COAL SECTOR REHABILITATION PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT OF THE INDIAN COAL SECTOR

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Table of Abbreviations

BCCL	Bharat Coking Coal Ltd.
BOD	biochemical oxygen demand
CBA Act	Coal Bearing Areas Act
CCL	Central Coalfields Ltd.
CPCB	Central Pollution Control Board
CMPDI	Central Mine Planning and Design Institute Ltd.
COD	chemical oxygen demand
DGMS	Director General of Mine Safety
EAP	Environmental Action Plan
ECL	Eastern Coalfields Ltd.
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
HEMM	heavy-earth moving machinery
IDA	International Development Assistance
LA Act	Land Acquistion Act
LHD	load haul dumper
MCL	Mahanadi Coalfields Ltd.
MOEF	Ministry of Environment and Forests
MP	Maharashtra Pradesh
NCL	Northern Coalfields Ltd.
NGO	non-governmental organization
OB	overburden
PAP	project-affected person
RAP	Rehabilitation Action Plan
R&R	Resettlement and Rehabilitation
RPM	respirable particulate matter
SDL	side discharge loader
SECL	South Eastern Coalfields Ltd.
SIA	Social Impact Assessment
SPCB	State Pollution Control Board
SPM	suspended particulate matter
TSS	total suspended solids
UP	Uttar Pradesh
WCL	Western Coalfields Ltd.

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PREFACE

This document was prepared by Coal India Ltd. to support its pending application for a Coal Sector Rehabilitation Project. Environmental and social mitigating actions are an integral part of the proposed investments. However, in consultation with the World Bank, it has been decided to formulate a freestanding, IDA-financed environmental and social mitigation project, which would precede the investment project. This Sectoral Environmental Assessment covers both projects.

Preparation of this document extended over a two-year period. The requirements for resettlement and rehabilitation action are shown as they presented themselves at the time the Rehabilitation Action Plans were prepared in 1994. These Plans will be updated in the course of project implementation.

After this document had been prepared, Coal India has informed the Bank that it plans to finance the investments for the six underground mines, that were originally included in the project, out of its own resources. The proposed investment project will now support investments in 25 opencast mines.

INTRODUCTION

Considering the size of its economy, India is poorly endowed with energy resources. It's major source of commercial energy is coal. Current reserves are sufficiently large to meet India's demand for coal over the next 250 years. By comparison, oil and gas reserves will last only for another 15-20 years.

By international standards India's per capita consumption of energy is among the lowest in the world. Food security and even modest improvements in the standard of living of almost a billion people will increasingly depend on the availability of relatively inexpensive energy. Unless major technological breakthroughs alter the options India faces for meeting its rapidly growing energy demand, the country has little choice but to rely on the development of its coal reserves. To be sustainable this strategy requires that:

- the Government adopts policies that ensure that energy is used efficiently; and that
- coal producers take whatever steps are required to minimise the adverse effects of coal mining on the environment and people.

In 1975, ownership and management of almost all Indian coal mines were transferred to a Government-owned corporation, Coal India Limited (Coal India). The exceptions were some captive mines belonging to steel plants and a few mines owned by the Government of Andhra Pradesh. Through its seven subsidiary coal companies, Coal India now produces about 90% of India's coal output. After nationalisation of the coal industry, the Government took full control of all major management decisions for the coal sector, including coal pricing, transport and allocation, and the financing of investments. Coal India was left with a single concern: to attain the coal output targets set by the Government. Soon after nationalisation Coal India recognised that underground mines, which at that time accounted for over 70% of production, would be unable to keep pace with rising demand for coal. To meet this demand, Coal India adopted a strategy that relied increasingly on opencast mining. This had two advantages: opencast mining significantly lowered the cost of coal production and made it possible to increase production quickly. This change of mining technology led to a rapid expansion of production from about 90 million tonnes in 1977 to the present rate of over 250 million tonnes.

While the reliance on opencast mining made it possible for Coal India to meet the increase in coal demand and contain the cost of coal mining, it brought with it the displacement of large numbers of people and extensive damage to the environment. The sheer size of opencast mines leads to large-scale disturbances of the surface topography, build-up of overburden dumps, generation of fine airbourne dust from blasting and transport of overburden

and coal, noise from the use of heavy earth moving equipment and degradation of the surface and ground water regimes due to contamination from waste materials and hydrological changes from the drawdown of ground water.

Underground mining, though less environmentally damaging, contributes to the degradation of water quality through the discharge of contaminated mine water and the disruption of ground water regimes. In addition, underground mining brings with it smoke pollution, surface caving (from underground fires), and surface instability and subsidence due to the collapse of mined-out workings. All of these impacts can be mitigated, and to some extent avoided all together, through appropriate mine designs and operational practices.

In response to growing concerns about environmental and social issues in coal mining areas, the Government of India and State Governments have begun to establish, over the past two decades, a legal and institutional regime for the protection of the environment. Like many other industries, the coal industry faces growing opposition to further expansion in many areas unless it can demonstrate that it can carry out its operations in an environmentally and socially sustainable manner. Full compliance with environmental standards, fair and comprehensive treatment of local people affected by projects, and the effective reclamation of lands to a productive or environmentally acceptable end-use will be the standards by which the industry's performance is measured.

This document was prepared by Coal India to provide the World Bank with an overview of the efforts the Indian coal industry and the Government are undertaking to mitigate the adverse effects of coal mining on the environment and the people living in mining areas and working in coal mines. Its preparation was triggered by Coal India Ltd.'s request for a loan from the World Bank to finance replacement of equipment in existing mines and equipment for completing the development of mines or for expanding production of existing mines, as well as the expansion and rehabilitation of mining operations. This document is based on extensive surveys of the environmental and social effects of coal mining that were carried out by international consultants, several Indian non-governmental organisations (NGOs) and the staff of Coal India. The findings of these surveys have led to substantial revisions of Coal India's approach to managing environmental issues and, perhaps most importantly, its policy for the resettlement and rehabilitation of people affected by its projects.

This assessment consists of four parts. The first part provides a brief description of the project; the second part focuses on the environmental effects of coal mining and their mitigation and the project-specific remedial actions; the third part deals with the impact of the proposed project on the people living in mining areas; and the fourth part provides an overview of the occupational health and safety aspects of the sector and the project.

PART I. SECTORAL AND PROJECT CONTEXT

1.01 This part briefly describes the sectoral backdrop against which the proposed Coal Sector Rehabilitation Project has been designed. The first section deals with the sectoral context. It argues that because of India's size, its lack of transportation infrastructure and the fact that it has relatively large coal reserves, coal-based electric power has emerged as the most efficient way to meet India's rapidly growing demand for energy.

Sectoral context

1.02 **Dominant role of coal.** Coal is India's most important source of commercial energy. It currently meets about two-thirds of India's energy needs. A comparison of reserves, production and consumption of major commercial energy resources in India highlights the extent to which coal dominates India's energy economy. Considering that India's coal reserves are large enough to meet projected demand for the next 250 years, and the fact that most of these reserves can be produced at significantly lower cost than other energy resources (taking fully into account associated environmental and social cost), coal will continue to play a dominant role in the years to come. As such, coal will remain the cornerstone of the Government's strategy for the foreseeable future unless there is a drastic shift in the relative prices of energy resources.

1.03 This strategy has to be assessed in the context of the medium and long-term prospects of India's power sector which consumes the bulk of India's coal production. India's per capita power consumption is among the lowest in the world. Even with pricing policies that would bring electricity tariffs in line with the long-term cost of production, the demand for power, and therefore for coal, will grow rapidly. To meet the growing demand for power and eliminate the persistent gap between supply and demand, the Government estimates a need for additional capacity of around 7,000-8,000MW per year.

1.04 **Demand side management.** To close the gap between power demand and supply, India will have to develop the full range of energy sources existing in the country while putting much greater emphasis on efficient pricing, demand side management (DSM), and increased efficiency in the use of existing generating transmission and distribution capacity as well as the utilisation of electric power.

1.05 **Energy conservation.** The prevailing low energy prices, when combined with the cost plus pricing mechanisms for many industrial products, provide little incentive for industry to conserve energy. Studies on India's energy conservation potential have shown that pricing of power at long run marginal cost would reduce the need for additional capacity by almost 1,000MW per year. The

macro-economic reforms undertaken by the Government since 1991 are now gradually bringing about an environment in which significant DSM activities could take place. In the expectation that major price reforms will be implemented, DSM programmes are now being formulated in several States of India with support from bilateral and multilateral sources (including the World Bank). Over the medium term, these programmes are estimated to generate energy savings of about 500MW per annum.

1.06 **Renewable energy.** The longer term scope for renewable energy development is estimated at over 20,000MW for wind and 5,000MW for mini-hydros, plus about 75,000MW for larger scale hydros. While some solar PV applications appear economical in remote areas, it will take a few more years for them to become economical in grid connected use.

1.07 **Conclusions.** It follows from the above that:

- after allowing for both price and non-price DSM measures and after fullest use of feasible alternative energy programmes, conventional hydro and thermal power projects will need to contribute some 5,000-6,000MW of additional capacity per year;
- the immediate prospect of hydro projects in India is not bright because of resettlement and rehabilitation problems and other environmental issues; in addition,
- in view of India's limited gas reserves, and until gas import options have been proven to be technically and economically feasible, India has little choice but to continue investing in coal-based power generation.

1.08 These conclusions are reinforced in light of India's current level of development: an estimated 500 million people in India have no access to electricity service, and a majority of households still rely on fuelwood and dung for cooking. Although research and development of alternate energy resources for cooking are in progress, the use of these traditional fuels will continue to increase in a population growing at about 2% per annum. Unless power generation and distribution systems improve and increase, this trend will result in unsustainable pressures on forests, soil and water resources, and add to the degradation of the general environment that is already too apparent in many parts of India.

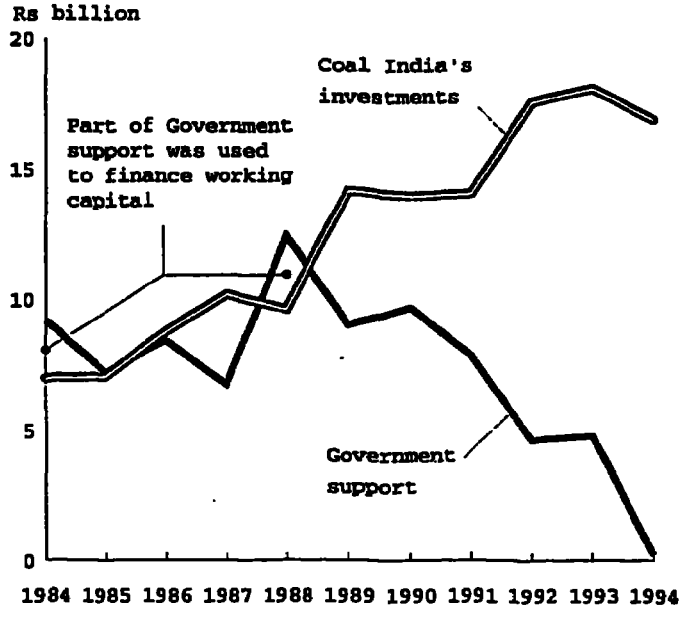
Project context

Origin of the project

1.09 **Phasing-out of budgetary support.** Until recently the Government financed between 70% and 90% of Coal India's investments. After the foreign exchange and budget crisis in 1991, the Government began to phase out its budgetary support for

Coal India's investments (Figure 1.1). Because internally generated resources were insufficient, over the past three years Coal India's capacity to produce coal began to erode gradually. Increasingly, equipment that has outlived its usefulness can no longer be replaced; and the lack of spare parts is forcing managers to 'cannibalise' part of their equipment. No new projects have been started. Without a major injection of financial resources, Coal India will enter a downward spiral of declining profits and diminishing capacity to borrow (as indicated by the downward trend of the debt service coverage ratio in Figure 1.2).

Figure 1.1 The phasing-out of Government financial support to Coal India



Source : Coal India

1.10 **Programme objectives.** Over the past two years, the Government of India and Coal India have implemented reforms aimed at making the coal industry commercially viable and financially self-sustaining. The primary objective of the proposed loan is to support this reform agenda and Coal India's transformation into a commercial company whose operations are environmentally and socially sustainable. The transformation, which would encourage, *inter alia*, reliance on market forces in the pricing and distribution of coal, closure of uneconomic mines, more extensive use of contractors, opening of the industry to private investors, phasing out of subsidies to loss-making operations, and investments in improving operational efficiency as well as coal quality, will be costly. The proposed loan from the Bank and the cofinancier will allow Coal India to meet part of these costs. The remainder will come from a projected increase in internally generated resources (due to efficiency improvements and the reforms that will be implemented under the programme) and some modest market borrowings.

1.11 In order for the programme to achieve the desired long-term financial impact, it would:

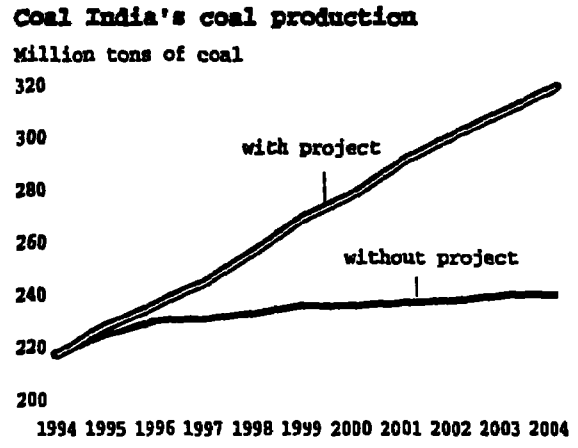
- support investments in opencast and underground mining operations that are projected to yield the highest economic returns;
- provide technical assistance in support of the programme; and

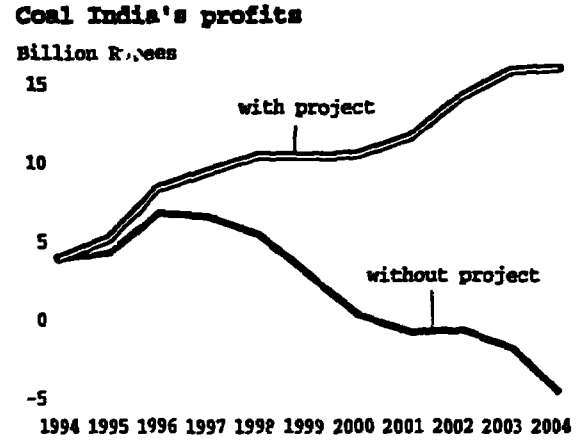
- assist Coal India in mitigating the adverse effects of mining operations on the environment and the people directly affected by mining activities.

