. N.: 1982, *Atmospheric Environment* **16**, 1785.
- Tichy, J.: 1996, *Environmental Pollution* **93**, 303.
- USEPA: 1995, *User's Guide for the Fugitive Dust Model (FDM)*, Vol. I, User's Instruction, Region 10, 1200 sixth Avenue, Seattle, Washington, U.S.A.
- USEPA: 1995a, *Compilation of Air Pollution Emission Factors*, Vol. I, Stationary Point and Area Sources, 5th ed., Research Triangle Park, North Carolina, U.S.A.
- Wahid, A., Maggs, R., Shamsi, S. R. A., Bell, J. N. B. and Ashmore, M. R.: 1995, *Environmental Pollution* **88**(2), 147.
- Zeller, K. F., Fox, G. F. and Marlate, W. E.: 1979, *Estimating Dust Production from Surface Mining*, Report No. EPA-600/7-79-182. Research Triangle Park, NC, U.S. Environmental Protection Agency, Industrial Research Laboratory.

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.907.211>

Analysis of Physico-Chemical Properties and Available Macro Nutrient Status of Soil Blocks of Alwar District Rajasthan, India

Priyanka Yadav*, Narendra Swaroop and Tarence Thomas

Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute,
SHUATS, Prayagraj, UttarPradesh, India

*Corresponding author

ABSTRACT

Keywords

Physico-chemical properties, Alwar district, Soil and macronutrient status

Article Info

Accepted:

17 June 2020

Available Online:

10 July 2020

The present study was conducted to assess the physico-chemical properties and available N, P, K status of soil of Alwar district, Rajasthan using standard laboratory procedure. Soil samples were collected from three blocks (Mundawar, Behror, Neemarana) of the Alwar district from two depth viz. 0-15 cm and 15-30 cm. Nine sampling points in different villages were selected for the analysis of pH, electrical conductivity (EC), Nitrogen, Phosphorus, Potassium, Soil texture i.e sand, silt and clay % in soil, Water holding capacity, Percent pore space in soil. Results of the study indicated that pH ranges from 7.6 to 8.4. The EC ranges from 0.22 to 0.98 dSm^{-1} . The Nitrogen ranges from 87.5 to 184.1 Kg ha^{-1} . The Phosphorus ranges from 25 to 39 Kg ha^{-1} . The Potassium ranges from 169 to 298 Kg ha^{-1} . The sand, silt and clay ranges were from 85.2 - 94.6 %, 1.3 - 8.3 % and 4.1-9.0 % respectively. The soil texture varied from Fine sand to Loamy sand. Range of water holding capacity from 42.42 % to 62.5 % and percent pore space 37.86 to 58.9 including mean highest percent pore space 55.87 % and the lowest percent space 42.35 %

Introduction

Soil consists of minerals and organic constituents, exhibits definite physical, chemical and biological properties of variable depth. Over the surface of earth provides a suitable medium for plant growth. The chemical properties of the soil are the interactions of various chemical constituents among soil particles and the soil solution. These physical and chemical properties are soil texture, bulk density particle density water holding capacity, soil structure, soil colour, pH, electrical conductivity, cation

exchange capacity, organic carbon, organic matter and soil nutrients (i.e divided as macro and micro nutrient). (Nautiyal and Kumar, 2004) Soil testing makes complete nutrient control a possibility, Fertilizer experiments are being patterned to determine economically optimum rates of nutrients application high yields with low production costs per unit are a must in modern farming.

Farmers of today are different in the failure is more certain and sooner unless they are obtaining reasonably high yields, improved drainage, many improved Cultural practices,

better varieties, and control of insects and disease have helped to set the stage for high yields. As a result, the demand on the soil has gradually increased. Soil testing lets farmers know how much and what kind of fertilizer they must apply to be sure of returns from their investments in other improved practices (Joshi, *et al.*, 2013).

The quality of soil is rather dynamic and can affect the sustainability and productivity of land use. It is the end product of soil degradative or conserving processes and is controlled by chemical, physical and biological components of a soil and their interactions (Papendick and Parr, 1992).

Limited studies are available so far on the changes in soil nutrient status over time in the drylands in general, and arid regions in particular where the sandy soils mostly suffer from several nutrient deficiencies. It has been documented (Wani 2008) that dryland soils are not only thirsty but also hungry.

In order to maintain and enhance the productivity of land, one needs to take-up not only proper soil and water management activities, but also appropriate knowledge-based soil nutrient management. In the arid sandy tract of western Rajasthan, the soils are usually deficient in several macro- and micronutrients, and there is large spatial variability in the plant-available nutrient content of the soils (Gupta *et al.*, 2000; Praveen-Kumar *et al.*, 2009; Mahesh Kumar *et al.*, 2011a).

Also, the soils of the region do not receive adequate nutrient replenishment through flood, *etc.* as the region is devoid of any major perennial stream, and the rainfall is low. Consequently, productivity of the soils in arid region is also relatively low. The district Alwar of Rajasthan is considered as the driest part of country.

Materials and Methods

Study area

The district is located in the south-eastern part of Rajasthan. Geographically, the district lies at 25°43'N latitude and 75°65'E longitude and 268 m altitude. Geographical Area of Alwar district is 5,776 sq km. It is approximately at a distance of 164 km from the state capital Jaipur. The climate of district is extremely hot in the summers and fairly cold in the winters. The prevailing climate in Alwar is known as local steppe climate. The climate here is classified as BSh by the Koppen-Geiger classification system. The average annual is 637 mm.

Sample collection and Analysis

Soil samples were collected from three different blocks of Alwar district Rajasthan. They are Behror, Neemrana and Mundawar. Soil samples were collected with the help of Khurpi, spade and meter scale. In each block three village selected for sampling and samples obtained from two different depths 0-15cm and 15-30cm, totally eighteen soil sample were collected then further were first air dried at room temperature, then crushed using wooden mallet and then sieved (2mm) for further analysis. Water holding capacity (%) was estimated by volume basis (Muthuvel 1992). The relative proportions of the various soil separates in a soil. Analysis of soil texture was done by Bouyoucos Hydrometer method (Bouyoucos, 1927). The pore space % was calculated from the 100ml graduated measuring cylinder (Black, 1965). The soil was distilled with alkaline potassium permanganate as suggested by (Subbiah and Asija 1956) and the ammonia evolved was determined. P in the soil extract is determined colorimetrically using a Photoelectric Colorimeter after developing molybdenum blue colour (Olsen *et al.*, 1954). The procedure was based on extraction with 1N NH₄OAC

(pH 7.0) and K was determined by Flame Photometer (Toth and Prince, 1949). The same procedure used for the estimation of K. The pH was determined in 1:2 soil water suspensions using digital pH meter (Jackson, 1958). The EC was determined in 1:2 soil water suspensions using digital EC meter (Wilcox, 1950).

Results and Discussion

The Table.1 and 2 depicted the soil texture in different blocks of Alwar district from depth (0-15 and 15-30). The Sand, Silt and Clay % ranges from 85.2 - 94.6 %, 1.3 – 8.3 % and 4.1-9.0 % respectively. The Table 1 and Figure 1.1 shows the variation in water holding capacity at different depths (0-15cm and 15-30 cm) in Alwar district soils which are collected from few villages those are located nearby coastal areas. Water holding capacity of soil at 0-15cm varies between 42.85 - 62.5 %. Depth of 15-30 cm of soil showing 42.42 - 59.35% of water holding capacity. In this situation water holding capacity of soil high at 0-15cm depth. The

Table1 and Figure 1.2 depicted the statistical accumulation on percent pore space of various farmers field and depths of 0-15 and 15-30. %Pore space varies between 37.86 - 56.15 at the depth of 0-15cm of soil and 37.9 – 58.95 % at the depth of 15-30cm depth of the soil. It means increasing the depth results increasing % pore space of soils. The mean highest percent pore space 55.87 % and the lowest percent space 42.35%. The Table 1 and Figure 1.3 depicted the statistical accumulation on pH of various farmers field and depths. The pH ranges from 7.6 - 8.4 at 0-15cm depth and 7.7 - 8.2 at 15-30 cm depth. The highest mean value is recorded 8.25 and the least mean value 7.65. When depth wise values were considered, 0-15cm samples show lower pH when compared to 15-30cm depth (deeper) soil samples. It means alkaline in nature these depth is having high amount of exchangeable sodium ions. it shows that higher amount of pH is present in 15-30 cm compared to 0-15cm depth of soil. It occurs because of downward movement of water accumulation of cations in lower layers of soils.

Table.1 Physico-chemical parameter 9 sampling sites at depth (0-15) selected from three blocks of alwar district

Parameters	V1 0-15	V2 0-15	V3 0-15	V4 0-15	V5 0-15	V6 0-15	V7 0-15	V8 0-15	V9 0-15
pH	8.2	8.0	7.9	8.3	7.8	7.8	8.4	7.6	7.8
EC	0.27	0.22	0.37	0.89	0.94	0.89	0.91	0.78	0.96
% Pore space	46.8	45.2	37.86	51.66	56.15	46.8	53.1	50	46.8
Water holding capacity	62.5	51.42	55.8	45.94	42.85	47.22	51.42	44.11	56.6
Sand%	86.0	88.5	89.5	94.6	94.0	94.0	85.2	85.2	86.2
Silt%	8.3	4.5	4.5	1.3	1.9	1.9	5.8	5.8	7.6
Clay%	5.7	7.0	6.0	4.1	4.2	4.2	9.0	9.0	6.2
Soil texture	Fine sand	Fine sand	Loamy sand	Fine sand	Fine sand	Fine sand	Loamy sand	Loamy sand	Loamy sand
Avai N	151.2	98.3	117.2	91.2	162.7	103.4	109.3	127.2	117.2
Avai P	39	36	36	31	27	26	30	33	36
K	223	197	186	223	181	169	298	284	230

Table.2 Physico-chemical parameter 9 sampling sites at depth (15-30) selected from three blocks of alwar district

Parameters	V1 15-30	V2 15-30	V3 15-30	V4 15-30	V5 15-30	V6 15-30	V7 15-30	V8 15-30	V9 15-30
pH	7.9	7.9	8.0	8.2	7.7	7.8	8.0	7.7	7.7
EC	0.30	0.32	0.45	0.94	0.96	0.98	0.79	0.70	0.94
%Pore space	53.1	44.5	56.9	53.4	55.6	37.9	41.2	58.95	45.18
Water holding capacity	57.57	57.14	59.35	47.2	42.4	43.2	48.48	48.57	58.06
Sand%	86.0	88.5	89.5	94.6	94.0	94.0	85.2	85.2	86.2
Silt%	8.3	4.5	4.5	1.3	1.9	1.9	5.8	5.8	7.6
Clay%	5.7	7.0	6.0	4.1	4.2	4.2	9.0	9.0	6.2
Soil texture	Fine sand	Fine sand	Loamy sand	Fine sand	Fine sand	Fine sand	Loamy sand	Loamy sand	Loamy sand
Avai N	138.7	102.1	87.5	99.4	170.2	134.2	129.4	139.2	184.1
Avai P	38	33	38	33	25	27	32	34	38
K	229	174	187	259	194	173	283	188	202

Fig.1 Water holding capacity (%) of farmer’s field at 0-15 and 15-30 cm depths

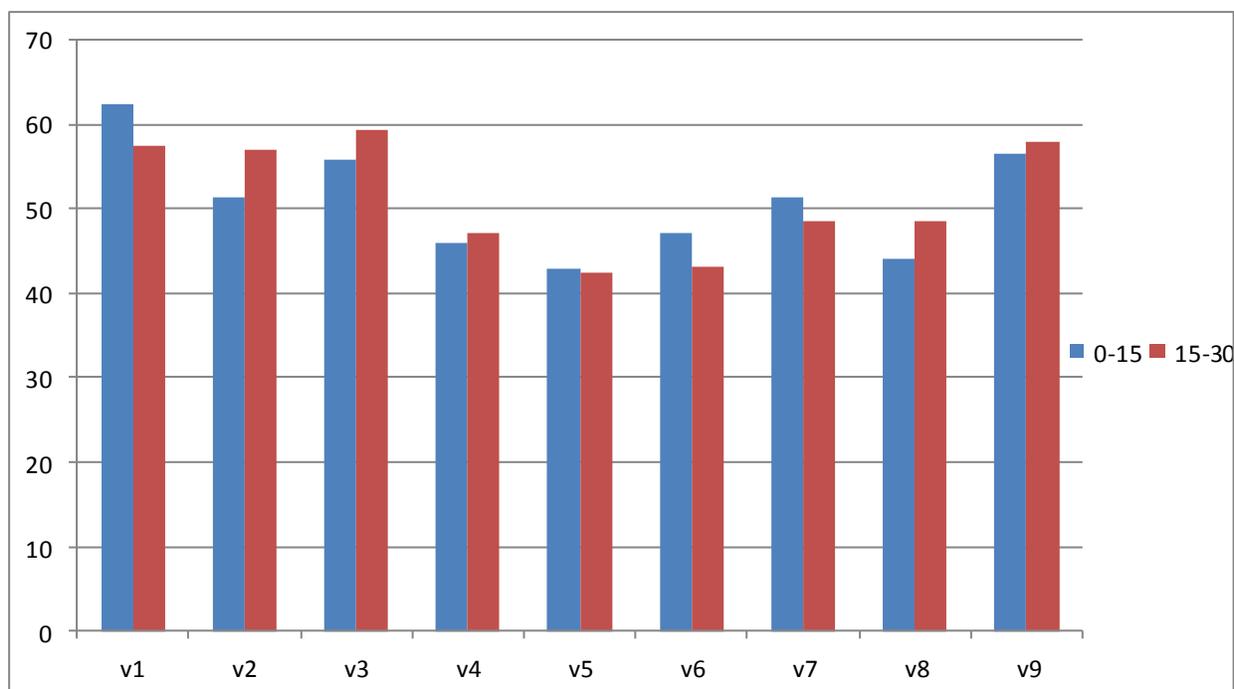


Fig.2 Percent Pore Space of farmer's field at 0-15 and 15-30 cm depths

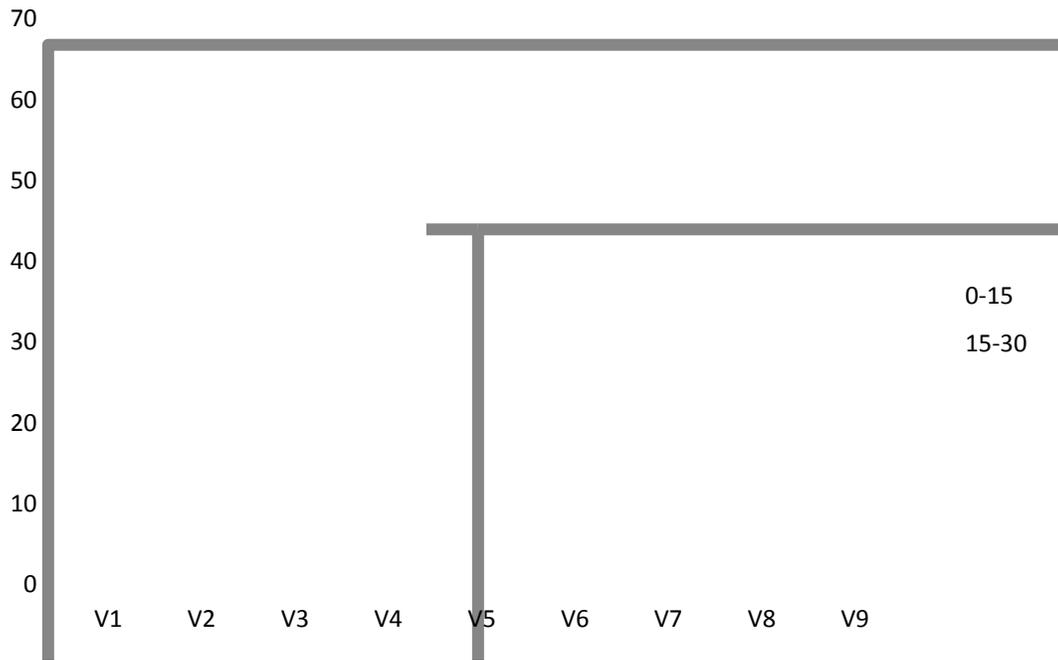


Fig.3 pH value of farmer's field at 0-15 and 15-30 cm depths

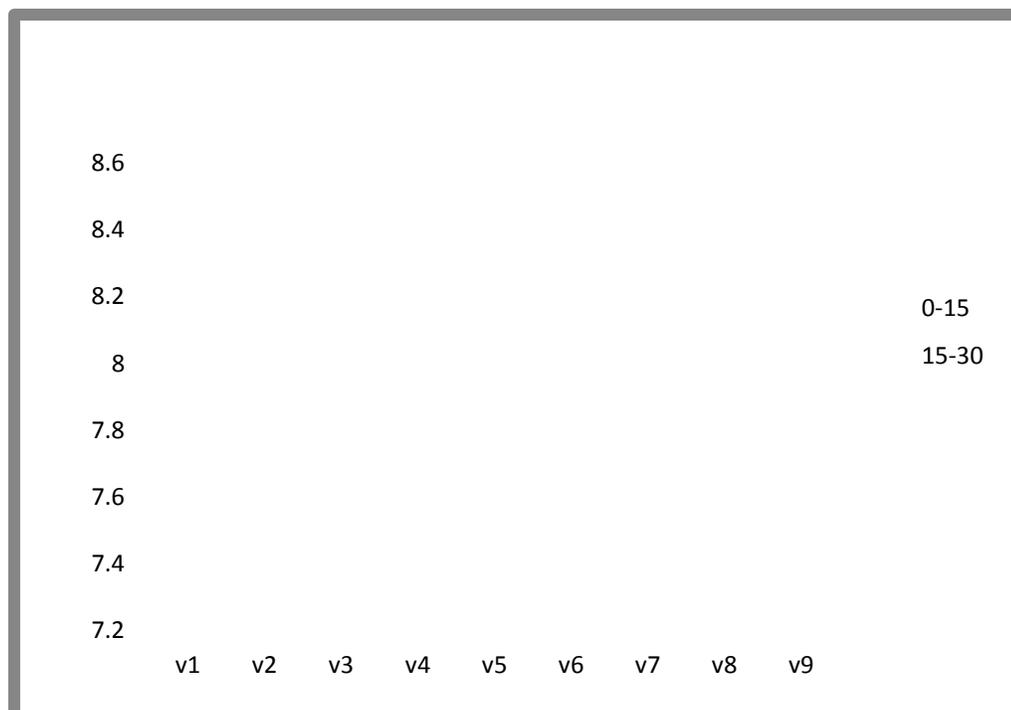


Fig.4 EC (dS m^{-1}) of farmer's field at 0-15 and 15-30 cm depths

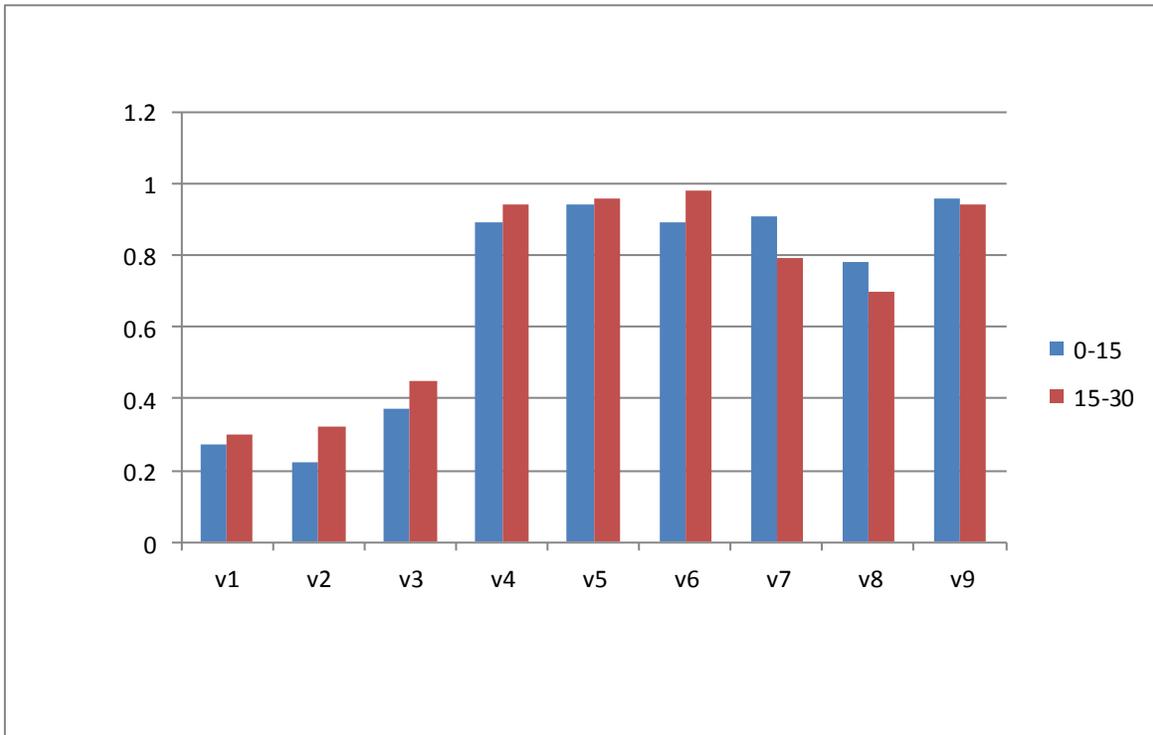


Fig.5 Available Nitrogen (kg ha^{-1}) of farmer's field at 0-15 and 15-30 cm depths

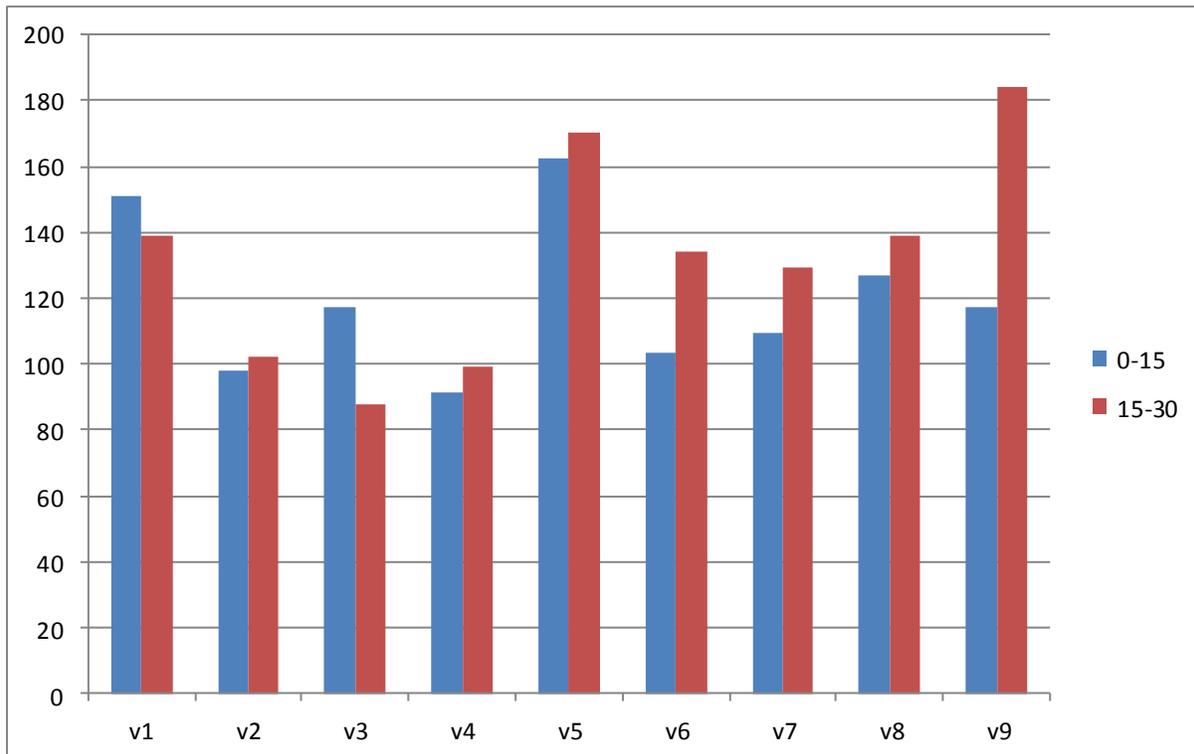


Fig.6 Available phosphorus (kg ha⁻¹) of farmer's field at 0-15 and 15-30 cm depths

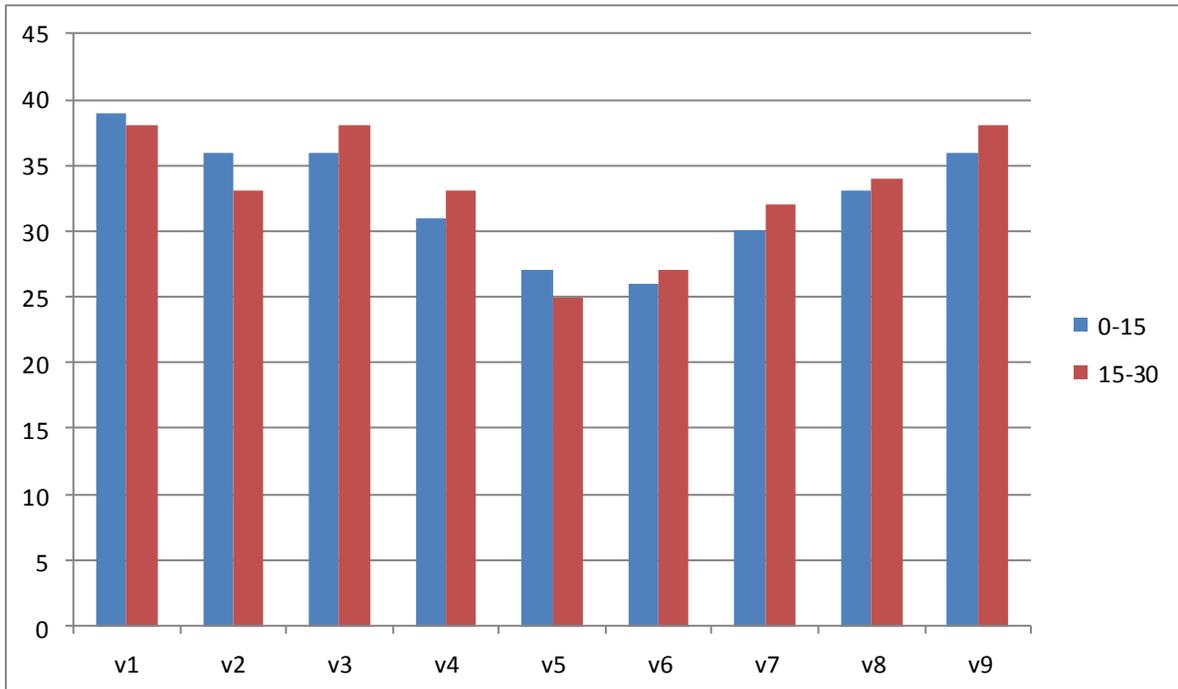
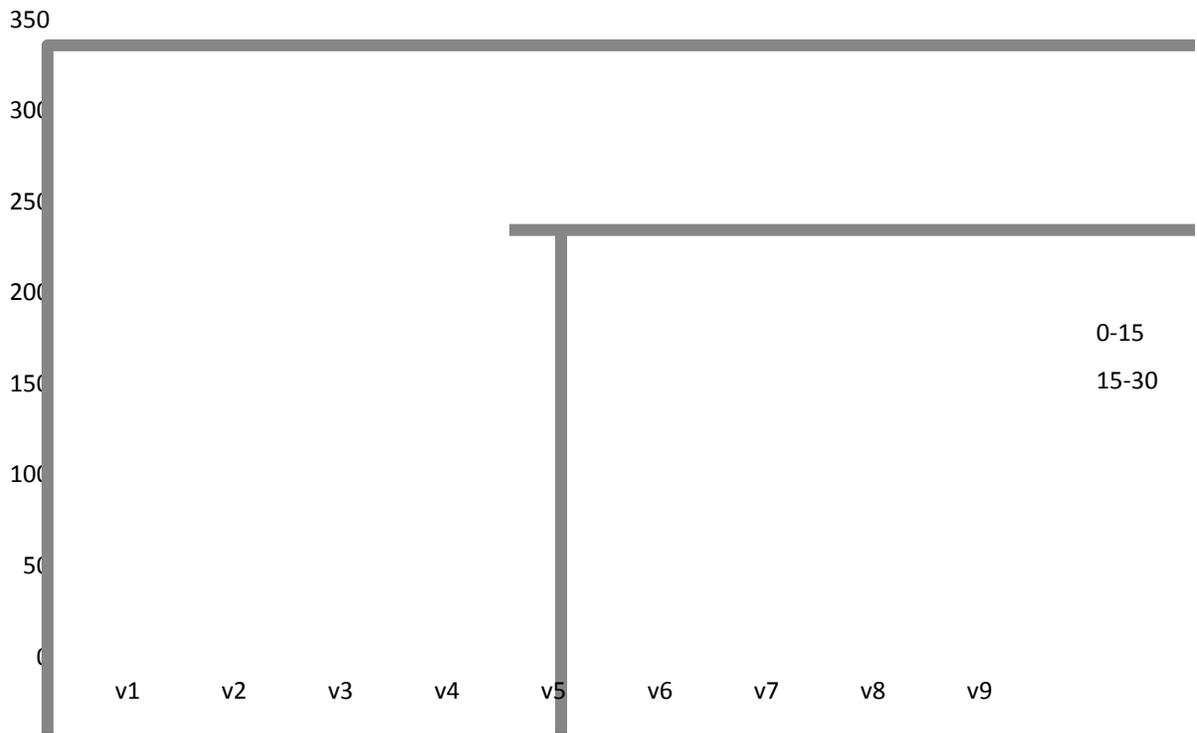


Fig.7 Available potassium (kg ha⁻¹) of farmer's field at 0-15 and 15-30 cm depths



The Table.1 and Figure.4 depicted the statistical accumulation on EC of various farmers field and depths. The highest mean value is recorded 0.95 dS m⁻¹ and the least mean value 0.27 dS m⁻¹. EC of this region soils 0-15 cm depth is various in between 0.22 – 0.96 dS m⁻¹. At the depth of 15-30 cm of soils showing 0.30 – 0.98 dS m⁻¹. Comparatively 0-15cm depth is showing fewer amounts EC than 15-30cm depth. The Table 1 and Figure 1.5 depicted the statistical accumulation on Nitrogen (kg ha⁻¹) of various farmers field and depths which was found to be non significant. The N ranges from 98.3 - 162.75kg ha⁻¹ at 0-15 cm and 87.5 – 184.1 kg ha⁻¹ at 15-30 cm. The highest mean value is recorded is 166.47 kg ha⁻¹ and the least mean value 95.3 kg ha⁻¹. The Table 1 and Figure 1.6 depicted the statistical accumulation on available phosphorus (kg ha⁻¹) of various farmers field and depths. The P ranges from 26 - 36kg ha⁻¹ at 0-15 cm and 25-38 kg ha⁻¹ at 15-30 cm depth. The highest mean value is recorded 38.5 and the least mean value 26kg ha⁻¹.

