

ENVIRONMENTAL IMPACT ASSESSMENT OF SANDSTONE (MINOR MINERAL) MINING PROJECT

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ABSTRACT

The Bundi district of Rajasthan is well known for its extensive sandstone mining activities, which contribute significantly to the regional economy and employment generation. However, continuous and unscientific mining operations have raised serious environmental concerns, particularly regarding the degradation of soil and water quality in and around mining areas. The project involves open-cast semi-mechanized sandstone (minor mineral) mining at villages Lambhakhoh, Barodiya, Dhakni, Astoli, Nathawa, Pech Ki Bavdi, Lakheri, Chamawali, and Kherli, Tehsil Bundi, District Bundi (Rajasthan) by M/s. Shree Charbhuj Mining, covering the lease areas. Baseline environmental monitoring was conducted during the summer season (March–May 2025) for ambient air quality, surface and ground water quality, noise levels, soil characteristics, and biological environment. The assessment identifies key environmental impacts during construction and operational phases and proposes comprehensive mitigation measures and an Environmental Management Plan (EMP) aimed at ensuring sustainable and responsible mining operations.

Keywords: Sandstone mining, open-cast, Bundi Rajasthan, ambient air quality, environmental management plan, minor mineral, baseline monitoring.

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Introduction

Mining is one of the most significant anthropogenic activities that disturbs the natural environment. Open-cast mining operations, in particular, lead to large-scale land use alteration, disruption of topography, increased airborne dust emissions, ground and surface water disturbance, and potential loss of biodiversity. In Rajasthan, the mining sector is a critical contributor to the state economy, with sandstone being among the most commercially important minor minerals extracted across several districts.

The present project pertains to a sandstone (minor mineral) mining operation proposed by M/s. Shree Charbhuj Mining at Near Village Lambhakhoh, Barodiya, Dhakni, Astoli, Nathawa, Pech Ki Bavdi, Lakheri, Chamawali, and Kherli, Tehsil Karera, District Bundi, Rajasthan.

Sandstone as a mineral resource has wide construction applications and is extensively quarried in the Bundi region of Rajasthan. The mine is proposed to be operated using open-cast semi-mechanized methods.

The principal objectives of this EIA are: (i) to establish baseline environmental conditions across physical, chemical, biological, and socio-economic parameters in the study area soil, water systematically assess and predict likely environmental impacts during pre-construction, construction, and operational phases of the project; (iii) to develop suitable mitigation measures and an Environmental Management Plan (EMP) to minimize adverse impacts; and (iv) to ensure legal compliance with applicable environmental regulations.

Mining activities, if not properly managed, can cause irreversible damage to land, water resources, and biological ecosystems. The generation of overburden

waste, dust from drilling and blasting, noise from machinery, and chemical contamination of soil and water are well-documented concerns in open-cast mining literature. This assessment addresses all such concerns with reference to the specific project site conditions.

Study Area

Location and Land Details

10 Sites has been selected for sample testing at Villages Lambhakhoh, Barodiya, Dhakni, Astoli, Nathawa, Pech Ki Bavdi, Lakheri, Chamawali, and Kherli, Tehsil Bundi, District Bundi in the state of Rajasthan, India and water samples were collected from ten selected sandstone mining sites of Bundi district using standard sampling procedures. The samples were collected from both mining-affected and nearby areas to evaluate the comparative impact of sandstone mining on environmental quality. Soil samples were collected from the top surface layer, while groundwater samples were collected from bore wells and nearby water sources in clean and sterilized containers for laboratory analysis.

Climate and Meteorology

The study area falls within the semi-arid climatic zone typical of Rajasthan. The climate is characterized by hot summers, a seasonal monsoon, and a mild winter. Prevailing wind directions and speeds in the area were recorded during the study period (March–May 2023, Summer Season). The meteorological data collected was used to determine the dispersion potential of air pollutants and to select appropriate monitoring locations in the predominant downwind direction. The area typically experiences high temperatures during the summer study season, often exceeding 40°C, with low relative humidity and low annual rainfall.

Geology and Mineral Resources

The geological formations in the Bundi district consist predominantly of sedimentary rock sequences. The sandstone deposit targeted by Mining occurs as part of the regional geological setting of the area. The sandstone is commercially valued for its structural properties and is widely used in construction and decorative applications. The deposit is classified into Blockable and Non-Blockable sandstone based on the quality and fracturing of the rock mass. The approved mining plan prescribes open-cast semi-mechanized extraction with proper waste management and progressive reclamation of the mined-out area.

Land Use and Ecological Setting

Land use and land cover (LULC) mapping of the core zone (mine lease area) and buffer zone (10 km radius) was carried out using satellite imagery and field verification. The study area comprises mineralized land, agricultural land, scrub and wasteland, and sparse vegetation patches. No areas designated as critically polluted as per the Central Pollution Control Board (CPCB) fall within 10 km of the mine boundary. The project area is free of Reserved or Protected Forest, and no Schedule I fauna were observed during the field study period.

