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BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

WESTERN ZONE BENCH, PUNE AT PUNE

ORIGINAL APPLICATION NO.88 OF 2022

SANJAY (BALA) VISHWANATHRAO BHEGDE

... APPLICANT

VS

THE STATE OF MAHARASHTRA

AND ORS

... RESPONDENTS

INDEX

Pune

Date

Adv. For Applicant

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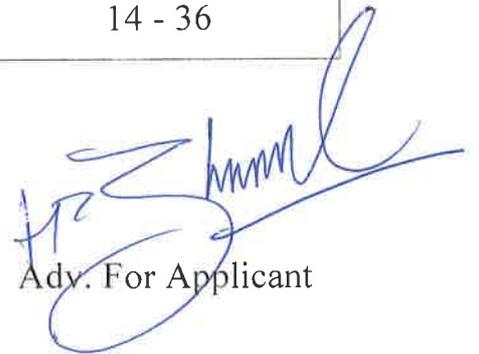
VS

THE STATE OF MAHARASHTRA

AND ORS

....RESPONDENTS

<u>**ADDITIONAL AFFIDAVIT FILED BY THE APPLICANT**</u>
<u>**HEREIN**</u>

I, Sanjay (Bala) Vishwanathrao Bhegade, Age: 45, Occupation: Social Worker, having address at 'Vishwakamal', Talegaon Dabhade, Taluka Maval, District Pune, do state on solemn affirmation as under:-

1. I state that, I have filed the captioned Original Application before this Hon'ble Tribunal seeking directions from to the Respondents No. 1 to 3 to investigate the excessive & illegal stone crushing / mining activities carried out by the Respondents No. 4 to 13. Furthermore, I in the Application am seeking directions from this Hon'ble Tribunal to stop the mining activities being undertaken

by the Respondent No. 4 to 13 in the Ambale Village in Maval Taluka, until conclusion of investigation.

2. I state that, in my Application, more specifically in Para IV to VIII, I have stated that the Respondents No. 4 to 13 are carrying out the illegal & excessive stone crushing & mining activities in an unregulated & unsanctioned manner by flouting the law, rules & regulations laid down which has caused massive damage to hydrology, ecology & topography to the entire area, which are close to water reservoirs and the Andhra Dam and also causing wide spread noise, water & soil pollution. I would therefore like to place on record and elaborate the laws, rules & regulations flouted by the Respondent No. 4 to 13 while conducting the activities of Stone Crushing / Mining, which are as under:-

   a. The Maharashtra Minor Mineral Extraction (Development and Regulation) Rules, 2013 lays down the guidelines for extraction of *minor mineral* as defined under Section 3(e) of the Mines and Minerals [(Development and Regulation)] Act, 1957 which include building stones, gravel, ordinary

clay, ordinary sand other than sand used for prescribed purposes.

b. As per Rule 11 of the said Rules, in order to secure a lease from the Competent Authority, the applicant has to make an application and shall be supported with various documents a stated as under:-

> *11. Application of quarry lease. - (1) Every application for quarry lease in respect of any land shall be made to the Competent Officer in Form-B. Every such application shall be affixed with a court-fee stamp of rupees twenty. (2) Every such application shall be accompanied by a challan of rupees five hundred as the application fee and also by a Solvency Certificate of the applicant issued from a revenue officer not below the rank of Tahsildar. (3) Every application for renewal of quarry lease shall be made to the Competent Officer in Form-C at least sixty days prior to expiry of the original period of quarry lease. Such application shall be accompanied with a challan of rupees five hundred as an*
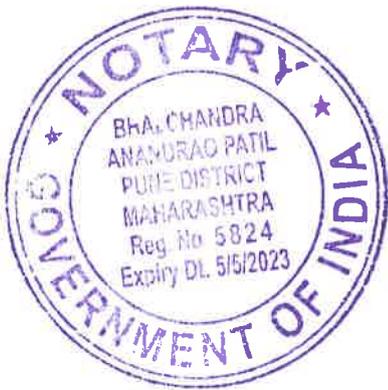
application fee and Solvency Certificate of the applicant issued from a revenue officer not below the rank of Tahsildar. (4) The area for which quarry lease is applied shall be a contiguous one. (5) Every application for grant or renewal of quarry lease shall be in addition to the documents mentioned above shall be accompanied with,
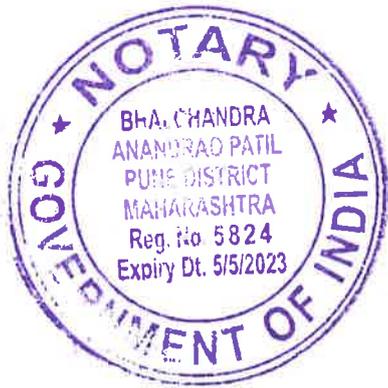
(a) Mining dues clearances certificate.

(b) Record of rights of the area applied for.

(c) A map showing the location of the area.

(d) Approved Mining plan and progressive mine closure plan for the area in case of renewal.

(e) Solvency Certificate of the applicant issued from a revenue officer not below the rank of Tahsildar.

(f) Environment Clearance Certificate issued from the appropriate authority, in case of renewal, if environment clearance period expires for the period requested for extraction.

It is amply clear from the above that as per sub-Rule (5)(f), an application for quarry lease cannot be made without

Environment Clearance. In the present case, the Environment Clearance was granted by the State Environment Assessment Committee (SEAC) as per the Notification of 20/01/2014 to various Gat No's 158, 121, 125, 136, 120/2, 118, 116 & 117 for limited area of mining and on the basis of which the Competent Authority i.e. the Respondent No. 2 granted the mining / quarry leases. However, the Respondents carrying on the mining & stone crushing activities are exceeding the area allocated in the SEAC Notification & the mining lease and are hence violating the law in the process. Furthermore, it is pertinent to note that mining & stone crushing activities on Gat Nos. 152, 154, 123, 123, 124, 126 & 171 are done without Environment Clearance and yet have been given quarry grants. Even if it is considered that the said Gat Nos. are operating on a temporary basis in pursuance to Rule 59 & 60, the benefit of doubt cannot be given to the said Gat Nos. as the mining & stone crushing activities have been going on over a long period of time, which in no way can substantiate the temporariness of the mining activity. Moreover in the case of *Deepak Kumar vs State of Haryana*
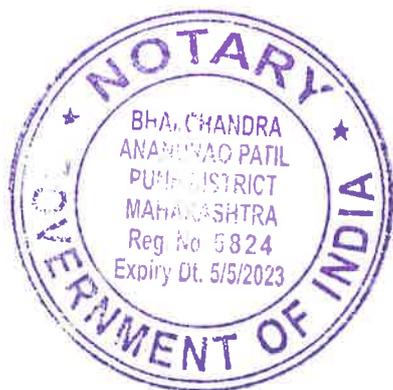
[(2012) 4 SCC. 629], the Hon'ble Supreme Court has specifically stated as under:-

> "...that leases of minor mineral including their renewal for an area of less than five hectares be granted by the States/Union Territories only after getting environmental clearance from the MoEF..."

Therefore, the Respondents operating the mining & stone crushing activities on the said Gat Nos. are clearly violating the law and hence going about their activities in an illegal manner.

c. Rule 46 of Maharashtra Minor Mineral Extraction (Development and Regulation) Rules, 2013, lays down conditions for quarry leases. Sub Rule (ix) states that the benches of the quarry should not exceed 6 meters. Furthermore, a bare perusal of the mining leases issued by the Respondent No.2, would show that the Respondents are permitted to mine beyond six meters in depth as per Rules 3 to 57, whereas a few Gat No's. have specifically granted permissions for mining between 3 to 6 meters. However,

the Respondents No. 4 to 13 have very clearly breached the

6 meter mark.

d. I state that, I had sought a survey from and independent

surveyor and was aghast to find that that Respondents No.