The Table.1 and Figure.7 depicted the statistical accumulation on potassium (kg ha⁻¹) of various farmers field and depths. The K ranges from 169-298 kg ha⁻¹ at 0-15 cm and 173-283 kg ha⁻¹ at 15-30 cm. The highest mean value is recorded 290.5 kg ha⁻¹ and the least mean value 171 kg ha⁻¹.

References

- Adikua, S. G. K. , G. Osei a , T. A. Adjadeh a & G. N. Dowuona (2007) Simplifying the Analysis of Soil Particle Sizes. I. Test of the Sur and Kukal's Modified Hydrometer Method Communications in Soil Science and Plant Analysis, 35:13-14, 1995-2003
- Arshi Iram and TI Khan (2018) Analysis of Soil Quality Using Physico-Chemical Parameters with Special Emphasis on Fluoride from Selected Sites of Sawai Madhopur Tehsil, Rajasthan. *Int J Environ Sci Nat Res* 12(5) (125-132)
- Gurjar, O.P., Ramawatar Meena and Achinkumar and Surya Kant (2017) Soil Fertility Status of Mandal Block in Bhilwara District of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences* ISSN: 2319-7706 Volume 6 Number 9 1154-1158
- Hukam Singh Kothiyari, K. C. Meena, B. L. Meena and Ramkishan Meena (2018) Soil Fertility Status in Sawai Madhopur District of Rajasthan *Int. J. Pure App. Biosci.* 6 (4): 587-591
- Mahesh Kumar, S.K. Singh¹ and B.K. Sharma (2009) Characterization, Classification and Evaluation of Soils of Churu District, Rajasthan *Journal of the Indian Society of Soil Science*, Vol. 57, No. 3, pp 253-261
- Pravin R. Chaudhari, Dodha V. Ahire, Vidya D. Ahire, Manab Chkravarty and Saroj Maity Soil Bulk Density as related to Soil Texture, Organic Matter Content and available total Nutrients *International Journal of Scientific and Research Publications*, Volume 3, Issue 2, 2250-3153
- Rakesh Gothwal, Govind Kumar Gupta. (2018). Physico-Chemical Analysis of Soil during Summer Season in Lentic Fresh Water Ecosystem: Nakki Lake-Mount Abu *WSN* 115 (2019) 117-127
- Ramana¹, Y.V. Singh, L. K. Jat, Santosh K. Meena Lakhapati Singh, H.S. Jatav and Alpana Paul. (2015). Available Macro Nutrient Status and their Relationship with Soil Physico-Chemical Properties of Sri Ganganagar. *Journal of Pure and Applied Microbiology*, Vol. 9(4), p. 2887-2894
- Sanjay Kumarbhati. (2017). Chemical Analysis of soil fertility parameters in

- Sri ganganagar and Hanumangarh District of Rajasthan. *IJIRMP* 5 (4).
- Singh, Y.V., Shashi Kant, S.K. Singh, P.K. Sharma, L.K. Jat, M. Kumar, S.K. Shahi, H.S. Jatav and R.N. Yadav. 2017. Assessment of Physico-Chemical Characteristics of the Soil of Lahar Block in Bhind District of Madhya Pradesh (India). *Int.J.Curr.Microbiol.App.Sci.* 6(2). 511-519.
- Subbaiah, B.V. and Asija, G.K (1956) A rapid procedure for utilization of available nitrogen in *Soil.Curr.Sci.* 26: 258-260.
- Tan (1945) Observed the procedure of soil sampling.
- Toth and Prince, (1949) Estimation of available potassium.
- VarshaPandey, PoonamGautam and AP Singh (2018) Assessment of physical properties of soil under different land use systems in a Mollisol *Journal of Pharmacognosy and Phytochemistry* ; 7(6): 2645-2648
- Vikram Kumar^{1*}, Jahangeer², PadmNabh Tripathi³ and Shaktibala Comparative study of soil physical characteristics of Jaipur district, Rajasthan (2017) *African Journal of Environmental Science and Technology* Vol. 11(1), pp. 45-55
- Walkley, A. and Black, I.A (1934) Estimation of Degtjareft method for determining soil organic matter, and a proposed modification of chromic acid titration method. *Soil Science* 37,29-38

How to cite this article:

Priyanka Yadav, Narendra Swaroop and Tarence Thomas. 2020. Analysis of Physico – Chemical Properties and Available Macro Nutrient Status of Soil Blocks of Alwar District Rajasthan, India. *Int.J.Curr.Microbiol.App.Sci.* 9(07): 1834-1842.
doi: <https://doi.org/10.20546/ijcmas.2020.907.211>

Meteorological data of January 2020 (CAAQMS,Alwar)

	AQ5_ ALWAR PM10	AQ5_ ALWAR PM2.5	AQ5_ ALWAR TEMP	AQ5_ ALWAR Rh	AQ5_ ALWAR WS	AQ5_ ALWAR WD	AQ5_ ALWAR BP	AQ5_ ALWAR SR
	ug/m3	ug/m3	degreC	%	m/s	degree	mmHg	W/m2
1/1/2020 1:00	109.36	63.96	8.67	94.16	1.05	311.27	731.97	34.81
1/1/2020 2:00	103.76	63.35	8.51	94.19	1.27	20.77	732.07	35.03
1/1/2020 3:00	89.47	56.71	8.89	94.18	1.13	310.32	732.14	34.72
1/1/2020 4:00	90.98	53.45	8.83	94.19	0.84	330.95	731.75	33.94
1/1/2020 5:00	97.74	53.41	8.25	94.22	0.63	315.98	732.11	33.86
1/1/2020 6:00	88.56	49.35	7.54	94.24	0.10	108.79	731.83	33.88
1/1/2020 7:00	89.57	47.93	7.77	94.25	0.84	318.99	732.10	34.18
1/1/2020 8:00	97.49	57.36	8.37	94.22	1.02	3.13	732.25	48.65
1/1/2020 9:00	115.26	66.29	11.05	89.14	1.05	239.84	731.97	112.10
1/1/2020 10:00	130.00	73.10	14.55	64.78	1.40	116.74	732.64	191.15
1/1/2020 11:00	124.32	69.00	15.44	56.48	0.91	84.18	734.09	224.04
1/1/2020 12:00	108.15	63.68	16.04	58.04	1.71	81.61	734.59	239.35
1/1/2020 13:00	104.49	53.80	16.62	56.73	1.95	74.56	735.03	269.20
1/1/2020 14:00	104.11	56.02	17.37	56.30	1.87	60.73	734.94	295.78
1/1/2020 15:00								
1/1/2020 16:00	85.69	50.08	18.72	55.75	1.50	100.35	733.87	123.31
1/1/2020 17:00	90.39	53.95	18.38	59.18	1.84	46.29	733.96	82.49
1/1/2020 18:00	116.18	57.86	17.06	68.51	1.41	55.52	732.67	37.77
1/1/2020 19:00	128.72	65.91	15.17	81.28	1.64	287.81	732.21	32.11
1/1/2020 20:00	122.88	74.21	13.95	87.66	1.66	281.12	732.34	33.47
1/1/2020 21:00	157.39	94.06	13.23	91.58	1.59	271.49	732.21	33.87
1/1/2020 22:00	146.03	92.59	12.89	93.74	1.44	282.45	732.32	34.28
1/1/2020 23:00	124.81	75.14	12.47	94.09	1.37	280.26	732.28	33.96
1/2/2020 0:00	108.28	62.59	12.09	94.14	1.24	278.69	732.32	33.77
1/2/2020 1:00	103.80	56.60	12.00	94.11	1.14	272.78	732.62	33.69
1/2/2020 2:00	104.32	51.92	11.65	94.12	1.14	280.69	732.21	33.66
1/2/2020 3:00	84.01	44.63	10.64	94.21	0.48	19.52	731.99	34.22
1/2/2020 4:00	75.87	38.64	10.18	94.23	0.38	286.88	732.05	33.79
1/2/2020 5:00	76.59	44.66	9.89	94.23	0.72	306.34	731.95	34.49
1/2/2020 6:00	94.08	48.04	9.88	94.23	1.23	282.08	732.02	34.69
1/2/2020 7:00	91.54	46.90	9.87	94.23	1.16	280.05	732.04	34.96
1/2/2020 8:00	87.17	44.67	9.67	94.23	0.68	15.82	731.83	46.20
1/2/2020 9:00	94.61	53.26	12.50	88.27	1.11	22.76	732.03	106.09
1/2/2020 10:00	120.80	65.33	17.76	58.77	0.75	19.19	732.29	214.79
1/2/2020 11:00	114.17	63.52	18.93	44.50	1.50	41.46	733.55	220.00
1/2/2020 12:00	93.53	45.24	20.46	41.39	0.80	50.45	733.70	307.91
1/2/2020 13:00	92.71	36.35	20.93	42.97	1.01	59.52	733.74	212.53
1/2/2020 14:00	72.06	35.47	21.15	43.88	1.33	58.41	733.38	167.41
1/2/2020 15:00	76.06	33.79	21.71	44.51	2.04	20.75	734.34	158.86
1/2/2020 16:00	86.91	37.35	21.65	45.39	1.95	9.25	733.93	119.85
1/2/2020 17:00	88.58	33.34	21.67	44.96	1.62	37.32	732.89	86.98
1/2/2020 18:00	85.23	33.77	19.78	55.77	1.45	63.80	731.97	36.68

1/2/2020 19:00	104.77	44.01	18.70	59.50	1.06	73.91	732.28	32.66
1/2/2020 20:00	113.86	54.86	16.37	75.83	1.03	258.82	731.75	33.26
1/2/2020 21:00	127.45	72.92	15.38	82.39	1.73	53.91	732.32	33.29
1/2/2020 22:00	127.74	78.24	14.87	83.61	1.64	32.04	732.26	33.35
1/2/2020 23:00	130.77	70.53	15.14	80.85	1.74	29.28	732.67	33.50
1/3/2020 0:00	108.37	58.18	15.42	77.61	1.19	16.48	732.11	34.03
1/3/2020 1:00	96.73	45.88	15.71	75.40	1.59	78.28	732.23	34.99
1/3/2020 2:00	79.69	38.48	14.17	85.65	1.36	49.30	732.15	34.41
1/3/2020 3:00	91.72	46.79	13.37	92.34	1.03	58.12	731.94	34.65
1/3/2020 4:00	97.60	46.12	13.48	88.64	0.97	112.86	732.05	34.04
1/3/2020 5:00	87.13	45.61	13.33	90.33	0.78	327.49	732.06	34.32
1/3/2020 6:00	85.25	48.99	13.06	93.32	1.21	20.64	731.98	34.36
1/3/2020 7:00	88.46	49.09	12.56	94.19	0.16	3.69	732.09	34.38
1/3/2020 8:00	101.39	51.24	12.32	94.20	0.80	326.78	732.22	45.00
1/3/2020 9:00	104.72	52.28	15.21	85.46	0.63	33.05	731.87	101.02
1/3/2020 10:00	129.77	65.98	18.30	65.45	2.17	15.74	734.30	206.91
1/3/2020 11:00	124.36	52.24	19.41	59.44	1.86	45.25	734.76	226.61
1/3/2020 12:00	95.20	38.52	17.64	62.98	1.75	58.99	735.30	326.83
1/3/2020 13:00	75.53	33.58	18.12	60.98	1.90	42.44	735.19	344.11
1/3/2020 14:00	75.98	27.27	19.04	57.02	2.57	39.19	736.48	252.11
1/3/2020 15:00	73.24	30.93	19.74	55.25	2.01	53.61	735.21	134.54
1/3/2020 16:00	68.66	23.16	19.90	51.58	2.17	63.23	735.75	107.66
1/3/2020 17:00	70.23	25.19	19.36	55.81	2.39	36.68	735.62	95.84
1/3/2020 18:00	83.26	26.93	18.02	61.36	1.55	85.49	733.31	38.86
1/3/2020 19:00	97.61	28.40	15.62	76.09	1.01	280.48	732.02	32.01
1/3/2020 20:00	116.52	45.54	14.18	84.32	1.03	347.74	731.88	33.92
1/3/2020 21:00	124.72	63.02	13.37	86.07	1.53	3.93	732.16	34.64
1/3/2020 22:00	121.54	59.72	12.74	88.70	1.46	7.59	732.22	34.91
1/3/2020 23:00	96.78	43.14	12.06	93.36	1.17	3.33	731.88	35.73
1/4/2020 0:00	78.69	31.18	11.58	96.41	1.32	12.24	732.06	36.03
1/4/2020 1:00	75.31	23.02	10.71	99.14	0.90	326.56	731.70	36.15
1/4/2020 2:00	65.19	21.88	10.47	99.19	0.52	45.89	731.83	36.52
1/4/2020 3:00	57.76	18.36	9.68	99.22	0.46	1.71	731.50	36.12
1/4/2020 4:00	57.48	26.24	9.39	99.23	0.54	62.23	731.67	36.24
1/4/2020 5:00	66.43	27.41	9.38	99.25	0.52	9.84	731.71	35.85
1/4/2020 6:00	70.36	25.22	9.43	99.27	0.26	130.91	731.73	35.22
1/4/2020 7:00	64.44	21.65	9.40	99.27	0.73	284.85	731.72	34.66
1/4/2020 8:00	65.82	23.61	9.20	99.28	0.47	54.29	731.70	46.12
1/4/2020 9:00	74.85	32.04	10.93	98.83	0.55	259.37	732.24	101.69
1/4/2020 10:00	96.40	44.91	14.15	85.21	1.04	311.84	733.17	197.37
1/4/2020 11:00	100.28	49.11	17.09	69.62	1.14	355.48	733.48	231.40
1/4/2020 12:00	86.50	45.57	18.76	62.08	1.27	291.89	734.04	334.00
1/4/2020 13:00	82.24	34.83	19.60	54.95	1.39	195.22	734.49	359.67
1/4/2020 14:00	65.57	23.01	19.24	51.59	1.43	218.40	734.03	144.67
1/4/2020 15:00	63.67	19.55	19.39	52.13	1.05	259.58	732.80	106.88
1/4/2020 16:00	62.50	19.68	19.59	50.62	0.83	262.28	733.16	112.28
1/4/2020 17:00	63.29	21.49	19.39	50.72	0.58	7.56	733.20	90.56

1/4/2020 18:00	68.16	22.81	17.24	65.64	1.26	10.41	732.22	36.90
1/4/2020 19:00	84.55	32.68	15.03	78.46	1.38	30.68	731.84	32.52
1/4/2020 20:00	109.10	51.24	14.24	80.22	1.32	12.25	732.35	33.53
1/4/2020 21:00	114.38	57.30	13.46	84.93	0.65	304.93	732.18	33.85
1/4/2020 22:00	115.07	59.15	12.88	90.55	1.10	328.59	732.11	34.62
1/4/2020 23:00	112.48	57.44	12.36	95.06	1.21	355.84	731.96	35.26
1/5/2020 0:00	109.00	57.06	12.30	94.27	0.92	41.43	732.18	34.90
1/5/2020 1:00	108.05	56.01	11.92	95.04	1.53	36.62	732.18	34.54
1/5/2020 2:00	99.46	51.31	11.50	94.47	1.45	27.88	732.17	34.81
1/5/2020 3:00	88.77	45.24	11.28	92.04	1.46	355.56	732.10	34.72
1/5/2020 4:00	75.16	37.68	10.56	93.41	1.70	32.26	732.65	34.63
1/5/2020 5:00	76.55	33.10	9.97	93.26	1.39	5.13	732.22	35.36
1/5/2020 6:00	80.43	34.35	9.66	92.03	0.35	354.01	732.09	35.13
1/5/2020 7:00	75.19	40.44	8.60	98.82	0.55	73.24	731.73	35.69
1/5/2020 8:00	83.47	38.30	8.70	98.50	0.65	37.51	731.80	47.05
1/5/2020 9:00	75.64	44.16	11.32	83.63	0.62	146.74	731.96	104.21
1/5/2020 10:00	103.51	54.13	14.59	66.89	0.82	40.63	732.12	203.85
1/5/2020 11:00	108.88	57.28	17.23	57.12	1.42	199.63	733.89	232.12
1/5/2020 12:00	105.08	49.94	18.70	52.80	1.66	222.28	734.39	331.49
1/5/2020 13:00	95.05	41.18	19.92	48.84	1.40	216.19	734.49	334.29
1/5/2020 14:00	82.61	36.95	20.48	46.61	0.39	150.02	734.18	238.38
1/5/2020 15:00	78.19	34.82	20.51	46.36	1.07	70.90	734.91	149.45
1/5/2020 16:00	91.03	38.92	20.81	42.89	0.84	66.05	733.29	131.25
1/5/2020 17:00	85.99	38.49	20.26	43.68	1.98	52.33	734.54	92.24
1/5/2020 18:00	84.11	32.76	19.13	49.97	1.86	45.99	733.59	39.05
1/5/2020 19:00	93.38	30.76	17.85	58.08	1.97	39.13	733.92	32.61
1/5/2020 20:00	105.14	36.88	16.39	64.31	1.49	48.23	733.34	31.80
1/5/2020 21:00	101.17	41.42	15.00	72.07	1.53	328.56	732.41	33.01
1/5/2020 22:00	109.91	45.15	13.90	74.21	1.61	59.98	732.18	33.73
1/5/2020 23:00	95.27	47.86	12.47	80.73	0.40	11.79	731.89	34.04
1/6/2020 0:00	102.28	43.25	12.20	80.76	1.08	343.31	732.22	34.46
1/6/2020 1:00	89.68	40.58	11.84	80.30	1.38	290.84	731.97	34.40
1/6/2020 2:00	80.66	32.86	11.29	82.99	0.59	270.47	731.84	34.84
1/6/2020 3:00	71.39	33.11	11.46	79.02	1.18	270.67	732.64	34.35
1/6/2020 4:00	80.35	37.58	11.28	80.29	1.59	248.54	732.39	35.67
1/6/2020 5:00	75.35	35.38	11.88	78.65	0.28	31.50	731.96	34.52
1/6/2020 6:00	71.32	32.63	11.56	82.60	0.55	115.20	731.99	32.77
1/6/2020 7:00	74.34	37.35	10.64	90.25	1.52	32.78	732.56	32.37
1/6/2020 8:00	79.74	40.73	10.43	94.46	0.67	179.36	731.94	45.40
1/6/2020 9:00	102.16	46.11	11.63	88.31	1.00	224.15	732.23	80.22
1/6/2020 10:00	98.68	48.72	15.90	59.74	1.21	197.33	732.78	204.46
1/6/2020 11:00			17.36	51.90	1.78	192.67	734.09	191.82
1/6/2020 12:00	0.00	0.00	18.75	53.94	0.96	189.57	735.18	283.28
1/6/2020 13:00	42.96	10.14	18.82	56.97	1.39	175.35	734.54	234.28
1/6/2020 14:00	44.45	26.34	19.54	55.34	2.30	177.54	736.07	219.55
1/6/2020 15:00	64.02	30.79	20.30	53.49	1.51	122.67	734.72	157.19
1/6/2020 16:00	66.37	31.94	20.33	55.93	1.76	106.09	734.47	131.10

1/6/2020 17:00	88.12	28.64	19.41	61.82	1.83	86.12	734.50	81.05
1/6/2020 18:00	75.83	25.43	18.25	69.96	1.30	88.66	733.03	39.10
1/6/2020 19:00	77.49	30.63	17.15	76.48	1.03	355.63	731.96	32.65
1/6/2020 20:00	111.64	45.92	16.54	79.26	1.00	347.96	732.42	33.02
1/6/2020 21:00	111.29	51.94	16.12	75.49	1.05	111.74	732.58	33.35
1/6/2020 22:00	103.15	49.12	15.82	64.83	1.40	69.15	733.76	33.07
1/6/2020 23:00	93.91	48.04	14.85	66.70	0.55	276.87	732.57	32.44
1/7/2020 0:00	92.99	37.56	14.21	69.67	0.78	186.59	732.48	33.51
1/7/2020 1:00	77.21	39.52	13.76	73.58	0.19	44.22	732.00	34.32
1/7/2020 2:00	81.29	37.25	13.92	73.69	0.75	268.28	732.68	34.27
1/7/2020 3:00	83.65	35.80	13.73	75.67	0.29	227.99	732.26	32.59
1/7/2020 4:00	70.29	32.54	13.05	79.63	0.42	356.20	731.93	32.85
1/7/2020 5:00	68.51	36.67	13.14	77.66	1.16	356.88	732.37	34.56
1/7/2020 6:00	72.63	34.75	13.36	76.70	0.96	38.87	732.10	33.91
1/7/2020 7:00	68.62	33.66	12.99	82.31	0.12	41.18	731.89	33.62
1/7/2020 8:00	68.27	32.61	13.01	82.35	0.84	178.79	732.34	40.39
1/7/2020 9:00	90.68	48.06	13.72	78.05	0.63	164.38	732.44	68.24
1/7/2020 10:00	137.31	55.38	14.84	68.68	1.63	79.78	733.36	125.20
1/7/2020 11:00	111.42	50.45	16.01	62.27	1.48	110.27	733.73	181.43
1/7/2020 12:00	91.24	44.76	16.59	60.29	1.08	100.25	733.46	175.19
1/7/2020 13:00	89.71	42.83	17.36	58.76	1.73	39.51	734.38	250.19
1/7/2020 14:00	94.23	39.31	18.04	58.58	1.74	78.37	734.20	196.33
1/7/2020 15:00	82.95	34.57	18.05	61.20	1.76	106.85	734.45	139.75
1/7/2020 16:00	78.03	39.08	17.83	64.41	1.70	96.05	734.12	114.86
1/7/2020 17:00	87.90	39.16	17.47	67.11	1.75	132.72	734.24	71.85
1/7/2020 18:00	82.19	37.15	16.89	71.54	1.44	159.30	732.74	35.77
1/7/2020 19:00	88.46	43.83	16.44	77.65	0.55	301.21	732.10	31.37
1/7/2020 20:00	100.21	55.05	15.89	87.14	0.74	277.42	732.20	33.30
1/7/2020 21:00	112.66	55.99	15.93	85.22	0.08	176.16	732.10	33.87
1/7/2020 22:00	110.33	56.17	15.70	86.75	0.66	71.74	732.42	33.38
1/7/2020 23:00	94.97	46.75	15.26	90.76	1.24	70.10	732.17	33.35
1/8/2020 0:00	77.88	45.13	15.21	87.96	0.67	282.57	732.19	33.31
1/8/2020 1:00	78.35	43.24	14.86	92.49	0.60	327.18	732.02	32.80
1/8/2020 2:00	76.29	49.06	14.12	98.80	0.82	69.96	731.85	32.58
1/8/2020 3:00	85.23	48.57	13.67	99.23	0.16	59.85	732.01	33.95
1/8/2020 4:00	81.08	45.76	13.44	99.28	0.44	58.82	732.00	33.40
1/8/2020 5:00	84.20	39.99	13.41	99.24	1.08	60.18	732.30	33.74
1/8/2020 6:00	62.70	31.98	13.34	99.22	0.69	148.79	731.95	33.35
1/8/2020 7:00	63.13	30.70	13.36	99.22	1.05	63.94	732.34	33.81
1/8/2020 8:00	64.84	38.34	13.54	99.19	1.36	43.46	732.25	37.09
1/8/2020 9:00	72.49	45.58	13.76	99.08	1.78	56.71	733.50	55.11
1/8/2020 10:00	89.75	50.68	14.02	98.12	1.82	46.07	734.22	75.63
1/8/2020 11:00	104.08	49.94	14.34	95.35	1.85	57.00	733.89	70.58
1/8/2020 12:00	86.26	43.99	14.42	91.95	2.16	39.30	734.30	65.92
1/8/2020 13:00	70.53	38.00	14.82	88.05	1.27	31.98	732.82	76.09
1/8/2020 14:00	69.18	38.81	15.52	83.55	1.48	67.11	733.43	128.93
1/8/2020 15:00	77.28	41.07	14.42	91.28	1.35	354.91	734.77	56.53