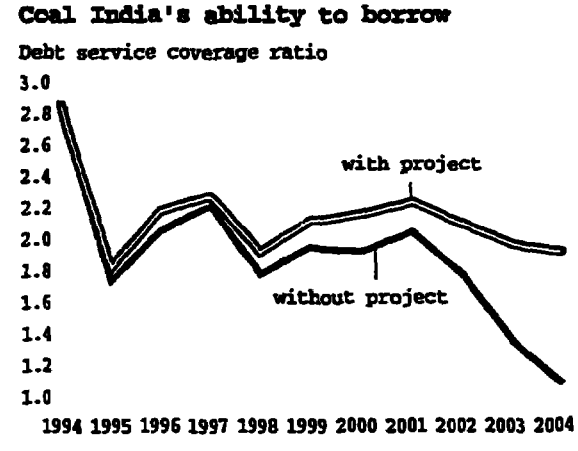
1.12 **Programme description.** The bulk of the proposed loan would finance the purchase of mining equipment for 31 mining operations in Madhya Pradesh, Maharashtra, Uttar Pradesh, Bihar and Orissa (Figure 1.3). Sixteen mines need to replace equipment; two mines need additional equipment in order to meet an increase in demand; four mines need both replacement of equipment and additional equipment; and nine mines are currently being developed and require equipment to reach their target production (Annex 1). Of these 31 projects, 25 are opencast mines and six are underground mines. The loan would also provide technical assistance for redrafting the regulatory framework that governs operations in the coal industry. The aim is to enhance the industry's competitiveness and efficiency. In parallel, the programme would assist Coal India in the resettlement and rehabilitation of the people affected by the proposed investments and in community development activities in the surrounding areas, as well as in mitigating the cumulative adverse effects of mining operations on the environment and the people living in these mining areas.

1.13 **Cost and financing arrangements of the proposed programme.** The total costs of the proposed programme are estimated at US$1.9 billion. The estimated for-

Figure 1.2 The impact of the proposed project on:







Source: Coal India

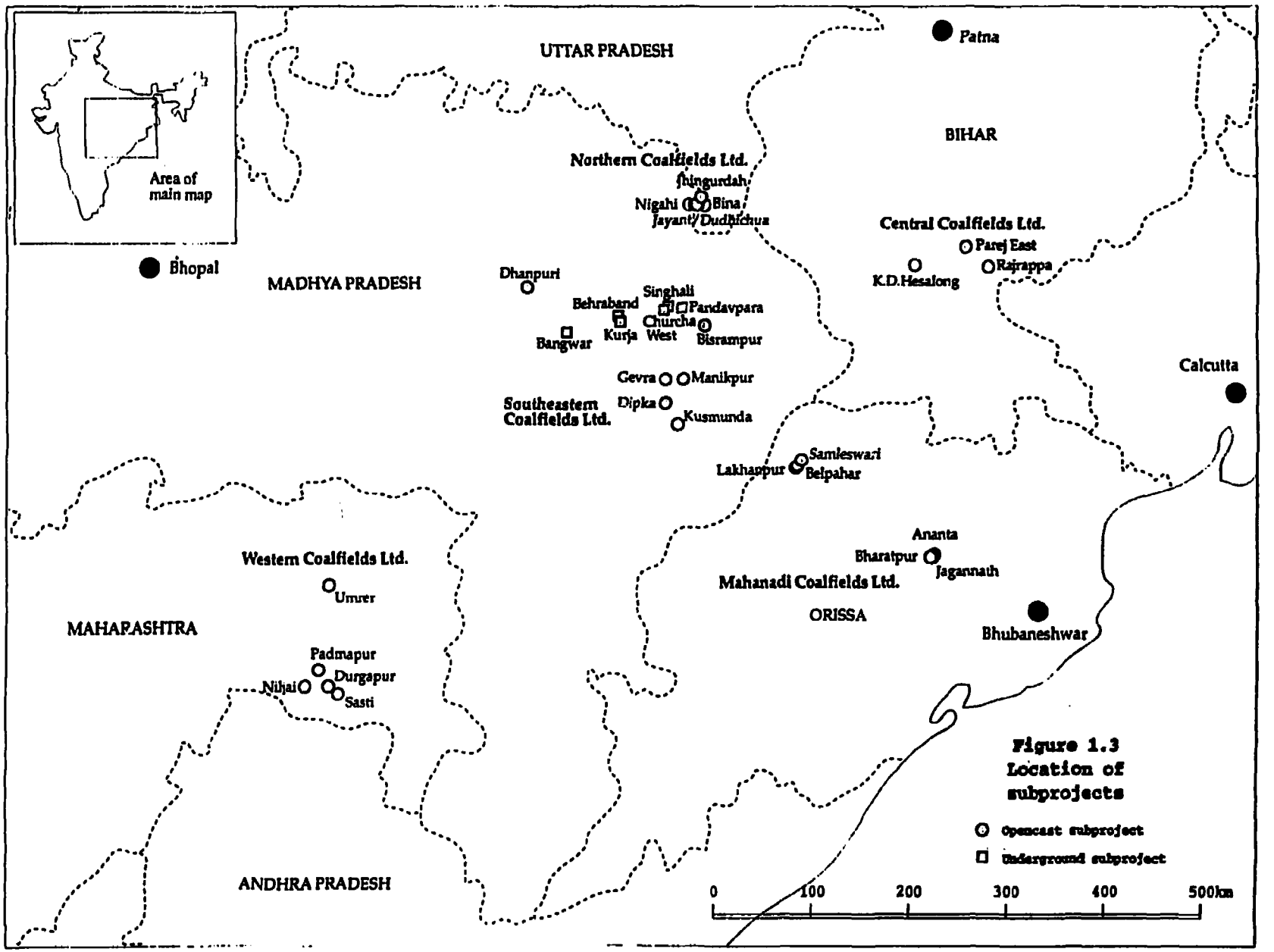


Figure 1.3
Location of subprojects

○ Opencast subproject
□ Underground subproject

eign exchange requirements are US$1.1 billion. Coal India has requested a World Bank loan of US$500 million, which would finance part of the required mining equipment and technical assistance, and an IDA credit of US$50 million, which would finance environmental and social remedial action programmes. Coal India has indicated that it would be able to finance about US$800 million of the estimated cost from internally generated resources and about US$150 million from borrowings in local capital markets. The remaining US$500 million is expected to be raised through cofinancing arrangements.

1.14 **Programme implementation.** The design of the programme, which involved the identification of investments (subprojects) yielding the highest economic and financial rates of return, included agreement with Coal India on (sub)project-specific implementation arrangements, a review of resettlement and rehabilitation requirements and plans and a review of Environmental Action Plans (EAPs). This has also provided the Bank with an opportunity to assist Coal India in strengthening its policies with regard to resettlement and rehabilitation and the environmental sustainability of its mining operations.

1.15 Coal India has set up a Project Implementation Division (which employs 15 local staff and three fulltime expatriate consultants) at its headquarters in Calcutta to monitor the implementation of the project, manage the procurement process, the deployment of equipment and the implementation of EAPs and Rehabilitation Action Plans (RAPs). In addition, the subsidiary coal companies are strengthening their capacities - both at their headquarters and the mine level - to deal with environmental and social issues.

1.16 **Programme sustainability.** As indicated in para. 1.10 above, the proposed programme would support Coal India's efforts to ensure that its operations are (a) commercially viable, as well as (b) environmentally and (c) socially sustainable. To ensure Coal India's financial viability beyond the period in which the programme is being implemented, financial support under the programme will be provided to mines that yield the highest economic return while minimising adverse social and environmental impacts. To ensure that Coal India's operations will be environmentally sustainable, Coal India is in the process of building capacity in the subsidiary companies and at the mine level and will follow mine designs and operating practices that meet existing Indian environmental standards. To ensure that Coal India's operations will be socially sustainable, Coal India has adopted an enhanced policy for the resettlement and rehabilitation of project-affected people (Annex 8). This policy enlarges the scope of rehabilitation to all project-affected people and safeguards against losses in their incomes or standards of living. To ensure proper implementation of this policy, Coal India now has resettlement and rehabilitation cells at its headquarters and in each subsidiary to implement and maintain resettlement and rehabilitation and has taken steps to work with NGOs in identifying self-employment opportunities for project-affected people.

PART II. ENVIRONMENTAL MITIGATION AND REMEDIAL ACTION

2.01 Part II of this assessment focuses on the effects of coal mining on the environment (Chapter 1) and the various mitigating and remedial efforts the Government (Chapter 2) and Coal India (Chapter 3) have adopted to deal with these effects.

CHAPTER 1 EFFECTS OF COAL MINING ON THE ENVIRONMENT

2.02 Coal mining like many other industrial activities, effects the ambient environment. Table 2.1 provides an overview of the major effects of coal mining on the physical and biological environments. It is important to keep in mind that not all mining operations generate all of these effects, and most of these effects are amenable to mitigation measures.

2.03 Table 2.2 provides a closer view of the underlying causes of the environmental effects of coal mining. It also gives an indication of the magnitude of these effects, the feasible technical solutions and a reference to environmental legislation which addresses these issues.

Table 2.1 Major potential environmental effects of coal mining

Potential effects on physical environment	*Potential effects on biological environment*
Air pollution • Increase in level of suspended particulate matter (SPM) and respirable (<10 microns) particulate matter (RPM) • Increase in the level of gases such as sulphur dioxide, nitrogen oxides and carbon monoxide	Soil • Mixing of organic and inorganic strata • Soil erosion from dumps • Sterilisation due to mine fires • Topsoil sterilisation due to stacking • Soil contamination from effluent discharge
Water pollution • Increase in total suspended solids (TSS) • Increase in oil and grease content • Acid mine drainage • Increase in chemical and biochemical oxygen demand • Increase in iron • Increase in nitrates	Flora • Devegetation Fauna • Impediments to migration • Loss of habitat
Noise pollution • Increase in the noise level	
Vibration • Vibration to ground and surface structures	
Hydrology • Changes in watershed and water courses • Reduction in water flow	
Hydrogeology • Changes in water tables • Changes in aquifer discharge	
Land • Formation of voids • Formation of waste heaps and overburden dumps • Transformation of agriculture and allied land uses into residential and industrial areas • Subsidence • Surface mine fires	

Source: Coal India Ltd.

Table 2.2 Environmental issues and their mitigation

Potential environmental effects	*Underlying causes*	*Magnitude of problem/adverse effects*	*Technical solutions* *cost is manageable **cost is high	*Legal policy/ provisions*
Air Pollution				
1. Increase in the level of suspended particulate matter (SPM) and respirable (<10 microns) particulate matter (RPM).	• Drilling rocks and coal. • Blasting rocks and coal. • Handling and transport of rocks and coal. • Coal crushing and loading in handling plant. • Soft coke making. • Beehive coke oven emissions.	Problem is inherent in all opencast mines and coal handling plants. Effects: bronchial problems, lung diseases, dust nuisance.	Blast in calmer conditions. *Extraction of drill gummings. *Metal/blacktop transport roads. *Dust suppression with water at crushing, transfer and loading points. *Stop open air soft coke making - manufacture in proper plants. *Modify emission chimney of beehive hard coke ovens. *Water haul roads. **Spray water and chemicals on haul roads. **Coal transport with conveyors.	Central Pollution Control Board (CPCB) has prescribed tolerance limits for SPM and RPM in industrial zones, rural/residential zones and sensitive zones. These standards are fixed under powers delegated to CPCB by Section 16(2h) of the Air Prevention and Control of Pollution Act (1981).
2. Increase in the level SO_2 and NO_x in the ambient air.	• Blasting in mines. • Soft coke making. • Beehive hard coke oven emissions. • Auto emissions. • Mine fires.	Mining does not cause any perceptible change in SO_2 or NO_x content of air. In Jharia coalfield levels exceed limits because of mine fires and manufacture of soft and hard coke. In Singrauli, because of super thermal power stations, levels sometimes exceed limits. None of the subprojects has levels that exceed standards. Effects: high level of SO_2 causes eye inflammation - excessive exposure to high levels may be fatal, NO_x can cause throat congestion and edema of lungs, high levels of either gas may cause acid rain and affect vegetation.	Use correct type and quantity of explosive charges for efficient blasting and to reduce the chances of incomplete detonation. *Stop open air soft coke miking - manufacture in proper plants. *Modify emission chimney of beehive hard coke ovens. *Proper maintenance of truck engines. **Control the mine fires.	See above.
Water pollution				
1. Increase in total suspended solids (TSS).	• Direct pumping from mine workings to natural water sources. • During coal washing, the effluents generated contain a lot of coal fines. • During transport by road, dust (fines) generated settles in drainage channels. • During monsoon, rain falling on stocks and dumps washes fines into water sources.	This problem is severe only during monsoon season. During other seasons the problem is only from coal washeries and unclarified mine discharge. Effects: Water is not potable and natural water sources are affected.	Provision of lagoons for settling of monsoon water is not practical due to high rainfall and discharge levels. *Develop settling ponds for face water from new mines. Use voids as lagoons in old mines. *Coal washing plants to have closed circuit for effluent treatment and to use clarified water in the washing circuit to minimise replenishment water. *Dust suppression on transport routes. *Garland/storm water drains around coal stocks and waste dumps.	Vide Gazette notification GRS-429(E) dated March 5, 1993. Central Government amended Environmental Protection Rules 1986 and standards for effluents were laid down in Schedule VI of Rule 3A(1). The tolerance limit for TSS is 100mg/l