4 to 13 have gone way beyond the same prescribed limit, as

shown in the table below:

GAT No.	Environmental Clearance Granted (In Hectares)	Collector Granted permission for Lease (in Hectares)	As per tehsildar Survey (in Hectares)	Private Survey (In Hectares)	Permission granted for mining Depth (in Meters)	Change in contour
108				3.1874		1
110	2-07	02-07-00	07-11-00	2.9219	As per Rule 3 to 57	25
111				4.3626		23
115				9.8027		35
116	4-95	04-95-00	05-81-00	4.8082	3	45
117	1-01	03-72-00	03-38-00	2.1121	As per Rule 3 to 57	48
118	8-15	08-15-00	04-34-00	7.9553	6	50
120	1-8	02-07-03	00-54-00	9.064	As per Rule 3 to 57	10
121	8-59	04-04-68	03-27-00	9.3512	As per Rule 3 to 57	44
158		02-00-00	01-97-00	7.1366	As per Rule 3 to 57	22
122				0.0959		0

123		01-20-00	01-08-00	4.678	As per Rule 3 to 57	23
124				1.6185	As per Rule 3 to 57	50
125	3-57	03-57-00	01-88-00	3.4268	6	40
126				6.2494	As per Rule 3 to 57	30
136	4	04-04-68	03-96-00	8.9328	As per Rule 3 to 57	15
137				4.9006		42
138				6.3512		33
141				5.8735		35
145			00-24-00			
149				1.307	As per Rule 3 to 57	16
150/1	4-95	07-00-00	00-78-00	0.2379	As per Rule 3 to 57	1
150/2					As per Rule 3 to 57	
153/1			01-17-00	1.6761	As per Rule 3 to 57	15
153/2					As per Rule 3 to 57	
151			01-10-00	2.8868	As per Rule 3 to 57	11
152		03-92-00	03-85-00	6.4594	As per Rule 3 to 57	21
154				2.9987		7
161				0		1
171				0.8552		10
191				2.95		20
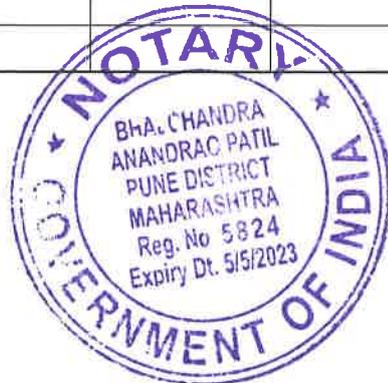
Hereto annexed as Exhibit – A is the Survey Report of the Gat Nos. conducted by an Independent Surveyor.

e. As per the Environment (Protection) Rules, 1986, Rule 3 of the said Rules lays down *'Standards for Emission or Discharge Of Environmental Pollutants'*. Rule 3 states as under:-

> *"(1) For the purpose of protecting and improving the quality of the environment and preventing and abating environmental pollution, the standards for emission or discharge of environmental pollutants from the industries, operations or processes shall be as specified in 2 [Schedule I to IV].*
>
> *(2) Notwithstanding anything contained in sub-rule (1),the Central Board or a State Board may specify more stringent standards from those provided in 3 [Schedule I to IV] in respect of any specific industry, operation or process depending upon the quality of the recipient system and after recording reasons therefore in writing.*

[(3) The standards for emission or discharge of environmental pollutants specified under sub-rule (1) or sub-rule (2) shall be complied with by an industry, operation or process within a period of one year of being so specified.]

The said Rule 3 provides for Schedule – I which lays down the Standards as stated above. At Sr. No. 11 & 37 of the said Schedule, the Industrial activity of Stone Crushing has been given various stipulations & standards which are as under:

Sr. No.	Industry	Parameter	Standards
11.	Stone Crushing	Suspended Particulate Matter [Meaning:-	The suspended particulate matter measured between 3 metres and 10 metres from any process equipment of a stone crushing unit shall not

			exceed 600 microgrammes per cubic metre
37.			The Standards consist of two paras : (i) Implementation of the following Pollution Control measures: (a) Dust containment cum suppression system for the equipment. (b) Construction of wind breaking walls. (c) Construction of the metalled roads within the premises. (d) Regular cleaning and wetting of the

			ground within the premises. (e) Growing of a green belt along the periphery. (ii) Quantitative standard for SPM : **[measured between three meters and ten metres from any processes equipment of a stone crushing unit shall not exceed 600 microgrammes per cubic metre] from a controlled isolated as well as from a unit located in a cluster should be less than 600 mg/Nm3

In the present case before this Hon'ble Tribunal, the showcause notices issued by the Respondent No. 3 to the Respondents No. 4 to 13 would show that noncompliance of the above Standards, hence show gross negligence & indulgence in Air, Noise & Water Pollution by the said Respondent No. 4 to 13. It is pertinent to note that Rule 49 to 57 of the of the Maharashtra Minor Mineral Extraction (Development and Regulation) Rules, 2013 lays down guidelines towards the protection of the environment, precautions against noise & air pollution, discharge of effluents and restoration of flora & fauna. It is mandatory on the Respondents No. 4 to 13 to abide by the Rules 49 to 57. However, the show cause notices issued by the Respondent No. 3 to the Respondents No. 4 to 13 would shed light on the fact that the Respondents No. 4 to 13 have neglected to abide by the said Rules. The sheer negligence on the part Respondent No. 4 to 13 to comply with the above standards would also result in high SPM being thrown into the Air & Water, which can result in causing not just health risks for the residents in the Amble Village but also to the fauna in the vicinity.

3. I therefore state that, considering the above-mentioned violations of the various provisions of law by the Respondent No. 4 to 13, it is clear that the Respondents No. 4 to 13 are indulging in excessive & illegal mining and stone crushing along with no abiding by the provisions of law as have been laid down in the above-mentioned Rules. I, therefore request this Hon'ble Tribunal to issue directions to stop the mining activities being undertaken by the Respondent No. 4 to 13 in the Ambale Village in Maval Taluka, until a proper investigation is carried out.

Adv. for Applicant

(Deponent)

VERIFICATION

Verified at Pune on this the 15th day of March, 2023 that the contents of the above Additional Affidavit are true and correct to the best of my knowledge **BEFORE ME**

BHALCHANDRA ANANDRAO PATIL
NOTARY
GOVT. OF INDIA

Adv. for Applicant

(Deponent)

Noted & Registered
At Srl.No. 373 /2023

13. 3. 2023

SPHERELABS

Abstract

Quarry sites result from human activity, which includes the removal of original vegetation and the overlying soil to dig out stones for building use. Therefore, the dynamics of the quarry area provide a unique view of human mining activities. Actually, the topographic changes caused by mining activities are also a result of the development of the local economy. Thus, monitoring the quarry area can provide information about the policies of the economy and environmental protection. In this report, we developed a combined method of machine learning classification and quarry region analysis to estimate the quarry area in a quarry region near Pune. A temporal smoothing based on the classification results of all years was applied in post-processing to remove outliers and obtain gently changing sequences along the monitoring term. The method was applied to various satellite images to derive a quarry distribution map and quarry area time series from 2011 to 2022, revealing significant inter-annual variability. The time series revealed a five-stage development of the quarry area with different growth patterns. An analysis concerning the relationship between quarry area and gross regional product (GRP) was performed to explore the potential application on socioeconomic studies, and we found a strong positive correlation between quarry area and satellite data. These results demonstrate the potential benefit of annual monitoring over the long-term for socioeconomic studies, which can be used for mining decision making.

Study Area

Materials and Methods

Data

While there are numerous satellites orbiting the globe with a multitude of instruments onboard that explore various bandwidths in the electromagnetic spectrum, Landsat-based images are ideally suited for surface feature analyses because of the long history of earth observation and rich bands with ample spectral information . Note that Landsat 5 Thematic Mapper (TM) operational imaging ended in November 2011; subsequently, Landsat 8 was launched in February 2013 . Therefore, only Landsat 7 imagery with missing data are available for 2012 due to the failure of the Enhanced Thematic Mapper Plus (ETM+) Scan Line Corrector (SLC) on Landsat 7 post-2003.

In this study, an annual observation is enough for tracking quarry areal extents because the processes that drive quarry area growth or decline are slow enough to be captured well with an annual repeat frequency. Thanks to the high temporal frequency of capturing images, we can easily find ideal annual observations with low cloud coverage from 2011 to present. Eventually, 33 Landsat 5 (TM) and Landsat 8 (Operational Land Imager—OLI) images were picked from the US Geological Survey's

(USGS) EarthExplorer platform, representing years from 2011to 2017 (except 2012), All scenes were ordered as surface reflectance (SR) data. Landsat 5 SR data provided by USGS are generated using the atmospheric correction chain called Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS)In 2010, USGS Earth Resources Observation and Science Center (EROS) released on-demand LEDAPS processing for generating SR products for the entire Landsat 5 archives.On the other hand, Landsat 8 SR data are generated from the Landsat Surface Reflectance Code (LaSRC) . Currently, both Landsat 5 and Landsat 8 SR data can be ordered using EarthExplorer. Because of the SLC failure of Landsat 7, we chose not to pick data for 2012 in order to avoid the influence of the missing scan line data in ETM+ images. The images from TM and OLI sensors have a common spatial resolution (30 m) and (six) overlapping spectral bands: blue, green, red, near-infrared (NIR), shortwave infrared 1 (SWIR1), and shortwave infrared 2 (SWIR2).