1/8/2020 16:00	79.60	38.53	13.98	92.06	1.32	351.05	733.92	75.75
1/8/2020 17:00	68.78	32.35	13.56	92.56	1.48	315.60	734.49	46.19
1/8/2020 18:00	71.99	33.01	13.10	93.23	1.94	64.35	735.06	38.13
1/8/2020 19:00	68.43	33.29	13.02	90.20	1.52	44.49	734.62	33.09
1/8/2020 20:00	60.19	25.20	12.97	86.83	1.30	340.02	734.14	32.37
1/8/2020 21:00	51.64	21.82	12.80	86.37	1.03	56.58	733.45	33.23
1/8/2020 22:00	51.02	20.08	12.87	82.50	0.90	16.66	733.60	33.14
1/8/2020 23:00	59.87	26.55	12.68	79.94	1.78	35.10	735.20	33.86
1/9/2020 0:00	56.96	28.50	12.09	80.15	1.82	57.93	734.78	32.58
1/9/2020 1:00	54.88	30.09	11.23	81.41	1.30	10.67	734.10	32.29
1/9/2020 2:00	54.18	29.11	10.48	81.60	1.38	54.59	733.46	32.49
1/9/2020 3:00	57.80	23.69	9.58	86.80	0.89	18.99	733.52	32.97
1/9/2020 4:00	49.56	19.99	9.37	85.21	2.52	20.75	735.43	32.75
1/9/2020 5:00	46.60	18.34	8.94	86.52	1.63	322.66	734.73	32.24
1/9/2020 6:00	48.19	18.95	8.69	85.15	1.43	339.92	733.90	32.15
1/9/2020 7:00	56.02	23.28	8.48	86.36	1.07	20.69	734.21	32.65
1/9/2020 8:00	61.24	30.55	8.68	87.38	0.93	334.66	734.48	45.50
1/9/2020 9:00	69.74	31.04	10.19	79.52	1.42	324.67	734.06	111.47
1/9/2020 10:00	60.45	27.64	11.45	73.99	2.15	31.36	735.26	219.73
1/9/2020 11:00	58.70	19.34	12.32	70.08	2.57	36.49	737.26	259.32
1/9/2020 12:00	58.26	21.62	13.69	59.92	2.53	39.58	737.55	411.39
1/9/2020 13:00	58.18	20.35	15.05	48.85	2.90	22.59	737.47	420.60
1/9/2020 14:00	62.35	21.68	16.01	41.39	2.38	14.67	736.90	299.17
1/9/2020 15:00	51.53	21.22	15.96	38.23	3.00	16.33	738.04	113.99
1/9/2020 16:00	50.49	19.96	15.73	36.27	3.09	24.58	738.29	111.58
1/9/2020 17:00	55.81	19.38	15.13	42.46	2.86	20.63	737.35	118.32
1/9/2020 18:00	60.18	16.51	14.17	49.96	2.55	14.86	736.12	43.53
1/9/2020 19:00	60.90	22.90	12.81	63.68	2.07	10.75	734.92	32.24
1/9/2020 20:00	73.71	27.26	11.88	68.03	1.54	33.51	733.72	32.87
1/9/2020 21:00	60.20	29.20	11.28	72.46	1.67	6.64	733.30	33.24
1/9/2020 22:00	61.37	27.38	10.07	88.55	1.34	50.16	734.12	33.02
1/9/2020 23:00	64.76	32.93	8.76	98.41	1.64	42.00	733.03	33.50
1/10/2020 0:00	65.86	35.13	8.85	96.36	1.95	17.16	734.22	33.40
1/10/2020 1:00	61.93	28.41	8.81	89.69	1.93	49.40	733.90	33.58
1/10/2020 2:00	53.33	22.64	8.03	92.97	1.28	45.98	732.29	34.46
1/10/2020 3:00	52.11	24.98	7.84	91.96	0.44	291.74	732.44	34.96
1/10/2020 4:00	61.22	26.68	8.66	77.46	0.66	212.45	732.70	33.20
1/10/2020 5:00	54.48	19.92	6.88	89.39	0.25	198.26	732.20	33.68
1/10/2020 6:00	53.89	17.48	6.18	97.80	1.24	358.09	732.27	35.07
1/10/2020 7:00	58.26	27.41	7.87	81.16	2.52	15.10	735.17	34.33
1/10/2020 8:00	67.37	32.14	8.36	80.24	2.28	22.47	735.05	46.29
1/10/2020 9:00	61.66	29.20	9.71	75.59	2.11	32.29	734.45	118.45
1/10/2020 10:00	78.69	28.41	11.90	64.44	2.51	28.60	735.79	256.57
1/10/2020 11:00	83.12	34.02	13.32	57.40	3.04	27.10	737.88	259.26
1/10/2020 12:00	75.19	27.24	14.66	52.16	2.71	60.61	737.40	407.94
1/10/2020 13:00	61.61	25.82	15.98	45.25	2.93	14.39	737.53	430.43
1/10/2020 14:00	63.81	25.47	16.86	37.55	3.21	22.29	738.52	303.91

1/10/2020 15:00	64.87	21.78	17.20	37.59	3.10	19.66	738.28	109.34
1/10/2020 16:00	57.42	19.46	17.34	34.04	3.02	18.71	737.61	102.37
1/10/2020 17:00	64.36	16.50	16.84	36.90	2.73	22.04	737.00	123.50
1/10/2020 18:00	61.86	25.04	15.53	42.02	1.81	352.06	733.98	38.75
1/10/2020 19:00	62.72	25.16	13.96	49.98	0.96	359.52	732.52	32.15
1/10/2020 20:00	68.51	28.21	12.29	58.63	0.81	15.19	732.15	32.97
1/10/2020 21:00	77.44	41.10	10.87	66.65	0.70	55.28	731.91	34.80
1/10/2020 22:00	106.01	47.56	10.17	69.42	1.22	8.85	732.19	35.10
1/10/2020 23:00	94.86	42.41	9.67	70.57	1.10	36.13	731.99	35.83
1/11/2020 0:00	77.10	33.60	9.27	74.10	0.70	10.89	731.96	34.87
1/11/2020 1:00	73.52	34.65	8.61	79.03	0.22	356.14	732.12	34.09
1/11/2020 2:00	82.68	33.06	8.75	75.65	0.89	300.98	732.56	34.25
1/11/2020 3:00	66.93	32.22	8.93	73.27	0.25	22.22	732.24	33.64
1/11/2020 4:00	71.32	33.13	8.29	76.40	0.51	136.03	732.64	34.20
1/11/2020 5:00	61.24	28.62	9.87	62.38	1.85	50.61	734.12	35.57
1/11/2020 6:00	59.74	24.45	9.13	68.00	0.67	209.07	732.53	33.12
1/11/2020 7:00	65.43	24.90	8.12	76.46	0.20	25.52	732.22	33.79
1/11/2020 8:00	65.87	27.72	8.26	77.27	1.19	128.70	732.28	43.37
1/11/2020 9:00	84.29	34.33	9.15	75.38	1.23	104.39	732.31	77.03
1/11/2020 10:00	91.51	42.77	11.90	59.74	1.55	132.05	733.06	195.42
1/11/2020 11:00	99.37	52.28	14.97	43.56	0.70	166.76	733.52	244.34
1/11/2020 12:00	93.12	45.03	16.54	40.16	1.17	249.55	733.79	386.36
1/11/2020 13:00	80.83	37.73	17.95	35.99	1.00	66.96	733.82	384.14
1/11/2020 14:00	82.60	33.55	18.40	34.21	0.86	91.03	734.95	286.01
1/11/2020 15:00	90.22	35.30	19.59	32.21	1.28	135.60	733.84	123.43
1/11/2020 16:00	84.17	36.03	19.20	32.85	1.15	104.82	733.93	116.00
1/11/2020 17:00	90.70	36.23	18.77	31.98	1.11	69.80	733.90	108.65
1/11/2020 18:00	80.77	31.33	17.12	39.46	0.90	85.49	732.16	39.34
1/11/2020 19:00	82.37	32.34	14.86	50.75	0.57	95.18	732.11	31.84
1/11/2020 20:00	106.46	47.81	13.16	58.11	0.85	18.87	732.08	34.10
1/11/2020 21:00	110.54	54.28	12.09	59.73	0.91	61.76	731.95	35.20
1/11/2020 22:00	102.95	46.35	11.68	60.25	1.48	13.87	732.56	35.64
1/11/2020 23:00	99.16	43.89	11.14	60.42	0.22	272.23	732.30	34.20
1/12/2020 0:00	84.63	35.99	10.44	68.57	0.76	52.05	731.98	34.95
1/12/2020 1:00	84.36	37.20	9.82	75.30	1.19	26.51	731.77	34.75
1/12/2020 2:00	79.89	42.50	9.21	80.36	0.71	353.26	731.79	34.95
1/12/2020 3:00	91.45	45.58	8.54	80.56	0.29	101.33	731.83	34.52
1/12/2020 4:00	80.27	36.53	8.81	75.31	0.69	26.46	732.23	35.06
1/12/2020 5:00	66.33	28.32	8.21	80.37	0.53	168.22	731.73	35.16
1/12/2020 6:00	74.09	24.34	7.98	81.33	0.48	337.48	732.10	34.44
1/12/2020 7:00	72.61	30.33	7.47	86.35	0.56	80.99	732.05	34.49
1/12/2020 8:00	73.11	35.26	7.47	86.90	0.30	73.66	732.34	45.42
1/12/2020 9:00	84.31	42.09	10.61	69.69	0.66	185.35	732.72	110.50
1/12/2020 10:00	110.01	52.38	14.46	53.64	1.56	157.83	733.31	240.46
1/12/2020 11:00	106.81	48.10	16.92	44.41	1.41	202.35	734.67	244.77
1/12/2020 12:00	84.23	34.35	18.61	41.13	1.63	176.70	734.78	395.61
1/12/2020 13:00	84.63	36.95	20.46	35.48	1.88	187.35	735.28	410.71

1/12/2020 14:00	74.79	29.53	21.65	33.36	2.00	170.71	735.81	306.38
1/12/2020 15:00	75.76	28.96	22.29	29.18	1.72	159.98	735.10	106.92
1/12/2020 16:00	62.29	27.73	22.55	26.13	1.34	280.16	734.58	110.82
1/12/2020 17:00	63.67	27.17	22.03	25.61	1.86	311.03	734.03	116.46
1/12/2020 18:00	71.00	24.45	19.80	36.51	0.41	129.31	732.01	38.70
1/12/2020 19:00	68.68	26.51	16.45	50.74	1.46	37.44	732.04	31.31
1/12/2020 20:00	107.18	39.50	15.02	53.36	1.51	264.72	732.20	33.70
1/12/2020 21:00	103.08	50.93	13.99	54.89	1.50	275.10	732.43	34.84
1/12/2020 22:00	107.50	51.17	13.01	57.70	1.40	259.93	732.23	34.61
1/12/2020 23:00	95.20	48.12	12.24	60.90	1.22	41.19	731.88	35.51
1/13/2020 0:00	82.58	43.25	11.78	64.33	1.13	316.42	732.20	35.48
1/13/2020 1:00	75.75	36.99	11.54	65.99	1.23	43.13	731.88	35.19
1/13/2020 2:00	73.82	39.15	10.86	73.10	0.87	25.21	731.78	35.06
1/13/2020 3:00	72.92	31.52	10.60	74.73	0.43	219.82	731.83	35.07
1/13/2020 4:00	74.68	31.68	9.96	79.87	1.02	65.35	731.81	34.72
1/13/2020 5:00	74.31	35.47	9.89	83.51	0.17	71.13	731.77	34.82
1/13/2020 6:00	84.98	43.27	10.00	85.03	0.32	153.80	731.57	34.84
1/13/2020 7:00	90.02	42.61	10.02	83.45	1.29	348.34	732.23	34.04
1/13/2020 8:00	94.87	51.08	10.49	78.79	1.49	51.41	732.28	45.66
1/13/2020 9:00	113.36	61.99	12.82	67.33	0.85	59.45	732.25	99.86
1/13/2020 10:00	112.30	57.25	14.62	59.38	1.36	91.72	732.88	198.73
1/13/2020 11:00	117.22	59.19	17.25	47.29	0.72	96.03	733.17	229.16
1/13/2020 12:00	113.73	51.56	18.30	45.40	1.61	219.78	735.25	261.18
1/13/2020 13:00	100.51	49.34	19.35	50.00	1.51	172.63	735.18	292.52
1/13/2020 14:00	93.67	44.93	21.08	51.16	0.77	155.58	734.92	279.44
1/13/2020 15:00	84.09	42.04	21.95	49.40	1.80	292.08	735.36	158.49
1/13/2020 16:00	84.13	36.31	21.82	53.08	0.67	182.97	734.32	123.25
1/13/2020 17:00	78.89	30.86	21.31	58.50	1.52	41.83	733.06	65.49
1/13/2020 18:00	95.73	29.89	20.50	61.35	1.98	37.37	734.72	36.72
1/13/2020 19:00	97.27	31.13	19.93	60.33	0.63	7.98	733.20	32.77
1/13/2020 20:00	87.74	29.85	19.04	63.70	0.17	51.97	732.17	32.52
1/13/2020 21:00	85.17	34.63	18.49	68.24	0.94	71.24	732.82	33.19
1/13/2020 22:00	98.37	43.06	17.36	73.60	2.96	31.23	737.49	34.01
1/13/2020 23:00	93.15	36.91	15.74	73.88	2.52	75.94	737.37	36.03
1/14/2020 0:00	73.06	25.97	14.40	83.06	2.97	52.93	739.14	34.34
1/14/2020 1:00	61.48	19.94	13.53	87.28	3.05	74.39	737.74	33.99
1/14/2020 2:00	61.62	23.12	13.01	86.96	2.31	54.40	737.18	33.98
1/14/2020 3:00	60.13	24.44	12.64	84.50	2.39	10.62	735.74	33.92
1/14/2020 4:00	54.46	20.88	12.45	76.60	1.95	30.85	735.16	34.20
1/14/2020 5:00	52.35	19.26	12.10	74.34	2.06	6.59	734.49	34.33
1/14/2020 6:00	50.63	24.41	12.03	73.76	1.69	27.17	733.92	36.05
1/14/2020 7:00	52.11	20.48	12.19	70.50	2.05	15.15	734.91	35.09
1/14/2020 8:00	51.17	20.47	12.32	70.69	0.84	20.94	732.64	46.17
1/14/2020 9:00	73.42	30.61	13.20	67.48	1.05	313.34	733.04	115.40
1/14/2020 10:00	75.14	34.72	14.55	63.34	1.71	52.21	733.95	219.20
1/14/2020 11:00			15.05	63.47	2.91	30.11	737.25	246.39
1/14/2020 12:00	0.00	0.00	15.75	61.28	3.39	27.02	739.17	376.90

1/14/2020 13:00	52.65	20.30	16.59	60.97	3.84	27.35	740.33	409.32
1/14/2020 14:00	51.73	29.47	17.12	60.32	3.44	26.01	739.80	314.57
1/14/2020 15:00	59.71	24.93	17.34	60.44	3.15	27.04	738.86	142.00
1/14/2020 16:00	69.23	28.48	16.82	63.16	3.35	21.63	738.99	136.76
1/14/2020 17:00	74.70	30.74	16.47	64.22	2.77	19.06	737.12	110.08
1/14/2020 18:00	73.63	32.49	15.67	68.56	2.46	27.27	735.88	44.56
1/14/2020 19:00	70.64	34.48	14.58	74.86	2.44	29.26	735.70	32.27
1/14/2020 20:00	79.85	42.31	13.72	78.26	2.32	16.00	735.12	32.97
1/14/2020 21:00	80.32	42.92	13.28	79.78	1.90	37.59	735.18	33.07
1/14/2020 22:00	76.52	34.90	13.06	83.49	1.92	64.50	734.09	33.13
1/14/2020 23:00	73.51	31.83	12.65	83.37	1.99	79.44	734.24	33.49
1/15/2020 0:00	70.35	34.10	12.26	83.46	1.56	57.92	733.83	33.68
1/15/2020 1:00	64.86	37.96	11.92	84.18	1.46	25.69	733.38	33.52
1/15/2020 2:00	65.83	32.82	11.86	83.62	1.73	28.37	734.04	33.33
1/15/2020 3:00	69.02	39.92	11.12	87.46	0.92	87.39	732.63	33.39
1/15/2020 4:00	66.70	36.87	10.33	90.90	1.79	73.57	733.40	33.99
1/15/2020 5:00	67.49	32.12	10.36	89.17	1.96	85.07	734.64	33.69
1/15/2020 6:00	62.43	27.25	10.04	91.38	2.10	48.18	734.65	33.46
1/15/2020 7:00	63.94	30.70	10.14	90.93	2.34	44.97	735.07	33.58
1/15/2020 8:00	69.62	31.60	10.24	89.34	2.02	36.62	734.84	45.35
1/15/2020 9:00	66.92	36.83	11.12	84.81	1.15	334.14	733.36	102.98
1/15/2020 10:00	61.39	35.18	12.03	79.70	2.45	74.42	735.78	216.23
1/15/2020 11:00	82.07	36.24	12.92	74.71	2.67	91.34	737.59	248.93
1/15/2020 12:00	70.07	33.37	14.34	66.68	2.44	104.46	736.93	340.98
1/15/2020 13:00	60.66	27.77	15.69	55.94	2.89	43.22	738.26	355.14
1/15/2020 14:00	65.76	27.05	15.77	55.87	2.14	85.69	737.94	208.44
1/15/2020 15:00	64.00	29.08	15.70	54.54	2.01	51.14	736.91	164.09
1/15/2020 16:00	70.89	30.71	16.12	54.24	2.51	76.62	737.21	134.31
1/15/2020 17:00	69.45	34.04	16.08	57.23	2.63	23.57	736.38	94.88
1/15/2020 18:00	76.39	32.47	15.54	62.53	1.99	21.93	734.60	44.40
1/15/2020 19:00	84.09	39.25	14.69	70.48	1.25	1.90	732.70	31.70
1/15/2020 20:00	86.44	39.00	13.65	77.86	1.51	65.60	732.37	34.00
1/15/2020 21:00	88.40	40.97	13.80	75.86	1.29	3.87	733.07	34.71
1/15/2020 22:00	96.63	46.38	13.99	74.53	1.96	35.83	733.97	35.34
1/15/2020 23:00	81.58	43.01	13.96	72.79	2.44	23.70	735.54	33.22
1/16/2020 0:00	76.34	36.77	13.57	74.22	2.40	9.40	736.66	33.46
1/16/2020 1:00	71.32	37.35	13.31	75.88	2.25	43.04	735.76	33.50
1/16/2020 2:00	77.23	38.30	12.66	83.09	2.19	47.91	736.15	33.29
1/16/2020 3:00	77.80	39.17	12.54	85.05	1.73	15.54	734.79	33.96
1/16/2020 4:00	64.60	34.12	12.17	88.37	1.97	20.33	735.86	33.11
1/16/2020 5:00	73.36	33.17	11.98	96.50	1.15	79.85	733.25	34.13
1/16/2020 6:00	78.05	34.60	11.81	97.86	1.56	52.10	734.41	33.89
1/16/2020 7:00	64.74	35.67	11.97	93.85	2.30	36.16	734.58	34.61
1/16/2020 8:00	70.02	40.76	11.95	91.43	1.33	64.98	733.80	38.30
1/16/2020 9:00	75.57	39.78	12.17	83.29	2.50	38.21	735.71	52.88
1/16/2020 10:00	76.38	42.27	12.51	75.17	2.52	29.68	735.70	98.26
1/16/2020 11:00	67.57	35.85	13.39	65.15	2.44	27.88	735.58	121.77

1/16/2020 12:00	78.78	34.46	14.03	59.75	2.59	28.59	736.27	110.54
1/16/2020 13:00	73.34	35.14	13.89	65.84	2.79	17.37	736.44	94.89
1/16/2020 14:00	65.39	34.42	13.96	64.30	2.24	40.57	736.36	91.51
1/16/2020 15:00	73.35	38.59	13.81	69.79	2.75	19.56	736.46	81.84
1/16/2020 16:00	86.71	39.54	13.64	72.88	2.77	27.88	737.42	68.43
1/16/2020 17:00	74.82	39.42	12.95	78.71	2.41	64.67	736.19	41.52
1/16/2020 18:00	75.68	37.46	11.86	88.05	2.38	30.53	735.54	36.85
1/16/2020 19:00	64.17	34.86	11.76	89.73	2.63	23.61	736.26	34.89
1/16/2020 20:00	71.91	34.43	11.88	92.17	2.14	22.69	735.19	35.14
1/16/2020 21:00	71.70	36.82	12.06	93.98	1.17	351.54	733.03	33.71
1/16/2020 22:00	68.69	38.84	12.05	96.41	2.13	38.30	733.63	34.03
1/16/2020 23:00	70.46	37.17	11.95	98.52	1.17	325.87	732.79	33.56
1/17/2020 0:00	79.64	39.02	11.85	99.19	1.15	340.56	732.67	33.81
1/17/2020 1:00	69.76	35.39	11.97	99.13	1.07	20.95	732.55	33.65
1/17/2020 2:00	60.60	36.18	11.76	99.20	1.12	18.96	732.47	33.81
1/17/2020 3:00	70.12	39.49	11.82	95.79	2.49	30.68	735.22	35.07
1/17/2020 4:00	80.15	40.34	11.89	90.61	2.61	33.69	735.72	35.59
1/17/2020 5:00	74.85	38.80	11.60	93.05	1.94	15.67	735.42	35.02
1/17/2020 6:00	70.05	43.82	11.74	94.93	1.42	23.56	734.08	34.93
1/17/2020 7:00	78.06	42.75	12.11	93.16	1.59	31.79	733.70	34.97
1/17/2020 8:00	76.68	44.70	11.91	94.27	0.48	46.78	732.69	44.33
1/17/2020 9:00	73.04	36.88	12.14	96.12	1.89	177.46	733.58	106.90
1/17/2020 10:00	73.67	44.50	14.15	83.21	0.75	49.21	732.84	215.83
1/17/2020 11:00	84.22	43.47	15.09	75.55	2.91	44.19	736.67	255.87
1/17/2020 12:00	83.60	39.36	16.10	69.17	2.64	36.35	736.66	389.78
1/17/2020 13:00	68.56	39.33	17.43	60.23	1.87	69.99	735.32	414.47
1/17/2020 14:00	70.83	36.54	18.44	56.32	1.38	84.53	734.48	293.83
1/17/2020 15:00	67.54	34.99	18.18	57.96	1.84	71.06	734.80	165.29
1/17/2020 16:00	59.25	29.16	18.27	58.05	1.36	96.38	734.33	138.53
1/17/2020 17:00	60.84	26.91	17.69	63.93	1.78	128.38	734.45	80.64
1/17/2020 18:00	70.13	27.74	16.79	71.25	1.70	150.75	733.71	37.09
1/17/2020 19:00	74.12	30.15	16.10	76.64	1.49	64.91	732.78	31.29
1/17/2020 20:00	65.41	32.67	15.44	83.99	1.81	63.08	733.41	34.26
1/17/2020 21:00	80.13	43.96	14.85	88.39	2.27	45.35	734.82	33.41
1/17/2020 22:00	82.35	41.92	14.28	92.59	1.72	77.61	734.11	33.55
1/17/2020 23:00	87.83	44.76	13.89	94.59	1.62	54.26	733.26	33.14
1/18/2020 0:00	78.57	39.23	13.62	94.49	1.88	48.71	733.63	33.25
1/18/2020 1:00	79.49	42.49	13.39	95.98	1.02	73.71	732.90	32.44
1/18/2020 2:00	77.45	45.22	13.27	97.34	0.90	7.44	731.99	33.95
1/18/2020 3:00	79.43	45.24	13.10	98.20	0.55	76.04	731.99	33.13
1/18/2020 4:00	71.98	44.74	12.88	99.03	1.09	140.91	732.41	33.38
1/18/2020 5:00	73.69	48.99	12.78	99.15	1.64	142.86	732.44	33.47
1/18/2020 6:00	85.24	42.69	12.75	99.18	1.08	145.89	732.24	33.27
1/18/2020 7:00	76.88	37.27	12.75	99.18	1.49	146.70	732.57	33.76
1/18/2020 8:00	78.54	44.86	12.88	99.18	1.33	136.26	732.41	41.85
1/18/2020 9:00	88.35	45.99	13.33	96.88	0.97	95.75	732.53	95.20
1/18/2020 10:00	104.21	51.28	14.76	84.70	0.52	55.58	733.26	191.60

1/18/2020 11:00	85.89	48.56	15.37	80.44	1.93	49.23	734.85	240.07
1/18/2020 12:00	92.32	53.56	16.72	72.90	1.65	44.83	734.77	347.52
1/18/2020 13:00	90.50	49.35	17.79	69.23	1.70	84.80	735.31	372.51
1/18/2020 14:00	82.34	45.36	17.94	63.77	1.76	73.10	734.79	212.91
1/18/2020 15:00	72.28	37.75	17.55	62.39	1.85	81.16	734.77	95.46
1/18/2020 16:00	80.34	34.12	17.08	73.80	2.09	102.77	735.64	124.41
1/18/2020 17:00	77.99	35.58	16.19	81.76	1.78	101.47	734.99	66.09
1/18/2020 18:00	82.41	38.66	14.83	92.49	2.01	130.38	734.86	37.79
1/18/2020 19:00	82.96	46.78	14.04	97.73	1.37	102.87	733.52	31.77
1/18/2020 20:00	82.58	51.66	13.29	99.17	1.86	137.99	733.48	33.55
1/18/2020 21:00	99.63	47.99	13.12	99.18	1.72	153.83	733.39	33.44
1/18/2020 22:00	80.25	46.92	12.80	99.19	1.35	154.85	733.32	32.93
1/18/2020 23:00	97.66	51.39	12.82	99.19	1.67	71.58	733.41	33.69
1/19/2020 0:00	88.04	49.56	12.62	99.05	1.85	46.32	734.53	32.09
1/19/2020 1:00	83.83	54.46	12.36	93.29	2.23	25.13	735.73	33.18
1/19/2020 2:00	79.63	50.73	11.56	91.13	2.27	25.19	735.20	32.05
1/19/2020 3:00	87.18	48.49	10.58	93.41	2.50	32.34	735.31	32.84
1/19/2020 4:00	69.58	46.04	9.92	97.02	1.67	29.97	734.57	32.70
1/19/2020 5:00	77.75	38.59	9.46	98.28	0.80	11.28	733.15	33.08
1/19/2020 6:00	66.67	38.59	8.71	99.11	1.36	54.29	732.49	33.87
1/19/2020 7:00	78.03	42.36	8.11	99.19	0.86	142.07	732.03	34.31
1/19/2020 8:00	78.34	41.39	7.78	99.19	1.12	116.77	732.19	47.07
1/19/2020 9:00	73.03	44.06	9.54	95.50	1.10	127.71	732.97	116.90
1/19/2020 10:00	91.77	54.80	13.01	58.20	2.06	42.96	735.05	262.07
1/19/2020 11:00	91.41	45.71	13.42	60.13	2.79	18.19	737.30	267.71
1/19/2020 12:00	76.49	40.51	13.17	69.54	3.46	22.10	739.80	400.05
1/19/2020 13:00	95.60	43.01	14.30	65.35	3.34	34.03	739.28	415.36
1/19/2020 14:00	88.50	48.65	16.01	53.96	2.85	24.71	738.42	331.56
1/19/2020 15:00	89.91	46.55	18.22	39.01	1.46	320.99	734.98	163.85
1/19/2020 16:00	71.49	43.90	17.96	34.63	1.93	353.46	735.38	142.82
1/19/2020 17:00	71.77	38.09	16.86	35.03	3.05	30.19	737.86	135.91
1/19/2020 18:00	75.71	38.97	15.65	39.08	2.44	17.18	736.18	48.55
1/19/2020 19:00	73.05	35.69	14.28	41.84	1.39	0.54	734.33	32.06
1/19/2020 20:00	78.49	39.09	12.04	54.52	1.18	34.10	732.37	33.21
1/19/2020 21:00	97.32	47.92	11.70	74.54	1.90	21.32	733.30	34.48
1/19/2020 22:00	98.34	54.13	10.46	88.52	1.26	6.71	733.09	34.21
1/19/2020 23:00	96.46	46.14	9.96	92.39	1.90	35.39	733.48	34.21
1/20/2020 0:00	77.28	41.88	9.00	96.72	0.66	160.70	732.34	33.91
1/20/2020 1:00	86.44	43.52	7.88	99.17	0.87	72.58	732.16	35.07
1/20/2020 2:00	82.46	43.92	7.58	99.19	0.80	129.90	732.10	35.27
1/20/2020 3:00	78.45	44.88	6.73	99.20	1.09	124.96	732.08	35.51
1/20/2020 4:00	74.21	42.21	6.55	99.23	1.62	79.75	733.01	35.36
1/20/2020 5:00	72.08	40.26	6.43	99.25	1.59	41.56	733.27	34.03
1/20/2020 6:00	74.98	39.33	6.28	99.26	1.54	69.72	732.68	33.35
1/20/2020 7:00	63.13	31.45	6.04	99.28	1.33	88.02	732.95	33.22
1/20/2020 8:00	78.27	36.97	6.11	99.29	0.53	121.83	732.28	53.25
1/20/2020 9:00	73.52	35.25	7.01	99.33	1.83	148.69	733.06	112.25