Environmental effects	Underlying causes	Magnitude of problem/adverse effects	Technical solutions *cost is manageable **cost is high	Legal policy/ provisions
2. Increase in oil and grease content.	• Washings from workshops. • Oil and grease leakage from machinery. • Effluents from coal washery having froth floatation oil.	Problem of oil and grease in mine water is negligible, however washings from workshops and effluent from washeries contain quantities which may exceed the limit of 10mg/l. Effects: water unfit for domestic and even agricultural uses.	*Develop settling ponds for sedimentation of TSS. *Install oil and grease traps and allow top water to be processed in them. *Collect skimmed oil and grease in a small sump. When dry, dispose of it in backfilled areas of mining voids.	The maximum tolerence level of oil and grease in effluent is .10mg/l.
3. Acid mine drainage.	• Acidity due to under/over lying strata (rocks). • Pyritic band in coal seam.	Only 2% of Indian mines have this problem. Only one (Churcha West) of the subprojects has a mildly acidic discharge. Effects: Acidic water corrodes metals, damages vegetation in flow path until diluted and makes water non-potable and non-useable when acidity is high.	*Treating acidic water with lime before discharge into natural sources.	The pH tolerance limits are 5.5-9.0.
4. Increase in biochemical oxygen demand (BOD).	• Effluent from colonies contains biodegradable materials. • Effluents from sewage system.	Problem is moderate with colony effluents, since most water is guided to wastelands and acts as biomanure. No problem from sewage effluents since soak pits are designed to handle the total sewage.	*Soak pits are designed to completely soak sewage - no effluent comes out. **Treatment of colony effluents if they are not within the tolerance limits and if they are to be discharged to bodies of water.	The tolerance limit for BOD is .30mg/l.
5. Increase in chemical oxygen demand (COD).	• Coal washing effluents have a dense slurry in the form of coal fine.	Limited to coal washeries discharging dense slurry.	Washery effluents are to be treated and coal fines recovered to reduce COD and bring it within standards. *Recovery of fines through the sedimentation and floroculation in the slurry management system.	The tolerance limit for COD is 250mg/l.
6. Increase in iron.	• Presence of pyrites or other iron components in the coal seam.	Problem is limited to coal seams with pyritic bands. Even in these, the absorption of iron into effluents does not exceed the limits. Effects: metabolism disorders and staining and weakening of teeth, clothes, etc.	Aeration of the effluents converts ferrous to ferric which is precipitated and can be removed. However, effluents invariably meet the standards.	Tolerance limit for Iron is 3mg/l.
7. Increase in nitrates.	• Wash off from coal stacks or waste dumps.	No problem encountered. Main wash off occurs during monsoon when rain dilutes effluents. Nitrate levels during other seasons are 12-15mg/l. Effects: Nitrate levels in water may affect fetus and young children.	**Treatment of nitrate is feasible by denitrification through use of Methyl Alcohol. Search for other chemicals is ongoing, because this is cost prohibitive. However, no treatment is required in the mines.	Tolerance limit for NO_3 is 45mg/l. Tolerance limit for nitrate nitrogen is .10mg/l.

Environmental effects	*Underlying causes*	*Magnitude of problem/adverse effects*	*Technical solutions* *cost is manageable **cost is high	*Legal policy/ provisions*
Noise pollution	• Drilling in coal and overburden (OB). • Blasting in OB. • Operation of HEMM. • Operation of workshop. • Transport vehicles.	Problem is marginal outside work zone. Ambience is affected only by transport vehicles passing through habitats. Effects: Annoyance and anxiety and hearing loss.	*Proper equipment design. *Proper maintenance of equipment. *Attenuate between source and receptor (e.g. strip of tree plantation). **Divert haul roads away from habitats. **Construction of coal handling plant at mine to stop transport through habitat.	Noise tolerance limits are laid down in Schedule III of Environmental Protection Rules (1986). Coal India's policy is to comply with the above provisions. Even high cost alternatives may be considered to avoid the problem.
Vibration of ground and structures	• Blasting in coal and OB.	Problem is marginal. Blasting is carried out with due consideration to the distance of structures from site. Effects: Psychological fear and cracks if vibration is large.	*Blasting carried out under norms for quantity of explosives and timing. *Blasting patterns and charges to be fixed for specific situations. *Special blasting techniques for closer distances to contain vibrations. **Resettlement if no other option for inhabitants.	Blasting procedure/methods are guided by the Coal Mines Regulations (1957). Uncontrolled blasting is permitted 300m from structures. Within 300m permission from Director General of Mine Safety is required and any conditions are complied with.
Hydrology 1. Changes in watershed and water courses.	• Removal of OB. • Dumping of OB and disturbing surface contour. Voids created affect watershed. • Planned diversion of water courses.	Magnitude of problem is mild to severe depending on topography and coal-OB ratio. Planned diversion will have marginal problems. Effects: changes in water table, drying of part of natural water courses.	**Planning to maintain the general topography. **Planning to maintain similar ground profile where feasible, however cost is prohibitive. **Diversion of water courses.	No legal provisions against causing changes in watersheds. Diversion of perennial water courses (rivers), requires clearance from State Governments. Environmental Management Plans document to impact on hydrology and Coal India's policy is to comply with the provisions of clearance letters.
2. Reduction in water flow.	• Changes in watershed and water courses. • Voids created along course reduce downstream flow. • Water utilisation by mine reduces downstream flow.	Mining is a subsurface activity. This involves dealing with subsurface water and water entering mine in monsoon season. Mines are required to pump regularly to keep the workings dry.	Generally there is an overall increase in water available in coal mining areas.	No specific legal provisions except clearance of the operation by Ministry of Environment and Forests.
Hydrogeology 1. Changes in the water table.	• Excavation in opencast mines cuts across the water table. • Underground mining may cause cracks in overlying strata and disturb the water table.	Opencast mining may affect the water table up to 400/500m from the edge of the quarry. Underground mines have similar effects, but to a much lesser degree depending on geomining conditions and extraction method. Effects: water level in wells, ponds and bore wells are changed.	*Pumping water into voids created during excavation. **Partial extraction of coal. This causes permanent loss of coal reserve, but minimises effects on water table. **Stowing/backfilling of voids underground to prevent cracks and disturbances.	No legal provisions have been laid down. The operations are guided by conditions of environmental clearance letters for individual projects. Where village wells become dry due to mining, Coal India policy is to arrange water for the village.
2. Damage to aquifer.	• Opencast excavations and underground extraction opens aquifers to unrestricted flow.	The problem is limited to up to 500m from the workings. Effects: open wells and borewells become dry and ground water quality in effect zone may be affected.	In underground mines, coal extraction is to be planned to keep the aquifers undisturbed. This results in permanent loss of large quantity of coal reserves.	The operations are guided by the conditions of environmental clearance letters for individual projects.

Environmental effects	*Underlying causes*	*Magnitude of problem/adverse effects*	*Technical solutions* *cost is manageable **cost is high	*Legal policy/ provisions*
Land				
1. Formation of voids.	• Excavation of rocks and coal below the surface.	Problem associated with all opencast mines. Effects: damage to land and flora.	**Best solution may be to backfill voids with waste - not feasible where lower seams will be mined later.	
2. Formation of waste heaps and overburden dumps.	• OB rocks from opencast mines. • Rejects from coal handling plant and washeries.	Problem is acute if no backfilling is possible (due to geomining conditions) otherwise it is manageable. Effects: degraded land and aesthetics, air and water pollution due to wind and rain corrosion, source of fires.	**Backfilling part of the pit, converting part of pit to water body and landscaping of the external dump. Ecologically, this is an acceptable solution.	No legal provisions exist. Operations are guided by environmental clearance letters which require: maximum backfilling to reduce waste heaps, regrading of slopes and bioreclamation.
3. Transformation of agricultural and allied land uses into residential and industrial areas.	• To meet the development of infrastructure.	Land selected for infrastructure is generally waste and poor quality land to minimise damage to good land. Effects: green cover reduced, seepage and recharging to ground water is reduced and land used for life of mine.	*Greenery developed in blocks, strips and on avenues in the built up areas.	Only environmental clearance guides the actions. No legal provisions exist.
4. Subsidence.	• Extraction of coal by underground mining.	Magnitude depends on geomining factors and method of extraction. Effects: damage to surface, built up areas, aquifers and water table.	*Partial extraction and backfilling **Filling voids with incombustible materials. Leaving coal to support surface results in permanent loss of reserves. After ground movements have ceased, land can usually be returned to original state.	Governed by Coal Mines Regulation (1957) which lay down norms for individual methods of extraction. Environmental clearance also gives guidelines, especially if aquifers exist. These guidelines are project specific and no general norms exist.
5. Surface mine fires.	• Underground fires travel to surface. • Surface seams/stocks/waste dumps may catch fire. • Fire in weeds/dry vegetation on mine surface.	Acute where all problems combine and if fire is old and established. New fires are manageable. Effects: air and soil pollution.	*Dozing and filling of surface cracks. *Fires in coal stocks are immediately quenched. *Bioreclamation of waste dumps. **Provide layer of soil over the fire area after dozing and filling cracks.	Governed by Coal Mines Regulations. Environmental clearance letters may also give guidelines on surface fires. Coal India's policy is to comply with the requirements of environmental clearances and Coal Mines Regulations.
Soil				
1. Mixing of organic and inorganic strata.	• When OB is removed, mining of soil and rocks is to some degree inherent. • If soil layer is thin, it can not be segregated. • If sufficient space for separate stacking of soil is not available, mixing with rocks occurs.	With thin layer of soil, mix up is acute. With thick layer and space for stacking, soil can be segregated. Effects: soil loses fertility when stacked for long period; bioreclamation of dumps is difficult when soil is mixed with debris or buried in it.	*Separate equipment for soil winning, stacking and rehandling. *When mining and backfilling are simultaneous, soil can be used for top layer filling and problem is avoided. **Separate stacking areas for top soil.	No legal provisions exist. Environmental clearances provide guidelines for handling and use of top soil.

Environmental effects	Underlying causes	Magnitude of problem/adverse effects	Technical solutions *cost is manageable **cost is high	Legal policy/ provisions
2. Soil erosion from dumps.	• Runoff from dump during monsoon season. • Minor erosion by strong winds in dry seasons.	The problem is inherent with external dumps. Effects: loss of soil from dumps, siltation of water drainage system **Provision of garland drains and settling lagoons to prevent siltation of water course.	*Bioreclamation of dumps at earliest possible time. **Minimisation of external dumps in opencast mines by rehandling.	No legal provision exists. Environmental clearance letters guide the formulation and reclamation of dumps. These guidelines lay down slope angles and priority for dump reclamation.
3. Soil contamination from effluent discharge.	• If effluents from mine or washery with high TSS are left over the land areas without proper channeling, top soil is polluted.	Problem is marginal, because most effluents are guided into channels. Effects: pollution of soil with suspended solids	*All effluents to be guided by permanent drainage systems and treated before discharge to water courses so that top soil is not effected. **Before discharge, effluent to be treated for pollutant in addition to disposal in channels.	Legal provision for treatment of effluents exists and is explained in the section concerning water pollution.
4. Sterilisation due to mine fires.	• Surface mine fires or underground fires reaching the surface.	Problem is acute in older coalfields with large number of mine fires (Jharia coalfield). The mines under this project do not have this problem.	*Dozing and leveling mine fire areas. Then blanketing the leveled area with soil about 1m thick to prevent loss of soil in surrounding areas.	No legal provision exists under the Environmental Protection Act. Fire management is done under provisions of the Coal Mines Regulations.
Microbiota				
1. Top soil sterilisation due to stacking.	• Soil forms top layer of OB over coal seams, so it is extracted and stacked for years before it is reused in new mines. Because of stacking, microbiota dies and soil becomes sterile.	This problem is associated with opencast mines where reuse of soil is delayed. Effects: Loss of microbiota and soil cannot support plant growth without soil amendments. Loss of nutrients.	*Soil amendments to be added when using sterile soil. **Stacking to be avoided by using soil elsewhere when feasible. **Stacking in thin layers to avoid sterilisation.	No legal provision exists. Good and effective practises will be followed and the provisions of environmental clearance letters will be complied with.
Flora				
1. Devegetation.	• Mining and infrastructure development. (Mining brings site specific activity and inherently involves some devegetation of forests.)	Problem associated with opencast mining and, to a lesser extent, underground mining. Effects: Loss of green cover, healthy surroundings and forest product for neighbouring community.	*Maximum plantation in mine, colony and infrastructure areas. *Forest land disturbed is reforested. *Compensatory afforestation in non-forest land equal to forest area disturbed to increase total forest cover as early as possible. *Emphasis on grasses, legumes and shrubs.	Legal provision under Forest (Conservation) Act (1980). (Amended in 1987 for compensatory afforestation in non-forest land). Act does not allow diversion of forest land involving sanctuaries, parks, bioreserves and sensitive forest areas. Conditions laid down in environmental clearance are complied with.

Environmental effects	*Underlying causes*	*Magnitude of problem/adverse effects*	*Technical solutions* *cost is manageable **cost is high	*Legal policy/ provisions*
Fauna				
1. Impediments to migration.	• Devegetation. • Operation of mines.	Problem is limited since forests are contiguous to mines and fauna can easily migrate. Effects: general effect on ecology due to migration of fauna.	*Reforestation of mined area. *Compensatory forestation of contiguous non-forest lands to provide living space for fauna.	There is no specific legal provision, but since forest including parks, reserves, sanctuaries and fragile ecology are not released no fauna can be disturbed in such zones. Provisions for remedial actions are included in environmental clearance.
2. Loss of habitat.	• Reduction of forest cover.	Problem is not appreciable because fauna have migrated from degraded forest of the mine site to contiguous forest.	*Increase forest cover to help rehabilitate fauna.	(See above)

Source: Coal India Ltd.

CHAPTER 2 ENVIRONMENTAL LAWS AND REGULATIONS

2.04 The previous chapter provided an overview of the range of possible effects of coal mining on the environment. This chapter (Chapter 2) and the following one (Chapter 3) will present various mitigating actions the Government (Chapter 2) abd Coal India (Chapter 3) have taken to minimise the adverse environmental effects of coal mining.