All common spectral bands were used for analysis while the remaining bands were excluded from further processing. Images from the first Landsat sensor generation (Multispectral Scanner/MSS) were not taken into consideration at this point because of their coarser spatial resolution and lower spectral fidelity. The image selection was filtered to acquisition dates in May/October as we observed that Landsat images of the study area always had no or very little cloud in May among these years. Finally, we got 33 scenes with a cloud coverage near to zero in the study area.

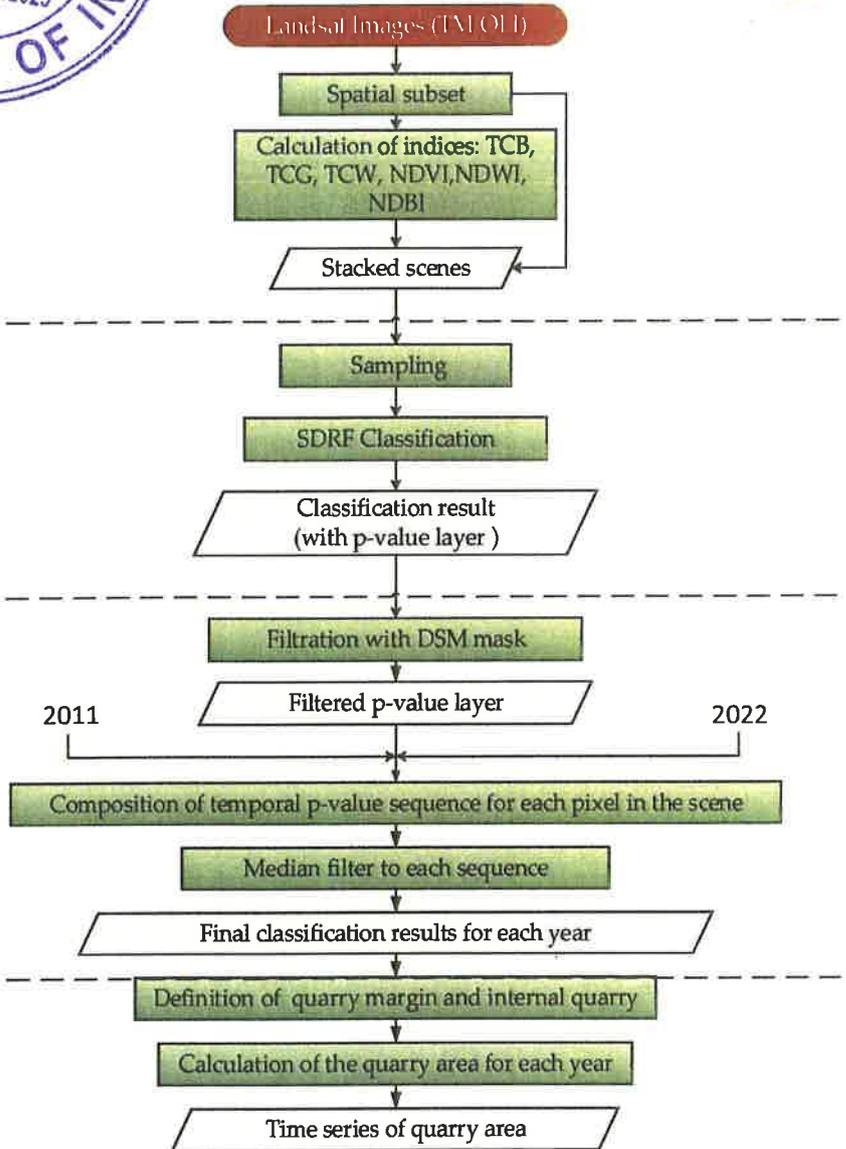The additional data was sourced from MAXAR Technologies, AirBus2022, CartoSAT-II and additional such data sets.

Method

Pre-processing

Classification

Post-processing

Calculation

Pre-Processing

After being being procured, all images were clipped into the study area. Then, we calculated several multispectral indices for each scene, serving as proxies for different land surface properties. We included the Landsat specific Tasseled Cap indices of brightness (TCB), greenness (TCG), and wetness (TCW), as well as other general indices, such as the Normalized Difference Vegetation Index (NDVI) [35], the Normalized Difference Water Index (NDWI), and the Normalized Difference Building Index (NDBI) [37]. They were chosen to reflect a variety of surface characteristics such as vegetation status, surface moisture, or buildings. The TC indices were calculated with the sensor-specific formulas for reflectance data. The calculation was performed using the following equations:

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$$TCx = \rho B * FB + \rho G * FG + \rho R * FR + \rho NIR * FNIR + \rho SWIR1 * FSWIR1 + \rho SWIR2 * FSWIR2$$

$$NDVI = \rho NIR - \rho R \rho NIR + \rho R$$

$$NDWI = \rho G - \rho NIR \rho G + \rho NIR$$

$$NDBI = \rho SWIR1 - \rho NIR \rho SWIR1 + \rho NIR$$

Then, the six calculated index layers were stacked together with the six original bands to get a 12-band scene for each year.

Classification

We first applied a supervised machine learning classification approach, which separated the image into two target classes: quarry class and non-quarry class. Random forest (RF) has been established as one of the most accurate and widely used algorithms for remote sensing and other classification applications. One of its advantages is that it produces an estimation of classification accuracy based on out-of-bag cross-validation (OOB-CV) . However, OOB-CV strongly overestimates model accuracy when classifying remote sensing imagery using training areas with several pixels, which was recently demonstrated in . We think the reason is that pixels in a training patch are not independent—they have a strong spectral similarity—whereas the OOB-CV takes all samples as being independent. To deal with the problem, a modification of the RF algorithm, splitting the training patches instead of the pixels that compose them, is proposed in and implemented in the R package called SDRF (Spatial Dependence Random Forest). For the classification process, we used the modified random forest function in the SDRF package. In this function, there are two important parameters that should be controlled to acquire a better classification result: ntree (number of trees to grow), and mtry (number of variables randomly sampled as candidates at each split). Since the random forest classifier is computationally efficient and does not overfit, the number of trees can be as large as possible . However, the classification no longer improved as the number of trees increased above a threshold, as demonstrated in some studies investigating the sensitivity of the RF classifier to the number of trees . A default value of ntree for remote sensing imagery classification is 500. Higher mtry will result in stronger individual decision trees but with an enhanced correlation between trees the model accuracy is reduced . Usually, a square root of the total number of variables is used in the classification task.

Training Sampling

We selected 20~50 training sample areas within and in close proximity to our study sites with respect to a set of remote sensing imagery with higher resolution, which mainly came from Maxar Technologies. The ground truth selection process is based on a stratified manual sampling. Since the non-quarry class can have a variety of different surface conditions, we increased its sample size to attribute for this variety. We assumed that quarry range changes slightly over several years and its change limits to its boundary. Therefore, once a sample is identified as an inside part of the quarry according to high-resolution images, we can assume this sample remains unchanged in several near years unless it shows an extensive spectral change on these years' images. The Landsat data and in situ data, as well as high-resolution images, were used for determining suitable locations of the manually selected and determined ground truth locations.

Classification Method Details

The six common spectral bands (blue, green, red, NIR, SWIR1, and SWIR2), as well as the six calculated indices (TCB, TCG, TCW, NDVI, NDBI, NDMI), were used as input features for the pixel-based classification process. The SDRF classification model was trained for each image in every year using the respective training samples. The two parameters ntree and mtry were determined with a test based on the modified out-of-bag (M-OOB) accuracy in this study and we found that the number of 500 for ntree and 4 for mtry worked well for the classification task. As the quarry area covered only a small fraction of the study area before 1995, we used the class weights for the models before 1995 according to the prior of the sample areas.

The classification output contains a hard classification output with the two pre-defined classes. This is an ensemble result voted by all decision trees in the RF classifier. The random forest can also output a ratio result for each class, which is calculated as the proportion of trees voting for one class against all votes. Each ratio result is output as a confidence layer for each class, which contains the classification probability (confidence index) of each class in a range from 0 to 1. The SDRF-internal M-OOB accuracy, Cohen's Kappa, and area under the ROC curve (AUC) were used for quality assessment of the classification.

|		
2002	1517 (18)	17,445 (43)
2010	3341 (36)	17,312 (42)
2013	2791 (30)	18,341 (43)
2016	3828 (18)	18,975 (31)

Post-Processing

The output from the random forest is a per-pixel classification with two classes. The per-pixel results tend to be noisy due primarily to the effects of pixel-scale misclassification. These effects include couples of pixels among vegetation area where naturally bare stones are misclassified as quarry. There are also some

speckles in the classification results, which is common to many per-pixel classification results. Thus, a post-classification editing step is necessary.