1/20/2020 10:00	78.93	38.72	10.09	93.31	0.83	105.12	732.85	244.10
1/20/2020 11:00	82.20	45.89	12.36	77.22	1.51	57.98	733.75	228.31
1/20/2020 12:00	109.98	57.78	14.48	64.87	0.44	23.16	733.32	315.22
1/20/2020 13:00	107.04	38.47	16.63	60.31	1.29	95.95	733.89	337.28
1/20/2020 14:00	90.12	39.33	17.77	56.19	1.25	80.84	734.20	327.65
1/20/2020 15:00	128.70	51.25	18.18	49.02	1.55	72.16	735.02	220.58
1/20/2020 16:00	107.25	41.45	17.63	58.31	2.16	63.34	735.78	153.67
1/20/2020 17:00	95.79	49.94	16.89	63.51	1.74	65.89	734.36	113.87
1/20/2020 18:00	88.50	49.17	15.90	67.63	1.85	69.21	734.24	41.65
1/20/2020 19:00	91.97	58.42	14.77	62.07	1.78	34.30	733.42	32.20
1/20/2020 20:00	94.91	58.35	13.65	75.41	1.33	139.75	732.46	32.54
1/20/2020 21:00	94.79	66.33	12.86	94.25	0.15	166.98	732.00	33.50
1/20/2020 22:00	89.92	68.15	12.51	95.85	0.61	87.54	731.92	33.99
1/20/2020 23:00	107.20	70.06	12.09	98.83	0.59	128.05	731.86	34.03
1/21/2020 0:00	106.13	73.93	11.87	99.17	1.21	160.24	732.04	33.64
1/21/2020 1:00	94.14	67.59	11.53	99.20	1.20	122.46	732.10	33.54
1/21/2020 2:00	96.12	70.41	11.21	99.20	1.00	186.23	732.21	33.16
1/21/2020 3:00	99.80	69.11	10.73	99.22	1.29	158.57	732.43	33.50
1/21/2020 4:00	80.55	61.96	10.13	99.23	1.41	141.69	732.29	33.50
1/21/2020 5:00	78.02	59.80	9.45	99.25	1.29	52.07	731.83	34.57
1/21/2020 6:00	94.15	67.59	8.94	99.27	1.29	154.95	732.23	35.14
1/21/2020 7:00	101.15	69.90	7.50	99.29	1.84	152.92	733.30	33.66
1/21/2020 8:00	96.83	56.86	7.33	99.32	1.38	122.26	732.22	42.84
1/21/2020 9:00	78.57	49.14	7.92	99.33	1.74	154.68	733.14	103.92
1/21/2020 10:00	84.73	59.25	9.46	95.52	1.33	124.34	733.03	151.47
1/21/2020 11:00	100.00	63.27	12.28	90.23	1.50	187.04	733.93	230.47
1/21/2020 12:00	93.40	65.61	14.36	74.78	1.96	177.48	735.06	281.51
1/21/2020 13:00	87.93	62.21	16.20	62.94	1.45	173.19	735.10	343.40
1/21/2020 14:00	88.46	58.16	17.04	60.60	1.21	155.81	735.17	325.25
1/21/2020 15:00	81.04	57.76	17.90	56.15	1.87	161.91	735.50	175.89
1/21/2020 16:00	84.97	53.00	17.65	60.75	1.96	99.82	735.50	161.46
1/21/2020 17:00	86.27	51.57	16.86	66.94	1.86	102.81	734.79	109.45
1/21/2020 18:00	95.01	51.19	15.78	75.24	1.66	144.39	733.82	44.91
1/21/2020 19:00	72.80	53.60	14.65	81.33	0.84	136.64	732.82	32.02
1/21/2020 20:00	90.47	59.34	13.65	87.73	1.00	23.66	732.18	33.56
1/21/2020 21:00	99.20	66.19	13.03	92.82	1.19	3.51	731.98	34.75
1/21/2020 22:00	103.76	68.04	12.50	94.57	1.19	287.41	732.02	35.06
1/21/2020 23:00	89.85	58.39	11.92	95.18	1.08	309.26	732.09	34.81
1/22/2020 0:00	90.13	57.18	11.34	95.19	0.29	238.59	731.84	34.56
1/22/2020 1:00	98.14	62.74	10.94	95.20	1.16	280.79	732.26	34.59
1/22/2020 2:00	86.45	59.91	10.75	95.20	1.53	269.23	732.57	34.15
1/22/2020 3:00	71.57	55.99	10.40	95.20	0.71	183.51	732.30	33.28
1/22/2020 4:00	81.34	57.08	9.45	95.23	0.18	241.37	731.78	34.89
1/22/2020 5:00	78.32	56.05	9.52	95.23	1.03	286.56	731.90	35.58
1/22/2020 6:00	69.21	48.06	8.95	95.25	0.94	86.40	731.95	35.08
1/22/2020 7:00	79.92	50.25	8.46	95.28	0.53	111.82	731.69	34.61
1/22/2020 8:00	88.53	55.43	8.11	95.27	1.30	119.54	731.97	47.01

1/22/2020 9:00	92.68	64.33	9.57	94.80	1.58	106.01	732.53	106.17
1/22/2020 10:00	110.23	72.68	12.80	80.71	1.36	79.64	733.13	215.46
1/22/2020 11:00	120.35	82.91	15.32	70.30	2.06	36.84	734.86	255.98
1/22/2020 12:00	104.19	67.61	17.51	52.19	2.57	22.70	736.55	379.84
1/22/2020 13:00	77.88	54.46	18.13	50.83	3.49	23.96	739.18	404.16
1/22/2020 14:00			18.80	45.91	3.45	20.89	739.55	340.11
1/22/2020 15:00	0.00	0.00	19.20	42.60	3.39	25.15	739.50	162.55
1/22/2020 16:00	68.52	47.20	19.47	36.48	2.85	43.31	738.59	142.60
1/22/2020 17:00	60.70	47.57	18.99	29.36	2.96	22.49	738.12	147.03
1/22/2020 18:00	76.95	45.55	17.91	28.60	2.66	14.83	736.89	52.49
1/22/2020 19:00	75.33	45.51	16.53	44.40	2.00	24.57	734.01	32.07
1/22/2020 20:00	78.81	51.50	15.30	57.06	1.17	11.13	733.18	32.72
1/22/2020 21:00	87.95	51.19	13.47	65.91	0.08	44.39	732.21	33.34
1/22/2020 22:00	92.36	60.83	14.34	53.83	1.05	19.82	733.88	35.56
1/22/2020 23:00	88.45	50.31	15.40	46.47	1.36	335.46	734.11	34.03
1/23/2020 0:00	69.51	42.29	14.99	52.09	1.45	331.39	734.51	33.15
1/23/2020 1:00	63.45	40.91	14.10	54.92	1.25	295.04	733.18	32.28
1/23/2020 2:00	69.46	42.09	13.47	56.85	1.21	326.74	733.16	33.72
1/23/2020 3:00	60.19	40.47	12.73	60.85	0.70	18.86	732.78	32.84
1/23/2020 4:00	62.12	37.77	12.42	63.86	1.69	29.84	733.75	34.07
1/23/2020 5:00	57.54	36.22	12.42	64.66	1.88	29.44	734.43	33.81
1/23/2020 6:00	59.76	42.06	11.25	72.32	0.87	95.45	732.86	32.85
1/23/2020 7:00	64.68	41.60	9.16	86.04	0.56	118.26	732.31	33.26
1/23/2020 8:00	66.57	42.73	8.85	90.25	0.32	302.55	732.13	47.30
1/23/2020 9:00	80.15	57.42	13.01	66.22	0.69	17.38	732.52	123.94
1/23/2020 10:00	102.14	61.10	15.61	48.33	0.44	37.46	733.55	259.84
1/23/2020 11:00	79.44	47.47	16.85	36.69	1.01	316.08	735.45	262.31
1/23/2020 12:00	71.14	42.97	17.95	29.68	1.85	0.70	735.98	437.52
1/23/2020 13:00	64.80	38.77	19.00	22.73	1.74	348.04	736.70	461.60
1/23/2020 14:00	64.40	35.94	19.82	22.31	1.18	5.13	737.07	362.64
1/23/2020 15:00	60.19	34.77	19.99	18.81	1.78	329.82	737.15	128.36
1/23/2020 16:00	62.77	37.21	20.05	19.03	1.83	350.09	735.92	131.24
1/23/2020 17:00	66.81	34.40	19.45	20.85	1.76	352.31	735.82	153.47
1/23/2020 18:00	62.22	37.01	18.47	23.48	1.67	1.35	734.70	53.04
1/23/2020 19:00	64.63	35.45	17.24	24.03	1.66	29.87	733.32	31.61
1/23/2020 20:00	70.25	38.58	16.04	25.72	1.08	35.78	732.64	32.68
1/23/2020 21:00	74.96	40.78	13.61	37.77	0.49	148.12	732.19	33.29
1/23/2020 22:00	84.35	46.30	13.32	41.89	1.02	0.67	732.50	35.31
1/23/2020 23:00	87.10	51.59	13.89	39.96	1.53	42.87	733.19	35.13
1/24/2020 0:00	77.93	47.16	12.95	43.62	0.42	154.37	732.86	32.78
1/24/2020 1:00	64.41	41.31	10.65	54.81	0.40	161.29	732.67	33.29
1/24/2020 2:00	76.06	42.47	10.72	52.38	0.81	154.36	733.15	34.10
1/24/2020 3:00	67.61	41.41	11.59	46.43	0.41	15.17	733.07	34.34
1/24/2020 4:00	63.76	41.57	12.04	43.62	1.41	6.51	733.93	35.16
1/24/2020 5:00	61.24	36.84	13.01	41.03	1.77	18.17	735.07	33.33
1/24/2020 6:00	56.29	36.35	12.83	42.01	1.80	6.89	734.76	33.01
1/24/2020 7:00	61.98	40.05	12.85	40.75	1.82	11.43	735.00	33.46

1/24/2020 8:00	63.83	39.48	13.19	38.89	1.66	18.08	735.28	48.56
1/24/2020 9:00	67.11	36.25	14.44	34.95	0.34	78.15	734.03	133.28
1/24/2020 10:00	60.89	37.12	15.86	29.41	2.06	16.13	736.18	283.95
1/24/2020 11:00	65.40	39.41	17.31	25.05	1.55	350.79	735.86	276.59
1/24/2020 12:00	70.41	37.04	18.64	21.61	1.41	345.27	735.46	439.86
1/24/2020 13:00	60.29	37.34	19.58	22.14	1.83	289.13	735.79	445.27
1/24/2020 14:00	59.48	37.16	20.72	19.95	1.68	321.81	735.63	356.76
1/24/2020 15:00	63.62	36.00	21.57	16.66	1.80	293.94	735.44	145.66
1/24/2020 16:00	64.72	33.17	21.75	16.35	1.56	312.13	734.50	146.56
1/24/2020 17:00	62.49	31.67	21.05	18.39	1.70	343.07	734.74	138.24
1/24/2020 18:00	67.24	32.90	19.52	22.13	1.44	323.34	733.48	47.12
1/24/2020 19:00	68.11	36.36	17.67	28.30	1.54	347.43	732.91	31.41
1/24/2020 20:00	73.30	48.71	15.54	37.33	1.01	324.04	732.26	33.18
1/24/2020 21:00	96.84	59.60	13.64	44.84	0.93	312.30	732.13	33.97
1/24/2020 22:00	91.82	59.35	12.79	48.43	1.08	289.36	732.34	34.84
1/24/2020 23:00	94.51	55.88	11.36	56.05	0.13	304.06	732.21	34.44
1/25/2020 0:00	88.56	48.82	10.73	60.49	0.73	326.43	732.35	34.71
1/25/2020 1:00	92.62	49.20	10.25	60.40	0.22	198.99	732.38	34.13
1/25/2020 2:00	81.45	49.17	9.94	57.71	0.69	309.67	732.03	34.98
1/25/2020 3:00	75.68	44.34	9.20	59.79	0.81	244.16	731.86	35.29
1/25/2020 4:00	64.51	37.83	8.59	62.92	0.51	248.30	731.89	35.09
1/25/2020 5:00	58.15	39.28	8.70	58.38	0.90	345.29	732.12	35.45
1/25/2020 6:00	54.70	41.54	8.07	63.61	0.27	39.23	731.93	34.80
1/25/2020 7:00	58.62	38.78	7.48	68.56	0.19	212.75	731.96	35.03
1/25/2020 8:00	67.01	40.01	7.85	71.18	0.36	40.93	731.83	48.24
1/25/2020 9:00	93.07	56.80	12.56	51.61	1.43	100.68	732.04	129.29
1/25/2020 10:00	121.53	70.22	15.58	40.79	1.36	60.44	732.96	250.38
1/25/2020 11:00	158.90	88.44	17.48	33.35	1.13	95.99	733.75	259.65
1/25/2020 12:00	134.55	77.78	18.77	30.00	1.01	84.31	733.89	378.26
1/25/2020 13:00	107.75	62.45	19.84	28.14	1.63	105.53	734.93	415.39
1/25/2020 14:00	95.33	51.47	20.63	24.15	0.83	76.76	734.99	340.15
1/25/2020 15:00	80.32	42.51	21.42	20.26	1.49	41.58	735.26	125.12
1/25/2020 16:00	65.35	36.46	21.17	22.40	1.81	105.08	735.42	123.03
1/25/2020 17:00	69.30	35.54	20.82	23.55	1.71	54.84	734.21	148.62
1/25/2020 18:00	66.68	39.88	19.47	31.76	1.90	52.00	733.78	51.98
1/25/2020 19:00	71.87	43.16	17.25	42.05	0.30	300.26	732.13	30.50
1/25/2020 20:00	88.39	54.59	15.37	52.11	0.88	40.55	731.93	33.33
1/25/2020 21:00	125.21	66.64	14.52	54.97	1.26	281.14	732.26	34.23
1/25/2020 22:00	112.23	64.97	13.75	55.90	1.58	281.45	732.15	34.69
1/25/2020 23:00	109.17	64.17	13.28	57.52	1.43	270.70	732.31	35.10
1/26/2020 0:00	91.66	55.84	12.17	64.21	0.71	317.25	731.91	35.06
1/26/2020 1:00	83.12	53.72	11.96	62.60	1.59	267.99	732.33	35.00
1/26/2020 2:00	81.92	52.59	11.63	62.45	1.21	281.50	732.49	34.19
1/26/2020 3:00	83.43	47.81	11.18	63.98	1.34	266.15	732.55	34.59
1/26/2020 4:00	67.49	43.75	10.18	69.90	1.01	352.02	731.67	35.43
1/26/2020 5:00	59.49	40.42	9.46	74.70	1.03	121.76	731.83	35.12
1/26/2020 6:00	55.55	39.59	8.86	80.61	0.92	60.42	731.87	35.15

1/26/2020 7:00	66.97	47.40	8.71	85.49	0.77	153.04	731.91	35.11
1/26/2020 8:00	92.22	57.44	8.70	85.40	0.33	213.20	732.13	48.27
1/26/2020 9:00	104.13	69.81	12.81	62.35	0.35	33.32	732.35	128.97
1/26/2020 10:00	121.94	73.25	16.73	44.10	1.47	101.43	732.65	248.70
1/26/2020 11:00	130.83	67.41	18.71	39.68	0.50	163.60	733.38	247.06
1/26/2020 12:00	126.26	76.15	20.89	25.51	1.35	188.15	734.26	392.29
1/26/2020 13:00	90.32	53.48	22.63	22.80	0.42	67.51	733.68	423.63
1/26/2020 14:00	70.79	42.01	23.22	24.16	1.49	93.42	734.25	343.61
1/26/2020 15:00	79.90	45.69	23.30	23.22	1.67	64.85	734.88	146.59
1/26/2020 16:00	71.80	43.43	23.56	23.00	1.71	48.47	735.23	128.40
1/26/2020 17:00	70.07	43.94	22.88	23.93	3.10	31.13	737.75	146.20
1/26/2020 18:00	73.94	43.58	21.24	32.22	2.14	45.09	735.30	51.35
1/26/2020 19:00	79.84	43.14	19.23	42.43	2.37	20.69	734.90	31.85
1/26/2020 20:00	85.29	46.04	18.04	47.39	0.56	317.44	733.13	32.33
1/26/2020 21:00	90.75	52.48	15.82	58.71	0.84	127.20	732.13	33.19
1/26/2020 22:00	109.00	58.75	14.94	63.75	0.98	266.12	732.08	34.80
1/26/2020 23:00	93.55	62.07	14.47	63.22	1.44	277.68	732.16	34.52
1/27/2020 0:00	97.94	63.60	13.96	64.27	1.68	264.51	732.45	34.52
1/27/2020 1:00	98.15	60.44	13.46	66.11	1.37	284.49	732.15	34.53
1/27/2020 2:00	82.19	53.48	12.80	71.38	0.35	56.48	731.84	35.58
1/27/2020 3:00	73.38	46.89	12.67	74.93	0.28	105.07	731.98	35.88
1/27/2020 4:00	62.42	43.56	12.39	77.50	0.61	63.88	731.79	33.15
1/27/2020 5:00	78.69	49.84	11.50	82.26	0.41	52.71	731.78	34.97
1/27/2020 6:00	74.43	53.67	11.59	83.21	0.33	192.84	732.00	33.41
1/27/2020 7:00	77.18	55.46	10.95	86.61	1.04	50.43	731.58	34.58
1/27/2020 8:00	98.96	60.97	11.55	85.07	0.57	71.00	732.00	52.76
1/27/2020 9:00	106.41	66.42	14.97	66.11	1.39	53.07	732.64	127.54
1/27/2020 10:00	131.66	73.06	17.36	55.37	1.96	38.20	733.79	217.93
1/27/2020 11:00	153.88	88.62	19.40	48.40	1.66	126.51	734.02	254.56
1/27/2020 12:00	156.98	91.04	20.23	45.86	1.93	87.49	735.25	322.68
1/27/2020 13:00	133.79	75.18	20.89	44.02	1.60	120.46	735.30	297.93
1/27/2020 14:00	97.09	57.37	21.29	43.83	1.79	132.01	735.39	265.61
1/27/2020 15:00	81.21	49.40	22.07	41.95	1.81	110.15	735.20	199.66
1/27/2020 16:00	79.34	46.75	22.06	43.82	1.78	90.47	735.24	149.31
1/27/2020 17:00	70.58	46.84	21.41	44.55	2.02	79.79	735.80	115.71
1/27/2020 18:00	90.69	42.30	20.39	46.54	1.73	97.35	734.03	47.55
1/27/2020 19:00	95.49	43.77	18.86	55.10	1.03	74.54	732.46	32.21
1/27/2020 20:00	90.05	51.00	17.79	61.98	1.22	205.13	732.76	33.40
1/27/2020 21:00	86.87	56.73	16.85	68.26	1.14	341.36	732.51	33.38
1/27/2020 22:00	91.90	56.67	16.74	67.20	1.29	184.77	732.89	33.64
1/27/2020 23:00	98.58	59.80	15.99	70.94	0.24	225.09	732.35	33.56
1/28/2020 0:00	87.04	54.29	15.35	75.41	1.27	25.06	732.43	33.93
1/28/2020 1:00	82.45	51.32	15.10	77.20	0.91	10.26	732.28	34.26
1/28/2020 2:00	82.98	51.86	14.27	82.69	1.23	54.96	732.28	34.41
1/28/2020 3:00	91.23	53.03	14.19	81.89	1.67	8.87	732.92	34.27
1/28/2020 4:00	87.41	49.07	14.04	81.86	1.79	14.61	733.08	33.50
1/28/2020 5:00	69.80	53.56	13.72	82.98	1.75	25.22	733.07	33.78

1/28/2020 6:00	80.56	56.85	13.47	83.46	1.51	28.64	732.97	34.01
1/28/2020 7:00	74.25	58.99	13.06	84.55	1.00	42.89	732.96	33.78
1/28/2020 8:00	96.78	56.69	12.85	87.07	0.37	273.82	732.20	42.15
1/28/2020 9:00	87.41	61.77	13.30	82.55	1.43	172.38	733.26	77.98
1/28/2020 10:00	98.11	62.54	14.38	75.43	1.19	144.53	733.54	169.40
1/28/2020 11:00	95.89	61.51	15.00	72.67	1.34	73.26	734.34	201.35
1/28/2020 12:00	98.36	65.66	16.78	64.88	1.75	105.50	734.62	323.15
1/28/2020 13:00	89.99	62.00	17.91	61.62	1.45	73.90	734.26	305.70
1/28/2020 14:00	98.62	60.19	19.03	58.17	1.43	85.10	734.31	272.00
1/28/2020 15:00	86.50	59.29	19.86	56.61	1.92	139.97	734.69	175.65
1/28/2020 16:00	80.94	55.27	19.10	65.27	1.80	138.00	729.69	100.41
1/28/2020 17:00	88.14	56.35	18.68	70.69	1.48	83.80	723.63	79.81
1/28/2020 18:00	85.72	56.67	17.85	77.97	1.49	53.38	723.83	48.55
1/28/2020 19:00	87.57	62.45	16.81	85.47	0.64	20.27	724.64	33.05
1/28/2020 20:00	107.92	73.62	16.38	90.99	1.23	359.77	725.55	32.81
1/28/2020 21:00	118.30	76.38	15.76	92.45	0.65	354.68	726.40	33.30
1/28/2020 22:00	115.80	71.09	15.69	91.77	1.59	15.90	726.77	33.67
1/28/2020 23:00	91.06	55.41	15.06	95.31	1.08	333.55	726.97	33.44
1/29/2020 0:00	71.03	51.58	15.08	92.05	2.20	16.91	727.55	34.03
1/29/2020 1:00	73.42	52.21	14.15	90.57	2.40	22.06	727.67	33.82
1/29/2020 2:00	82.80	48.17	13.63	82.62	2.73	29.53	727.84	34.68
1/29/2020 3:00	67.01	44.44	13.55	72.04	1.67	16.69	727.92	35.32
1/29/2020 4:00	61.03	40.98	12.77	75.33	1.83	71.72	727.92	34.21
1/29/2020 5:00	65.40	38.98	12.44	75.60	1.37	54.31	727.83	34.41
1/29/2020 6:00	58.37	36.13	11.67	79.64	0.50	168.33	728.01	34.00
1/29/2020 7:00	60.55	38.20	10.59	90.06	0.48	135.50	728.63	33.44
1/29/2020 8:00	55.77	37.08	10.70	92.34	0.98	21.16	729.27	51.86
1/29/2020 9:00	69.77	49.24	13.50	74.44	1.83	156.93	729.80	126.48
1/29/2020 10:00	94.04	57.64	16.16	57.26	2.06	52.61	730.57	253.57
1/29/2020 11:00	94.99	53.44	17.68	45.68	2.65	44.57	731.13	288.21
1/29/2020 12:00	86.07	46.19	18.73	38.33	2.41	91.56	731.01	402.31
1/29/2020 13:00	68.58	38.37	19.30	32.99	2.63	124.25	730.42	446.99
1/29/2020 14:00	59.70	34.37	19.82	31.94	2.89	107.03	729.83	398.91
1/29/2020 15:00	57.86	34.05	19.56	33.67	3.17	38.56	729.50	146.50
1/29/2020 16:00	67.30	39.72	19.23	34.97	2.89	48.17	729.20	136.67
1/29/2020 17:00	59.48	38.25	19.08	35.63	3.49	38.72	729.14	162.40
1/29/2020 18:00	66.78	34.35	18.14	42.36	2.86	42.06	729.36	58.57
1/29/2020 19:00	80.08	42.92	16.81	50.03	1.42	81.66	729.90	31.58
1/29/2020 20:00	79.94	45.68	15.44	57.07	1.17	67.30	730.36	33.46
1/29/2020 21:00	75.17	49.87	15.25	60.49	1.32	53.77	730.64	34.44
1/29/2020 22:00	77.17	48.10	14.00	68.07	0.46	295.99	730.91	33.66
1/29/2020 23:00	71.90	51.27	12.76	74.97	0.77	140.84	731.13	33.63
1/30/2020 0:00	95.62	51.55	12.29	78.71	0.47	190.09	731.06	33.74
1/30/2020 1:00	106.99	56.39	11.20	83.90	0.65	59.69	730.94	33.74
1/30/2020 2:00	93.70	57.21	10.78	86.57	0.47	44.85	730.90	34.49
1/30/2020 3:00	93.92	53.44	10.32	89.23	0.27	171.02	730.81	34.29
1/30/2020 4:00	81.62	42.67	10.24	89.38	0.08	166.56	730.57	34.56

1/30/2020 5:00	66.94	42.19	10.12	88.50	1.70	56.09	730.43	35.19
1/30/2020 6:00	67.25	45.74	10.67	84.53	0.61	22.98	730.38	34.57
1/30/2020 7:00	63.04	42.15	9.41	91.93	0.47	75.84	730.65	34.32
1/30/2020 8:00	72.29	46.05	9.76	91.53	0.05	87.36	731.43	49.42
1/30/2020 9:00	96.01	62.65	12.59	76.67	1.32	125.83	731.91	137.69
1/30/2020 10:00	100.29	59.62	15.28	66.67	1.34	68.51	732.11	257.64
1/30/2020 11:00	104.54	63.17	16.67	59.52	2.46	40.21	731.98	294.39
1/30/2020 12:00	86.54	47.70	18.58	44.25	2.81	29.57	731.70	367.40
1/30/2020 13:00	73.03	39.42	19.68	30.18	1.99	3.85	731.09	439.42
1/30/2020 14:00	62.05	35.20	20.27	23.50	2.16	14.99	730.24	413.53
1/30/2020 15:00	56.61	32.70	20.37	23.27	2.22	3.40	729.79	186.55
1/30/2020 16:00	57.81	34.94	19.93	25.40	1.65	351.48	729.57	149.17
1/30/2020 17:00	60.89	32.74	19.16	29.94	3.60	40.56	729.30	156.29
1/30/2020 18:00	66.12	39.65	18.10	35.70	2.75	32.23	729.19	59.72
1/30/2020 19:00	59.33	35.34	16.87	40.33	2.33	9.73	729.50	32.06
1/30/2020 20:00	73.60	39.73	16.14	43.53	1.99	0.55	729.70	32.73
1/30/2020 21:00	69.25	43.39	15.44	50.92	1.85	356.24	729.79	32.87
1/30/2020 22:00	75.29	45.38	15.06	53.31	1.39	350.24	729.72	33.33
1/30/2020 23:00	69.48	43.84	13.57	59.41	0.97	110.11	729.92	32.49
1/31/2020 0:00	78.68	45.62	11.88	69.15	1.38	156.29	729.71	33.99
1/31/2020 1:00	82.11	47.02	11.17	73.03	1.63	162.06	729.59	33.78
1/31/2020 2:00	74.25	44.86	10.57	76.27	1.17	135.00	729.36	33.93
1/31/2020 3:00	72.23	41.34	9.81	81.77	0.74	11.81	729.13	34.35
1/31/2020 4:00	62.76	43.72	9.55	85.40	0.40	140.20	728.83	34.51
1/31/2020 5:00	59.95	43.25	9.17	86.83	0.29	76.01	728.56	33.99
1/31/2020 6:00	78.76	44.23	8.72	89.65	0.38	343.46	728.70	34.65
1/31/2020 7:00	88.50	49.18	8.59	92.33	0.25	20.96	728.99	35.21
1/31/2020 8:00	88.02	52.36	9.02	91.94	0.27	15.39	729.43	50.85
1/31/2020 9:00	90.70	58.15	12.00	76.05	1.73	140.91	729.76	136.62
1/31/2020 10:00	99.99	59.11	14.46	64.08	1.17	109.42	730.04	247.44
1/31/2020 11:00	97.79	57.50	16.40	54.81	1.53	91.50	730.31	277.16
1/31/2020 12:00	101.52	59.46	17.74	48.51	1.47	78.45	729.75	351.57
1/31/2020 13:00	90.49	54.39	19.11	41.93	1.03	118.14	728.92	402.47
1/31/2020 14:00	86.14	48.66	19.96	37.87	1.28	217.04	728.02	375.51
1/31/2020 15:00	71.75	41.49	20.28	34.41	1.43	159.45	727.24	198.84
1/31/2020 16:00	65.74	35.89	20.48	33.56	1.43	174.38	726.83	170.12
1/31/2020 17:00	58.66	33.29	19.60	36.68	2.05	68.21	726.74	125.11
1/31/2020 18:00	67.38	38.13	18.45	43.86	2.86	34.59	726.84	62.11
1/31/2020 19:00	75.03	38.59	16.86	52.14	2.23	38.81	727.24	31.25
1/31/2020 20:00	81.84	46.81	15.73	57.23	2.27	27.48	727.75	32.31
1/31/2020 21:00	81.55	50.25	15.03	61.14	2.15	11.58	728.49	32.71
1/31/2020 22:00	95.06	52.98	14.57	63.31	1.88	13.97	729.00	33.10
1/31/2020 23:00	84.95	52.99	13.82	67.39	1.52	30.93	729.30	33.40
2/1/2020 0:00	76.05	45.23	12.57	75.49	1.10	297.57	729.25	34.13

Article

A Satellite-Based High-Resolution (1-km) Ambient PM_{2.5} Database for India over Two Decades (2000–2019): Applications for Air Quality Management

Sagnik Dey ^{1,2,*} , Bhavesh Purohit ¹, Palak Balyan ¹, Kuldeep Dixit ¹ , Kunal Bali ¹, Alok Kumar ¹, Fahad Imam ¹, Sourangsu Chowdhury ³, Dilip Ganguly ¹ , Prashant Gargava ⁴ and V. K. Shukla ⁴

¹ Centre for Atmospheric Sciences, IIT Delhi, New Delhi 110000, India; ast182713@cas.iitd.ac.in (B.P.); Palak.Balyan@cas.iitd.ac.in (P.B.); kdixit@cas.iitd.ac.in (K.D.); Kunal.Bali@cas.iitd.ac.in (K.B.); ird12852@cas.iitd.ac.in (A.K.); ird12990@cas.iitd.ac.in (F.I.); dilipganguly@cas.iitd.ac.in (D.G.)