Legislation

2.05 The United Nation Conference on Human Environment which was held in Stockholm in June 1972 focused the world's attention on the urgent need for environmental protection. Table 2.3 provides an overview of legislative measures India has enacted for the protection of the environment. It shows that the legislative measures have kept pace with the growing attention the country places on environmental issues. The following is a summary of India's environmental legislation.

Table 2.3 Overview of legislative enactments

Enactments up to 1972	*Enactments after 1972*
The Indian Forest Act, 1927	Water (Prevention and Control of Pollution) Act, 1974
Bihar Wastelands Act (Reclamation, Cultivation & Improvement), 1946	Water (Prevention and Control of Pollution) Rules, Rules, 1975
Mines and Minerals Act (Regulation and Development), 1947	Water (Prevention and Control of Pollution) Cess Act, 1977
Factories Act (Pollution and Pesticides), 1948	Forest Conservation Act, 1980
Mines Act, 1952	Air (Prevention and Control of Pollution) Act, 1981
Orissa River Pollution and Prevention Act, 1953	Environmental Protection Act, 1986
Wildlife Protection Act, 1972	Amended Forest Conservation Act, 1987

Source: Coal India Ltd.

The Water (Prevention and Control of Pollution) Act, 1974

2.06 This Act provides for prevention and control of water pollution. The objective is to maintain or restore water quality. The Act provides for the establishment of Pollution Control Boards, both at Central and State levels. The Boards have the power to give consent for the discharge of pollutants into

the (natural) water system and establish standards for such discharges. The Act also prescribes penalties for non-compliance.

The Water (Prevention and Control of Pollution) Rules, 1975

2.07 These Rules are the basis for the day-to-day operations of the Pollution Control Boards including the appointment of members. The Rules also provide for the setting up of laboratories for analysis of water/effluents.

The Water (Prevention and Control of Pollution) Cess Act, 1977

2.08 This Act is the legal basis for collection of a cess on water consumption by industries and local authorities. The cess finances the day-to-day operation of the Pollution Control Boards and provides an incentive to eliminate the wasteful use of water.

The Forest (Conservation) Act, 1980

2.09 Forest land (as all other land) was, prior to this Act, a State 'subject.' Growing concerns about the rapid decline of forests in India led to the enactment of this legislation. The Act requires that State Governments must obtain the approval of the Central Government before they can release forest land for non-forest purposes. Subsequent modification of this Act in 1980 required that the buyer of the forest land commits himself to the afforestation of an area twice the size of the forest land he has acquired; and after mining operations on forest land have been completed, Coal India is required to afforest the land and return it, without compensation, to the Forest Department.

The Air (Prevention and Control of Pollution) Act, 1981

2.10 This Act provides the legal basis for the control and abatement of air pollution, restrictions on emissions, and for penalties in cases of noncompliance with the standards set by the Boards. This Act expands the responsibilities of Central and State Pollution Control Boards to setting standards for and monitoring of air quality.

The Environmental Protection Act, 1986

2.11 This Act provides the legal basis for environmental protection in areas not covered by other Acts and for establishment of the Ministry of Environment and Forests (MOEF). It empowers the MOEF to assume a lead role in long-term environmental management and short-term response to environmental emergencies. The Act defines the environment as including "water, air and land, and the interrelationship which exists among and between water, air, land, human be-

ings, other living creatures, plants, microorganism and property." The Act assumes precedence over the previous pollution control Acts by establishing the power to issue directions "to any person, officer or authority," and such authority is bound to comply with such direction "not withstanding anything contained in any other law". The power to issue directions includes "the power to direct the closure, prohibition, or regulation of any industry, operation or process, or the stoppage or regulation of any industry, operation or process, or the stoppage or regulation of the supply of electricity, water or any other services." The Act provides the Central Government with the power to undertake "all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling, and abating environmental pollution" and to coordinate the "actions by the State Governments, officers and other authorities." The measures assumed by the Central Government under this Act now include nationwide waste management planning; establishing objectives for the quality of the environment "in its various aspects;" establishing standards for all sources of pollution emissions and discharges; designation of areas where certain types of industries may not operate or may not operate, or may operate only under specified restrictions; development of environmental emergency response and contingency planning procedures; hazardous substance regulations; environmental protection and waste management research; inspections of water generating facilities and the issuance of pollution prevention, control and abatement orders; establishment or "recognition" of environmental laboratories; and the preparation of environmental management manuals, codes and guidelines.

Regulations

2.12 Pursuant to these Acts, the Government issues notifications from time to time to ensure compliance with the legal provisions. The more important ones are summarised below.

Ambient objectives for air and drinking water quality and noise level

2.13 Ambient environmental management objectives are set to protect public health and sensitive natural resources such as fisheries, vegetation and soil productivity. Ambient or 'receiving' environmental objectives are the basis for assessing and managing the cumulative impacts of point-source discharges or emissions, which are usually regulated by permits or consent letters, and non-point or dispersed pollution sources which are not usually amenable to direct regulation. Coal mining is a non-point source of air pollution and is therefore guided by ambient objectives or standards.

2.14 Ambient objectives have been established for air quality, noise level and drinking water quality. Tables 2.4, 2.5 and 2.6 show the standards for air quality, noise level and drinking water quality. These objectives are gener-

ally consistent with standards elsewhere in the world under similar conditions and, are adequate to protect public health and the environment.

Table 2.4 National ambient air quality standards

ug/m³ (except Carbon monoxide which is mg/m³)

Pollutant	*Time weighted average*	*Concentrations allowed in ambient air*		
		Industrial areas	*Residential, rural and other areas*	*Sensitive area*
Sulpher dioxide	Annual average	80	60	15
	24 hours	120	80	30
Oxides of nitrogen	Annual average	80	60	15
	24 hours	120	80	30
Suspended particulate matter	Annual average	360	140	70
	24 hours	500	200	100
Respirable particulate matter	Annual average	120	60	50
	24 hours	150	100	75
Lead	Annual average	1.0	0.75	0.50
	24 hours	1.5	1.00	0.75
Carbon monoxide	8 hours average	5.0	2.0	1.0
	24 hours	10.0	4.0	2.0

Notes: Annual arithematic mean (minimum 104 measurements in a year taken twice weekly, 24 hourly at uniform intervals) of 24 hourly/8 hourly values should be met 98% of the time each year. However, 2% of the time they may exceed the values, but not on two consectutive days.

Source: Central Pollution Control Board Notification No. SO 384(E) dated 11-4-1994.

Table 2.5 Noise standards

Land Use	*Limits in dB(A)*	
	Days (6 am to 9 pm)	*Nights (9 pm to 6 am)*
Industrial	75	70
Commercial	65	55
Rural/Residential	55	45
Silence Zone (100m from schools, hospitals, etc.)	50	40

Source: Environmental Protection Rules, 1986.

Table 2.6 Drinking water standards

Parameter	*Standard (All figures except pH are mg/L)*
pH	6.5-8.5
Dissolved solids	500
Total hardness (as $CaCO_3$)	300
Iron (as Fe)	0.03
Sulphate (as SO_4)	150
Nitrate (as NO_3)	45
Mercury (as Hg)	0.001
Cadmium (as Cd)	0.01
Mineral oil & grease	0.01
Residual free chlorine (Cl)	0.20
Manganese (Mn)	0.10
Lead (Pb)	0.10
Arsenic (As)	0.05
Coliform	0.00

Source: Indian Standards (10500 - 1983).

Table 2.7 compares the standards for ambient air quality in residential and rural areas for several developing countries.

Table 2.7 Ambient air quality standards in developing countries

Country	*24 hour max (ug/m^3)*	*Annual mean (ug/m^3)*
Indonesia	230	90
Thailand	330	100
Singapore	260	75
WHO	150-230	60-90
India	200	130

Source: Coal India Ltd.

2.15 Recent concerns about the possible effects of nitrates in drinking water on the unborn fetus have prompted some jurisdictions to reduce acceptable nitrate levels to the 10 to 20mg/l range. This parameter is of relevance to mining operations because of the possibility of nitrates from uncombusted explosives leaching to surface and ground water from overburden dumps. However, water samples of leachate from dumps of a large number of mines show that the nitrate content of these samples varies from 12 to 15mg/l compared to the tolerance standard of 45mg/l.

2.16 **Noise.** The noise level limits prescribed (Table 2.3) are generally in line with the international standards. Monitoring of noise levels at and around mining operations indicates that they are well below threshold limits.

2.17 Discharge and emission standards usually apply to point sources of pollution, for example the typical 'stacks and pipes' discharges. Most of the air quality problems at minesites come from 'mobile' and 'dispersed' sources of pollution, that is from 'line and area' sources instead of point sources of emission. Pollution levels must be managed, therefore, through the use of 'ambient objectives.' Waste water discharge standards, established under Schedule II of the Environment (Protection) Rules 1986 and subsequent Gazette Notice No. GSR 422(E) of 19 May 1993, apply to the discharge from mines, other infrastructural areas and from domestic sewage treatment systems. Discharge standards for effluents from coal mines are shown in Table 2.8. These standards are consistent with those used in similar conditions in other countries. The State Pollution Control Boards, while applying these standards for giving consent to discharge, take account of the assimilative capacity of receiving waters. Where quality of discharges is not meeting the standards, the effluent has to be treated before being discharged.

Table 2.8 Discharge standards for effluents
values except pH in mg/L

Items relevant to mines	*Tolerance limits (discharge to inland water)*
pH	5.5 - 9.0
TSS	100
Oil and grease	0.10
Biochemical oxygen demand	0.30
Chemical oxygen demand	250
Iron (Fe)	3.0
Nitrate	0.10

Source: Schedule VI

Standards for disturbed land reclamation

2.18 Although coal mining, in particular opencast mining, alters the structure and appearance of the land considerably, no statutory standards for containing these land disturbances exist. Similarly, there are no standards for land reclamation. However, in recent years the MOEF has made the clearance of coal projects conditional on a commitment from coal companies to reclaim mined-out areas so that the land can be used for the same purposes as before mining started. To facilitate this, the MOEF is limiting the slopes of over-

burden dumps to an angle of 28° or less. (The decision to constrain the slopes of overburden dumps to 28° or less was taken to facilitate land reclamation and has no bearing on the safety of overburden dumps.)

Institutional arrangements

2.19 The following agencies of the Central and State governments deal with environmental issues (Figure 2.1):

- The Ministry of Environment and Forests (MOEF)
- The MOEF's regional offices
- The MOEF's State offices
- Central Pollution Control Board (CPCB)
- State Pollution Control Boards (SPCBs)
- Regional Offices of the SPCBs
- Regional Planning Authorities

The Ministry of Environment and Forests

2.20 The MOEF is primarily responsible for environmental planning at the national level; drafting of environmental objectives, standards and codes of practices; as well as reviews/approvals of Environmental Management Plans (EMPs), impact assessments and the issuing of environmental clearances.

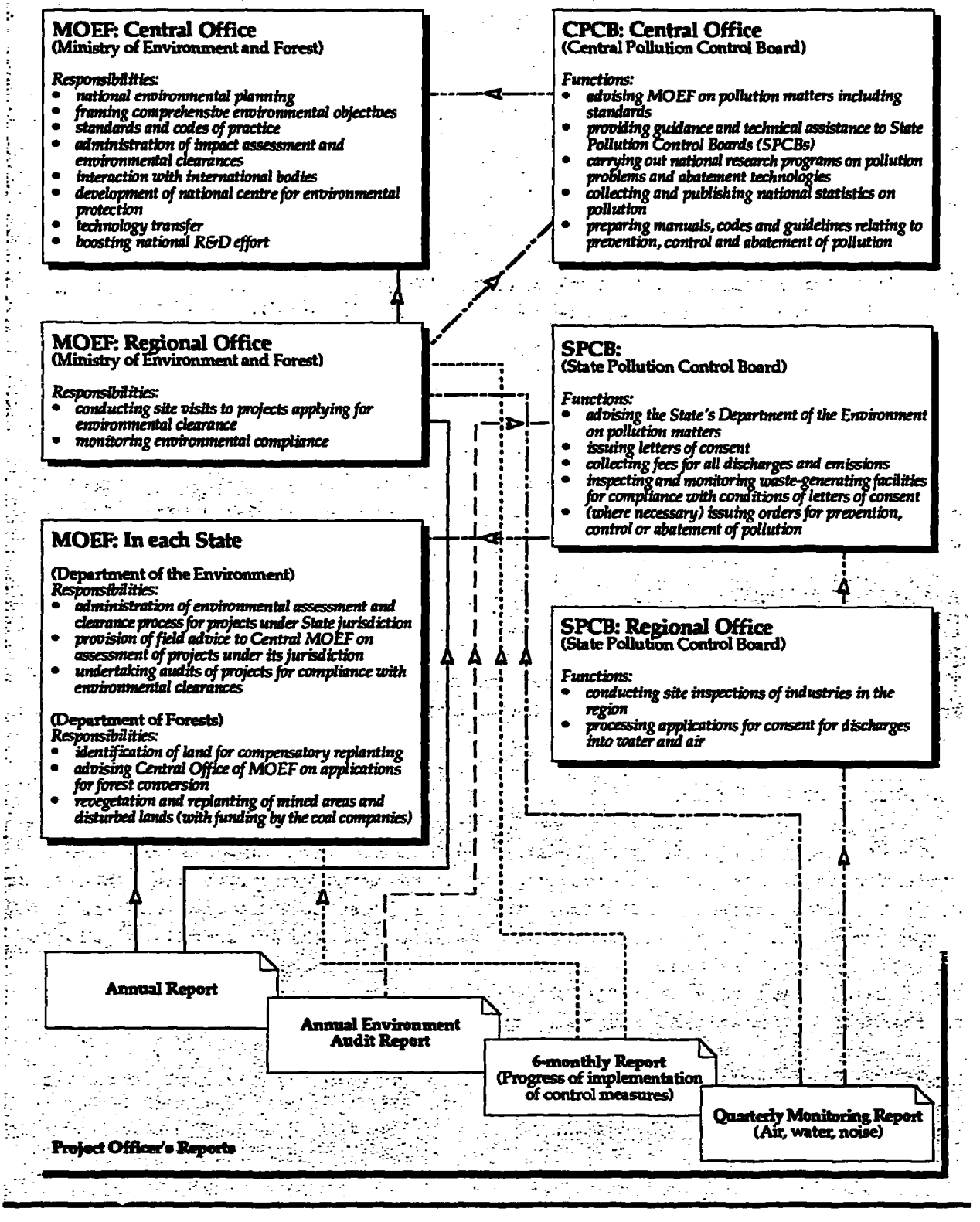
The MOEF's regional offices

2.21 The MOEF's regional offices have two major functions: to conduct site visits to projects that have applied for an environmental clearance and to monitor compliance with environmental standards and the conditions of consent letters.