The presence of bright topographic features dominated by cement and stones poses a challenge when trying to extract quarry location. For example, cement ground, cement roads, and the depositories for raw rock materials in the flat terrain can be mistaken by the analysis algorithm as quarry sites as they present a very similar ground feature because of their similar surface materials. Thus, we need to introduce some degree of filtering that would eliminate anomalous pixels from the quarry pixels. For example, quarry sites only exist near or on hill slopes where the altitude is higher than other flat terrain. Therefore, we decided to process the classification result images with an altitude mask. We obtained the altitude mask from the ALOS DSM data by taking an area higher than 50 m as a valid field and then dilating this field by 9 pixels in order to cover quarry hollows at the foot of the hills.

Figure below illustrates the altitude mask we processed from DSM image. Only quarry pixels inside the valid area were considered as true quarry area.
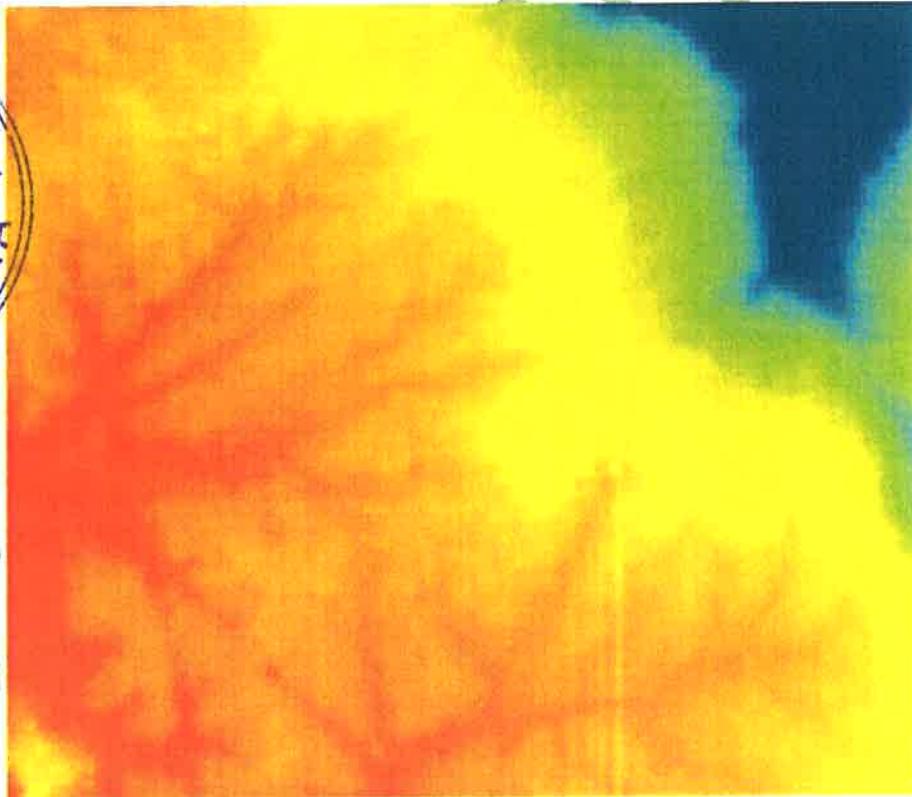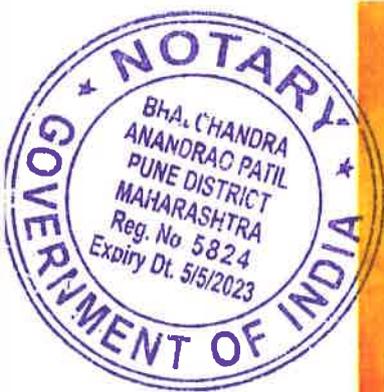
Temporal Smoothing

After all scenes are processed using the above steps, we applied a temporal smoothing to exclude some non-quarry pixels in the quarry class, such as dusty land

caused by wind around the quarry in certain years and also to obtain a consistent change result. Once other classes are changed to quarry (always with the removal of vegetation and surface soil), it will remain as quarry for deep exploration of stones for the following years. For the reverse situation, once a quarry changes to other classes, whether naturally or artificially, it would not change back to a quarry in a short time because it is obviously forgotten or protected by humans. Based on this, it is safe to assume that outliers in the temporal sequence of confidence index is very possible a misclassified one. For each class, we first composed a confidence sequence for each pixel by putting together the confidence index of each year in order. Then, we applied a median filter to the sequences in order to remove outliers and obtain gently changing sequences along the observation period.

An example of this method is expressed in figure below where the lines indicate the confidence index of the quarry class during the monitoring period. Obviously, an outlier in 2005 is successfully removed using the temporal smoothing strategy.
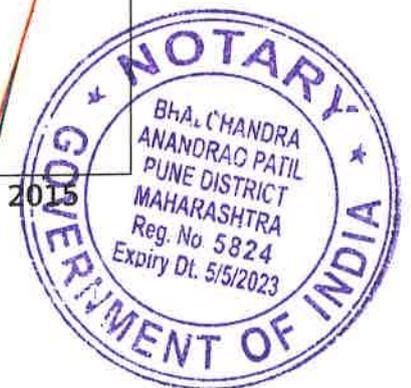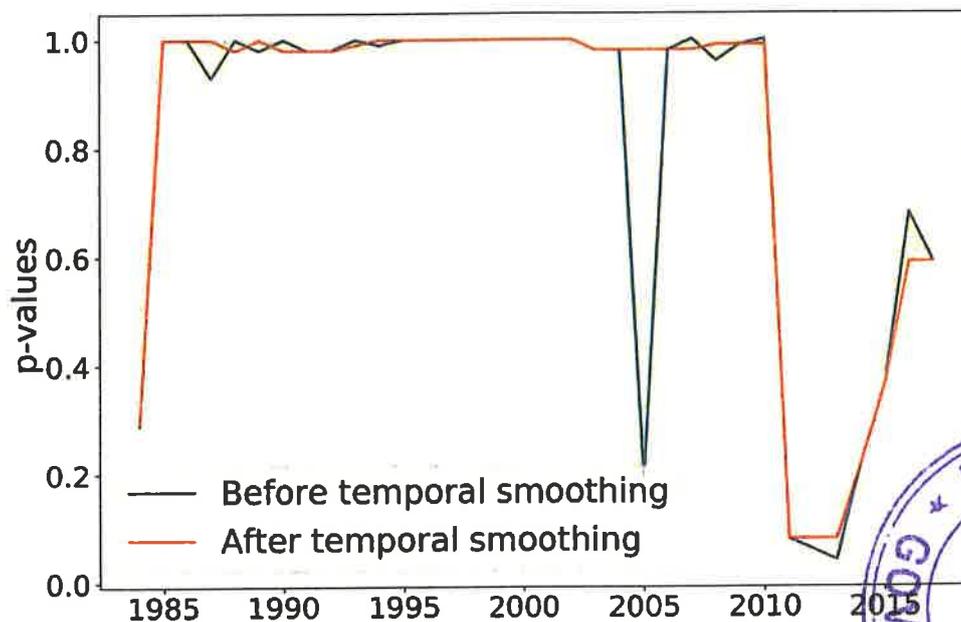
Calculation of Quarry Area

During the final step, we calculated the areal extent of quarries in the study area. We noted that unlike other naturally occurring changes, such as land becoming a lake, quarries are exploited by humans in a short time, which means we cannot distinguish a transitional state of the land between quarry and other land-cover types. Therefore, it is reasonable that we obtained a per-pixel classification with just two classes. However, in the quarry margins, quarry expansion tends to occur on a sub-pixel scale

(<30 m), resulting in mixed pixels in these areas. In order to obtain an accurate area result, we calculated the area of the internal zone and margin zone in different ways.

Based on the hard classification results, edges of quarries were identified. Then, we defined two zones to obtain a sub-pixel level accuracy in the quarry area calculation. The quarry margins are defined by the edges being dilated by 1 pixel to capture the sub-pixel expansion of the quarry. To obtain the internal zone, we used the hard-classified quarry mask and applied a morphological erosion to reduce the quarry's radius by 1 pixel to avoid the quarry margin.