² Centre of Excellence for Research on Clean Air, IIT Delhi, New Delhi 110000, India

³ Max Planck Institute for Chemistry, 55128 Mainz, Germany; S.Chowdhury@mpic.de

⁴ Central Pollution Control Board, New Delhi 110000, India; prashant.cpcb@gov.in (P.G.); vkshukla.cpcb@nic.in (V.K.S.)

* Correspondence: sagnik@cas.iitd.ac.in; Tel.: +91-11-2659-1315

Received: 17 August 2020; Accepted: 9 October 2020; Published: 26 November 2020



Abstract: Fine particulate matter (PM_{2.5}) is a major criteria pollutant affecting the environment, health and climate. In India where ground-based measurements of PM_{2.5} is scarce, it is important to have a long-term database at a high spatial resolution for an efficient air quality management plan. Here we develop and present a high-resolution (1-km) ambient PM_{2.5} database spanning two decades (2000–2019) for India. We convert aerosol optical depth from Moderate Resolution Imaging Spectroradiometer (MODIS) retrieved by Multiangle Implementation of Atmospheric Correction (MAIAC) algorithm to surface PM_{2.5} using a dynamic scaling factor from Modern-Era Retrospective analysis for Research and Applications Version 2 (MERRA-2) data. The satellite-derived daily (24-h average) and annual PM_{2.5} show a R^2 of 0.8 and 0.97 and root mean square error of 25.7 and 7.2 $\mu\text{g}/\text{m}^3$, respectively against surface measurements from the Central Pollution Control Board India network. Population-weighted 20-year averaged PM_{2.5} over India is 57.3 $\mu\text{g}/\text{m}^3$ (5–95 percentile ranges: 16.8–86.9) with a larger increase observed in the present decade (2010–2019) than in the previous decade (2000 to 2009). Poor air quality across the urban–rural transect suggests that this is a regional scale problem, a fact that is often neglected. The database is freely disseminated through a web portal ‘satellite-based application for air quality monitoring and management at a national scale’ (SAANS) for air quality management, epidemiological research and mass awareness.

Keywords: PM_{2.5}; MAIAC; AOD; India; air quality

1. Introduction

Exposure to ambient fine particulate matter (PM_{2.5}) is one of the leading causes of health burden in India [1,2]. The rising ambient PM_{2.5} concentration [3,4] and its staggering health burden [5,6] led the Government of India to launch the National Clean Air Program (NCAP) in early 2018. Though the NCAP addressed air pollution as a national scale problem, its focus on the urban centres essentially fails to recognize the air quality status in the rural areas. This is reflected in the ground-based monitoring network maintained by the Central Pollution Control Board (CPCB) with all of the 230+ continuous and

650+ manual monitoring sites (www.cpcb.nic.in) deployed in the urban centres. Although the number of ground-based monitoring sites seems to be large, it is not adequate for air quality management [7] because (1) the network is disproportionately distributed (Figure A1 in the Appendix A); (2) PM_{2.5} monitoring started in 2009 (unlike PM₁₀ that has a longer record [8]), but the network expanded nationally only after 2015–2016; and (3) the manual monitoring sites only sample twice a week and do not provide continuous data. The population-weighted distance to the nearest monitoring site in India is estimated to be 80 km [7].

These limitations rendered the surface measurements inadequate for air quality management at a regional scale [9] and restricted the epidemiological community from using these data alone to generate indigenous evidence of air pollution health impacts consistently [10]. Furthermore, many cities in India do not have any surface measurements to determine if they are or are not non-attainment sites (with respect to the Indian annual national ambient air quality standard, NAAQS of 40 µg/m³). We earlier demonstrated the utility of satellite-derived aerosol products to infer surface PM_{2.5} and complement the surface measurements [3,5,11,12]. With the improvement of the spatial resolution of satellite-based aerosol optical depth (AOD) products and modelling techniques, we were able to track PM_{2.5} buildup in the Delhi national capital region (NCR) at a high resolution (1-km) over 15-years [13]. These analyses demonstrated the need to have a long-term PM_{2.5} national database for an efficient air quality management under the NCAP.

Broadly, there are two methods to estimate surface PM_{2.5} from satellite AOD. Several studies have adopted a regression-based or machine learning-based approaches that train the model with various geospatial variables [14,15]. In the other approach, a scaling factor (η , that is the ratio of PM_{2.5} and AOD) is derived to convert satellite AOD to PM_{2.5} [16–19]. The global database generated for the Global Burden of Disease (GBD) study derived the scaling factor from a chemical transport model at a coarse (usually 2° × 2.5°) resolution and interpolates it to match satellite AOD spatial resolution. Subsequently, the accuracy of the product was improved by fusion with the local surface measurements [20]. However, having a national database that is tuned against local surface measurements will be a better representative of the local conditions. Furthermore, the database can be updated as per the national requirement and used for policy.

In this work, we develop and present a satellite-based national PM_{2.5} database at a high resolution (1-km) for India over two decades (2000–2019). The database is used to understand the long-term trends in PM_{2.5}, the urban vs. rural air quality comparison, seasonal fluctuation in PM_{2.5} and the state-level statistics, all of which are highly important for air quality management.

2. Materials and Methods

2.1. Details of the Algorithm to Estimate PM_{2.5} from Satellite AOD

We build our algorithm based on the philosophy of the previous works following the scaling factor approach [3,16–19]. This scaling factor includes the impacts of local emissions, atmospheric processes, meteorology and regional transport on the AOD–PM_{2.5} relationship. Here, we derive η from the Modern-Era Retrospective analysis for Research and Applications (MERRA-2) reanalysis product because (1) MERRA-2 data are continuously available at near real-time, and (2) processing MERRA-2 data is computationally much less expansive than running a chemical transport model. We note that MERRA-2 spatial resolution is finer than that of the GEOS–Chem model that was utilized to derive η for the global data. We also analyze the Aerosol Robotic Network (AERONET) data to assess the satellite and MERRA-2 AOD products. The steps in the algorithm are as follows (Figure 1). To clarify the source of the various parameters discussed below, we denote the respective products from AERONET, satellite and reanalysis by using sub-scripts “AERO”, “sat” and “model”, respectively.

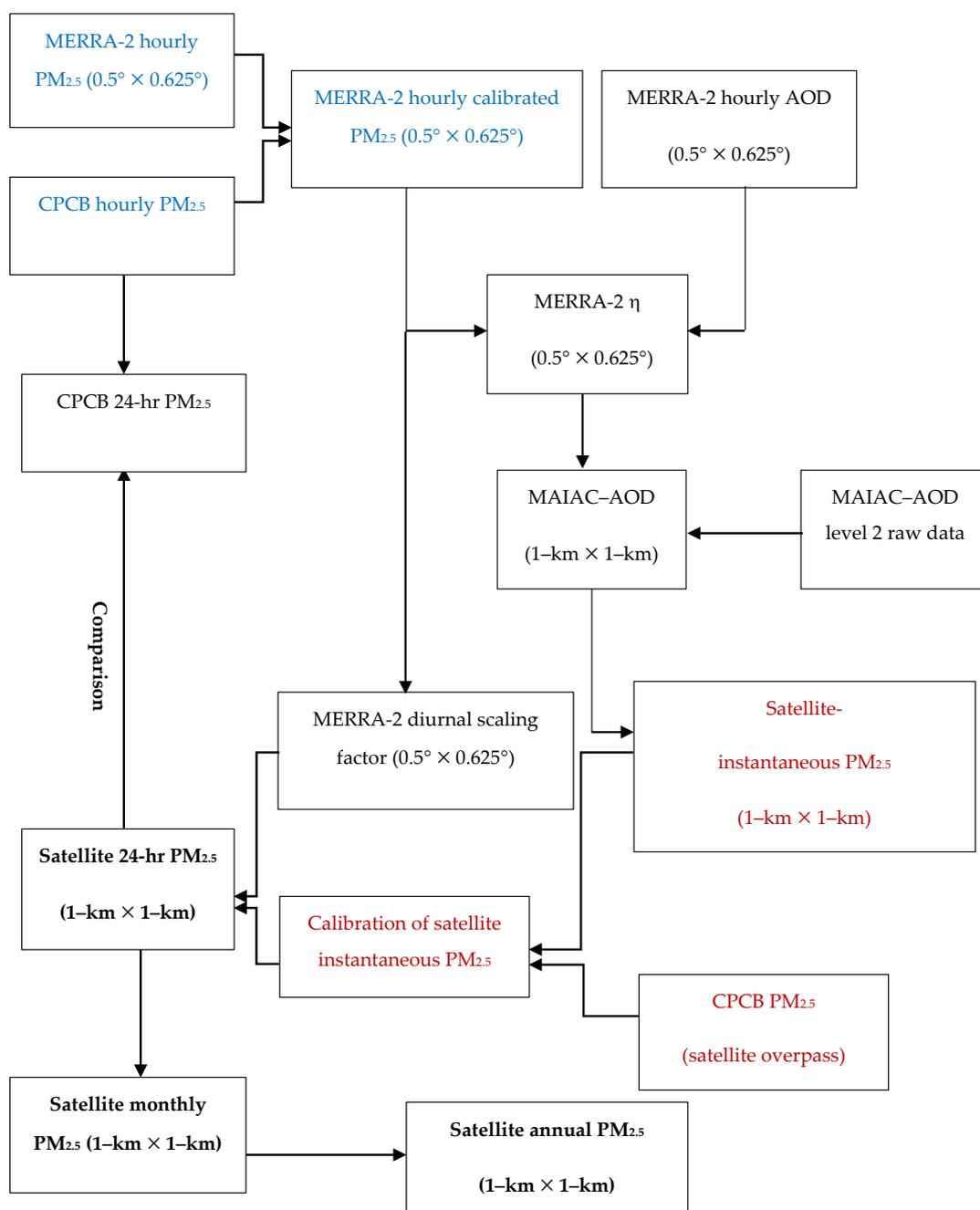


Figure 1. The flow chart of the entire process with the Modern-Era Retrospective analysis for Research and Applications Version 2 (MERRA-2) calibration steps shown in blue colored font, satellite fine particulate matter (PM_{2.5}) evaluation in red colored font and generation of the final products that are disseminated through the ‘satellite-based application for air quality monitoring and management at a national scale’ (SAANS) portal in bold black font.

First, we process level 2 AOD data retrieved by the Moderate Resolution Imaging Spectroradiometer (MODIS) using the Multiangle Implementation of Atmospheric Correction (MAIAC) algorithm at 1-km × 1-km resolution for each day (i) from 26 February 2000, to 31 December 2019. MAIAC provides global AOD retrievals over dark and bright surfaces using an explicit surface reflectance model and it features an improved cloud detection scheme, a general lack of bias in the urban areas and a better spatial coverage relative to the deep-blue or dark-target approach [21]. In this study, we have used the combined Terra and Aqua AOD product (MCD19A2) provided by the MODIS

science team. The combined product enhances the spatial and temporal coverage and provides a more representative AOD during 10:00 AM to 2:00 PM local time [21]. MAIAC AOD validation over South Asia revealed that it has a better accuracy than the deep blue and dark-target AOD products [22]. We also examine the product over India (Figure A2) and find that MODIS–MAIAC AOD at 550 nm shows a statistically significant ($p < 0.05$) correlation and root mean square error (RMSE) of 0.13 with AOD from AERONET [23] sites in India. MAIAC AOD is provided at 550 nm wavelength, therefore for a proper comparison, we estimate AERONET AOD at 550 nm wavelength from the spectral AOD measurements and Angstrom Exponent (α) at 440–870 nm wavelength following:

$$\text{AOD}_{550,\text{AERO}} = \text{AOD}_{500,\text{AERO}} \times \left(\frac{500}{550}\right)^{\alpha_{\text{AERO}}} \quad (1)$$

When the MAIAC–AOD tiles are merged, it shows a high variance along its swath edge. To minimize the edge effect across the swaths, we use the Savitzky–Golay filter [24] with a frame length of five pixels across the X- and Y-directions of the target pixel.

In the second step, we analyze aerosol products of MERRA-2 available at $0.5^\circ \times 0.625^\circ$ [25]. MERRA-2 $\text{PM}_{2.5}$ is estimated as:

$$\text{PM}_{2.5,\text{model}} = \text{Dust}_{2.5,\text{model}} + \text{SS}_{2.5,\text{model}} + \text{BC}_{\text{model}} + \text{OC}_{\text{model}} \times 1.6 + \text{SO}_4^{2-}\text{model} \times 1.375 \quad (2)$$

where $\text{Dust}_{2.5,\text{model}}$ and $\text{SS}_{2.5,\text{model}}$ are dust and sea-salt masses in size bins smaller than 2.5 μm , BC_{model} is black carbon, OC_{model} is organic carbon and $\text{SO}_4^{2-}\text{model}$ is the sulfate. OC is multiplied by a factor of 1.6 to estimate total organic matter [26]. Sulfate in the MERRA-2 dataset is present in neutralized $(\text{NH}_4)_2\text{SO}_4$ form, so a factor of 1.375 is used [25]. MERRA-2 $\text{PM}_{2.5}$ is underestimated over the Indian region [27]. We therefore calibrate MERRA-2 hourly $\text{PM}_{2.5}$ with the coincident hourly $\text{PM}_{2.5}$ from 120 sites in the CPCB network that provide multi-year data from 2009 to 2019 (Figure A1). These CPCB stations use an automatic air quality monitoring system, where quality-control procedures are performed routinely to remove any unreliable, low-quality and invalid observations arising from instrument malfunction and electric power outage [28]. We note that the length of observations differs from site to site. To ensure enough samples, we use all quality-controlled data. We could not use the data from the manual monitoring sites because the robustness of the quality and the days when they are sampled are not consistent.

We train our calibration model for the 55 MERRA-2 grids having at least one CPCB site and develop a percentile-based calibration factor [3]. For every 10 percentile ranges, we estimate the ratio of surface $\text{PM}_{2.5}$ and MERRA-2-derived $\text{PM}_{2.5}$ for each site. Using the site-specific calibration factors representative for each month, we tune the MERRA-2 hourly $\text{PM}_{2.5}$ data in these grids close to the observed values and use the nearest neighbor algorithm to adjust the bias for the grids devoid of any CPCB site. Using this calibrated $\text{PM}_{2.5}$ and hourly AOD (at 550 nm) from MERRA-2, we estimate η for every day (i) and every grid (x and y) as:

$$\eta_{i,x,y,\text{model}} = \frac{\text{PM}_{2.5\ i,x,y,\text{model}}}{\text{AOD}_{i,x,y,\text{model}}} \quad (3)$$

We find that MERRA-2 and AERONET AOD show a statistically significant ($p < 0.05$ for $N = 4546$) R^2 of 0.71 (Figure A3) with a RMSE similar to that of MAIAC AOD. Therefore, we interpret that calibrating the MERRA-2 $\text{PM}_{2.5}$ is sufficient to improve the calibration of η and apply on satellite AOD.

In the third step, we interpolate η to finer resolution using spline interpolation to match the resolution of the AOD product (1-km \times 1-km). The spatial patterns of interpolated η for every month are shown in Figure A4. Wherever η values are high (>160), most of the particles within the column stay close to the surface, resulting in high $\text{PM}_{2.5}$ due to a stable boundary layer (e.g., winter months). Whenever the atmospheric condition is conducive for dispersion (e.g., in summer months), particles are raised above the boundary layer and hence although $\text{PM}_{2.5}$ remains moderate (between 100 to 160),

AOD remains high (i.e., moderate η values). During the monsoon, both AOD and $PM_{2.5}$ remain low and the high convective strength does not contain particles closer to the surface. As a result, η is found to be low (<100). We convert MAIAC AOD for the day i during the satellite overpass time (h) to $PM_{2.5}$ at the same resolution using the η values from Equation (2) as:

$$PM_{2.5,i,x,y,h,sat} = \eta_{i,x,y,model} \times AOD_{i,x,y,h,sat} \quad (4)$$

We call this $PM_{2.5}$ as the instantaneous $PM_{2.5}$ because the satellites carrying the MODIS sensor cross the Indian region between 10:00 AM and 2:00 PM local time, and therefore, the satellite-derived $PM_{2.5}$ does not represent the 24-h cycle.

We assume that the spatial heterogeneity in $PM_{2.5}$ within a coarse MERRA-2 grid (used to derive η) can be captured by the MAIAC AOD data at 1-km resolution and will not be affected much by the interpolation of η . We compare (Figure 2) the interpolated η from MERRA-2 with that derived directly for the grids having at least one CPCB site by taking the ratio of $PM_{2.5}$ (measured from the ground) and AOD (from MAIAC). Though most of the data points lie within 1:2 and 2:1 lines, the MERRA-2 η shows slightly low bias with respect to the in-situ data with a correlation coefficient that is statistically significant ($p < 0.05$) and a RMSE of 66.8 (that corresponds to an error of $20 \mu g m^{-3}$ in retrieved $PM_{2.5}$ for an AOD of 0.3). To minimize this bias in satellite-derived instantaneous $PM_{2.5}$ due to the interpolation of η to a finer resolution, in the fourth step, we perform the second calibration. We estimate the calibration factors for each 10 percentile ranges as the ratio of $PM_{2.5}$ measured at the surface during the satellite overpass time and satellite-derived instantaneous $PM_{2.5}$. Using the site-specific calibration factors representative for each month, we tune the satellite-derived instantaneous $PM_{2.5}$ data in these grids closer to the observed values and use the nearest neighbor algorithm to adjust the bias for the grids devoid of any CPCB site.

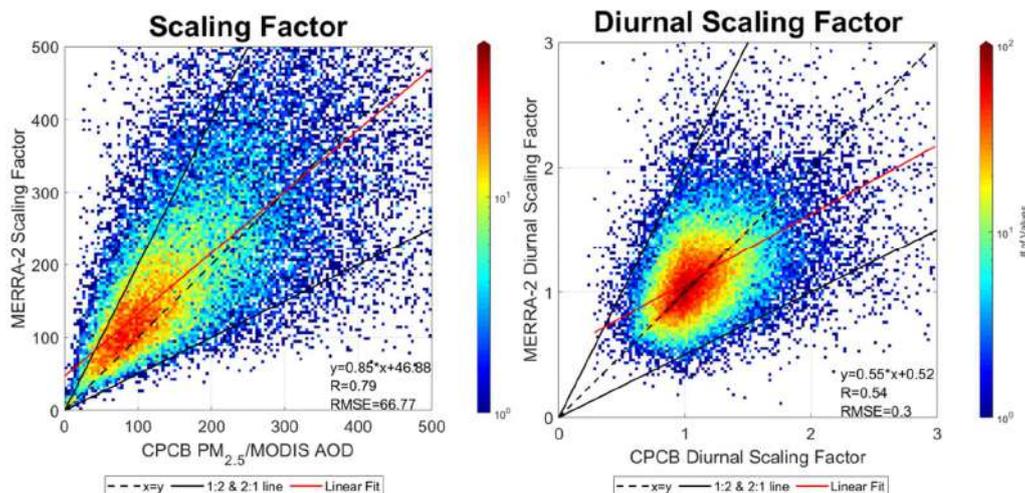


Figure 2. Regression statistics of the (left) scaling factor (η) and (right) diurnal scaling factor from MERRA-2 and ground-based measurements over India.

In the fifth step, we estimate the diurnal scaling factor (DSF) of each grid (x, y) for the conversion of calibrated satellite-derived $PM_{2.5}$ during the satellite overpass time (h) to the 24-h average of each day (i) using MERRA-2 data as:

$$DSF_{i,x,y,h,model} = \frac{PM_{2.5,i,x,y,24-h,model}}{PM_{2.5,i,x,y,h,model}} \quad (5)$$

The spatial patterns of the mean monthly diurnal scaling factors are shown in Figure A5. We find that the $PM_{2.5}$ concentrations during the satellite overpass time are lower than the 24-h average (hence

the ratio is >1) almost everywhere in every month, except over the Western Ghats during July and August and parts of Central India in May. We also compare the diurnal scaling factor derived from MERRA-2 with that from CPCB data (Figure 2). We find that the MERRA-2 diurnal scaling factor shows a statistically significant ($p < 0.05$) correlation with CPCB diurnal scaling factor, but with a low bias and a RMSE of 0.3. It implies that the retrieved 24-h $PM_{2.5}$ concentration is likely to be underestimated (as compared to the reference monitoring) if the diurnal scaling factors are underestimated.

In the sixth and final step, we convert the satellite-derived instantaneous $PM_{2.5}$ to 24-h average $PM_{2.5}$ (our daily product) using $DSF_{i,x,y,h,model}$ as:

$$PM_{2.5,i,x,y,24-h,sat} = DSF_{i,x,y,h,model} \times PM_{2.5,i,x,y,h,sat} \quad (6)$$

We find that our daily (i.e., 24-h average) $PM_{2.5}$ product has spatial gaps due to the cloud cover and satellite-retrieval issues. This gap is filled when we average the daily $PM_{2.5}$ to generate the monthly and subsequently the annual $PM_{2.5}$ product. All the products are developed for the entire duration (26 February 2000–31 December 2019).

2.2. Comparison of Satellite-Derived and Ground-Based Daily and Annual $PM_{2.5}$

For cross-validation, we train our two-stage calibration model with 70% of the surface measurements randomly chosen from 120 CPCB sites. The remaining 30% of the data are used for validation. We find that the calibration improves the R^2 of satellite-derived instantaneous $PM_{2.5}$ and surface measurements during the overpass from 0.51 to 0.67. Since our main products are the daily (24-h average) and annual satellite-derived $PM_{2.5}$, we further compare these two against surface measurements from the CPCB network (Figure 3). Note that no further calibration is carried out after we estimate the daily $PM_{2.5}$ in the sixth and final step from the calibrated instantaneous $PM_{2.5}$. The slope (0.98) of the regression line and the intercept ($2.6 \mu\text{g}/\text{m}^3$) of the daily satellite-derived and surface measured $PM_{2.5}$ are close to the ideal values. The regression statistics are statistically significant at 95% CI following student's t -test ($p < 0.05$). Less than 0.5% of data points (out of the total number of samples = 34324) lie outside the 1:2 and 2:1 line. The cases ($<0.3\%$) where surface measurements are more than double the satellite-based $PM_{2.5}$ are confined to the Delhi NCR when the satellite fails to capture the extreme pollution events [13]. In the other cases ($<0.2\%$) where the surface measurements are much lower than the satellite-derived $PM_{2.5}$, the satellite data are overfitted. Most of the epidemiological studies [4] are carried out with annual $PM_{2.5}$ exposure and the NCAP also aims to reduce the annual $PM_{2.5}$ concentration. Our annual $PM_{2.5}$ product shows a RMSE of $7.2 \mu\text{g}/\text{m}^3$ and R^2 of 0.97 with the slope and the intercept similar to those of the daily product.

To understand the behavior of the error in the retrieved $PM_{2.5}$ dataset across a wide range of $PM_{2.5}$, we plot the retrieval bias (which is $PM_{2.5}$ from the CPCB sites— $PM_{2.5,sat}$) as a function of $PM_{2.5}$ from the CPCB sites (Figure 4). The median bias remains lower than $10 \mu\text{g}/\text{m}^3$ ($<5\%$) up to a $PM_{2.5}$ level of $200 \mu\text{g}/\text{m}^3$, beyond which the underestimation in $PM_{2.5,sat}$ starts to increase. Ground-based measurements reveal that 24-h $PM_{2.5}$ concentration in India usually remains below $200 \mu\text{g}/\text{m}^3$ in most of the days [28]. $PM_{2.5}$ concentration exceeds this range during the peak pollution season for a few days, that too, mostly in the Delhi NCR, which the satellite-derived data underestimate. Retrieval of these extreme cases is challenging in urban areas [13]. Further, we segregate the entire dataset of our daily product into various seasons (Figure A6) and various geographic regions (Figure A7) to understand if there is any systematic seasonal or regional bias in the dataset. Seasonally, we get the highest R^2 during the winter (DJF) season followed by the post-monsoon (ON) season with comparable RMSE, when the $PM_{2.5}$ level remains high (as shown in Section 3.2). In the other seasons, the RMSEs are lower and though R^2 values are slightly lower they are statistically significant ($p < 0.05$). We note that there are no ground-based monitoring sites in North and Northeast India. However, comparable regression statistics across the various geographical regions covering a diverse land use attest to the robustness and applicability of the dataset for air quality management. As the ground-based network

is being expanded including the rural areas under the NCAP, we expect further improvement in the product in future.

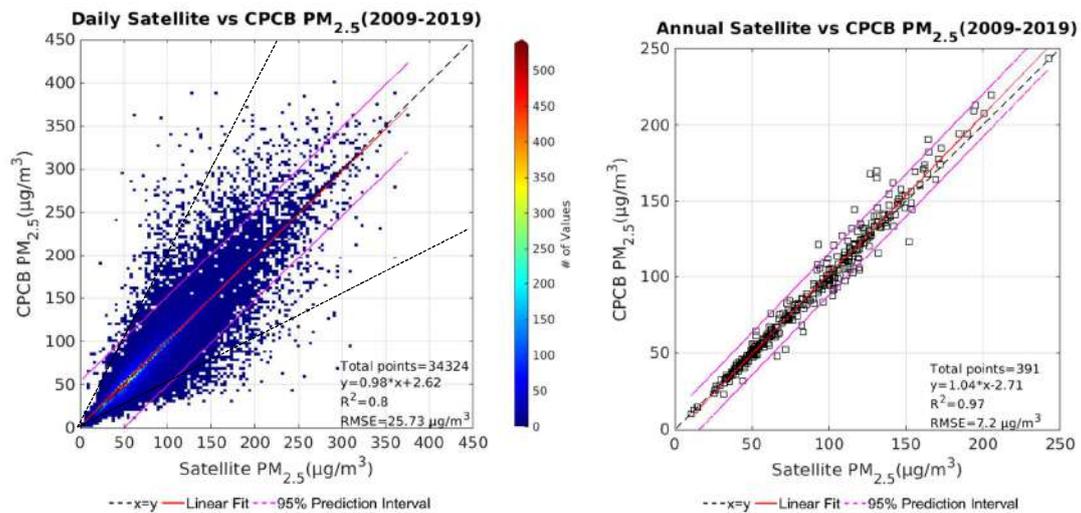


Figure 3. Regression statistics of (left) daily and (right) annual satellite-based and ground-based PM_{2.5} concentration over India. The points falling outside the 1:2 and 2:1 line (shown as dotted lines) are considered as the outliers (<0.5% for the daily PM_{2.5} product).

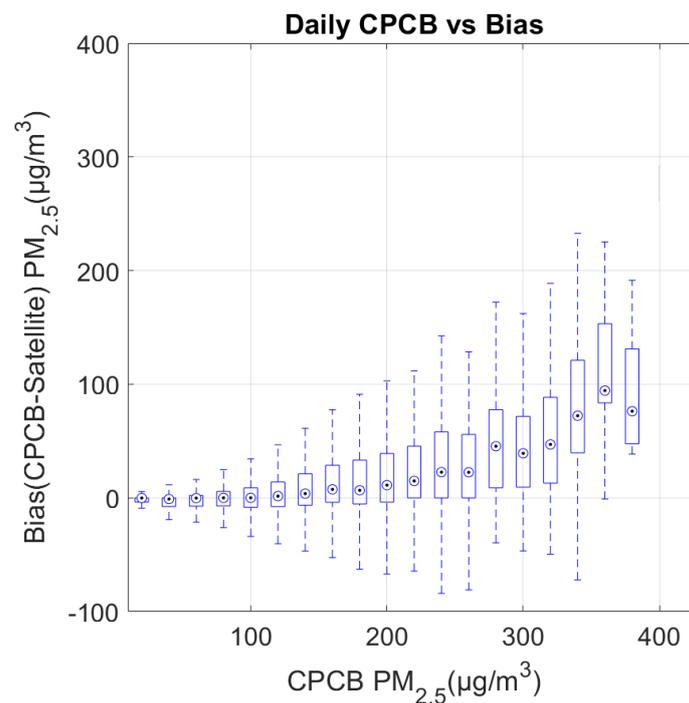


Figure 4. Variation in the bias in daily satellite-based PM_{2.5} concentrations relative to the ground-based measurements with an increase in the PM_{2.5} level. The box plots represent 5–95 percentile levels.