The MOEF's State offices

2.22 At the State level, the Department of Environment is primarily responsible for administering the environmental assessment and clearance process for projects under State jurisdiction, for advising the MOEF on the assessment for these projects under its jurisdiction, and for undertaking compliance audits of environmental clearances. In parallel, the Department of Forests at the State level identifies land for compensatory afforestation; advises the MOEF on the use of forest land for coal mining and organises the applications for forest conversion; and undertakes revegetation and replanting of mined-out areas (including disturbed lands) with funds provided by the coal companies.

Figure 2.1 Institutional structure of environmental management



Central Pollution Control Board

2.23 The Central Pollution Control Board advises the MOEF on pollution matters, including environmental standards; provides guidance and technical assistance to State Pollution Control Boards; carries out national research programs on pollution problems and abatement technologies; collects and publishes national statistics on pollution; and prepares manuals, codes and guidelines relating to the prevention, control or abatement of pollution.

State Pollution Control Boards

2.24 State Pollution Control Boards advise the Department of Environment at the State level on pollution matters; they issue consent letters and collect fees for all discharges and emissions; monitor waste-generating facilities for compliance with the conditions set on in the consent letters; and, where necessary, issue orders for the prevention, control or abatement of pollution.

Regional offices of State Pollution Control Boards

2.25 The main function of the Regional SPCBs is to carry out site inspections of the industries in the region. They also process applications for approval of discharges of that would result in water or air pollution.

Regional planning authorities

2.26 Coal mining and pithead power generation has transformed several coalfields into major sources of commericial energy which have attracted numerous (frequently energy-intensive) industries. To coordinate the development of these regions and to better manage the (combined) impact of these industries on the environment and social fabric of the region, Central and State governments have established Special Area Development Authorities (SADAs) in the Singrauli, Korba, Talcher, Jharia and Ranigunj coalfields. SADAs focus in particular on environmental and social issues that cannot be addressed effectively by companies or organisations individually. These include monitoring of regional water and air quality; management of regional environmental mitigation measures, such as pollution abatement programmes; development of inventories ('regional banks') of non-forest and degraded land that could be afforested for compensatory purposes; and regional resettlement plans that would prevent people from having to resettle more than once due to lack of coordination of project implementing agencies. To achieve these objectives, SADAs seek representation from all major industries and agencies operating in a region. They usually include the Central and State government agencies, Coal India, power utilities, Indian Railways, other public and private industries, as well as local NGOs.

Environmental Management Plans (EMPs)

2.27 Since 1981-82, the Central Government involved the Department of Environment in investment decisions for coal projects. This was the first step towards taking environmental concerns fully into account at the planning stage of new projects. Since 1986, the Government requires submission of EMPs for investments in new coal mines or an increase of coal production from existing mines. (Environmental Impact Assessments (EIAs) are an intergral part of the EMPs. The MOEF bases its decision on a single document, the EMP.)

Preparation of EMPs

2.28 According to regulations issued by the Government for the preparation of EIAs and EMPs, the agency proposing to implement a coal project is required to submit an application to the Secretary of the MOEF for an environmental clearance and, if the acquisition of forest land is involved, for a forest clearance. The application needs to include the project report as well as the EMP for the proposed project. The MOEF will then review the EMP. In doing so, they will usually seek the assistance of specialised advisory committees (Environmental Appraisal Committees [EACs]). In their review of project proposals, EACs usually include NGOs. The MOEF, at the advice of the EACs, can call for hearings on proposed projects with project-affected people, if they believe that this would be in the public interest. (Hearings are usually held if there is large-scale resettlement involved or if there are likely to be significant environmental impacts.) Project-affected people and their (elected) representatives can convey their views or objections to the MOEF before a clearance letter is issued. If considered necessary, the EAC visits the project site. After the EAC is fully satisfied with the EIA and the mitigation measures in the EMP, the MOEF issues a clearance letter for the project with stipulations that would ensure the implementation of the required mitigation measures.

2.29 The present EMPs cover almost all environmental aspects. They usually include:

- a description of the geology and mining technology of the project;
- a description of the present (pre-mining) environmental conditions;
- an assessment of the environmental impact of the proposed project, in particular how the project would change the pre-mining environment;
- a detailed description of measures to minimise noise and air and water pollution;
- the preparation of mining and detailed reclamation plans for each period of five years of operation;
- the preparation of final land use plans covering different viable land uses;
- a proposal for biological reclamation;

- a description of the organisation for implementation and monitoring of the environmental protection measures; and
- the financial estimates covering the capital and revenue expenditure.

2.30 Coal India's EMPs cover most of the subjects required by OD 4.01. Areas not dealt with in the EMPs, such as environmental policy, environmental law, institutional arrangements, occupational health and safety, and public consultation, have been addressed in this report.

Consultations

2.31 Consultations with project-affected people and NGOs take place before the clearance letter is issued (as indicated above), during project implementation and in the course of mine operations.

2.32 **During project implementation.** If there are any environmental issues affecting the people living nearby during the implementation of the mining project, Coal India discusses these issues with the people and takes steps to alleviate them as soon as possible. For example, if wells dry up, Coal India supplies potable water. If houses or other structures are damaged due to vibrations from blasting, Coal India repairs them. Whenever people in mining areas have concerns about the impact of mining operations on their health, safety or welfare, they convey them to respective mine managers. As such, mine managers are involved in an ongoing process of consultation with project-affected people on environmental issues and appropriate actions are taken based on these discussions. Coal India has agreed to keep records of these discussions and any actions taken.

Dissemination

2.33 Coal India is in the process of making all project-related documentation (project descriptions, EMPs, the MOEF approvals, consent letters, letters of noncompliance pointed out by regulatory bodies, and the EAPs) available to the public at Coal India's headquarters in Calcutta and at the headquarters of subsidiary coal companies. Notices to this effect will be put up at the offices of the subsidiary company headquarters and the project sites. General Managers (Environment) at all corporate offices have been instructed to handle any inquiries and follow up any questions from concerned parties, including NGOs.

Enforcement

2.34 **Reporting requirements.** To enforce compliance with environmental laws and the conditions contained in the clearance letter, all project managers are re-

quired to submit quarterly reports on air and water quality and noise levels in their jurisdiction; semi-annual reports of the status of EMP implementation are sent to the MOEF for all environmentally cleared projects; and all coal mines have to submit annual environmental statements to the respective State Pollution Control Board.

2.35 In addition, representatives of the regional offices of State Pollution Control Boards and the MOEF monitor compliance through site visits. The main concern of the State Pollution Control Boards is pollution due to the discharge of effluents. In their infrequent visits of mining operations, they focus primarily on effluents from coal washeries. At the end of their site visits, they make mostly verbal comments. As of now, Coal India and its subsidiary companies have not received any written comments from the reresentatives of (regional) State Pollution Control Boards. The representatives of the regional offices of the MOEF focus on (a) the effluents from coal washeries and (b) on applications for forestry clearances. MOEF personnel visits mine sites only sporadically. The lack of regular inspections seems to be largely due to a shortage of inspectors.

CHAPTER 3 COAL INDIA'S ENVIRONMENTAL POLICY

Objectives

2.36 Coal India is committed to comply with all environmental laws, regulations and the conditions contained in letters of clearance by the MOEF. In addition, Coal India's corporate environmental policy aims at:

a. full integration of EMPs and environmental impact management with mine planning and design to facilitate the attainment of environmental standards, laws and regulations; and
b. mitigation, to the maximum extent possible, of the environmental and social impacts of mining.

Strategy

2.37 To achieve these objectives, Coal India has adopted the following strategy:

- Coal India is in the process of changing its designs for coal mines. In the future, Coaal India will follow designs that not only meet environmental standards, but minimise adverse effects on the ambient environment and the people living in the surrounding area.
- On new mines, environmental management will be fully integrated with mine design, planning and development; comprehensive baseline sur-

veys will serve as the basis for EIAs and the planning of reclamation activities.

- Reclamation of 'mined-out' areas will aim at achieving post-mining conditions that will help local people sustain or improve their livelihood. Reclamation activities will be carried out in such a way as to minimise delays between mining activities and post-mining use. In carrying out these activities, Coal India will develop and adopt reclamation technologies that are best suited for the Indian ecological conditions.
- Coal India will work closely with State Governments in identifying an inventory of deforested land that can be used for compensatory afforestation.
- In the years ahead, Coal India will give priority to the protection of air and water quality, the abatement of noise and the strengthening of its capability to reclaim mined-out areas.

Mitigating environmental management programmes

Mine planning and design

2.38 Coal India is now fully integrating environmental management considerations into the design and planning of new mines and the expansion of existing mines. Coal India is in the process of reviewing its current approach to the design and planning with a view to minimise adverse effects on the environment and to facilitate land reclamation after the completion of mining activities.

2.39 In addition, Coal India will add 'rolling' five year operational plans for all mine-related environmental activities to the EMPs for new mines. These plans will be updated annually as long as a mine is in operation.

Environmental monitoring

2.40 Coal India believes that it is the company's responsibility to police the compliance with environmental rules and regulations. With the growing concern about environmental issues, environmental monitoring has taken on a significance that is well beyond Coal India's current capabilities. To strengthen Coal India's capabilities in this area is an important element of Coal India's Corporate Environmental Action Plan (Annex 5).

2.41 Coal India has decided that for environmental monitoring, the regional environmental cells of the Central Mine Planning and Design Institute (CMPDI) will be responsible for overall supervision and guidance. Technically acceptable monitoring programmes will be in place on all subprojects by the beginning of the pre-monsoon period 1996. Environmental laboratories are being set up in the subsidiary companies and at CMPDI. CMPDI laboratories currently

cover the subprojects of CCL, NCL and the SECL subprojects in Korba coalfield. Until the other laboratories are completed, agencies approved by MOEF are engaged to carry out the environmental monitoring of the subprojects of MCL, WCL and those of SECL not in Korba coalfield.

Air quality management

2.42 The monitoring of the air quality at Coal India's mines indicates that gaseous pollutants are generally within standard limits. However, monitoring of suspended particulate matter (SPM) shows that this aspect of environmental management needs concerted mitigating efforts. Monitoring records and analyses indicate that 54% of mines meet the industrial SPM standard of 500µg/m³. The remaining mines exceed the limit, especially in pre-monsoon months which is the most dry and dusty period of the year. Material handling and transport, especially on haul and transport roads, generates large quantities of fugitive dust. Many of the known control/remedial measures for fugitive dust, during its generation and dispersion, are in place in the coal projects. These are metaling/paving of permanent roads, regular water spraying of roads, provision of bag filters in drills, blasting restriction during high winds and water spraying at other dust generating points. Newer mines have enclosed coal handling plants and auto water sprinklers at coal transfer and loading points. In addition, most mines have planted trees along the sides of roads, around infrastructure facilities and around residential areas.

2.43 Air quality monitoring at townships or colonies indicates that only 44% of the areas are in compliance with the rural/residential standard of 200µg/m³. Over half (56%) recorded values during the pre-monsoon period are in excess of the environmental standards. However, many of the colonies come under the project leasehold and environmental clearance permits the level of SPM up to 500µg/m³ in the leasehold area. The high SPM in colony area can only be partly attributed to mining activities. Fly ash from power plants, dust from poorly maintained local roads, the burning of domestic fuel wood, wind erosion from bare areas, and emission from other industrial activities such as cement and chemical plantscontribute to high SPM levels. Coal India has decided to analyse the existing air monitoring data for colony areas in order to determine the most problematic areas.

2.44 **Mitigating measures.** Air quality monitoring will be undertaken in all villages currently situated within core zones and on the fringe of buffer zones to determine compliance with the environmental standards for suspended particulate matter (SPM). All necessary measures, including watering of haul roads, fine mist spraying at transfer points and quick regreening of overburden dumps, will be taken to reduce dust to acceptable levels. Existing air monitoring information for all colonies will be analysed to determine problem

areas, and remedial air quality management plans will be prepared for all of these areas.

Noise management

2.45 Recorded noise levels on the mine sites are quite moderate. A few projects have recorded a day time noise levels above the 75 dB(A) level but in most cases the noise level in the mines and colony areas are within these limits.

Hydrology and water quality management

2.46 Mining needs continuous pumping of water out of the workings. In the past, Coal India has not prepared water balance studies. However, a recent EIA notification (27-1-94) makes water balance studies for proposed coal projects mandatory. Nitrates levels in effluents are well within the MOEF standards. Nitrate levels in leachate from some dumps show a concentration of only 12 to 15mg/l. Regarding sewage treatment, a common practice in colonies is to have soak pits for individual houses or a block of houses and there is no need to have separate treatment facilities. However, Coal India will monitor the ground water in its colonies to ensure that the soak pits do not contaminate the ground water regime. The water quality from mines meets the standards except with regard to total suspended solids (TSS) and oil and grease discharge. The thrust for dealing with water quality is based on the use of settling ponds and lagoons to allow some sedimentation time before the clarified water is discharged into local water courses. Coal India will ensure that oil and grease traps are provided, especially for effluents from workshops, washeries, and coal handling plants.