The two defined zones were treated differently. The internal zone was regarded as pure pixels and its area was therefore calculated as a full quarry area. For margins, we chose a more dynamic sub-pixel analysis approach to account for its mixed pixels. Its area was represented by the classification probability (confidence index), which was assumed to be the fraction of each endmember/class and they were tested for plausibility on high-resolution imagery, as well as field measurements and observations, which were available for selected locations. These confidence indices were used as a weighing factor of quarry class within each pixel of the quarry margins. For example, a pixel in the margin zone has a confidence index of 0.705 for a quarry, representing 70.5% of the 900 m^2 per- pixel; hence, 424.5 m^2 is calculated as quarry within this pixel.

Conclusions

We used long time-series data from the MAXAR archive to investigate the annual change in the quarry area. A 10-year annual monitoring result from 2010 to 2022 in a quarry region near Pune was derived in this study using an efficient approach based on a modified random forest classification and quarry region analysis.

A temporal smoothing strategy was proposed and applied to the multi-temporal result of classification for post-processing. The result exhibits a large growth in quarry area in the study region, namely from 0 acre to 383.2 acre, which is more than 400%.

The quarry area time series revealed a five-stage development with different growth patterns:

(1) 2005-2010: No quary area present in the region

(2) 2010-2013: the quarry area grew from 0 acres to 10 acres with an average annual growth rate higher than 60% per year

(3) 2013–2015: this period saw a modest increase in the quarry area with a total increment of 50 acres during the 2 years;

(4) 2015–2020: a large growth in the quarry area occurred with the area in 2017 reaching 150 acres.
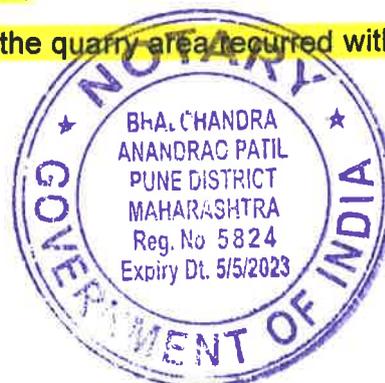
(5) 2022: A total area of about 383.2 acres is seen in the imagery.

GRAPH SHOWING INCREASE IN MINNED AREAS

Series 1	2005-2010	2010-2015	2015-2020	2020-2022
	0	60	150	383.2

YEARS
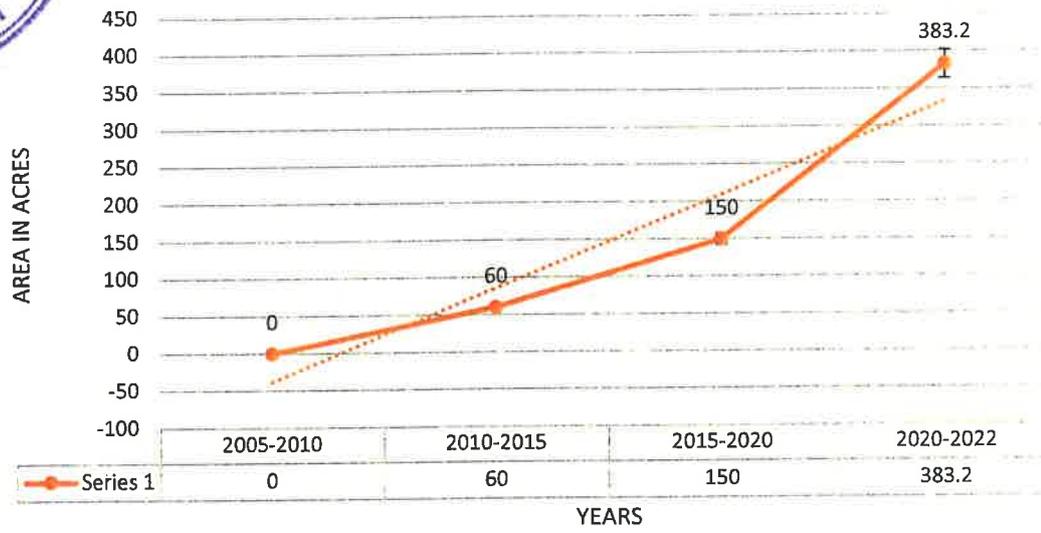
Natural Changes In streams Obstruction due to Mines