2.3. Analysis of PM_{2.5} Trends and Meteorological Parameters

We examine the PM_{2.5} trends in two different ways. First, we estimate the linear trends in annual PM_{2.5} within the last decade (2000 to 2009) and the present decade (2010 to 2019). Secondly, we estimate the mean seasonal PM_{2.5} over the entire duration for the winter (December–February), pre-monsoon (March–May), monsoon (June–September) and post-monsoon (October–November) seasons. The seasonal variations are examined in terms of the anomaly (i.e., mean seasonal PM_{2.5}–mean

annual $PM_{2.5}$) related to the annual concentration. The mean seasonal values are then used to estimate the linear trends in each season. The grids that are statistically significant ($p < 0.05$) following the student's t -test are marked.

We also analyze the planetary boundary layer (PBL) height and wind speed from the MERRA-2 reanalysis data. PBL height is inversely proportional to $PM_{2.5}$ as the particles get trapped if PBL height is low. Similarly, wind speed is also inversely proportional to $PM_{2.5}$ as stronger wind will allow particles to disperse easily. The combined effect of these two important meteorological factors on the $PM_{2.5}$ concentration is represented by the ventilation coefficient (VC), which is simply the product of PBL height and wind speed [29]. High VC implies a favorable condition for the dispersion, while low VC implies the condition as unfavorable. Therefore, the spatial and seasonal variations in $PM_{2.5}$ can be partially attributed to the changes in VC. We estimate the seasonal anomaly in VC with respect to the annual mean to understand the observed seasonal changes in $PM_{2.5}$ and the seasonal trends in VC to understand the seasonal trends.

2.4. Exposure Attribution

Population-weighted $PM_{2.5}$ exposure is estimated using the population data from the Indian Census. To separate the urban and rural $PM_{2.5}$, we analyze the Global Human Settlement Layer (GHSL) data [30]. This dataset was developed as part of a European Union project using 40-years of Landsat imagery that tracked the land use and land cover changes globally. Various other geospatial data (e.g., global cover of the artificial surface, open street maps, global urban extents and population distribution) are integrated with the land use data to identify each 1-km \times 1-km grid as one of the four classes—high-density urban (at least 1500 per km² population density), low-density urban (300–1500 per km² population density), rural (<300 per km² population density) and no-settlement (no permanent human occupancy). The GHSL provides the information in four distinct years—1975, 1990, 2000 and 2015. Here, we combine the high-density and low-density urban grids into a single urban class. Since the satellite-derived $PM_{2.5}$ is available from 26 February 2000, we consider the urban and rural $PM_{2.5}$ in 2001 as a baseline and estimate the changes in 2015. We assume that the human settlement pattern did not change much from 2000 to 2001 to affect our results.

The state/union territory (UT)-averaged urban and rural settlement fractions in India for the year 2000 and 2015 are shown in Figure A8. Overall, both the urban and rural settlement area has increased in India in a varying proportion to accommodate the growing population. We match each 1-km \times 1-km grid of satellite-based $PM_{2.5}$ with the GHSL data and estimate the urban and rural $PM_{2.5}$ population-weighted exposure in each state and UT for the years 2001 and 2015. We compare and report the statistics of rural and urban exposure along with the changes between 2001 and 2015 (Table A1). For the geographical locations of the states, UTs and the regions, see Figure A1.

3. Results

This section is divided into four subsections. First, we present the spatial pattern of $PM_{2.5}$ concentration over India in Section 3.1, followed by the seasonal changes in Section 3.2, the trend analysis in Section 3.3 and the urban–rural divide in $PM_{2.5}$ exposure in Section 3.4.

3.1. Spatial Pattern in $PM_{2.5}$ Concentration over India

The spatial distribution of $PM_{2.5}$ at the annual scale shown in Figure 5a mimics the spatial pattern observed by satellite-derived AOD (Figure 5b). Four points are notable in this figure. First, ambient $PM_{2.5}$ exceeds the annual NAAQS of 40 $\mu\text{g}/\text{m}^3$ in every state except the states of Jammu and Kashmir (including the new Ladakh UT), Himachal Pradesh, Sikkim, Arunachal Pradesh, Manipur and Nagaland (see Figure A2 for the geographical locations), where the population is sparse and a large part is covered by mountains. As of 2019, we find that 99.5% of the Indian districts (second administrative levels) do not meet the World Health Organization (WHO)-air quality guideline (AQG) of 10 $\mu\text{g}/\text{m}^3$. Second, the $PM_{2.5}$ level in the Indo-Gangetic Plain (IGP) and the western arid region is more than

double the annual NAAQS. The IGP is a low-lying fertile alluvial plain bounded by the Himalayas in the north and central Indian highlands in the south. Due to its fertility, it is densely populated with a population more than 700 million. Continuous emissions of primary $PM_{2.5}$ and secondary precursor gases (that contribute to $PM_{2.5}$ eventually) from a range of anthropogenic activities (e.g., household solid fuel use, power plants, industries, open biomass and solid-waste burning, vehicles, brick kilns, diesel generator sets, construction activities, etc.) coupled with unfavorable topography and meteorology lead to a massive $PM_{2.5}$ buildup. This $PM_{2.5}$ does not disperse away towards the north or south (bounded by the mountains); rather it oscillates east–west by the seasonal winds [31]. The only pathway of the pollution dispersion is through the Gangetic West Bengal towards the Bay of Bengal. The IGP, therefore, has become a giant valley trapped with high annual $PM_{2.5}$ that persists throughout the year. Third, the $PM_{2.5}$ shows a north (high)–south (low) gradient, which, to some extent, mimics the population distribution (and therefore the anthropogenic source distribution). The only exception is the western arid region, which is sparsely populated but highly polluted because of the large contribution of desert dust raised by wind [3]. Fourth, $PM_{2.5}$ is not proportionally (as compared to the IGP states) high over the states of Odisha, Telangana and Andhra Pradesh where AOD is high. In these regions, the condition for dispersion is favourable for February–October (as shown by low η values in Figure A4). We note that a large part of the IGP and many other states where the ambient $PM_{2.5}$ is high are rural. We discuss the urban–rural contrast in $PM_{2.5}$ exposure separately.

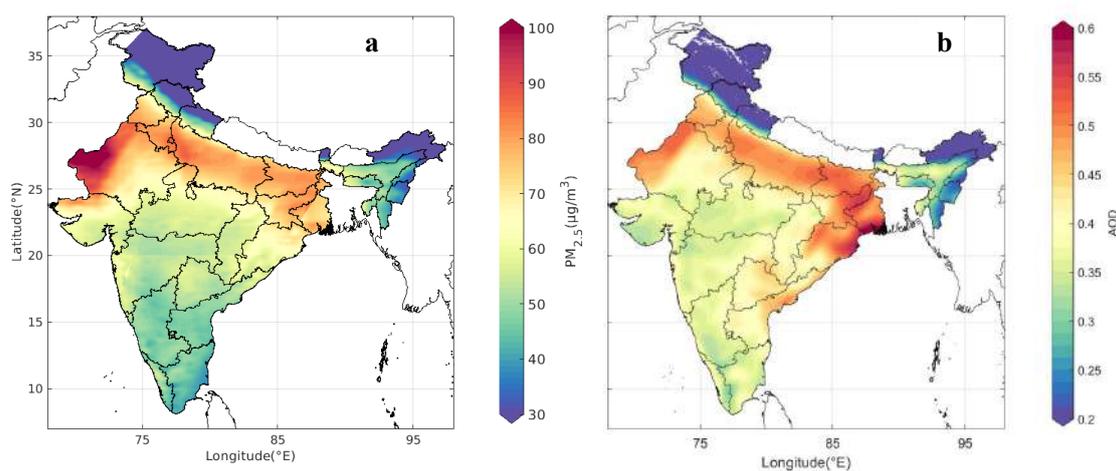


Figure 5. The spatial patterns of (a) annual $PM_{2.5}$ and (b) annual aerosol optical depth (AOD) averaged for the 20-year (2000–2019) period over India.

3.2. Seasonal Anomaly in $PM_{2.5}$ Concentration

Figure 6 shows the seasonal anomaly in $PM_{2.5}$ relative to the annual average $PM_{2.5}$ distribution. $PM_{2.5}$ is the highest in the winter season across the country except for the high-altitude regions in the north and the western arid region. This wintertime enhancement (a positive anomaly ranging from 5 to 40 $\mu\text{g}/\text{m}^3$ relative to the annual average) in $PM_{2.5}$ has been attributed to the additional emission from households (especially in the colder places due to space and water heating) and a stable atmosphere under calm conditions [12]. In the western arid region, dust activity remains at a minimum during the winter and in the high-altitude states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand, major commercial activities remain closed due to extreme cold. Therefore, $PM_{2.5}$ shows a negative anomaly relative to the annual average. In the pre-monsoon season, the PBL expands with a rise in the surface temperature and wind speed increases, allowing $PM_{2.5}$ to be dispersed. As a result, $PM_{2.5}$ concentration decreases over the highly polluted IGP. However, this impact is partially compensated by the additional dust load in west India and emissions from seasonal open biomass burning over a large part of the northeast and peninsular India [3].

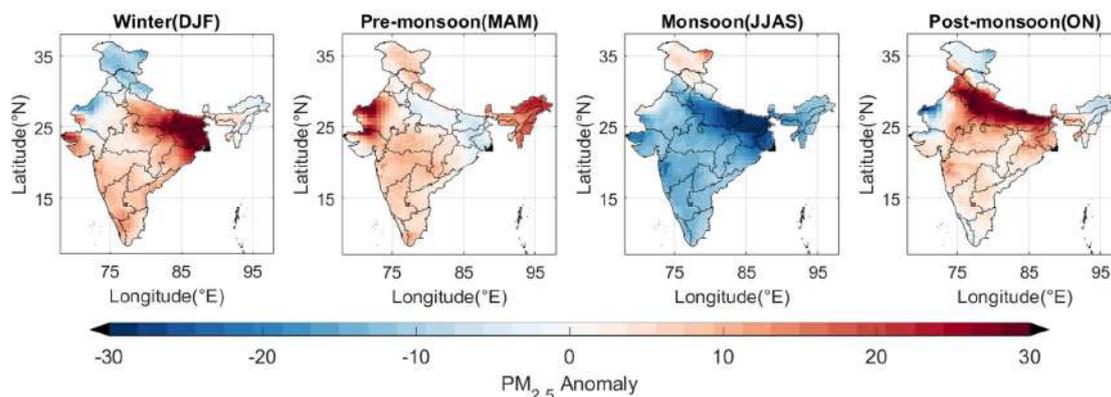


Figure 6. Spatial patterns of seasonal PM_{2.5} anomaly (i.e., the difference between mean seasonal and mean annual PM_{2.5}) averaged over the 20-year (2000–2019) period over India.

PM_{2.5} decreases in the monsoon season (as shown by a negative anomaly ranging from -5 to -35 $\mu\text{g}/\text{m}^3$ relative to the annual average) substantially as the particles are washed out by monsoon rain. The largest reduction is observed over the eastern IGP and along the west coast of India. In this season, PM_{2.5} level remains lower than 40 $\mu\text{g}/\text{m}^3$ over entire India except for the arid region in the west (where the monsoon rain is scanty) and the western IGP including Delhi NCR (where the emission strength is so high that the aerosol recovery overcompensates the loss due to washout [32]). However, we note that PM_{2.5} does not meet the 24-h WHO–AQG (25 $\mu\text{g}/\text{m}^3$) on most of the days in most parts of the country even in this season, suggesting the severity of the problem. The temperature starts dropping with the monsoon retreat, especially in the north (including the IGP), northeast, west and central India in the post-monsoon season. In addition, the open biomass burning is prevalent across the country, more so in the western and central IGP, in this season, which adds to the regional PM_{2.5} buildup due to a lower average PBL height [13].

3.3. Trends in PM_{2.5} Concentration

We next present the rate of changes in annual PM_{2.5} concentration (i.e., the annualized rate of changes) in the last and the current decade (top panel in Figure 7). The state-level statistics are shown in Table A1 (in the Appendix A). During the last decade, PM_{2.5} over India shows a significant ($p < 0.05$) increase (by >1 $\mu\text{g}/\text{m}^3$ per year) over the states of Jharkhand, Chhattisgarh, Odisha, Telangana, Andhra Pradesh, Tamil Nadu, Kerala, and parts of Karnataka, Maharashtra and north-east India, while it decreases (not significantly though) over the high-altitude states of Jammu and Kashmir and Himachal Pradesh, and the Indian desert. In the current decade, the increase is found to be significant ($p < 0.05$) over the states of West Bengal, Odisha, Telangana, Maharashtra, and parts of Gujarat, Karnataka, Bihar, Uttar Pradesh, Madhya Pradesh and Uttarakhand. The decline continues over the eastern part of Jammu and Kashmir (now Ladakh UT) and parts of Rajasthan.

Emission data of primary PM_{2.5}, BC and OC and secondary gaseous precursors (e.g., SO₂, NO₂ and volatile organics) from the Evaluating the Climate and Air Quality Impact of Short-lived Pollutants (ECLIPSE) emission inventory [33] suggest that the emissions from anthropogenic sources increased steadily over the last two decades everywhere in India with a larger increase in the eastern and central part of India dominated by mining activities and related industries and thermal power plants [34]. However, since we do not have continuous data, we can only qualitatively attribute the observed decadal trends in PM_{2.5} to the rising emissions. The decadal changes in the VC (bottom panel in Figure 7) suggest that the meteorological condition became increasingly unfavorable in the last decade. This, coupled with the rising emissions, led to the observed increase in PM_{2.5} in eastern and peninsular India. In the current decade, the VC does not show a significant trend. In fact, it has slightly increased (although not significantly) over western and central India, where we find a decrease in PM_{2.5}. However, in southeastern Maharashtra, the PM_{2.5} increased despite an increase in VC. We only speculate that,

perhaps, the meteorological impact is overcompensated by the impact of rising emissions and regional transport in this region. For more quantitative interpretation, simulations from a chemical transport model are required and are beyond the scope of this work.

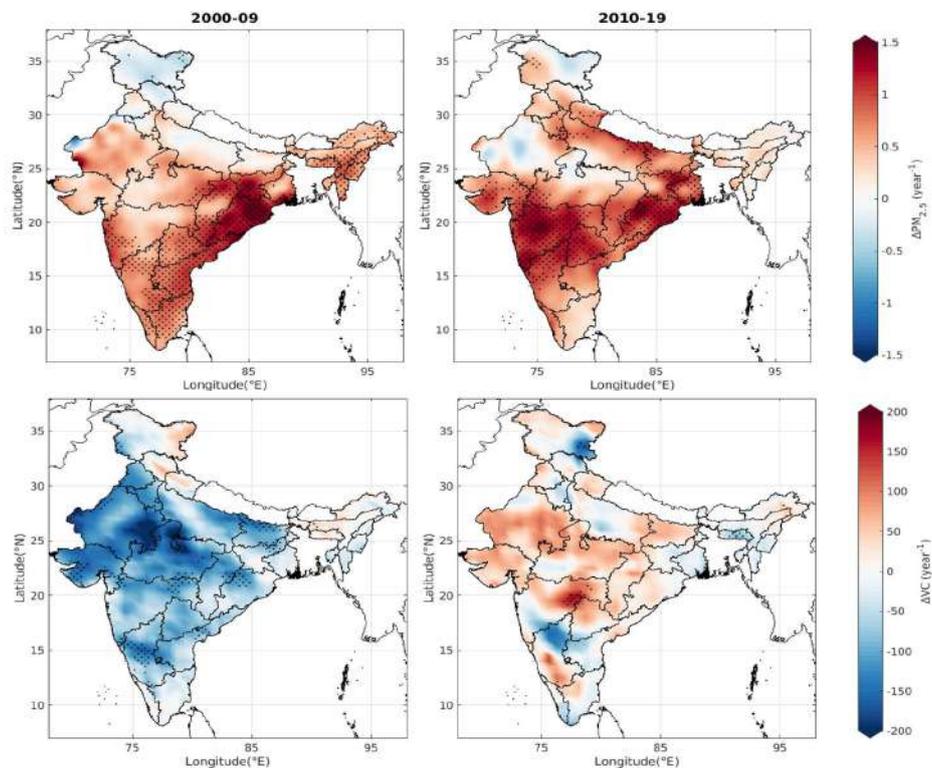


Figure 7. Spatial patterns of the annualized rate of changes in (top panel) $PM_{2.5}$ (in $\mu g/m^3$ per year) and (bottom panel) ventilation coefficient, VC (in m^2/s per year) over India during the last decade (2000–2009) and the current decade (2010–2019). The statistically significant trends ($p < 0.05$) are identified as stippled marks.

The annualized rate of changes at the seasonal scale is displayed in Figure 8. We note several key features. First, ambient $PM_{2.5}$ shows a significant increase ($p < 0.05$) over almost the entire country in the post-monsoon and winter seasons, except over the arid regions in the west and high-altitude regions in the north and northeast. The largest trends ($>2 \mu g/m^3$ per year) are observed over the IGP, eastern and southeast India (along the east coast), large parts of peninsular India and the state of Gujarat. In the pre-monsoon season, $PM_{2.5}$ increases over east, northeast and peninsular India, which are affected by open biomass burning [35]. The decreasing trend over west and northwest India is perhaps attributed to the declining dust activity [36]. In the monsoon season when $PM_{2.5}$ generally remains low (Figure 6), no apparent trend is observed, except over some patches in the west and central IGP. In terms of major emission sources, open biomass burning is a seasonal source and is observed in the pre-monsoon (after the wheat cultivation) and the post-monsoon (after the rice cultivation) seasons. Studies have suggested that the post-monsoon burning has increased post-2009 in the states of Punjab and Haryana [13] while the pre-monsoon burning marginally increased all over the country [37]. Since the $PM_{2.5}$ shows an increasing trend over the peninsular and east India in the three seasons, the largest trend in annual $PM_{2.5}$ is observed in these regions (Figure 9a). The trend over the IGP, the most polluted region in India (and one of the top polluted regions in the world), is governed mainly by the rising $PM_{2.5}$ during the post-monsoon to winter seasons. Overall, the trends are higher over eastern and peninsular India ($>1.6\%$ per year) where the number of hazy days has been increasing at a faster rate than over the IGP [38] where the annual $PM_{2.5}$ is the highest but the rate of increase is $<1.2\%$ per year (Figure 9b).

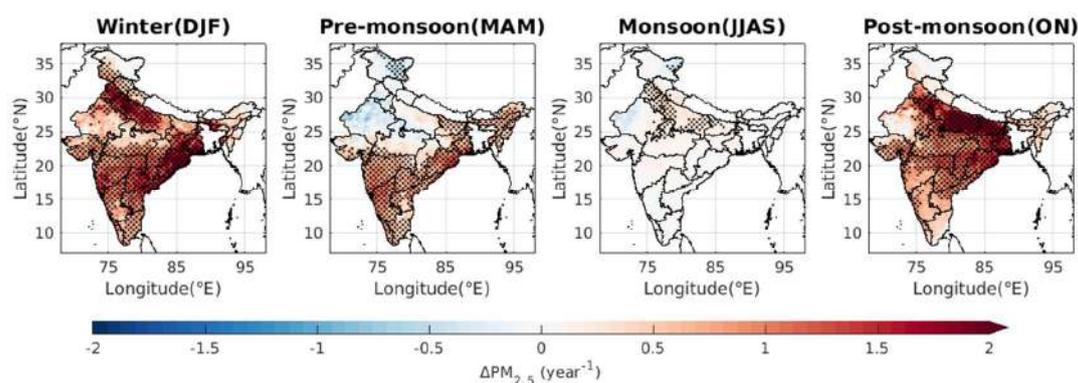


Figure 8. Spatial patterns of the annualized rate of changes in seasonal $PM_{2.5}$ (in $\mu\text{g}/\text{m}^3$ per year) over India during the last 20 years. The statistically significant trends ($p < 0.05$) are identified as stippled marks.

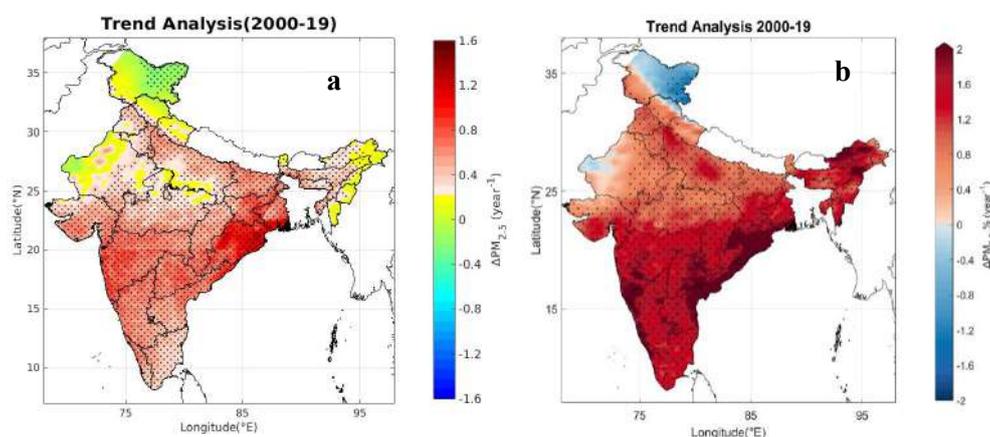


Figure 9. Spatial patterns of (a) the annualized rate of changes in $PM_{2.5}$ (in $\mu\text{g}/\text{m}^3$ per year) and (b) the relative changes (in % per year) over India during the 20 years. The statistically significant trends ($p < 0.05$) are identified as stippled marks.

3.4. Urban vs. Rural $PM_{2.5}$

Unlike the developed countries where $PM_{2.5}$ is considered to be an urban problem, we observe that high $PM_{2.5}$ cuts across the urban–rural transect. We therefore present comparative statistics of urban vs. rural population-weighted $PM_{2.5}$ exposure in Figure 10 for the year 2001 and the state-averaged changes in urban and rural population-weighted exposure from 2001 to 2015 in Figure 11. We observe that the urban $PM_{2.5}$ exposure in Delhi increased by 10.9% from 82.2 (5–95 percentile ranges: 27.8–168.9) $\mu\text{g}/\text{m}^3$ in 2001 to 91.3 (33.7–190.7) $\mu\text{g}/\text{m}^3$ in 2015. During the same period, the rural $PM_{2.5}$ exposure increased by 11.9% from 81.1 (27.8–163.4) $\mu\text{g}/\text{m}^3$ to 90.7 (32.5–192.5) $\mu\text{g}/\text{m}^3$. We point out that though the urban and rural exposure is comparable, the urban area (80%) is disproportionately higher in Delhi than the rural area (10%). The remaining 10% area does not have any permanent human settlement and therefore can be considered as the background. Several key features are now presented. First, population-weighted $PM_{2.5}$ exposure increased in all the states/UTs from 2001 to 2015 (Table A1). Second, in 2001, all the states/UTs except Arunachal Pradesh (28.1 $\mu\text{g}/\text{m}^3$), Manipur (38.9 $\mu\text{g}/\text{m}^3$), Mizoram (39.7 $\mu\text{g}/\text{m}^3$), Nagaland (35.2 $\mu\text{g}/\text{m}^3$) and Puducherry (24.6 $\mu\text{g}/\text{m}^3$) had rural $PM_{2.5}$ exposure exceeding the NAAQS. In 2015, the rural $PM_{2.5}$ exposure remained below the NAAQS only in Arunachal Pradesh (33.5 $\mu\text{g}/\text{m}^3$), Puducherry (26.9 $\mu\text{g}/\text{m}^3$) and Sikkim (39.7 $\mu\text{g}/\text{m}^3$). Sikkim was the only state where rural exposure reduced. Third, in 2001, the urban $PM_{2.5}$ exposure exceeded the NAAQS in all the states/UTs except Arunachal Pradesh (34.1 $\mu\text{g}/\text{m}^3$), Daman and Diu (36.2 $\mu\text{g}/\text{m}^3$), Goa (33.9 $\mu\text{g}/\text{m}^3$),

Kerala ($36.7 \mu\text{g}/\text{m}^3$), Nagaland ($37.4 \mu\text{g}/\text{m}^3$), Puducherry ($25.3 \mu\text{g}/\text{m}^3$) and Tamil Nadu ($38.0 \mu\text{g}/\text{m}^3$), while in 2015, it remained below the NAAQS only in two states/UTs—Arunachal Pradesh ($38.7 \mu\text{g}/\text{m}^3$) and Puducherry ($30.3 \mu\text{g}/\text{m}^3$). Fourth, both rural and urban $\text{PM}_{2.5}$ exposure exceeded the double of the NAAQS in 2001 in only Delhi (81.0 and $82.3 \mu\text{g}/\text{m}^3$), while in 2015, it happened in five states—Delhi (90.7 and $91.3 \mu\text{g}/\text{m}^3$), Haryana (84.5 and $85.7 \mu\text{g}/\text{m}^3$), Uttar Pradesh (82.4 and $82.8 \mu\text{g}/\text{m}^3$), Bihar (81.3 and $81.4 \mu\text{g}/\text{m}^3$) and Jharkhand (81.1 and $83.2 \mu\text{g}/\text{m}^3$). Finally, in most of the states, the urban and rural $\text{PM}_{2.5}$ exposure are comparable.

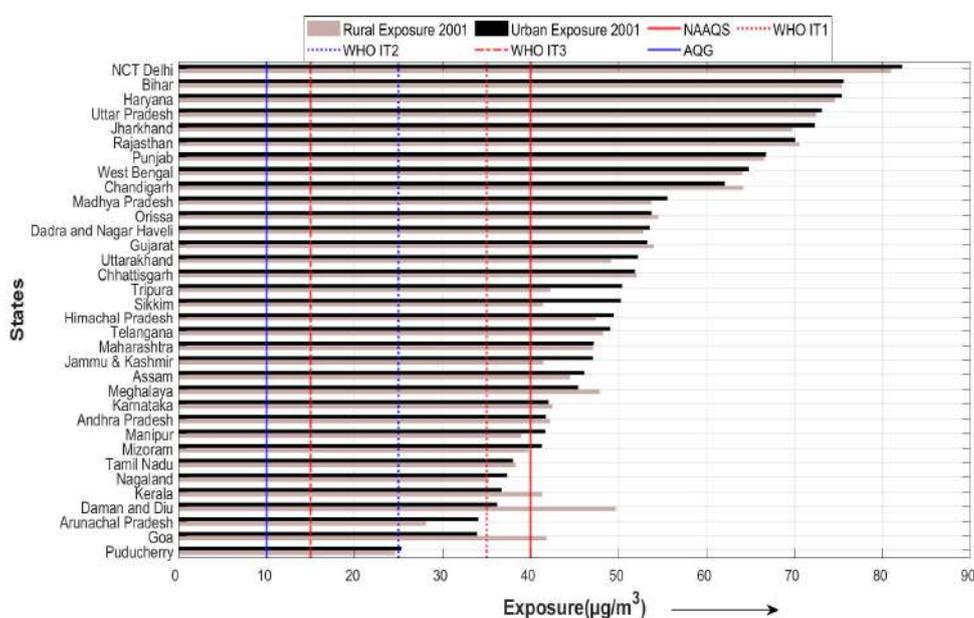


Figure 10. State-wise urban and rural population-weighted $\text{PM}_{2.5}$ exposure in 2001. World Health Organization air quality guideline, WHO AQG ($10 \mu\text{g}/\text{m}^3$) and the interim targets (IT-1: $35 \mu\text{g}/\text{m}^3$; IT-2: $25 \mu\text{g}/\text{m}^3$ and IT-3: $15 \mu\text{g}/\text{m}^3$), and national ambient air quality standard, NAAQS ($40 \mu\text{g}/\text{m}^3$) are marked by the vertical lines. The states/union territories are arranged in the decreasing order of $\text{PM}_{2.5}$ level.