2.47 **Mitigating measures.** Surface water control and treatment schemes, including collection drains, adequately-sized settling ponds and polishing ponds before final discharge will be implemented at all subprojects by December 1996. There will be no further discharge of untreated industrial effluent directly to the environment after June 1996. Monitoring and soil suitability studies will be undertaken in colony areas to determine the acceptability of septic field sewage disposal and, where needed, sewage treatment facilities will be provided. Programmes for strengthening and/or constructing drains and settling tanks are provided in the EAP for each subproject. An assessment of the quantity of water to be discharged from each mine is required to obtain consent from the State Pollution Control Board for the discharge of effluents. Mines will ensure that effluents meet Indian environmental standards before discharge.

2.48 The impact of mining on local groundwater supplies will be assessed once every quarter through monitoring of water levels and quality in local wells. Where domestic wells are adversely affected, Coal India will provide alternate sources of potable water.

Disturbed land reclamation

2.49 It is Coal India's policy to afforest mined-out areas. The refractory soil conditions of external and internal dumps make it extremely difficult to reclaim mined-out areas for agricultural purposes. In the course of time, as rocks degrade and the soil becomes more fertile, the dumps can accept some plantation. The reclamation of these spoils for agricultural purposes would be extremely costly. According to Coal India, afforestation of mined-out areas and overburden dumps is a desirable activity to mitigate the declining forest cover in rural areas. Furthermore, if the pre-mining land use was mostly marginal farming with low yields, then any attempt to restore the land to full-fledged agriculture may not be economic.

2.50 The top soil conservation and its reuse is a commonly suggested proposal in EMPs. However, it has yet to be established whether the top one meter of soil is good or the one meter soil lying below it is better. In tropical climates the lower soil may have more nutrients due to heavy monsoons and leachate. Coal India will carry out a study to determine the quality of top soils before finalising its reclamation strategy.

2.51 One of the standard conditions in recent environmental clearances is to keep the slope angle of overburden dumps to 28° or less. This slope is considered a general guideline that will permit early establishment of self-sustaining vegetation cover. In light of this requirement, slopes of future overburden dumps are planned to be kept below 28°. As far as existing overburden dumps are concerned, Coal India will appoint a panel of experts which will review the safety of these dumps by June 30, 1996. (Coal India will submit the terms of reference for this panel to the Bank before appraisal.) If the panel, which would consist of international and Indian experts, finds that an overburden dump is unsafe, it will suggest remedial measures. Coal India will immediately proceed with the implementation of these measures. This panel of experts will also review the various options for the reclamation of existing overburden dumps (Annex 4). Based on these reviews, the panel will submit to Coal India proposals for reclamation of these dumps. Coal India will closely interact with local authorities and local people to establish end use objectives for each minesite. Native species will be used wherever possible in reclamation programmes. For new dump areas studies will be carried out to determine the most cost effective combination of initial spoil placement and subsequent recontouring to achieve the desired spoil configuration. A common

pool of earth-moving equipment for the exclusive use of reclamation will be placed under the control of area environmental cells. Significant horizons of organic soil will be conserved for use in plant propagation facilities or in reclamation. Spoil placement will be carried out to ensure that the most suitable materials for plant growth are placed on the dump surface.

2.52 Biological reclamation on many mine sites has been carried out by the State Forest Department or associated State Forest Research Institutes. The species most commonly used in reclamation planting are shown in Annex 3 and these have almost invariably been planted in block monocultures. Some excellent survival and growth rate has been achieved. However, while the selection of tree species has been appropriate (with the possible exception of Eucalyptus species which seem to suppress the establishment of self-seeding ground plants), the monoculture plantings and the use of trees to the exclusion of other plant groups is not. The main objectives of disturbed land reclamation are to stabilise the soil, to begin the process of soil rebuilding and enrichment, and to re-establish a productive land use. These objectives are most likely to be achieved through the establishment of mixed communities of trees, shrubs, grasses and forbs. Trees alone are unable to stabilise the surface soil since they lack the fibrous root systems and ground cover like grasses, legumes and many shrubs. Nitrogen fixation, an important consideration in reclamation, is much more efficient in herbaceous and shrubby legumes. Grasses, herbaceous legumes and shrubs can provide valuable livestock forage, and many shrubs because of their resprouting ability can provide continuous supply of domestic firewood. Relatively few trees have this "coppicing" ability. Annex 3 contains recommendations on shrub species suitable for reclamation planting in central India. Some project staff are beginning to experiment with grass and legumes on a project-by-project basis. Grass species such as vetiver (Vetiveria zizanoides), red oat (Avena byzantina), Seymour grass (Bothriochlo-apertusa), foxtail (Cenchrus biflorus and C.cilaris), and zinzvo (Dichanthium annulatum) have been used to reclaim degraded pasture land and may prove useful for mine reclamation as well. It is therefore decided that company and area environmental cells will consult the State Department of Agriculture and local university agricultural faculties to determine the most suitable grass and legume species and seed sources for each location. Successful establishment of grasses and legumes usually entails sacrification of the surface to cover the seed. Seed sown onto unsacrified overburden material often washes off, particularly if the surface is compacted. The use of conventional agricultural equipment is constrained by uneven and rocky ground. To overcome this, different types of heavy harrows are proposed to be tried.

Subsidence

2.53 Surface subsidence due to the collapse of underground workings continuess to be a major problem in many older underground coal mines. Many of

these mines were started before nationalisation. They are quite shallow and their former owners had little experience with the size of pillars necessary to prevent gallery collapse. Most of the present mines are much deeper, knowledge of pillar size is much more reliable, and many mines now practice gallery backfilling. For these reasons, subsidence in modern mines is expected to be relatively small, and easily mitigable by filling up the cracks appearing at the surface and some recontouring. All land subject where subsidence has occurred is acquired by the coal companies and is not made available for post-mining use until fully stabilised. Meanwhile some vegetation is grown over such land to stop entry of air and water and to help improve the ecology.

Regional land and environmental management planning

2.54 The rapid expansion of industrial activity, in areas such as the Singrauli, Talcher, Wardha Valley and Korba coalfields, has resulted in a complex interaction of economic, environmental and social impacts that can no longer be be managed solely on a project-by-project basis. Land use zoning is being established to minimise inter-sectoral conflict and provide each sector with the land base necessary to implement its programs. Regional environmental and social monitoring networks are being established, linked to monitoring activities of individual projects and companies. Programs of environmental and social impact management are being coordinated where possible, in order to avoid duplication and the potential of working at cross purposes. This regional approach to development planning is posing a substantial challenge to the abilities of the State government agencies and local industries to work jointly towards a common objective. Coal India is actively participating in the implementation of regional environmental management plans coordinated by various Regional Area Development Authorities.

Coal quality and ash management

2.55 The ash content of Indian coal used for power generation ranges from 30% to 50%. Ash disposal has become a major problem for power stations. Most of the ash in run-of-mine (ROM) coal in India originates from mineral matter interbedded with carbonaceous material at the time of formation of coal. However, some mineral contamination also takes place from roof and floor stones and various thin dirt bands lying within the coal bed, during the mechanised mining process.

2.56 **Remedial action.** Coal India recognises the increasing problem of fly ash disposal in the country and is cooperating with pit head power generation companies in identifying ash management options, in particular ash disposal in abandoned opencast or underground mines. Coal India proposes the following actions to assist the power utilities in their ash management:

- removal of extraneous mineral matters at the pit head and

- beneficiation of ROM coal for power plants located farther than 750km from the mine, if they are prepared to bear the cost; in addition
- Coal India will assist pithead power plants in a study of the feasibility of ash disposal in mined-out areas.

Organisational structure for environmental management

2.57 The primary responsibility for implementation of Coal India's corporate environmental policy will remain with Coal India headquarters in Calcutta, coal producing subsidiaries and CMPDI. In order to be able to address environmental issues more effectively, CMPDI, which provides expert services for mine planning and design, environment and research, established in January 1993 an Institute of Environment (IOE) at its head office at Ranchi and regional environmental cells at its regional offices. To safeguard the effective implementation of its environmental policy, Coal India will carry out, as part of the proposed program, a review of its capacity to deal effectively with environmental issues. This review will focus in particular on the need for changes in the organisational structure, the skills and staffing requirements. Annex 5 describes in somewhat more detail Coal India's corporate environmental strategy and action plan and includes a flowchart of the organisational structure currently in place to deal with environmental and mine safety issues.

Staff development and training

2.58 To overcome the shortage of trained environmental staff, Coal India will train available staff and recruit new staff when specific skills are not internally available. Coal India is planning to develop practical training programmes for existing and inducted staff and new recruits with specially designed curricula at local universities. The training programmes will include environmental impact appreciation for senior management, effluent treatment schemes for engineers, dump stability and reclamation techniques, and inspection and monitoring scheduling. A detailed training program will be developed in the context of the review of Coal India's environmental capacity. Coal India is currently in the process of selecting executive and non-executive staff for environmental positions throughout the companies. Executives will undergo training at the Centre of Mining Environment at the Indian School of Mines. In addition, training on environmental requirements and the implementation of environmental measures is being provided to all mine managers.

2.59 Coal India subscribes to the principle that good environmental management is the responsibility of everyone - equipment operators, production staff, environmental personnel and senior management.

2.60 In addition, Coal India proposes to establish annual awards to its employees for excellence in environmental programmes, paralleling the award programmes for production and worker safety.

2.61 In line with the corporate environmental policy outlined above, in particular the commitment to self-police compliance with environmental laws and regulations, Coal India has reviewed the status of environmental compliance of the mines proposed to receive financial support under the programme. The review showed that, in spite of adequate planning, the implementation of EMPs is not as effective as it should be. There are still areas of environmental non-compliance and many of the environmental mitigation measures called for in EMPs have yet to be implemented. A programme of action (EAPs), which would bring all mines into full compliance with required environmental standards is attached as Annex 6. Coal India is committed to full compliance with environmental standards, EMPs, letters of consent and EAPs for all 31 subprojects by December 1997. In addition, all surface areas subject to mining disturbances will be stabilised and reclaimed by December 2000. In order to ensure that this schedule is achieved, Coal India has prepared multi-year EAPs for each subproject with benchmarks and budgets. Box 2.1 contains a brief description of the basic structure and information provided in the EAPs. Each of the EAPs contains a time-bound action programme for environmental mitigation which clearly identifies benchmarks to facilitate monitoring of the implementation of these plans.

Consultations

2.62 Coal India is consulting project-affected people, their representatives and NGOs about the remedial and mitigating actions it plans to take in the context of implementing the Environmental Action Plans. These consultations are held at the offices of mine managers on mine-specific issues, and at Coal India headquarters on environmental and social policy issues that cover the majority of Coal India's mining operations. Annex 7 provides an example of the concerns raised at consultative meetings.

Box 2.1 Structure of Five-Year Environmental Action Plans (EAPs)

1. Background information:
   - Name of mine
   - Location (coalfield and State)
   - Type of mine
   - Method of mining
   - Sanction date and startup date
   - Current and maximum production
   - Mine life in years (total and residual)
   - Number of coal seams, their thickness and ash content
   - Stripping ratio (opencast mines)
   - Maximum depth of mining
   - Coal destination(s)
   - Summary description of mining method and type of equipment in use

2. Current environmental status:
   - the environmental setting,
   - mine planning and design,
   - project monitoring, auditing and evaluation,
   - hydrology and water quality management,
   - air quality and noise management and
   - disturbed land reclamation

3. Environmental management programmes for Fiscal Years 1995-96 to 1999-2000:
   - project monitoring, auditing and evaluation,
   - hydrology and water quality management,
   - air quality and noise management, and
   - disturbed land reclamation

This section also includes a five-year annual budget summary (operating and capital) for each of the above.

4. Also included in the EAPs are the areas covered by overburden dumps and plantation. In addition, the programmes (with appropriate benchmarks) for the completion of protection measures, such as effluent treatment ponds (settling tanks) and oil/grease traps, are shown.

PART III. SOCIAL ISSUES

3.01 Because coal mining and associated power developments have generally been sited in remote rural areas, the period of rapid expansion has also brought about some fundamental changes, both positive and negative, to the lifestyles of local people, many of whom have lived at subsistence level, are poorly educated, and are from traditional cultures. Resettlement projects fall generally into two categories; voluntary and involuntary. Voluntary resettlement usually involves younger people - natural risk-takers seeking new opportunities who have made the decision to move on their own. By contrast, involuntary resettlement usually expropriates the rights of people who may not want to move, and involves whole communities of individuals who had previously lived in interdependence: young and old, healthy and sick, affluent and poor, landholders and landless, skilled and unskilled. Since compensation has usually been tied to loss of land rather than loss of livelihood, displacement divides the community. Often, with the break-up of the community, the wealthier and more highly-skilled move to pursue opportunities elsewhere, leaving behind a disproportionately poorer community with limited ability to adapt to changing circumstances. In addition, increasing industrial activity typically attracts immigrants. Disadvantaged local people often either end up as exploited contract labourers trapped in perpetual poverty or they simply leave the area, to reappear in the slums of the city or as squatters, encroaching on unoccupied lands (often forest areas) in other parts of the region. The intrusion of industrial activity into traditional, rural communities and the resulting adverse social impacts occur in nearly every country and no country has yet dealt with them well. Therefore, there are no successful models of displacement and resettlement that can guide the coal industry and the thermal power sector in their local rehabilitation programs.

3.02 Judging from the experience in industrial countries and other Asian countries, economic growth will intensify the demand for energy in India. Currently, much of the energy that is produced in India is used inefficiently. Appropriate pricing policies and other incentives would undoubtedly reduce the use of energy by many end users. While efficient energy use will definitely reduce the demand for energy per unit of output, it will not alleviate the need for more energy to produce additional units of output. As the standard of living of India's growing population rises, so does the demand for energy, in particular electricity. A comparison with energy use in industrial countries clearly demonstrates this.

3.03 At least in the foreseeable future, this additional energy will have to come mostly from coal-based thermal power generation. Therefore, efficient and environmentally sustainable coal production is essential if India wants to

reap the benefits of its liberalisation program, accelerate economic growth and continue to make headway in its efforts to alleviate poverty.