Digital Surface Model
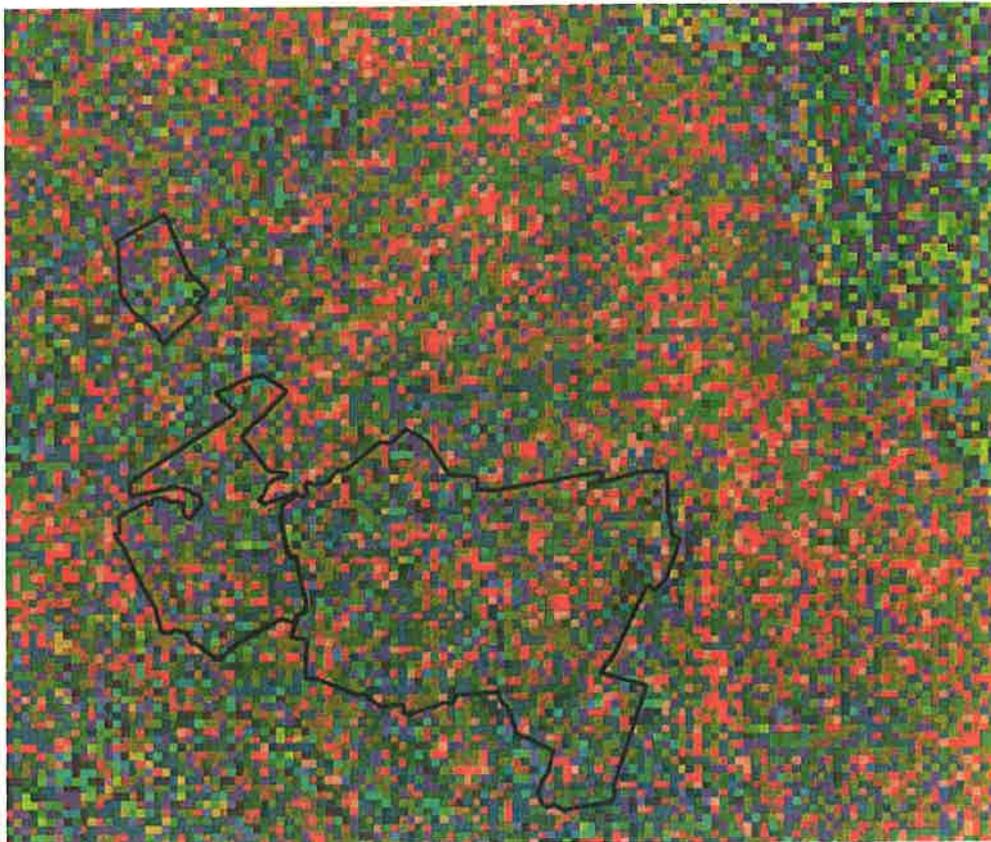

2011-2022

Unprocessed Data

SPHERELABS
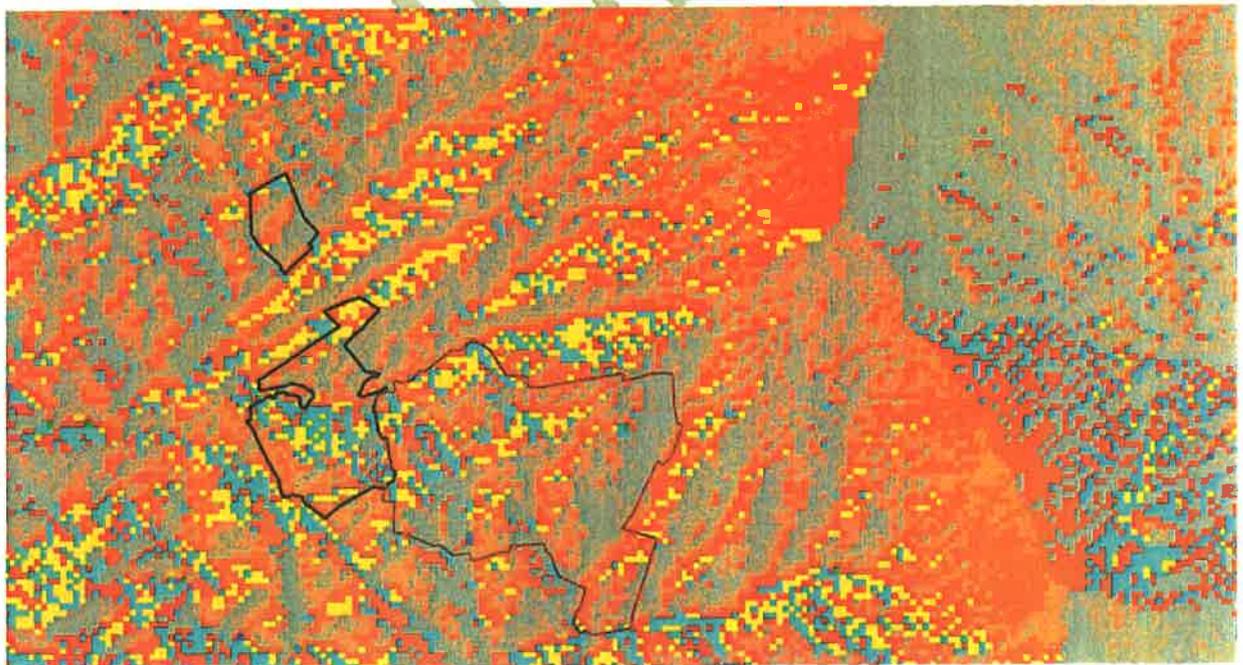
Mine Detection Algorithm

Digital LIDAR Model

SAR DATA 2022

SPHERELABS
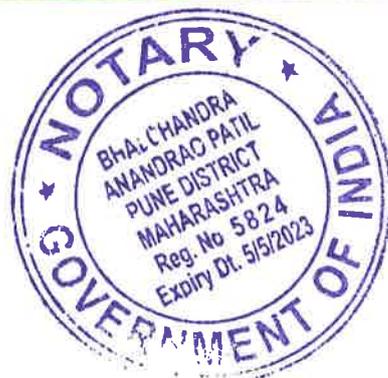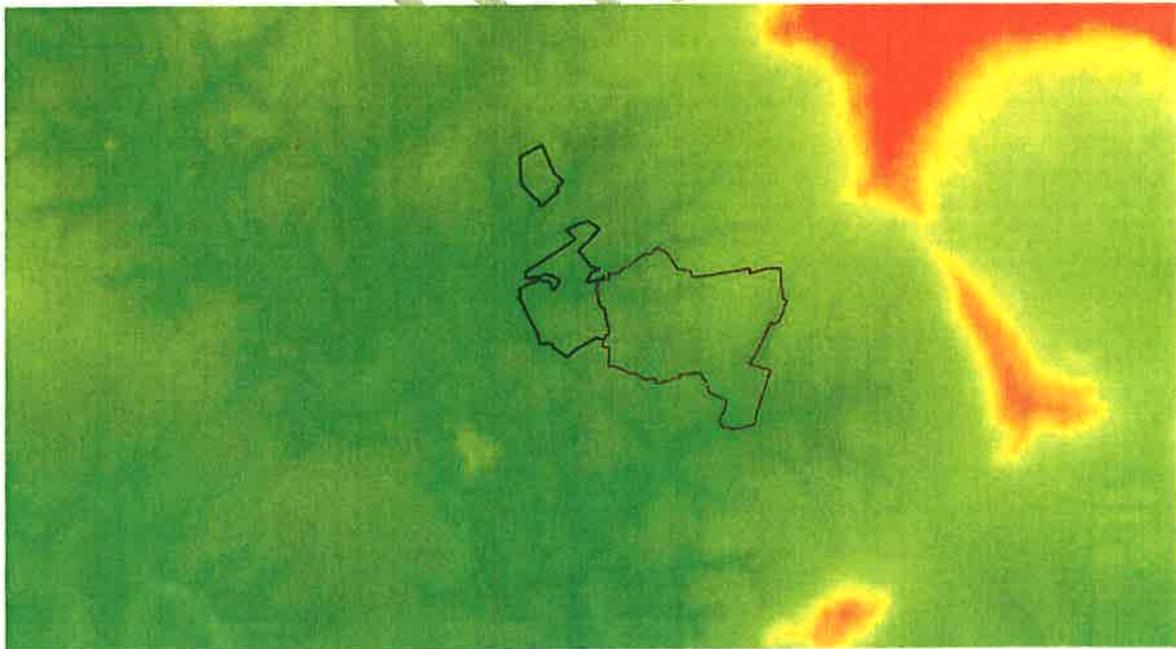
Features in Sentinel-2A satellite bands

| Band		Spectral /wavelength range (nm)	Objective	Spatial range (m)
B1	Coastal aerosol	433-453	Aerosol correction	60
B2	Blue	458-523	Aerosol correction, land measurement	10
B3	Green	543-578	Land measurement	10
B4	Red	650-680	Land measurement	10
B5	Red edge1 (RE1)	698-713	Land measurement	20
B6	Red edge2 (RE2)	733-748	Land measurement	20
B7	Red edge3 (RE3)	773-793	Land measurement	20
B8	Near infra red	785-900	Water vapour correction, Land measurement	10
B8a	Near infrared narrow	855-875	Water vapour correction, Land measurement	20
B9	Water vapour	935-955	Water vapour correction	60
B10	Shortwave infrared	1360-1390	Cirrus detection	60
B11	Shortwave infrared 1	1565-1655	Land measurement	20
B12	Shortwave infrared 2	2100-2280	Aerosol correction, land measurement	20
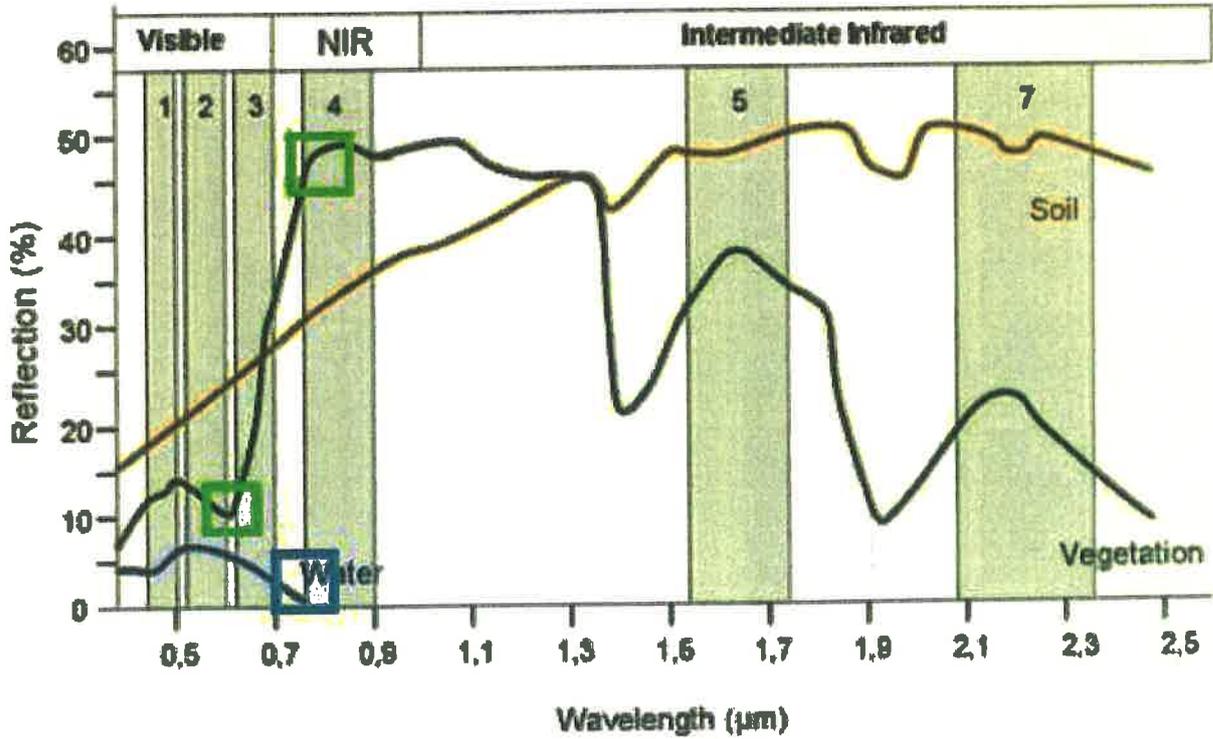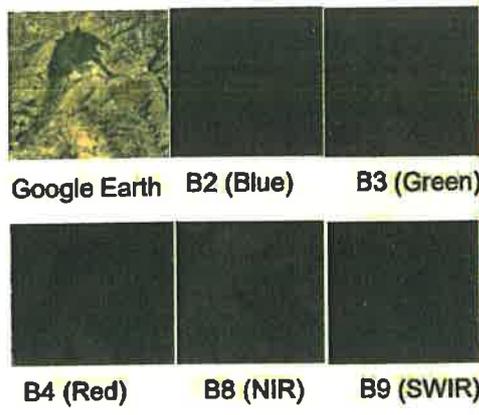
Spectral curves for various natural features