Parameter	Details
Village	Lambhakhoh, Barodiya, Dhakni, Astoli, Nathawa, Pech Ki Bavdi, Lakheri, Chamawali, and Kherli
Tehsil	Bundi
State	Rajasthan
Mining Method	Opencast Semi-Mechanized
Study Period	March–May 2025 (Summer Season)

Material and Methods

Baseline Environmental Monitoring Design

Baseline environmental monitoring was conducted during the summer season from March to May 2025. The monitoring network was designed covering the core zone (mine lease) and buffer zone (10 km radius) with sampling locations selected based on prevailing meteorological conditions, particularly wind direction and speed, to ensure representative data collection in the downwind direction from potential emission sources.

Monitoring was carried out for the following

environmental components: Ambient Air Quality (AAQ), Ground Water Quality, Surface Water Quality, Noise Levels, Soil Quality, Biological Environment (Flora and Fauna), and Socio-Economic Environment. All sampling, analysis, and reporting protocols conformed to relevant CPCB, BIS, and WHO standards.

Ambient Air Quality Monitoring

Ambient air quality monitoring was conducted using Respirable Dust Samplers (RDS) deployed at multiple locations within and around the study area. Parameters measured included Respirable Suspended Particulate Matter (RSPM/PM10), Suspended Particulate Matter (SPM), Sulphur Dioxide (SO₂), and Nitrogen Dioxide (NO₂), in accordance with CPCB norms. The monitoring locations were selected in the downwind direction of the proposed mining and associated activities, incorporating nearest sensitive receptors such as habitation areas and vegetation. Sampling was done over 24-hour periods on designated monitoring days. Calibrated instruments and certified chemical standards were used for analysis.

Water Quality Assessment

Both surface water and ground water quality were assessed as part of the baseline study. Ground water samples were collected from bore wells and hand pumps in the study area and analyzed for physical, chemical, and bacteriological parameters. The parameters analyzed included pH, Total Dissolved Solids (TDS), Total Hardness, Chloride, Fluoride, Nitrate, heavy metals (Iron, Manganese, Lead, Cadmium, Chromium, etc.), and coliform bacteria. Surface water sampling locations were identified at perennial and seasonal water bodies in the vicinity of the mine. Results were compared against Bureau of Indian Standards (BIS) drinking water quality standards IS:10500:2012 and CPCB surface water quality criteria. The water sampling location map (Figure 3.11) clearly delineated all monitoring sites within the study area.

Soil Quality Assessment

Soil samples were collected from representative locations within the core and buffer zones at depths of 0–15 cm (A horizon) and 15–30 cm. The sampling locations were identified on a soil sampling location map (Figure 3.14). Physico-chemical properties analyzed included soil texture, pH, electrical conductivity, organic carbon content, nitrogen, phosphorus, potassium, and heavy metal concentrations. Samples were processed following standard procedures and analyzed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and conventional titrimetric/colorimetric methods at accredited laboratories. Results were compared with national and international soil quality standards.

Noise Level Monitoring

Ambient noise levels were monitored at designated locations using calibrated Sound Level Meters.

Measurements were taken at day-time (6 AM to 10 PM) and night-time (10 PM to 6 AM) as per CPCB ambient noise standards. Monitoring locations included residential zones, commercial areas (if applicable), and areas near proposed operational machinery. The results were evaluated against CPCB ambient noise standards for different land use categories.

Biological Environment Survey

A primary field survey of the biological environment was conducted from 1st March 2025 to 31st May 2025, covering the core area and buffer zone (10 km radius). Terrestrial flora was enumerated through transect-based surveys, recording plant species, their abundance, canopy cover, and conservation status as per IUCN Red List and Schedule categories of the Wildlife Protection Act, 1972. Faunal survey included systematic observations of mammals, birds, reptiles, and aquatic species using standard point count, line transect, and opportunistic encounter methods. Any Schedule I or endangered species were specifically recorded with locational data to assess potential impacts and plan conservation measures in consultation with State Forest and Wildlife Departments.

Socio-Economic Assessment

A socio-economic assessment was conducted through household surveys, key informant interviews, and secondary data analysis from census records and district statistical handbooks. The demographic profile of the study area, including population composition, literacy rates, occupational distribution, infrastructure availability, and livelihood patterns, was documented. The assessment evaluated likely changes in the socio-economic fabric of the area due to the proposed mining project, including employment generation, local procurement, and community development opportunities.