3.04 Coal production, whether it takes places in underground or opencast mines, requires access to land. Unlike other industries, the coal industry has little choice in the location of its activities because coal mines have to be developed where there are commercial reserves. In recent years, the social and environmental costs of developing coal resources have increased considerably, particularly in the densely populated areas of India's eastern States. Coal India finds it increasingly difficult to acquire land for the expansion of its operations. To deal with these challenges Coal India has changed the designs of new mines to minimise the adverse effects of these operations on the environment; it has adopted resettlement and rehabilitation policies that ensure that all people affected by its projects are compensated for their losses; it has intensified the community development programmes through which it aims to improve the living conditions in villages adjacent to its mining operations; and it is strengthening the organisational structure within the coal companies to ensure effective implementation of these policies.

3.05 This section provides an overview of the magnitude and issues involved in the acquisition of land by the coal industry, in particular the impact on the people affected by it. It gives a synopsis of the two main legal instruments for land acquisition by the coal industry (the *Land Acquisition Act* (1904) and the *Coal Bearing Areas Act* (1957)), as well as Coal India's policies for resettlement and rehabilitation. This will be followed by a summary of the main issues the coal industry faces in implementing the legal and policy provisions, and the options its needs to consider to deal with them. Against this background, this section will then describe the social impact of the proposed programme, and the arrangements that have been made to ensure that resettlement and rehabilitation programmes associated with the programme meet the Bank's Operational Directives.

Need for land

3.06 Shift towards opencast mining. With the shift towards opencast operations the need for land has increased dramatically. At the time of nationalisation, only a third of India's coal production came from opencast mines. Over the past two decades this share has almost doubled. As a result, the coal industry needs to acquire large tracts of land year after year. Table 3.1 shows the cumulative effect of the shift towards opencast mining on land requirements and people affected by coal projects.

3.07 Behind the shift towards opencast mining are mainly economic considerations. Opencast operations require relatively little labor; permit deployment of cost effective, highly mechanised operations; have a short gestation pe-

Table 3.1 Land acquisition & resettlement by Coal India, 1982-83 to 1992-93
hectares

Year	W. Bengal	Orissa	Madhya Pradesh	Other States*	Total land	Forest land	Families resettled
1982-83	557	0	0	2,079	2,636	644	352
1983-84	325	181	616	4,172	5,294	927	-
1984-85	312	74	690	1,432	2,508	401	-
1985-86	449	0	846	2,763	4,058	536	-
1986-87	424	122	1,777	1,800	4,123	368	-
1987-88	267	134	682	711	1,794	582	20
1988-89	370	411	30	1,021	1,832	83	224
1989-90	621	207	616	3,680	5,124	712	190
1990-91	332	691	175	1,737	2,935	9	567
1991-92	379	222	290	1,006	1,897	-	1,588
1992-93	459	86	766	1,724	3,035	183	849
Total	**4,495**	**2,128**	**6,488**	**22,125**	**35,236**	**4,445**	**3,790**

*Includes land acquired in Bihar, Uttar Pradesh and Maharpurshtra
Source: Coal India Ltd

riod, and as such allow the industry to accelerate production over a short time span; and are considerably safer than underground mines. On the other hand, they require the acquisition of large tracts of land and the resettlement and rehabilitation of large numbers of people, they result in widespread environmental degradation, and are the primary cause for the gradual decline of the average quality of coal output. Coal can only be mined through opencast mines if the coal deposits are close to the surface; the maximum depth of opencast coal mines is about 250m.

3.08 Deeper deposits have to be extracted through underground mining. These mines face many of the same social and environmental consequences as opencast mines: while land requirements are usually smaller, subsidence (due to the routine collapse of mined out areas) damages houses and infrastructure and impairs the use of land above underground mines, and effluents from underground mines are a major source of water pollution. From a commercial perspective, they are more costly to operate because they are more difficult to mechanise and require considerably more labor than opencast mines. Although they produce higher quality coal, most underground mines in India suffer heavy financial losses.

3.09 In recent years Coal India has faced growing pressure to safeguard the environment and welfare of the people affected by its operations. While this has added to the cost of mining and reduced the cost advantage opencast mining enjoyed, without these measures the coal industry would not be able to sustain its further growth.

Social implications

3.10 The development of coal mines has a wide range of effects on the local population. While some welcome the opportunities and changes that are part of mine development, others resist them. Among these changes are:

- EMPLOYMENT OPPORTUNITIES. The opening of a coal mine brings employment into an area. The relatively high wages of the coal industry (Rs45,000 a year, equivalent to US$1,331) are far above the prevailing minimum wage (Rs6,600 a year, equivalent to US$195) and make employment at the mine highly attractive. In almost all instances it remains the key to land acquisition and is the primary form of rehabilitation for landowners. This makes it virtually impossible for the coal industry to transfer surplus labor from other mines; not only would the local population resist, it would rob the coal company of its most valuable bargaining chip in its efforts to acquire the necessary land. Construction activities at the mine, and the increase in purchasing power of those that have found employment with the coal company, create numerous indirect employment opportunities.
- HEALTH CARE. Employees of the coal company enjoy some of the best health care available in India. In emergencies, coal companies make their facilities available to local people not employed by them. In addition, coal companies construct 'dispensaries' at resettlement sites, as part of the rehabilitation package to project-affected people. (State Governments are to provide the necessary staff, however, in practice, States frequently fail to do this.) As part of its community development program, coal companies frequently construct dispensaries and clinics in the surrounding villages, even if they are not directly affected by their operations.
- EDUCATION. Besides providing educational facilities in the employees' colonies, schools are also provided as part of the rehabilitation package to project-affected people. However, State Governments are responsible for providing teachers, which they frequently fail to do.
- ROADS, POWER, WATER, ELECTRICITY, ETC. The coal companies provide these facilities, not only to their employees, but also to project-affected people at resettlement sites.
- CHANGE IN TRADITIONAL LIFESTYLES. The most significant change that occurs as a result of the construction of a coal mine, is the change in traditional lifestyles. The construction of a coal mine inevitably introduces an element of modern lifestyle (characterised by salaried labor, money economy, and a split between production and consumption) into a subsistance economy, largely based on agriculture. This transition can be extremely painful and introduce new conflict elements into the local community. The disparity of monetary incomes created by the employment provided by the coal industry can be per-

ceived as creating new inequalities and give rise to dissatisfaction among those who have not found employment. The change in lifestyles will be significant where it affects people, such as tribals, that depend on forest for their livelihood and who previously had little contact with the 'outside world.' While the interests of tribals are protected by special laws, the loss of key resources, such as forest access, may result in impoverishment, loss of identity linked to a specific lifestyle, and the disintegration of communities. The sudden influx of money furthermore tends to create inflationary pressures in the local economy. This will of course especially affect those who are on the margin of the money economy, i.e. those who continue to pursue their traditional livelihood.

3.11 The Government has passed several laws that regulate the acquisition of land. The primary objective of these laws is to establish an orderly process for the transfer of land to public sector entities. In addition, Coal India and its subsidiary coal companies have evolved policies that spell out compensation and rehabilitation measures for people affected by coal projects.

Laws and policies

3.12 In the earlier days of nationalisation, land acquisition was a minor problem, since Coal India had acquired with the nationalised mines large tracts of land that were sufficient for the activities of small mines. Small stretches of land used to be acquired for extension or opening of new mines. Then land was acquired through private negotiation, the *Land Acquisition Act (LA Act)*, and the *Coal Bearing Areas Act (CBA Act)*.

The Land Acquisition Act

3.13 The LA Act is the main legislation governing the acquisition of private lands for both public purposes and companies. Since acquisition of property is part of the concurrent list of the Indian Constitution, this central Act has several State amendments. The LA Act is clear that for all land acquired for the purposes of the Union, the powers would vest in the Central Government; for all other acquisitions, it would be in the State Governments. In general, the powers of the District Collector under the LA Act are conferred on Land Acquisition Officers (LAOs), who belong to the State Civil Service.

3.14 THE PROCESS OF LAND ACQUISITION. Under Section 4 of the LA Act, the Government has to publish a preliminary notice identifying the land to be acquired and invite objections within 30 days. The District Collector arranges for a hearing of any objections to this land acquisition, and prepares a recommendation to the Government. Based on this recommendation the Government decides whether to issue a declaration under Section 6 notifying that the land is required for

a public purpose. The public notices under Sections 4 and 6 have to be published in two local newspapers and in the official gazette. If the acquisition of land is urgent, the declaration under Section 6 can be made immediately after the preliminary notification (Section 17), and the District Collector may take possession of the land after paying 80% of the estimated compensation.

3.15 If the Government decides, on the basis of the recommendation of the District Collector, that the land should be acquired, the District Collector is instructed to proceed with the land acquisition. He will then serve individual notices (under Section 9) to the affected landholders asking them to file their claims for compensation. The District Collector decides about the amount of compensation, taking into account the claims and other evidence. The land can be taken over as soon as the compensation amounts have been paid to the titleholder.

3.16 Compensation. The compensation of land is done according to the market rate prevalent at Section 4 notification. In practice, this is done by the State Government authorities (District Collector) by determining the average recorded sale prices of the last three years prior to notification. An additional 'solatium' of 30% is added for compulsory acquisition, and an interest of 12% per annum is added for the period between notification and the actual payment. In most cases, the amount will not be sufficient to buy replacement land in the area because the officially recorded sale price, on which taxation is based, is often substantially less than the actual price paid, and because the price of the land in the area will increase with the increased demand introduced by the subsidiary. The final award of compensation has to be determined within two years of the declaration of public purpose (Section 6), otherwise the acquisition proceedings must start anew.

3.17 Any affected person who is not satisfied with the compensation may apply to the District Collector within six weeks of the award. The District Collector has to refer the complaint to the District Court for adjudication. If the Court decides in favor of the person who has complained, interest, at the rate of 9% for the first year and 15% for subsequent years, is payable on the compensation amount.

The Coal Bearing Areas (Acquisition and Development) Act

3.18 Coal companies acquire land for coal mining under the CBA Act. The Department of Coal and the coal companies are vested with powers of land acquisition under the CBA Act.

3.19 The process of land acquisition. Based on available geological information, coal companies submit proposals to the Department of Coal for preliminary notifica-

tion of their intention to prospect for coal in a specific area. This notification (under Section 4) permits coal companies to mark out and survey the land.

3.20 As soon as a coal company has determined that coal can be obtained from land notified under Section 4, the Department of Coal may (within two years of the date of the preliminary notification) issue a **notice of intention** (under Section 7) to acquire this land. This notice has to be published in the Central Gazette and requires prior consultation with the State Government. Affected persons may file objections with the Coal Controller at Calcutta. After considering the report of the Coal Controller, the Department of Coal may issue (within three years after issuing a notice of intention) a **declaration of acquisition** (under Section 9). Following the announcement of the declaration of acquisition in the official Gazette, the Government of India becomes the owner of the land with all the rights associated with it. The Government may then turn the land over to the coal company.

3.21 **Compensation.** Compensation to land owners is based on the market value (in practice similar to LA Act compensation) of their land on the day of the preliminary notification (Section 13). If the landowner does not accept the amount of compensation, or where it is not possible to determine individual rights over the notified land, the matter is referred to a tribunal, usually the District Judge in the jurisdiction the land is located (Section 14).

Differences between the Land Acquisition Act and the Coal Bearing Areas Act

3.22 Land acquisition under the CBA Act is more advantageous to coal companies.

- Land acquisition under the CBA Act is carried out entirely by the Department of Coal and the coal companies. Theoretically, the District Administration is only involved in obtaining copies of village land records. In practice, coal companies have to rely on the help of the District Administration in the process of land acquisition, and frequently seek its 'coercive force' to take over the land acquired. This has led to friction between the Central and State Governments, which argue that all lands should be acquired under the Land Acquisition Act and the CBA Act should be repealed.
- Land acquisition under the CBA Act is more authoritarian than under the LA Act.
  - Project-affected people do not receive individual notices at any state of the proceedings.
  - Land ownership is transferred to the Government, after the declaration of land acquisition has been issued, without any stipulation that compensation should be paid before taking over the land.

- The CBA Act does not incorporate any of the measures introduced in the LA Act in 1984 that make compensation more equitable.

3.23 The Government is aware of the many disparities between the two Acts and has been considering possible legislative action to bring the CBA Act more in line with the LA Act. In the meantime the Department of Coal has issued an order that makes compensation under the two Acts roughly equal. Box 3.1 summarises the main differences between the two Acts.

Coal India's resettlement and rehabilitation policy

3.24 Before considering the present status of resettlement and rehabilitation activities within Coal India, it is essential to appreciate the timescale and duration of mining projects and to recognise that many mines which currently are operational were designed and commissioned as many as 30 years ago. Within that time span there have been many progressive changes in the application of resettlement and rehabilitation in India and within the mining sector, so the situation seen at an old mine should not be taken as representative of the current approach of Coal India.

3.25 Standards and approaches have also changed because of the nature of projects, because of regional differences in policies and their implementation, and because of variations in the approaches and applications taken by project personnel. Because of the great number of opencast mines which have developed over the past 30 years, the current situation of resettlement and rehabilitation of project-affected people has become quite complex. To appreciate the current situation, the timing of the resettlement and rehabilitation activity and the situation at the time of project implementation must be taken into account.

3.26 Coal India's decision to establish a policy for resettlement and rehabilitation of project-affected people represents an effort to provide uniform guidance to subsidiary coal companies, in response to persistent and growing discontent of project affected people in many locations. The evolution of this policy has been influenced by several factors. The driving motive has been the continuous and growing need for land. Until the late 1980s, the coal companies dealt mainly with the landowners, and ensured their cooperation by providing employment to families of landholders of a certain size (usually more than two acres) in addition to paying the compensation for lost assets.