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Raster Histogram — NIR
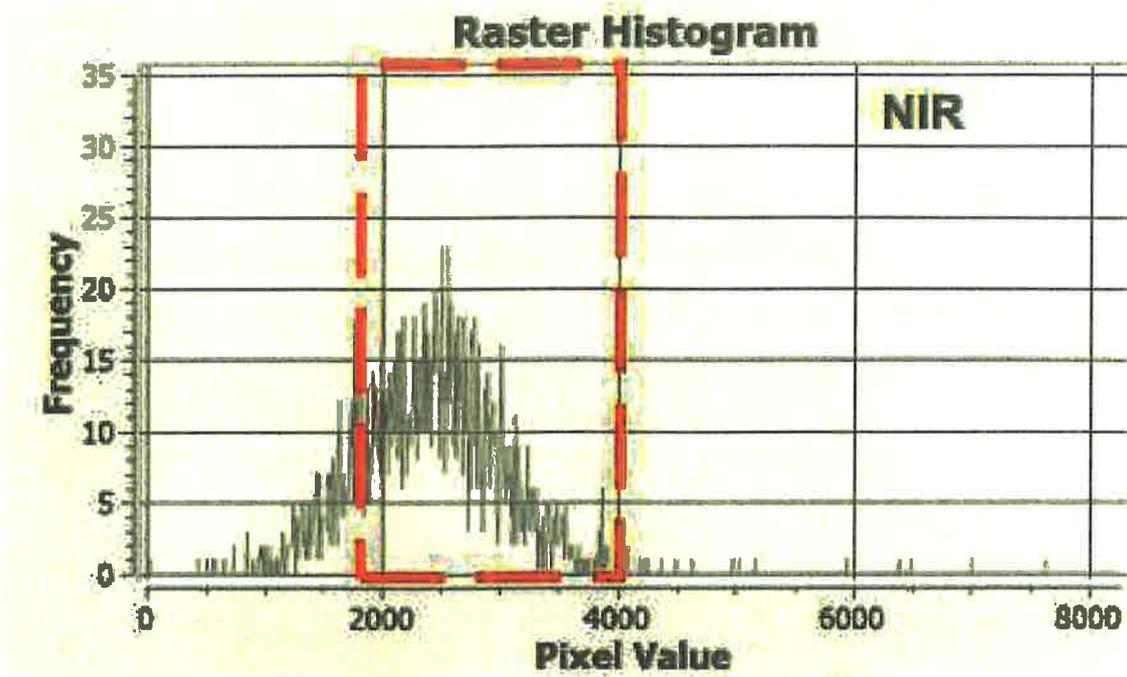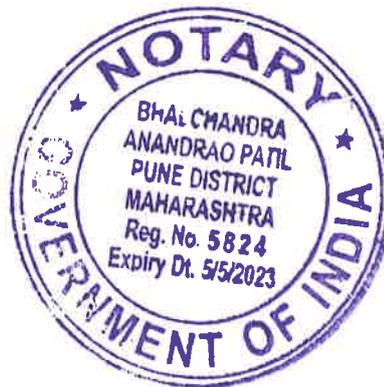

False color composite (FCC)
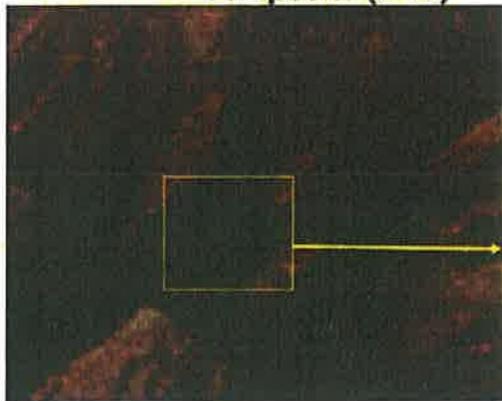
R: 703
NIR: 1502
R:480
NIR:1018
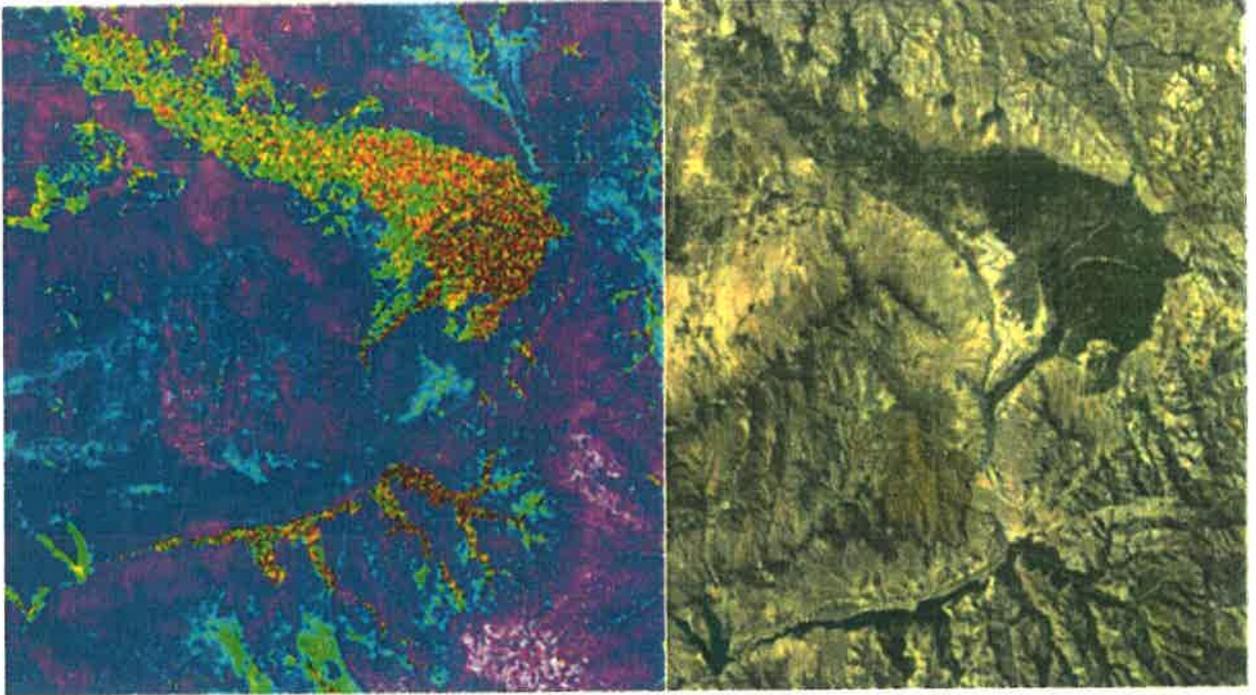

vegetation indices (NDVI)