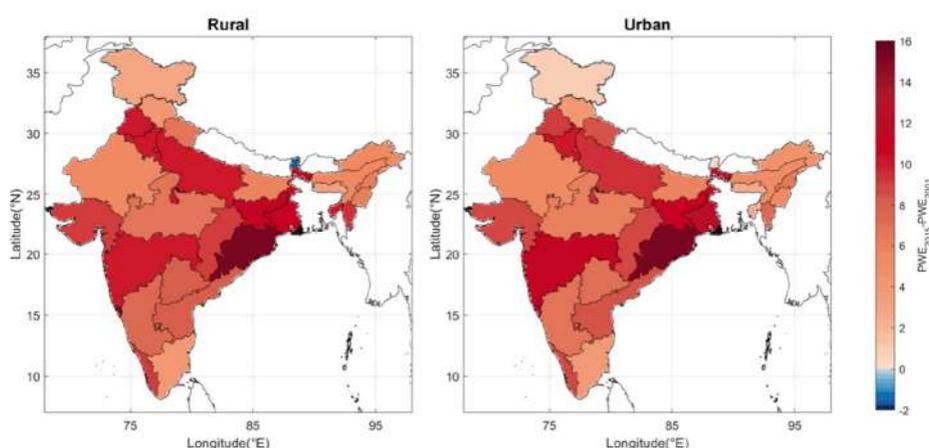


Figure 11. Changes (in $\mu\text{g}/\text{m}^3$) in (left) rural and (right) urban population-weighted $\text{PM}_{2.5}$ exposure in 2015 relative to 2001 (shown in Figure 9).

4. Discussion

In this work, we develop and present a 20-year ambient $\text{PM}_{2.5}$ database for India at a high (1-km) spatial resolution. The data are disseminated freely through a web portal ‘satellite-based application of

air quality monitoring and management at a national scale', SAANS (www.saans.co.in) for use in air quality management, epidemiological studies and creating awareness amongst the citizens, especially from the states/UTs where the ground-based measurements are unavailable or scanty. Our work adds to the recent efforts of retrieving PM_{2.5} at high resolution [19,22] for an improved exposure assessment. We note the following issues for the proper interpretation of our database. First, we could not calibrate the scaling factor with ground-based data before 2009 and assume the calibration factors would be the same in this period. Second, the evaluation of the data is restricted to the urban centres as rural air quality monitoring from the surface does not exist in India. In future, when the surface network will be expanded to the rural area, the true error in satellite-based PM_{2.5} can be identified. We discuss several important implications and potential applications of our database.

High PM_{2.5} in the rural area is not surprising as a large fraction of the population still relies on solid fuel for domestic use (cooking, heating and lighting) [4]. These emissions do not remain confined with the household and filtrate out to pollute ambient air. Household sources are found to be the largest contributor to ambient PM_{2.5} in India [39–42]. This implies that poor air quality in India is not an urban-centric problem; rather it is a regional scale problem. Therefore, India requires a regional scale management strategy that transcends urban boundaries and focuses on regional airsheds. The NCAP focuses on 122 non-attainment cities. Many cities/towns in India do not have any ground-based measurements and hence whether they are non-attainment could not be determined during the early phase of the NCAP. Using our database, we found that 436 cities/towns with a population more than 100,000 (as per the 2011 Indian Census) exceed the NAAQS in 2019. We recommend setting up ground-based monitoring in these cities/towns on a priority basis.

The Government of India launched a program—Pradhan Mantri Ujjwala Yojana (PMUY, the Prime Minister's program of clean household fuel)—in 2014 to empower rural women by promoting clean cooking fuel (LPG) in the rural areas. This policy is highly important as mitigating emissions completely from the household sources can potentially help India achieve the NAAQS [43]. As the PMUY is rolled out, it lacks a mechanism to track its progress. Since the household sources contribute more than 50% to ambient PM_{2.5} in the rural areas [44], successful implementation of PMUY with sustained usage should arrest or even reverse the increasing trend in rural PM_{2.5} in recent years.

The high-resolution database will enable track the local hotspots within a city, especially where a single or no ground-based monitoring sites exist. It also will facilitate identification of the representative sites for the expansion of the CPCB network under the NCAP in the coming years.

In India, the epidemiological studies are either time-series (as summarized in [12]) or by design establishing the association, not causality [45], or the acute exposure impact on health outcomes like birthweight [46]. For the chronic exposure impacts on mortality and various health outcomes, we still rely on the GBD framework [1,2,4] that does not include any cohort study from India on ambient PM_{2.5} exposure. Our database will be highly useful to fill this important gap by planning retrospective cohorts with the existing health data and generating India-specific exposure-response functions.

5. Conclusions

Using a novel high-resolution (1-km) ambient PM_{2.5} database, we examine the trends in PM_{2.5} concentrations in India over two decades (2000–2019). Our key conclusions are: (1) the urban and rural ambient PM_{2.5} exposure increased by an almost similar margin from 2001 to 2015; (2) particulate air quality in India is a regional scale problem and needs a coordinated clean air action plan addressing the urban and rural sources simultaneously; and (3) mitigating emissions during October–February in the north and east India and December–May in peninsular India would arrest the rising annual PM_{2.5} trend.

Author Contributions: Conceptualization, S.D.; methodology, S.D. and B.P.; software, B.P. and K.D.; validation, S.D., B.P., P.B. and K.D.; formal analysis, B.P.; investigation, S.D. and B.P.; resources, S.D.; data curation, P.B., K.B., A.K., F.I., P.G. and V.K.S.; writing—original draft preparation, S.D.; writing—review and editing, S.D., B.P., P.B., K.D., K.B., A.K., F.I., S.C., D.G., P.G., V.K.S.; visualization, B.P.; supervision, S.D.; project administration,

S.D. and D.G.; funding acquisition, S.D. and D.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Central Pollution Control Board, India under the National Clean Air Program.

Acknowledgments: MAIAC AOD data are available from the Langley Research Centre Data Archive and the MERRA-2 reanalysis data are available from the NASA Goddard Earth Science Data Information Service Centre. GHSL data are freely available from the project website (<https://ghsl.jrc.ec.europa.eu/data.php>). The authors acknowledge Nitu and Koseqa for help in data compilation. S.D. acknowledges the support for the Institute Chair position by Indian Institute of Technology Delhi. The Department of Science and Technology (Govt. of India)—Funds for Improvement of Science and Technology Infrastructure in universities and higher educational institutions (DST-FIST) grant (SR/FST/ES-II-016/2014) is acknowledged for the computing support at IIT Delhi. We thank the anonymous reviewers for providing feedback that helped improve the original manuscript.

Conflicts of Interest: P.G. and V.K.S. are employees of the Central Pollution Control Board, which funded this research under the National Clean Air Program. They contributed intellectually to this study. All other authors declare no conflict of interest.

Appendix A

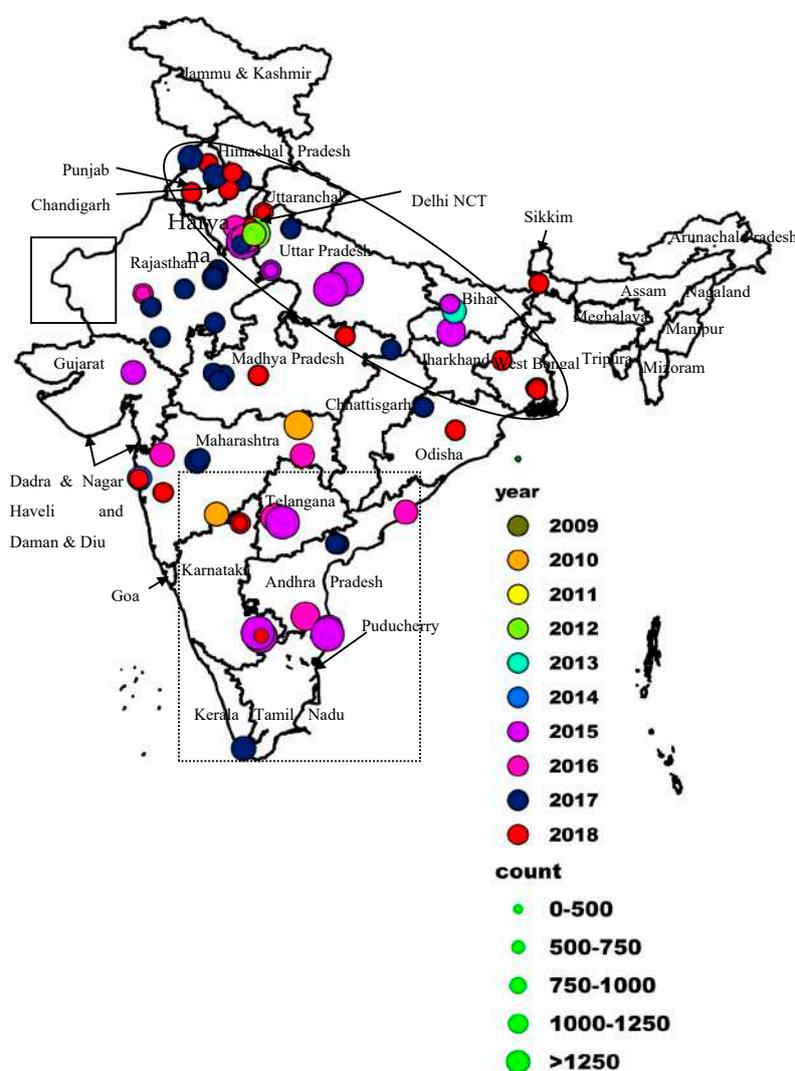


Figure A1. Central Pollution Control Board monitoring sites that are used to calibrate the satellite-PM_{2.5} dataset. The location of the Indo-Gangetic Plain, IGP (as discussed in the main text) is demarcated by oval shape, the Thar Desert by the rectangular box and Peninsular India by a dotted box. The size of the circles indicates the number of data and the colors represent the year from which the measurements started in each site.

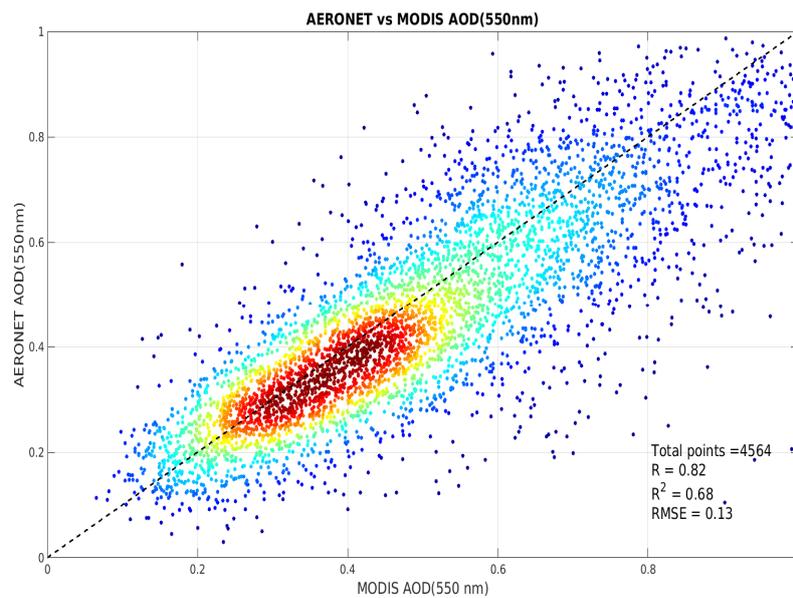


Figure A2. Comparison between Moderate Resolution Imaging Spectroradiometer–Multiangle Implementation of Atmospheric Correction (MODIS–MAIAC) AOD and Aerosol Robotic Network (AERONET) AOD over India. Three AERONET sites with multi-year data are chosen for the analysis—Kanpur (26.5° N, 80.3° E), Gandhi College (25.9° N, 84.1° E) and Jaipur (26.9° N and 75.8° E). Kanpur, Gandhi College and Jaipur sites have been operating since 2001, 2006 and 2009, respectively.

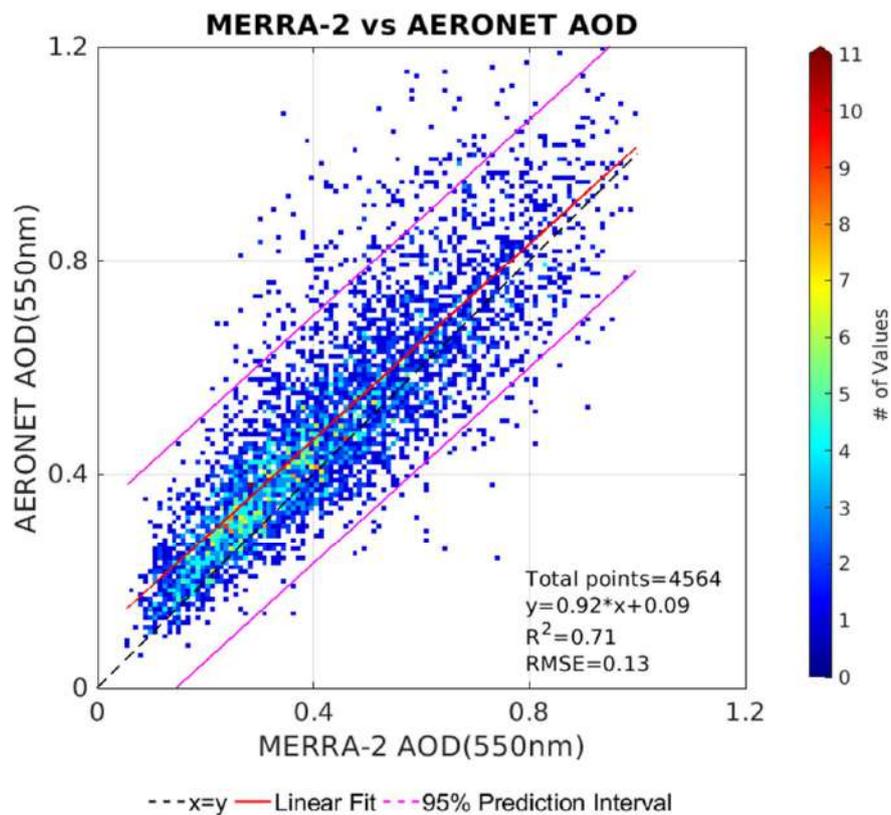


Figure A3. Correlation between hourly Modern-Era Retrospective analysis for Research and Applications Version 2 (MERRA-2) and AERONET AOD in India along with the regression statistics.

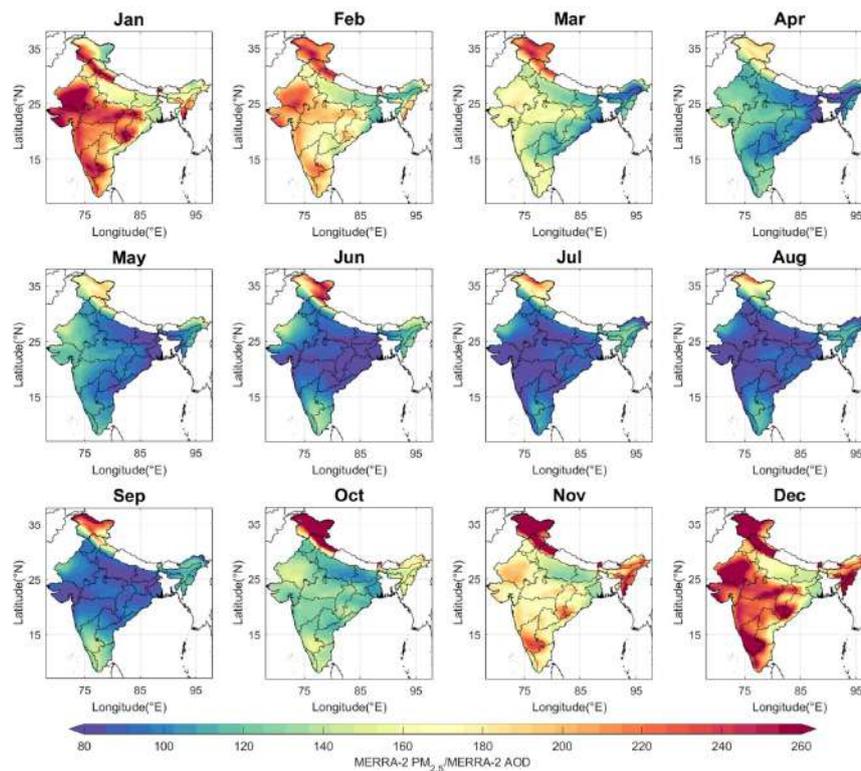


Figure A4. Spatial patterns of mean monthly η over India as derived from MERRA-2 data. η values are derived for each day during the entire study period and used to estimate $PM_{2.5}$ from satellite AOD.

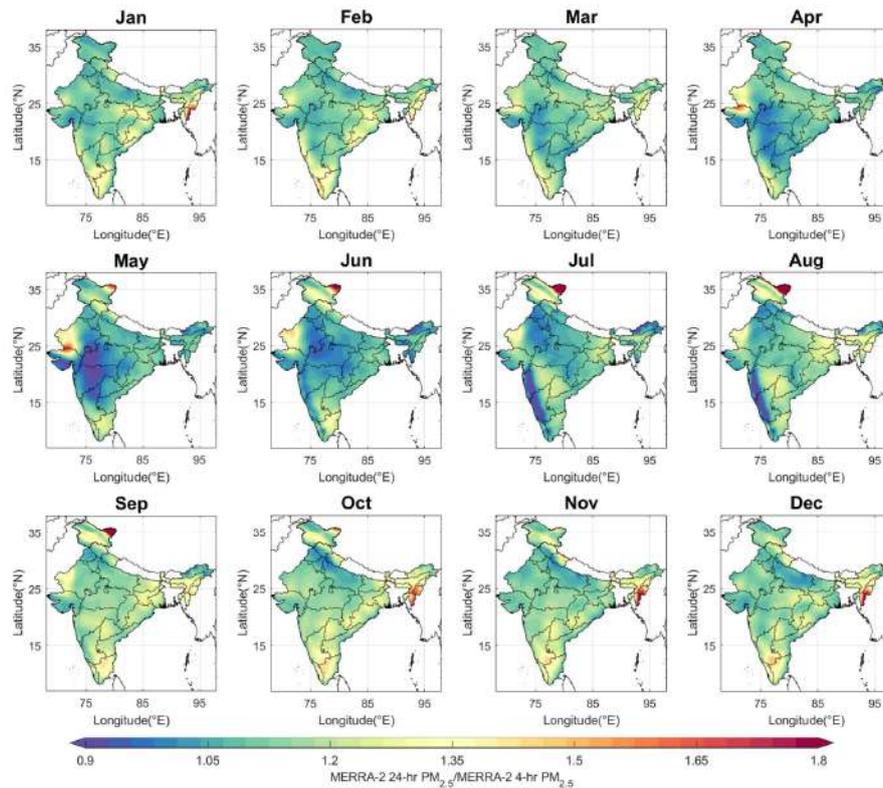


Figure A5. Spatial patterns of mean monthly diurnal scaling factor over India derived from MERRA-2 data. The diurnal scaling factor values are derived for each day during the entire study period and used to estimate 24-h $PM_{2.5}$ from instantaneous (i.e., during the satellite-overpass time) $PM_{2.5}$.

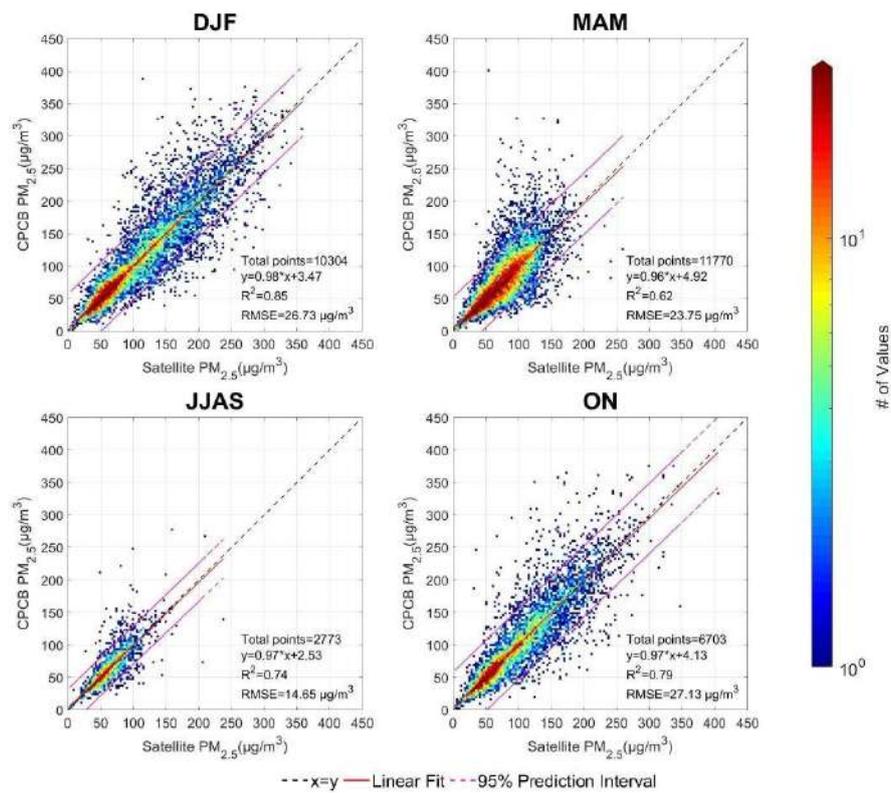


Figure A6. Regression statistics of the satellite-based daily PM_{2.5} with measurements from Central Pollution Control Board (CPCB) sites for the winter (DJF), pre-monsoon (MAM), monsoon (JJAS) and post-monsoon (ON) seasons over India.

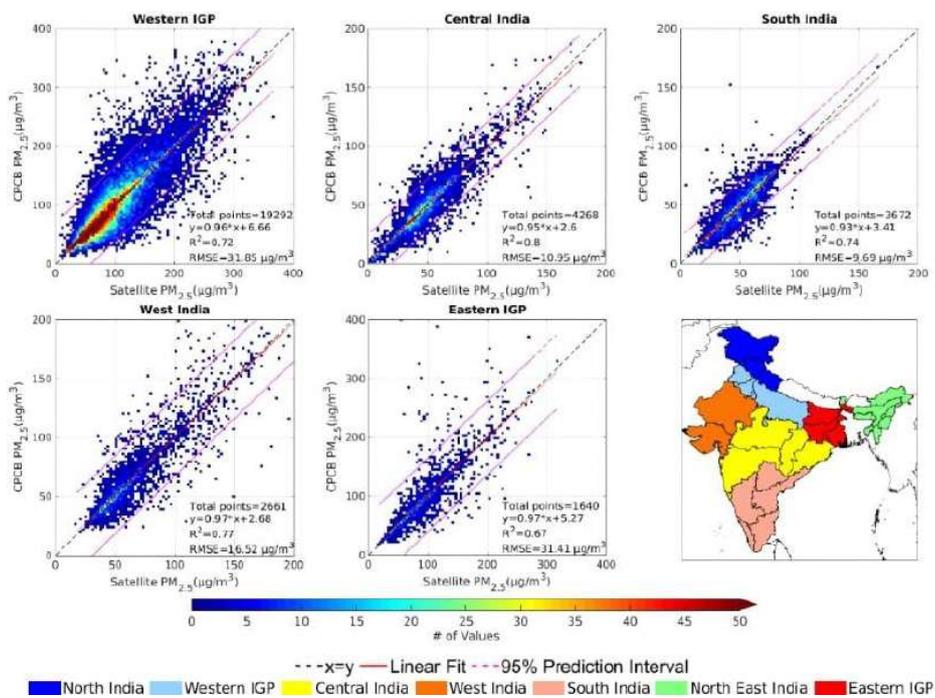


Figure A7. Regression statistics of the satellite-based daily PM_{2.5} with measurements from CPCB sites for the various geographic regions (shown in the bottom right panel) over India. There are no ground-based monitoring sites in Northeast and North India to validate the retrieved PM_{2.5}.

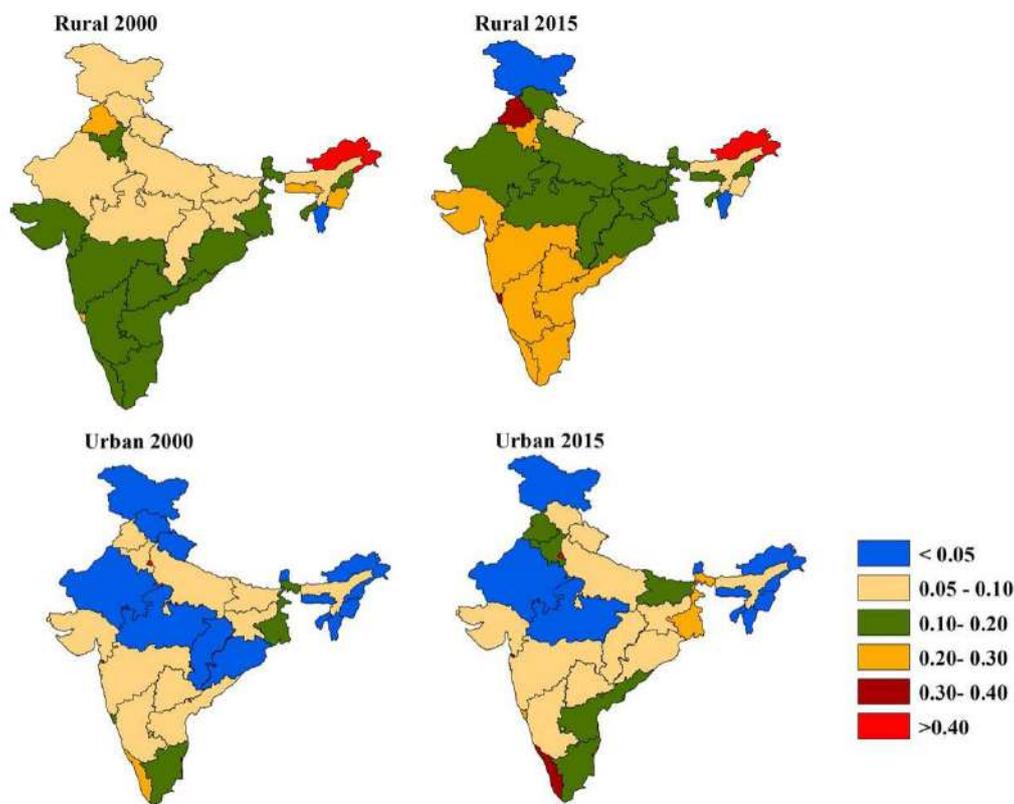


Figure A8. State-averaged fractional area (e.g., <0.05 means <5% area) populated by the urban and rural settlements in India in 2000 and 2015. Note that the remaining area has no permanent human settlement.

Table A1. State/UT level statistics of population-weighted PM_{2.5} exposure along with 5–95 percentile ranges for the years 2001 and 2019. The states/UTs are arranged in the decreasing order of urban area fraction in 2015. The urban and rural exposure changes shown here are estimated for the period 2001 to 2015, since the Global Human Settlement Layer (GHSL) data are available up to 2015.