Result and Discussion

Ambient Air Quality — Baseline Status

The ambient air quality monitoring results during the summer baseline study (March–May 2023) indicated that concentrations of RSPM (PM₁₀), SPM, SO₂, and NO₂ at all monitoring locations were within the prescribed National Ambient Air Quality Standards (NAAQS) for the respective land use categories. The relatively low background concentrations reflect the rural, sparsely industrialized character of the study area. However, dust generation from mining operations, overburden handling, and haul road transport is anticipated to be the primary air quality concern during the operational phase. Predicted ground-level concentrations were assessed using appropriate dispersion modelling. Mitigation measures such as water sprinklers on haul roads, dust suppression at loading/unloading points, and deployment of dust masks for workers are prescribed to maintain PM levels below permissible thresholds.

Water Quality — Baseline and Impact Assessment

Ground water quality analysis revealed that the water samples from the study area generally conformed to BIS standards (IS:10500:2012) for drinking water. However, certain parameters including Total Dissolved Solids (TDS), Fluoride, and Iron were observed to approach or marginally exceed permissible limits at some locations, indicating local geogenic influences rather than mining-specific contamination, since the project is a new mine. Surface water quality in seasonal streams and ponds within the buffer zone also showed acceptable baseline conditions. Impact assessment identified potential risk of particulate contamination of surface runoff during mining, particularly during the monsoon season. Measures such as construction of garland drains, silt traps, and check dams are proposed to prevent contamination of water bodies.

The project will have zero process water discharge. Water consumption will be minimal, primarily for dust suppression and sanitation. Ground water dewatering within the mine, if encountered, will be managed through pumping and directed into settling ponds for reuse or safe discharge.

Soil Quality — Physico-Chemical Characterization

Soil physico-chemical analysis (Table 3.15 of the EIA Report) indicated that soils in the study area are predominantly sandy loam to loamy, with near-neutral to slightly alkaline pH. Organic carbon content was low to moderate, consistent with the semi-arid land cover of the region. Heavy metal concentrations (Fe, Mn, Zn, Cu, Pb, Cd, Ni, Cr) in baseline soils were well within permissible limits, indicating negligible pre-existing anthropogenic contamination. The absence of prior mining activity at this specific lease site corroborates the clean baseline status of soils. The primary soil impact during mining operations will be from topsoil stripping and mixing with overburden. The EMP prescribes separate storage of topsoil for use in progressive and final reclamation and revegetation of disturbed areas.

Noise Environment

Baseline noise monitoring recorded day-time and night-time ambient noise levels at all monitoring stations. Results indicated that noise levels at residential locations were within CPCB standards. The primary noise sources during operations will be heavy earthmoving equipment, drilling machinery, and transport vehicles. The use of controlled blasting techniques as per DGMS (Directorate General of Mines Safety) norms, combined with silencers on machinery, scheduling of blasting during day hours only, and provision of Personal Protective Equipment (PPE) for workers, will ensure compliance with permissible noise standards.

Biological Environment — Flora and Fauna

The biological survey recorded a moderate diversity of plant species dominated by drought-resistant scrub vegetation typical of Rajasthan's semi-arid landscape. No rare, endangered, or threatened plant species listed under

the Wildlife Protection Act, 1972, or IUCN Red List were identified within the core zone. Common tree species included *Prosopis juliflora*, *Acacia nilotica*, *Ziziphus mauritiana*, and *Euphorbia* species. The faunal survey recorded common avifauna including House Sparrow (*Passer domesticus*), Common Myna (*Acridotheres tristis*), Indian Peafowl (*Pavo cristatus*), and various raptor species. Reptiles such as common lizards and monitor lizards were observed. No Schedule I fauna were recorded in the core zone. Impact on biological environment is considered moderate and manageable through progressive reclamation, plantation of native species in the reclamation plan, and avoidance of disturbance during key breeding seasons.

The carrying capacity of the cluster area for mining was established as 74,60,096 TPA, which significantly exceeds the proposed production of the project, ensuring compliance with cluster management norms.

Anticipated Environmental Impacts and Mitigation

The anticipated environmental impacts during the operational phase have been evaluated and classified by magnitude and significance. Key impacts include: (a) Air Quality — dust from mining and transport, addressed through water sprinklers, green belts, and PPE; (b) Water Resources — risk of surface runoff contamination, mitigated through drainage management and settling ponds; (c) Land Environment — topsoil loss and landscape alteration, addressed through progressive mine reclamation and afforestation; (d) Noise — machinery and blasting noise, controlled by DGMS norms and scheduling; (e) Biological Environment — habitat disturbance, minimized through restricted operational footprint and re-vegetation plans.

The project will not involve any displacement of human populations. No Rehabilitation and Resettlement (R&R) plan is required. The project is situated on private land and does not encroach upon any forest, wildlife sanctuary, or national park. No Critically Polluted Areas as notified by CPCB are located within 10 km of the project boundary.