Sunlit: 0.36
Shaded:0.359

LSWI

GEE   B4 (Red)   B6 (NIR)
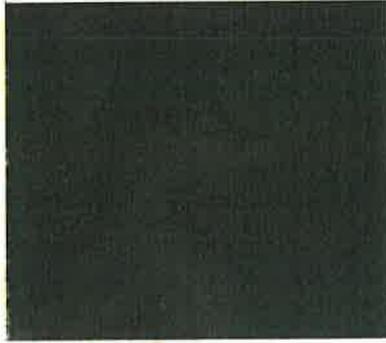
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2022 MINE DATA MAP YEARLY
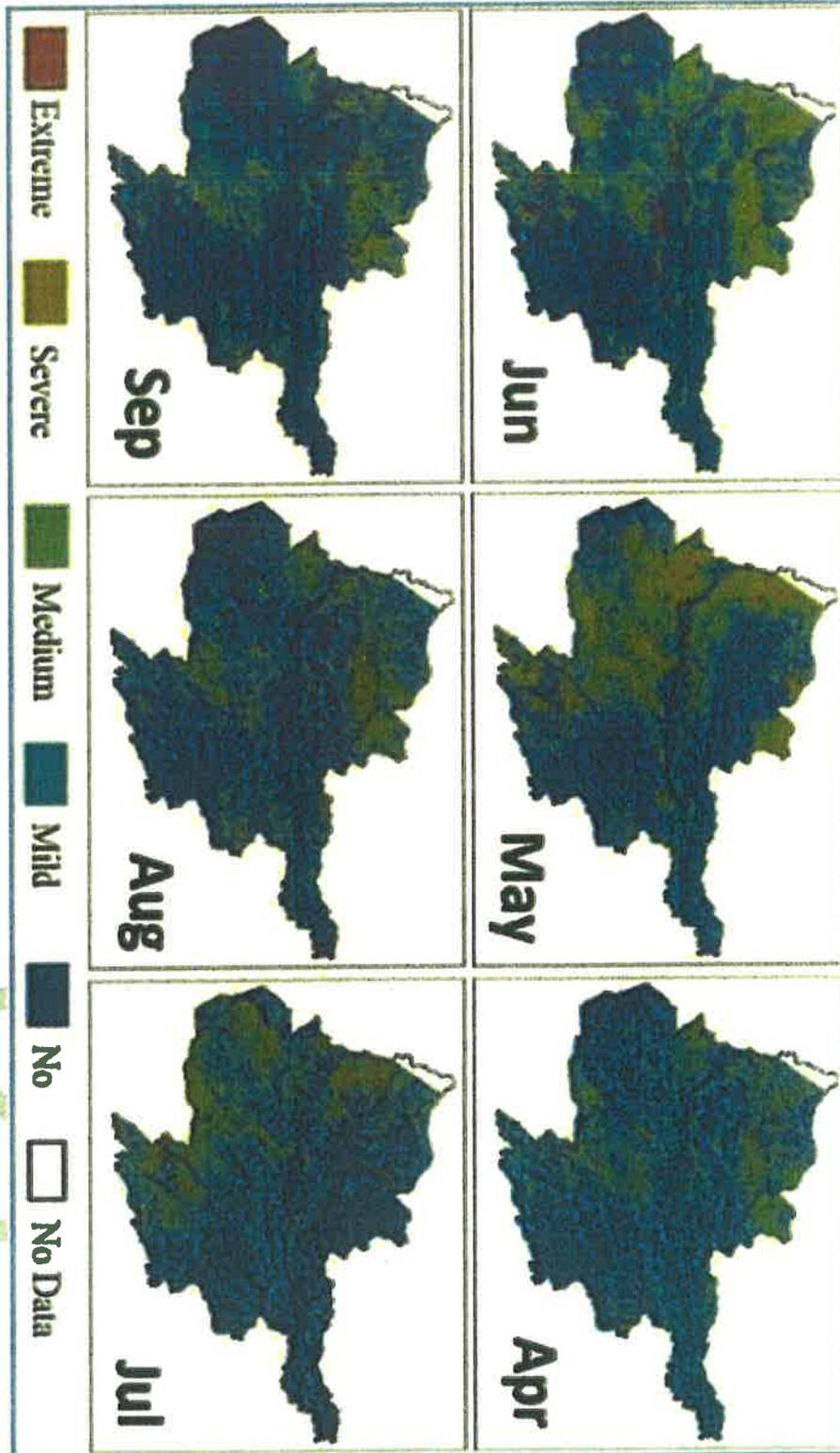
2011
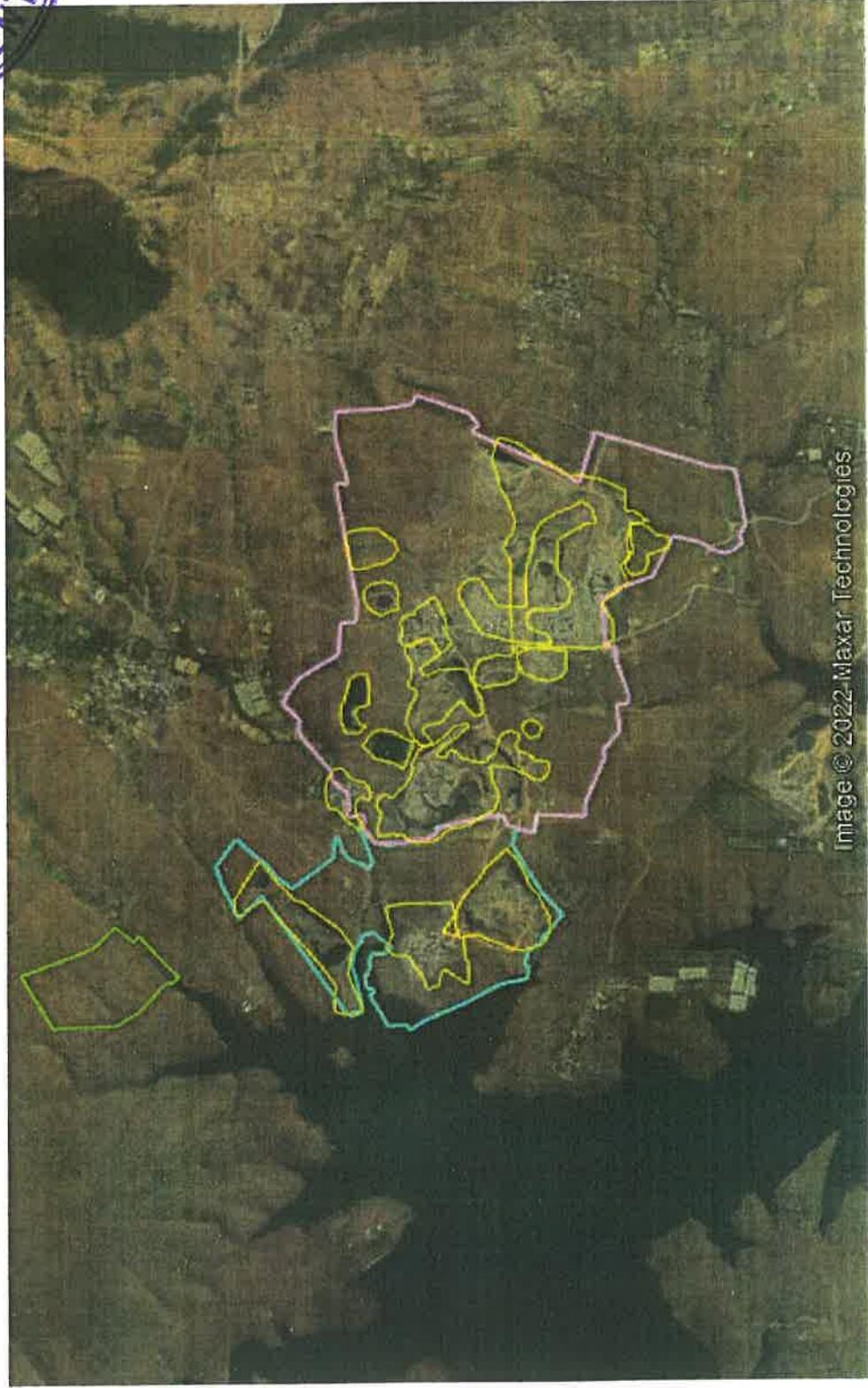
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2013

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2014

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34

2019

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35

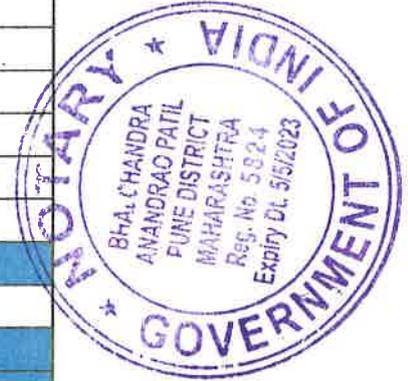2022

Image © 2022 Maxar Technologies

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Sr.No	S.No	Lowest Contour (m)	Highest Contour (m)	Lowest Contour below G.L. (m)	Highest Contour below G.L. (m)	Areas in hectares	Water filled mines
1	108	548	578	0	-1	3.1874	
2	110	572	596	-1	-25	2.9219	
3	111	585	602	0	-23	4.3626	
4	115	577	601	-18	-35	9.8027	
5	116	571	592	-4	-45	4.8082	
6	117	564	589	-7	-48	2.1121	
7	118	553	583	-3	-50	7.9553	
8	120	560	586	-1	-10	9.064	
9	121	563	585	-9	-44	9.3512	■
10	122	576	578	0	0	0.0959	
11	123	563	584	-2	-23	4.678	■
12	124	555	576	-11	-50	1.6185	■
13	125	550	577	-8	-40	3.4268	■
14	126	560	583	-6	-30	6.2494	■
15	136	550	577	-1	-15	8.9328	
16	137	560	574	-9	-42	4.9006	■
17	138	556	581	-7	-33	6.3512	■
18	141	556	577	-8	-35	5.8735	■
19	149	543	570	-5	-16	1.307	■
20	150	545	562	0	-1	0.2379	
21	151	550	578	-2	-11	2.8868	■
22	152	547	573	-5	-21	6.4594	
23	153	560	573	-6	-15	1.6761	■
24	154	541	566	-1	-7	2.9987	
25	158	539	565	-7	-22	7.1366	■
26	161	541	564	0	-1	0	
27	171	550	570	-3	-10	0.8552	■
28	191	544	575	-5	-20	2.95	■

Director
Spherelabs Pvt Pune