State/UT	PM _{2.5} in 2001 (µg/m ³)	PM _{2.5} in 2019 (µg/m ³)	Change in Urban Exposure from 2001–2015 (%)	Change in Rural Exposure from 2001–2015 (%)
Chandigarh	62.0 (23.9–127.2)	61.9 (24.5–141.5)	18.7	13.4
Delhi national capital territory	82.3 (27.9–169.8)	86.7 (34.2–185.3)	10.9	11.9
Puducherry	34.6 (22.4–56.7)	44.9 (21.1–80.5)	19.7	9.5
Dadra and Nagar Haveli	53.3 (24.2–99.9)	62.9 (24.6–121.9)	19.0	20.3
Kerala	40.5 (19.6–75.4)	51.1 (20.4–105.1)	24.2	21.9
West Bengal	66.6 (27.3–156.8)	78.2 (29.4–166.4)	19.3	17.2
Goa	44.1 (18.5–86.4)	60.4 (19.7–120.3)	36.4	37.3
Daman and Diu	54.6 (25.9–95.8)	61.2 (26.2–114.7)	25.7	17.3
Bihar	76.2 (27.6–175.9)	80.2 (29.7–176.2)	7.6	7.8
Punjab	70.3 (31.4–140)	73.4 (31.7–140.8)	13.6	14.9
Tamil Nadu	38.5 (20.5–69.8)	47.2 (21.9–91.6)	10.1	11.1
Haryana	75.9 (29.9–155.1)	81.5 (33.5–162.4)	13.6	13.2
Andhra Pradesh	42.3 (21.1–77.8)	54.6 (21.9–121.2)	20.1	18.9
Uttar Pradesh	71.8 (26.3–163.8)	79.3 (31–164.7)	13.2	13.7
Telangana	47.5 (23.6–89.1)	58.4 (24.1–113.7)	14.6	16.5
Jharkhand	68.4 (27.4–144.9)	79.1 (28.1–164.5)	15.1	16.2
Karnataka	42.4 (16.9–84.3)	51.3 (16.8–104.5)	16.6	17.1
Gujarat	54.7 (31.2–92.9)	63.4 (28–108.3)	16.5	16.7
Maharashtra	48.3 (21.7–83)	58.1 (22.4–107)	24.0	21.0
Assam	45.7 (16.4–111.5)	48.4 (17.3–97.9)	11.0	12.7
Odisha	55.7 (26.1–109.2)	72.7 (25.6–153.1)	28.2	28.3
Tripura	50.1 (17–149.7)	48.6 (16.8–102.1)	4.9	23.8
Uttarakhand	42.5 (12.4–68.3)	41.4 (15.4–73.8)	16	13.7

Table A1. Cont.

State/UT	PM _{2.5} in 2001 ($\mu\text{g}/\text{m}^3$)	PM _{2.5} in 2019 ($\mu\text{g}/\text{m}^3$)	Change in Urban Exposure from 2001–2015 (%)	Change in Rural Exposure from 2001–2015 (%)
Madhya Pradesh	53.8 (24.6–106.2)	60.3 (26.4–117)	11.2	12.8
Chhattisgarh	51.8 (23.7–96.3)	60.2 (23.2–121.5)	17.3	17.6
Himachal Pradesh	27.0 (13.3–52.8)	23.9 (12.1–50.2)	8.0	8.5
Rajasthan	74.8 (35.4–139.4)	74.7 (35.8–133)	7.5	7.9
Manipur	35.6 (5.6–94.9)	36.1 (6.5–90.2)	13.4	16.2
Jammu and Kashmir	17.1 (9.8–38.7)	13.1 (6.5–33.5)	2.1	7.3
Nagaland	36.2 (7.2–95.2)	37.9 (7.7–96.6)	17.5	17.1
Meghalaya	49.6 (16.5–139.7)	49.9 (17.4–107.4)	5.4	6.4
Mizoram	41.0 (7.5–115.3)	42.3 (8.3–97.7)	18.2	24.1
Arunachal Pradesh	23.3 (4.1–63)	25.9 (4.9–77.9)	13.4	18.9
Sikkim	27.9 (5.1–59.2)	29.4 (6.1–55)	0.2	−4.3

References

- Dandona, L.; Dandona, R.; Kumar, G.A.; Shukla, D.K.; Paul, V.K.; Balakrishnan, K.; Prabhakaran, D.; Tandon, N.; Salvi, S.; Dash, A.P.; et al. Nations within a nation: Variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. *Lancet* **2017**, *390*, 2437–2460. [[CrossRef](#)]
- Cohen, A.J.; Brauer, M.; Burnett, R.; Anderson, H.R.; Frostad, J.; Estep, K.; Balakrishnan, K.; Brunekreef, B.; Dandona, L.; Dandona, R.; et al. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: An analysis of data from the Global Burden of Disease Study 2015. *Lancet* **2017**, *389*, 1907–1918. [[CrossRef](#)]
- Dey, S.; Di Girolamo, L.; van Donkelaar, A.; Tripathi, S.N.; Gupta, T.; Mohan, M. Decadal exposure to fine particulate matter (PM_{2.5}) in the Indian Subcontinent using remote sensing data. *Remote Sens. Environ.* **2012**, *127*, 153–161. [[CrossRef](#)]
- Balakrishnan, K.; Dey, S.; Gupta, T.; Dhaliwal, R.S.; Brauer, M.; Cohen, A.J.; Stanaway, J.D.; Beig, G.; Joshi, T.K.; Aggarwal, A.N.; et al. The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: The Global Burden of Disease Study 2017. *Lancet Planet. Health* **2019**, *3*, 26–39. [[CrossRef](#)]
- Chowdhury, S.; Dey, S. Cause-specific premature death from ambient PM_{2.5} exposure in India: Estimate adjusted for baseline mortality. *Environ. Int.* **2016**, *91*, 283–290. [[CrossRef](#)] [[PubMed](#)]
- Apte, J.; Brauer, M.; Cohen, A.J.; Ezzati, M.; Pope, C.A. Ambient PM_{2.5} reduces global and regional life expectancy. *Environ. Sci. Technol. Lett.* **2018**, *5*, 546–551. [[CrossRef](#)]
- Martin, R.V.; Brauer, M.; van Donkelaar, A.; Shaddick, G.; Narain, U.; Dey, S. no one knows which city has the highest concentration fine particulate matter. *Atmos. Environ.* **2019**, *3*, 100040. [[CrossRef](#)]
- Pant, P.; Lal, R.M.; Guttikunda, S.K.; Russell, A.G.; Nagpure, A.S.; Ramaswami, A.; Peltier, R.E. Monitoring particulate matter in India: Recent trends and future outlook. *Air Qual. Atmos. Health* **2019**, *12*, 45–58. [[CrossRef](#)]
- Brauer, M.; Guttikunda, S.K.; Nishad, K.A.; Dey, S.; Tripathi, S.N.; Weagle, C.; Martin, R.V. Examination of monitoring approaches for ambient air pollution: A case study for India. *Atmos. Environ.* **2019**, *216*, 116940. [[CrossRef](#)]
- Gordon, T.; Balakrishnan, K.; Dey, S.; Rajagopalan, S.; Thornburg, J.; Thurston, G.; Agrawal, A.; Collman, G.; Guleria, R.; Limaye, S.; et al. Air pollution health research priorities for India: Perspectives of the Indo-U.S. communities of researchers. *Environ. Int.* **2018**, *119*, 100–108. [[CrossRef](#)]
- Pal, R.; Chowdhury, S.; Dey, S.; Sharma, A.R. 18-year ambient PM_{2.5} exposure and nightlight trends in Indian cities: Vulnerability assessment. *Aerosol Air Qual. Res.* **2018**, *18*, 2332–2342. [[CrossRef](#)]
- Pande, P.; Dey, S.; Chowdhury, S.; Choudhary, P.; Ghosh, S.; Srivastava, P.; Sengupta, B. Seasonal transition in PM₁₀ exposure and associated all-cause mortality risks in India. *Environ. Sci. Technol.* **2018**, *52*, 8756–8763. [[CrossRef](#)] [[PubMed](#)]
- Chowdhury, S.; Dey, S.; Di Girolamo, L.; Smith, K.R.; Pillarisetti, A.; Lyapustin, A. Tracking ambient PM_{2.5} buildup in Delhi national capital region during the dry season over 15 years using a high-resolution (1-km) satellite aerosol dataset. *Atmos. Environ.* **2019**, *204*, 142–150. [[CrossRef](#)]

14. Mhawish, A.; Banerjee, T.; Sorek-Hamer, M.; Bilal, M.; Lyapustin, A.; Chatfield, R.; Broday, D.M. Estimation of high-resolution PM_{2.5} over the Indo-Gangetic Plain by fusion of satellite data, meteorology, and land use variables. *Environ. Sci. Technol.* **2020**, *54*, 7891–7900. [[CrossRef](#)]
15. Yazdi, M.D.; Kuang, Z.; Dimakopouou, K.; Baratt, B.; Suel, E.; Amini, H.; Lyapustin, A.; Katsouyanni, K.; Schwartz, J. Predicting fine particulate matter (PM_{2.5}) in the Greater London area: An ensemble approach using machine learning methods. *Remote Sens.* **2020**, *12*, 914. [[CrossRef](#)]
16. van Donkelaar, A.; Martin, R.V.; Brauer, M.; Kahn, R.A.; Levy, R.C.; Verduzco, C.; Villeneuve, P.J. Global estimates of ambient particulate matter concentrations from satellite-based aerosol optical depth: Development and application. *Environ. Health Perspect.* **2010**, *118*, 847–855. [[CrossRef](#)] [[PubMed](#)]
17. van Donkelaar, A.; Martin, R.V.; Brauer, M.; Hsu, N.C.; Kahn, R.A.; Levy, R.C.; Lyapustin, A.; Sayer, A.M.; Winker, D.M. Global estimates of fine particulate matter using a combined geophysical-statistical method with information from satellites, models, and monitors. *Environ. Sci. Technol.* **2016**, *50*, 3762–3772. [[CrossRef](#)]
18. van Donkelaar, A.; Martin, R.V.; Brauer, M.; Boys, B.L. Use of satellite observations for long-term exposure assessment of global concentrations of fine particulate matter. *Environ. Health Perspect.* **2015**, *123*, 135–143. [[CrossRef](#)]
19. Hammar, M.S.; van Donkelaar, A.; Li, C.; Lyapustin, A.; Sayer, A.M.; Hsu, N.C.; Levy, R.C.; Garay, M.J.; Kalashnikova, O.V.; Kahn, R.A.; et al. Global estimates and long-term trends of fine particulate matter concentrations (1998–2018). *Environ. Sci. Technol.* **2020**, *54*, 7879–7890. [[CrossRef](#)]
20. Shaddick, G.; Thomas, M.L.; Amini, H.; Broday, D.; Cohen, A.; Frostad, J.; Green, A.; Gumy, S.; Liu, Y.; Martin, R.V.; et al. Data integration for the assessment of population exposure to ambient air pollution for global burden of disease assessment. *Environ. Sci. Technol.* **2018**, *52*, 9069–9078. [[CrossRef](#)]
21. Lyapustin, A.; Wang, Y.; Korkin, S.; Huang, D. MODIS collection 6 MAIAC algorithm. *Atmos. Meas. Tech.* **2018**, *11*, 5741–5765. [[CrossRef](#)]
22. Mhawish, A.; Banerjee, T.; Sorek-Hamer, M.; Lyapustin, A.; Broday, D.M.; Chatfield, R. Comparison and evaluation of MODIS Multi-angle Implementation of Atmospheric Correction (MAIAC) aerosol product over South Asia. *Remote Sens. Environ.* **2019**, *224*, 12–28. [[CrossRef](#)]
23. Holben, B.; Eck, T.; Slutsker, I.; Tanré, D.; Buis, J.; Setzer, A.; Vermote, E.; Reagan, J.; Kaufman, Y.; Nakajima, T.; et al. AERONET—A federated instrument network and data archive for aerosol characterization. *Remote Sens. Environ.* **1998**, *66*, 1–16. [[CrossRef](#)]
24. Kloog, I.; Chudnovsky, A.A.; Just, A.C.; Nordio, F.; Koutrakis, P.; Coull, B.A.; Lyapustin, A.; Wang, Y.; Schwartz, J. A new hybrid spatio-temporal model for estimating daily multi-year PM_{2.5} concentrations across northeastern USA using high resolution aerosol optical depth data. *Atmos. Environ.* **2014**, *95*, 581–590. [[CrossRef](#)]
25. Buchard, V.; Randles, C.A.; Da Silva, A.M.; Darmenov, A.; Colarco, P.R.; Govindaraju, R.; Ferrare, R.; Hair, J.; Beyersdorf, A.J.; Ziemba, L.D.; et al. The MERRA-2 aerosol reanalysis, 1980-onward, Part II: Evaluation and case studies. *J. Clim.* **2017**, *30*, 6851–6872. [[CrossRef](#)]
26. Ram, K.; Sarin, M.M.; Tripathi, S.N. Temporal trends in atmospheric PM_{2.5}, PM₁₀, elemental carbon, organic carbon, water-soluble organic carbon, and optical properties: Impact of biomass burning emissions in the Indo-Gangetic Plain. *Environ. Sci. Technol.* **2010**, *46*, 686–695. [[CrossRef](#)]
27. Navinya, C.D.; Vinoj, V.; Pandey, S.K. Evaluation of PM_{2.5} surface concentrations simulated by NASA's MERRA Version 2 aerosol reanalysis over India and its relation to air quality index. *Aerosol Air Qual. Res.* **2020**, *20*, 1329–1339. [[CrossRef](#)]
28. Central Pollution Control Board, Government of India Website. Available online: www.cpcb.nic.in (accessed on 1 May 2020).
29. Gani, S.; Bhandari, S.; Seraj, S.; Wang, D.S.; Patel, K.; Soni, P.; Arub, Z.; Habib, G.; Ruiz, L.H.; Apte, J.S. Submicron aerosol composition in the world's most polluted megacity: The Delhi aerosol supersite study. *Atmos. Chem. Phys.* **2019**, *19*, 6843–6859. [[CrossRef](#)]
30. Dijkstra, L.; Poelmann, H. A harmonized definition of cities and rural areas: The new degree of urbanization. *Eur. Comm. Urban Reg. Pol.* **2014**. Available online: https://ec.europa.eu/regional_policy/sources/docgener/work/2014_01_new_urban.pdf (accessed on 1 May 2020).
31. Dey, S.; Di Girolamo, L. A climatology of aerosol optical and microphysical properties over the Indian Subcontinent from 9 years (2000–2008) of Multiangle Imaging SpectroRadiometer (MISR) data. *J. Geophys. Res.* **2010**, *115*, D15204. [[CrossRef](#)]

32. Chowdhury, S.; Dey, S.; Ghosh, S.; Saud, T. Satellite-based estimates of aerosol washout and recovery over India during monsoon. *Aerosol Air Qual. Res.* **2016**, *16*, 629–639. [[CrossRef](#)]
33. Stohl, A.; Aamaas, B.; Amann, M.; Baker, L.H.; Bellouin, N.; Bernsten, T.K.; Boucher, O.; Cherian, R.; Collins, W.; Daskalakis, N.; et al. Evaluating the climate and air quality impacts of short-lived pollutants. *Atmos. Chem. Phys.* **2015**, *15*, 10529–10566. [[CrossRef](#)]
34. Upadhyay, A.; Dey, S.; Goyal, P.; Dash, S.K. Projection of near-future anthropogenic PM_{2.5} over India using statistical approach. *Atmos. Environ.* **2018**, *186*, 178–188. [[CrossRef](#)]
35. Bikkina, S.; Andersson, A.; Kirillova, E.N.; Holmstrand, H.; Tiwari, S.; Srivastava, A.K.; Bisht, D.S.; Gustafsson, O. Air quality in megacity Delhi affected by countryside biomass burning. *Nat. Sustain.* **2019**, *2*, 200–205. [[CrossRef](#)]
36. Pandey, S.K.; Vinoj, V.; Landu, K.; Babu, S.S. Declining pre-monsoon dust loading over South Asia: Signature of a changing regional climate. *Sci. Rep.* **2017**, *7*, 16062. [[CrossRef](#)] [[PubMed](#)]
37. Sahu, L.K.; Sheel, V.; Pandey, K.; Yadav, R.; Saxena, P.; Gunthe, S. Regional biomass burning trends in India: Analysis of satellite fire data. *J. Earth Sys. Sci.* **2015**, *124*, 1377–1387. [[CrossRef](#)]
38. Thomas, A.; Sarangi, C.; Kanawade, V.P. Recent increase in winter hazy days over Central India and the Arabian Sea. *Sci. Rep.* **2019**, *9*, 17409. [[CrossRef](#)]
39. Chafe, Z.; Brauer, M.; Klimont, Z.; van Dingenen, R.; Mehta, S.; Rao, S.; Riahl, K.; Dentener, F.; Smith, K.R. Household cooking with solid fuels contributes to ambient PM_{2.5} air pollution and the burden of disease. *Environ. Health Perspect.* **2014**, *122*, 1314–1320. [[CrossRef](#)]
40. Lelieveld, J.; Evans, J.S.; Fnais, M.; Giannadaki, D.; Pozzer, A. The contribution of outdoor air pollution sources to premature mortality on a global scale. *Nature* **2015**, *525*, 367–371. [[CrossRef](#)]
41. Conibear, L.; Butt, E.W.; Knot, C.; Arnold, S.R.; Spracklen, D.V. residential energy use emissions dominate health impacts from exposure to ambient particulate matter in India. *Nat. Commun.* **2018**, *9*, 1–9. [[CrossRef](#)]
42. GBD MAPS Working Group 2018. Burden of disease attributable to major air pollution sources in India. Health Effects Institute, Boston, MA, USA. *Spec. Rep.* **2018**, *21*. Available online: <https://www.healtheffects.org/publication/gbd-air-pollution-india> (accessed on 1 May 2020).
43. Chowdhury, S.; Dey, S.; Guttikunda, S.; Pillarisetti, A.; Smith, K.R.; Di Girolamo, L. Indian ambient air quality standard is achievable by completely mitigating emissions from household sources. *Proc. Natl. Acad. Sci. USA* **2019**, *116*, 10711–10716. [[CrossRef](#)] [[PubMed](#)]
44. Upadhyay, U.; Dey, S.; Chowdhury, S.; Goyal, P. Expected health benefits from mitigation of emissions from major anthropogenic PM_{2.5} sources in India: Statistics at state level. *Environ. Pollut.* **2018**, *242*, 1817–1826. [[CrossRef](#)] [[PubMed](#)]
45. Spears, D.; Dey, S.; Chowdhury, S.; Scovronick, N.; Vyas, S.; Apte, J. The association of early-life exposure to ambient PM_{2.5} and later-childhood age-for-height in India: An observational study. *Environ. Health* **2019**, *18*, 62. [[CrossRef](#)] [[PubMed](#)]
46. Balakrishnan, K.; Ghosh, S.; Thangavel, G.; Sambandam, S.; Mukhopadhyay, K.; Puttaswamy, N.; Sadasivam, A.; Ramaswamy, P.; Johnson, P.; Kuppaswamy, R.; et al. Exposure to fine particulate matter (PM_{2.5}) and birthweight in a rural-urban, mother-child cohort in Tamil Nadu, India. *Environ. Res.* **2018**, *161*, 524–531. [[CrossRef](#)]

Publisher’s Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

CAAQMS PM2.5 to Aerosol Optical Density (AOD) Ratio for the year 2020

Date	AOD PM2.5	CAAQMS 2020		CAAQMS/ AOD	Monthly	CAAQMS/ AOD
		PM10	PM2.5			
2-Jan-20	63	98	49	0.78	Jan	0.35
3-Jan-20	171	88	37	0.22	Feb	0.54
4-Jan-20	218	86	39	0.18	Mar	0.75
5-Jan-20	156	89	40	0.26	Apr	0.70
9-Jan-20	199	59	25	0.13	May	0.96
10-Jan-20	224	71	30	0.14	Jun	1.12
11-Jan-20	353	86	38	0.11	Jul	0.75
12-Jan-20	118	83	37	0.32	Aug	0.68
14-Jan-20	130	68	32	0.25	Sep	1.05
19-Jan-20	162	82	44	0.27	Oct	0.75
21-Jan-20	178	88	58	0.33	Nov	0.75
22-Jan-20	179	81	52	0.29	Dec	0.75
23-Jan-20	51	71	42	0.83		
24-Jan-20	81	71	42	0.52		
25-Jan-20	134	89	53	0.40		
26-Jan-20	182	89	54	0.30		
29-Jan-20	81	76	45	0.56		
30-Jan-20	77	73	44	0.57		
31-Jan-20	320	81	48	0.15		
1-Feb-20	126	80	49	0.39		
2-Feb-20	106	75	46	0.43		
3-Feb-20	147	84	52	0.35		
4-Feb-20	261	92	58	0.22		
5-Feb-20	194	88	55	0.28		
6-Feb-20	197	87	53	0.27		
7-Feb-20	134	82	52	0.39		
8-Feb-20	179	84	56	0.31		
9-Feb-20	232	87	56	0.24		
10-Feb-20	192	89	56	0.29		
11-Feb-20	161	97	60	0.37		
12-Feb-20	88	115	70	0.80		
13-Feb-20	42	84	47	1.12		
14-Feb-20	51	82	45	0.88		
15-Feb-20	47	77	44	0.93		
16-Feb-20	80	87	49	0.61		
17-Feb-20	50	80	46	0.92		
18-Feb-20	67	84	49	0.73		
19-Feb-20	46	96	53	1.15		
23-Feb-20	163	84	48	0.30		
24-Feb-20	177	95	50	0.28		
26-Feb-20	90	104	54	0.60		

Note: Data of AOD were not available for July, October, November & December month; the annual average of CAAQMS to AOD ratio was taken for these months.

27-Feb-20	126	101	55	0.43
1-Mar-20	41	74	40	0.98
2-Mar-20	62	91	49	0.79
3-Mar-20	102	102	55	0.54
5-Mar-20	110	73	37	0.33
8-Mar-20	54	75	38	0.69
9-Mar-20	60	77	39	0.65
12-Mar-20	104	98	43	0.42
13-Mar-20	69	116	50	0.72
14-Mar-20	108	98	44	0.41
17-Mar-20	77	96	44	0.58
19-Mar-20	77	89	46	0.60
22-Mar-20	49	77	41	0.83
24-Mar-20	40	78	42	1.04
25-Mar-20	34	85	38	1.12
28-Mar-20	11	52	20	1.79
29-Mar-20	24	37	16	0.66
30-Mar-20	27	30	17	0.62
1-Apr-20	39	38	19	0.49
3-Apr-20	19	32	18	0.94
5-Apr-20	32	53	25	0.79
7-Apr-20	24	56	22	0.90
8-Apr-20	18	48	21	1.16
9-Apr-20	34	35	19	0.57
10-Apr-20	27	42	21	0.80
12-Apr-20	40	38	20	0.51
15-Apr-20	20	47	24	1.17
16-Apr-20	60	51	24	0.39
17-Apr-20	37	44	23	0.61
21-Apr-20	38	40	20	0.53
24-Apr-20	29	41	19	0.66
26-Apr-20	44	37	21	0.46
28-Apr-20	41	36	20	0.48
2-May-20	25	50	22	0.91
5-May-20	24	37	19	0.77
7-May-20	24	66	26	1.09
8-May-20	50	67	25	0.50
12-May-20	38	47	19	0.50
14-May-20	27	73	29	1.07
15-May-20	45	59	26	0.58
16-May-20	38	58	27	0.71
18-May-20	35	70	30	0.85
20-May-20	44	62	33	0.75
21-May-20	18	61	37	2.06
23-May-20	25	77	38	1.49
25-May-20	17	61	36	2.07

28-May-20	54	87	40	0.73
29-May-20	56	68	32	0.58
30-May-20	37	52	29	0.78
1-Jun-20	30	55	26	0.86
2-Jun-20	27	67	28	1.06
3-Jun-20	35	46	28	0.81
7-Jun-20	61	67	43	0.71
8-Jun-20	33	73	43	1.29
10-Jun-20	22	88	39	1.76
14-Jun-20	75	84	44	0.60
17-Jun-20	25	86	45	1.77
19-Jun-20	31	99	46	1.47
29-Jun-20	51	67	41	0.82
27-Aug-20	51	63	35	0.68
11-Sep-20	32	77	38	1.17
15-Sep-20	46	77	44	0.96
16-Sep-20	63	76	42	0.66
17-Sep-20	37	64	38	1.02
18-Sep-20	35	61	37	1.05
25-Sep-20	41	69	39	0.96
26-Sep-20	31	66	38	1.21
27-Sep-20	28	72	39	1.40
28-Sep-20	36	80	41	1.14
29-Sep-20	42	81	43	1.03
30-Sep-20	42	75	41	0.97
		Average		0.72

**Field photographs of mines on periphery of Sariska Wildlife Sanctuary in
NGT O.A. 154 of 2020**



Non-operational mine of M/s Vinod Ajmera ML 342/87



Top view of non-operational mine, mine pit filled with rainwater



Crane to lift mined marble block



Mined marble blocks



Top view of operational mine M/s Pramod Goyal



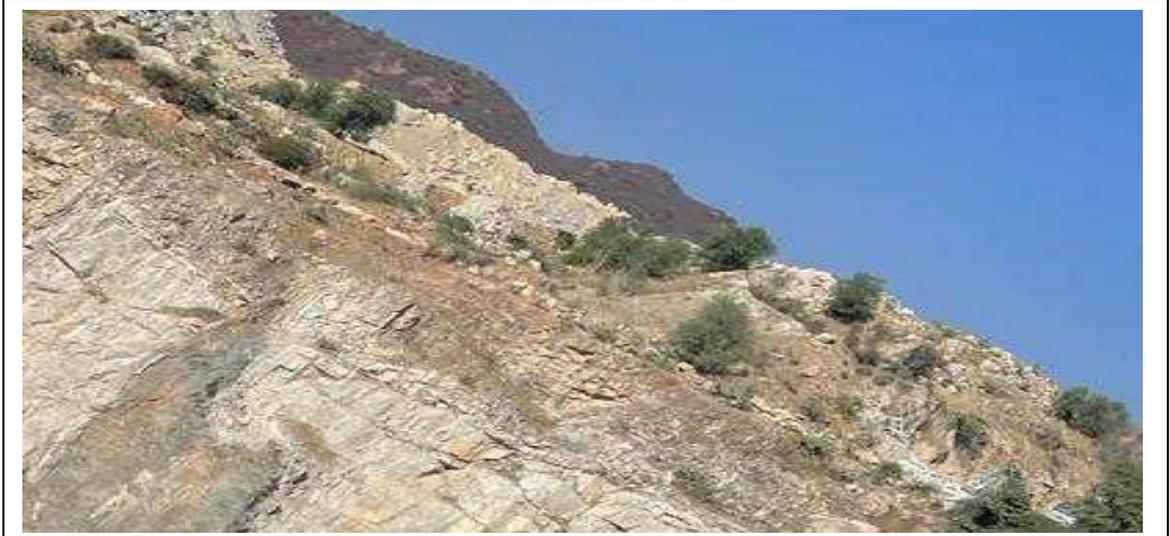
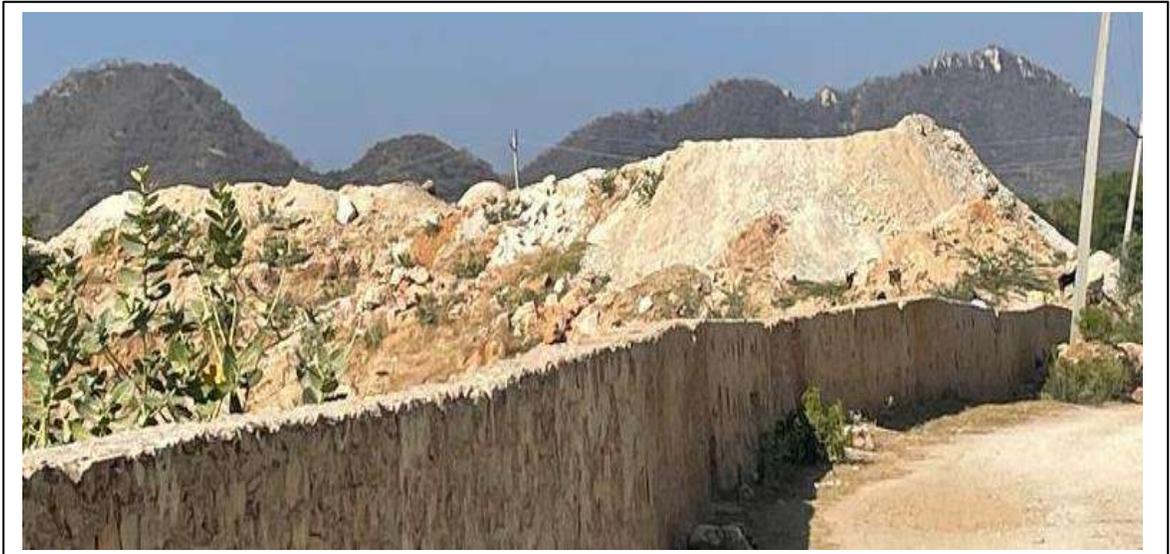
The JCB in operation



The standby DG set for electricity



Dumpers for loading & unloading of the mined material



Heaps of the dumped mined out materials & overburden lying outside the mine lease area