Quality	BIS limits	seepage	traps, monitoring
Surface Water	Acceptable baseline	Runoff contamination	Settling ponds, check dams
Soil	No heavy metal contamination	Topsoil stripping	Separate topsoil storage, reclamation
Noise	Within CPCB limits	Machinery and blasting noise	DGMS compliance, PPE, scheduling
Flora	Common scrub species, no RET	Vegetation clearance	Progressive reclamation, plantation
Fauna	No Schedule I species in core	Habitat disturbance	Restricted footprint, breeding season avoidance
Socio-Economy	Rural agrarian community	Positive — employment, income	Preference to locals in employment

Analysis of Alternatives

The EIA examined alternative technology and site options as required under the ToR. The open-cast semi-mechanized mining method was selected as the most appropriate technology given the shallow depth of the sandstone deposit, the nature of the mineral (dimension stone), and the project scale. Alternative locations were not considered feasible given the site-specific grant of the mining lease and the localized occurrence of the targeted sandstone deposit. The selected method offers adequate geological recovery, safety compliance under DGMS, and progressive rehabilitation potential.

Environmental Monitoring Programme

A post-clearance environmental monitoring programme has been designed to track environmental performance during the operational and closure phases. Monitoring will cover ambient air quality (quarterly), ground and surface water quality (quarterly), noise levels (half-yearly), and soil quality (annually). The mine management will submit six-monthly compliance reports to SEIAA and the Regional Office of MoEF&CC as stipulated under the environmental clearance conditions. An Environmental Management Cell (EMC) will be established at the mine with qualified environmental officer for day-to-day compliance management.

Environmental Component	Baseline Status	Key Impact	Mitigation Measure
Ambient Air Quality	Within NAAQS limits	Dust from mining & transport	Water sprinklers, green belt, PPE
Environmental Component	Baseline Status	Key Impact	Mitigation Measure
Ground Water	Mostly within	Leachate/runoff	Garland drains, silt

Project Benefits

The project is expected to generate direct and indirect employment for the local community, contributing to the socio-economic development of the area. Royalty payments and statutory levies will accrue to the state exchequer. The supply of sandstone for construction purposes will support regional infrastructure and housing development. Community development initiatives as part of the Corporate Social Responsibility (CSR) commitment of the project proponent are proposed to benefit nearby villages through infrastructure improvement, education support, and health camps.

Environmental Cost-Benefit Analysis

The environmental cost-benefit analysis demonstrates that the economic and social benefits of the project outweigh the anticipated environmental impacts, provided that the prescribed mitigation measures and monitoring

commitments are diligently implemented. The projected revenue from mineral extraction and associated employment generation, combined with the manageable magnitude of reversible environmental impacts through appropriate EMP implementation, supports the environmental and economic viability of the project.

Conclusion

This Environmental Impact Assessment establishes a comprehensive baseline of environmental quality in the core and buffer zone of the proposed Sandstone (Minor Mineral) Mining Project of M/s. Shree Charbhuj Mining at Village Lambhakhoh, Barodiya, Dhakni, Astoli, Nathawa, Pech Ki Bavdi, Lakheri, Chamawali, and Kherli, Tehsil Bundi, District Bundi, Rajasthan. The summer season baseline monitoring (March–May 2023) confirms that the existing environmental quality across air, water, soil, noise, and biological parameters is within acceptable limits, with no significant pre-existing anthropogenic contamination detected at the project site.

The project proposes open-cast semi-mechanized sandstone extraction. The proposed mining activities are expected to cause manageable and largely reversible environmental impacts, primarily related to dust generation, surface runoff, topsoil disturbance, and temporary noise increase during the operational phase. None of these impacts are of irreversible or catastrophic nature, given the relatively small lease area and the absence of ecologically sensitive features such as forests, wildlife sanctuaries, or Schedule I fauna within the core zone.

The Environmental Management Plan (EMP) prescribes a comprehensive suite of mitigation measures across air, water, land, noise, and biological environment components, supported by a robust post-clearance environmental monitoring programme. Progressive mine reclamation, topsoil conservation, afforestation with native species, construction of drainage management

structures, controlled blasting as per DGMS norms, and regular environmental compliance reporting constitute the cornerstone of the EMP.

The project does not involve any forest land, displacement of human settlements, or Rehabilitation and Resettlement issues. The Aravalli NOC has been secured from the Department of Mines and Geology, Bundi. No Critically Polluted Area falls within 10 km of the project boundary.

In conclusion, the proposed sandstone mining is environmentally feasible and recommends for environmental clearance, subject to strict compliance with the conditions of the EMP, the post-clearance monitoring programme, and applicable statutory requirements under the Environment (Protection) Act, 1986, the Mines and Minerals (Development and Regulation) Act, 1957, and the Rajasthan Minor Mineral Concession Rules, 2017.

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