3.27 With the increased mechanisation of the coal mines, the increase of population with smaller land holdings, and increased political attention to involuntary displacement, it has become increasingly difficult for the coal companies to continue this practice. The demand for jobs in the coal companies for surrendering land has increased and the need for unskilled labor has de-

Box 3.1 Main differences between the Land Acquisition Act and CBA Act

Item	*Land Acquisition Act, 1904*	*Coal Bearing Areas Act, 1957*
Application of the law	For the acquisition of land needed for public purposes and for companies.	For the acquisition of unworked land, including mining rights, containing or likely to contain coal deposits.
Authorities involved	The State Government. Divisional Commissioners, District Collectors and officials appointed to perform the functions of a Collector under the Act.	Department of Coal, officials of the coal companies.
Notifications	Preliminary notification under Sect. 4 and declaration of intended acquisition under Sect. 6 to be published in the official gazette and public notice in the affected locality.	Preliminary notification under Sect. 4 and notice of acquisition under Sect. 7 to be published in the official gazette.
Objections to acquisition	May be filed with the local Land Acquisition Collector.	May be filed with the Coal Controller in Calcutta.
Notice to project-affected people	Individual notice is mandatory (Sect. 9).	Individual notice is not required at any stage. Declaration of acquisition under Sect. 9 must only be published in the official gazette and local Government offices.
Prescribed time limits	Declaration of intended acquisition under Sect. 6 to be made within one year of preliminary notification under Sect. 4: amount of compensation to be finalised within two years of the declaration.	Notice of acquisition under Sect. 7 to be issued within 3 years of preliminary notification under Sect. 4; declaration of acquisition to be made within 3 years of the Sect. 7 notice.
Compensation	In addition to 'market value' of the land, the following compensation applies: a. Solatium of 30% on market value of land. b. 12% on the market value from the date of preliminary notification to date of award. c. For 'enhanced awards' awarded by Courts, interest on compensation payable is 9% for the first year and 15% for subsequent years.	Act provides only for reimbursement of the market value of land. However, executive instructions issued by the Department of Coal direct coal companies to pay compensation in line with the LA Act.
Timing of payment	At least 80% of the estimated compensation has to be paid before taking possession of any land, even where the urgency clause is applied; full payment in all other cases.	Payment of compensation not required before the acquired land is occupied.
Adjudication	Affected persons not satisfied with an award proposed by the Collector may appeal to the Court of the District Judge. Further appeals must be made to the High Court.	Appeals are directed to Tribunals. All District Judges are notified as one member Tribunals. Further appeals must be made to the High Court.
Scope of court orders	Benefits of enhanced compensation awarded by District Courts are extendible to all landowners in similar circumstances.	

Source: Coal India

clined with the increasing mechanisation of mining operations. All coal companies employ more labor than they need.

3.28 The State Governments of Madhya Pradesh and Orissa have responded to this situation by issuing guidelines for rehabilitation measures, largely based on the size of the land expropriated. These are formulated as entitlements for jobs in the coal company for the families of the titleholders. Although first priority is given to those families losing both homestead and one third of agricultural land, the provisions generally favor larger landowners by providing employment for one person coming from families losing two or more acres of irrigated land or three or more acres of unirrigated land. The aim of these policies seems to be based on the State Governments' wish to secure employment in the region.

3.29 In 1990, a circular (the so-called Gulla package) was given to all subsidiaries by Mr. O.P. Gulla, Joint Secretary to the Government of India, Department of Coal, Ministry of Energy. This document was the first attempt to formulate a corporate policy for resettlement and rehabilitation in Coal India, and has provided the basis for resettlement and rehabilitation activities up to April, 1994. The circular stipulates the following responsibilities for the coal company:

a. all new employment opportunities for unskilled and semiskilled labor must go to land losers,
b. vocational training should be provided to upgrade project-affected peoples' skills for employment in the coal company,
c. cash compensation for land must be deposited by the coal company to the District Authorites before taking possession in order to avoid delays in payment, and
d. a monthly allowance for 20 years, depending of the size of the lost land holding, should be paid to the titleholder who did not get a job in the coal company.

3.30 In addition to the provisions made in the Gulla Package, the coal companies continued to follow the State guidelines of providing employment for one person coming from families losing two or more acres of irrigated land or three or more acres of unirrigated land.

3.31 The provision of jobs is regarded by almost all project-affected people as the most desirable rehabilitation option, since it results in a five-fold increase of income for most. At present, the average wage is Rs30,000 (equivalent to about US$1,000) per year for semiskilled or unskilled labor in the Indian coal mines. This is five times the minimum wage rate. In addition, employment in the coal mine brings additional benefits, such as free medical care and subsidised housing. Table 3.2 shows the employment of land oustees

from 1973 to 1993, during which period a total of 33,470 land oustees were employed by the subsidiaries of Coal India.

Table 3.2 Employment of land oustees by Coal India, 1973 to 1993

Year	Number of Persons given employment							
	ECL	BCCL	CCL	WCL	NCL	DCC	MCL	SECL
1973		4						
1974		21						
1975		21						
1976		2						
1977	452	18						
1978	435	84	142					
1979	503	96	62					
1980	779	117	165					
1981	924	237	621					
1982	676	217	517			4		
1983	748	184	118			1		
1984	485	53	130			3		
1985	347	43	327		1,492**	0		
1986	360	59	16	852*	90	34		
1987	272	212	232	156	252	4		
1988	126	173	125	42	511	22		
1989	247	395	331	167	151	3		
1990	122	664	360	623	300	11		
1991	439	387	174	664	374	0		
1992	763	192	241	253	156	0		7,988***
1993	463	70	215	365	118	0		192
Total	8,141	3,249	3,776	3,122	3,444	82	3,476	8,180

Notes: *Prior to 1986
**1973 to 1985
***Prior to September 1993
Source: Coal India

3.32 With the phasing out of Government support, Coal India can no longer afford the heavy financial cost of employing more labor than it needs. Coal India has therefore imposed severe restrictions on the hiring of new staff and, in parallel, adopted programs to reduce its manpower. This situation forced Coal India to rethink its policy of rehabilitating project-affected people. Since provision of jobs cannot be taken for granted in the future, the coal companies have had to find other ways to restore the incomes of people who are adversely affected by the acquisition of land.

3.33 It has long been recognised by the coal companies that not all the people that live in communities occupying or using land required by the mine are land owners. This group could be large and may include tenant farmers, sharecroppers, squatters and agricultural laborers. Until now, these people have not been entitled to any resettlement and rehabilitation assistance.

However, when resettling a village, the subsidiaries have often provided accomodation for some of these families at the resettlement site.

3.34 The salient features of the State guidelines, the Gulla package, and the new Coal India policy are summarised in Box 3.2. Coal India's current policy (Annex 8) was approved by the Board on April 4, 1994. It represents the latest stage in a development brought about by the increased challenges confronting the coal companies when acquiring land. The developement is characterised by several trends:

- from recognising only the loss of land in the compensation process to considering the loss of economic assets,
- from considering only landowners/titleholders to be dealt with to considering the surrounding communities as the partner in the resettlement and rehabilitation process,
- from considering landowning families as the unit of entitlement to considering every adult individual as the unit of entitlement,
- from acting on the basis of regional guidelines to acting of the basis of a corporate policy,
- from provision of employment with the coal company as the major vehicle of rehabilitation to multiple rehabilitation efforts,
- from being mainly accountable to the coal company to being primarily accountable to the project-affected people, and
- from not involving the project-affected people in the planning and implementation to extensive consultation and participation of project-affected people in the process.

Implementation of Rehabilitation Action Plans under the project

3.35 The implementation of the new policy will be a difficult process which will require substantial attention and support. The policy limits the rehabilitation assistance from life-long employment in the coal company to assistance during a limited period, during which the project-affected people also have to contribute to their own successful rehabilitation.

3.36 This policy will be implemented throughout Coal India, however the following section describes only Coal India's organisational structure for the implementation of resettlement and rehabilitation in the projects proposed for Bank funding, and should be considered as an example of the arrangements and issues that have to be dealt with throughout projects involving resettlement and rehabilitation. The present project is a learning ground, and as such a pilot and demonstration project; an area that is relatively unchartered territory for Coal India.

Box 3.2 Evolution of Coal India's resettlement and rehabilitation policies

Category of project-affected people	MP package (1991)	Orissa package (1989)	Bihar package (1990)	Coal India's current policy (1994)
Landowner	Compensation as per legal norm. a. Losing homestead land and one third of the agricultural land: one job to one member of the family on first priority. b. Losing three acres unirrigated or two acres of irrigated land: one job to one member of the family on second priority. c. Losing total agricultural land: one job to one member of the family on third priority. d. Losing at least two thirds of agricultural land: one job to one member of the family on availability	Compensation as per legal norm. a. Losing house, homestead land and at least one third of the agricultural land: one job to one member of the family on first priority. b. Losing at least three acres unirrigated or two acres irrigated land: one job to one member of the family on second priority. c. Losing total agricultural land: one job to one member of the family on availability. d. Losing one third agricultural land: one job to one member of the family on availability.	Compensation as per legal norm. a. Losing land: all new and semi-skilled and unskilled jobs of the project reserved for them. b. Losing land: if no job is given, pro-rata subsistence allowance every month for 20 years. c. Suitable vocational training to landlosers to upgrade their skills for employment in other categories of jobs in the project, on a preferential basis.	Compensation as per legal norm. a. If feasible, subsidiaries will offer employment as per their own policies. b. Project-affected people identify and purchase, with the assistance of the subsidiary, equivalent replacement land using their land compensation. c. The subsidiary will assist an affected person to establish non-farm self-employment. d. If none of the previous are available, a person losing less than two acres whose annual income is less than Rs12,000 will receive rehabilitation assistance in the form of a subsistence allowance or grant to be used for productive investments.
Adult members of the landowner's family (> 18 years old)	No provision.	No provision.	No provision.	Adult males and females entitled to be rehabilitated through self-employment schemes.
Homestead owners	Losing homestead: one job to one member of the family on third priority and one plot of land of 400m².	Losing only homestead: one job to one member of the family and one plot of land up to 400m².	Losing house: alternative house site.	Replacement cost of homestead and the structures on it. One plot of 100m² per family, assistance in designing the new house (if desired) and shifting allowance to cover full cost of shifting to new site. Rehabilitation through self-employment schemes.
Members of the homestead owner's family	Major sons on or before the date of notification of intention to acquire to be given a separate plot.	Major sons separated from the family on or before the date of notification of intention to acquire to be given a separate plot and eligible for self-employment.	No provision.	Adult members entitled to be rehabilitated through self-employment schemes.
Sharecroppers, land lessees, tenants, day-labourers, etc.	No provision.	No provision.	No provision.	Adults to be rehabilitated through self-employment schemes or jobs with contractors.

Category of project-affected people	MP package (1991)	Orissa package (1989)	Gulla package (1990)	Coal India's current policy (1994)
Squatters having houses	No provision.	No provision.	No provision.	Replacement cost of house and other structures. One plot of 100m² per family, assistance in design of new house (if desired) and shifting allowance to cover full cost of shifting to new site. Adults to be rehabilitated through self employment schemes.
Tribals cultivating land under traditional rights	No provision.	No provision.	No provision.	Adults to be rehabilitated through self-employment schemes or jobs with contractors.
Tribals residing in villages having houses not owned by them	No provision.	No provision.	No provision.	Replacement cost of house and other structures. One plot of 100m² per family, assistance in designing the new house (if desired) and shifting allowance to cover full cost of shifting to new site. Community to be shifted in a group with provision of facilities to meet their specific needs. Adults to be rehabilitated through self-employment schemes.
Infrastructure in resettlement colony	To be provided.	To be provided.	To be provided.	To be provided.
Shifting and housing grant	Housing grant of Rs2500	Housing grant of Rs2000	Housing grant of Rs5000 and shifting grant of Rs2000	Full cost of shifting.

Source: World Bank Staff

Planning for resettlement and rehabilitation

3.37 In identifying the number of project-affected people, Coal India relied initially on estimates prepared by mine managers. Since families were the unit of entitlement for compensation of the loss of land in guidelines provided by the States and the policies issued by the Ministry of Coal, mine managers provided the data in terms of families. In addition, data was only provided

for families affected by land acquisition in the course of project implementation. No count was taken of families whose land had been acquired earlier and who continued to cultivate (and in some instances live on) this land with the permission of the coal company.

3.38 The revision of Coal India's policy for resettlement and rehabilitation in April, 1994 changed the definition and categories of project-affected people and the data collected earlier had to be re-estimated. Subsidiary coal companies hired consultants, NGOs and research organisations for doing socio-economic baseline surveys and censuses of the project-affected persons. The terms of reference were provided by the Bank.

Status of resettlement and rehabilitation

3.39 Out of a total of 31 subprojects proposed for Bank financing, 18 involve resettlement and/or rehabilitation issues. In these 18 subprojects, a total of 18,225 people (3,899 families) will be adversely affected in the period from 1994 to 2003. During the project period (1994 to 1998) the total number of people adversely affected will be 16,672. The majority of the project-affected people (11,750) are located in Orissa, within MCL. Overall, 10,928 people will lose their houses and will have to be physically resettled. Tables 3.3 and 3.4 provide details. Sixteen subprojects require detailed Rehabilitation Action Plans. The two remaining subprojects combined will affect only 21 people (4 families), involve no resettlement, and do not require Resettlement Action Plans, although the affected people will be rehabilitated according to the same entitlements and principles.

3.40 An overview of project-affected people over 18 years of age and classified according to the Coal India policy of entitlements is provided in Table 3.5. This table shows that 2,886 landless people who would not have been entitled to assistance under previous guidelines, are now entitled to rehabilitation assistance.

3.41 A summary of the Rehabilitation Action Plans is provided in Table 3.6. For the project period, a total of 9,418 persons (3,575 families) are entitled to rehabilitation assistance. The provision of jobs with the coal company and contractors is planned to rehabilitate 3,569 people (38%) and 5,853 people will be entitled to assistance for self-employment. Since these figures comprise the total number of entitled persons they are a maximum figure. Some people may decline the offer for reasons such as old age or because they are married to persons employed by the coal company; this will be determined in the process of implementation. If the rehabilitation entitlement had been provided under the previous guidelines, each family, generally, would have been given one employment opportunity.

Table 3.3 Number of people affected by the Coal Sector Rehabilitation Project, 1994 to 1998

Company	Mine	Land to be acquired (ha)	Land to be posessed (ha)	Total PAPs	Tribal PAPs	Entitled PAPs >18 years	PAPs to be resettled	Total affected families
MCL Opencast	Ananta	0	0	685	0	455	0	147
	Belpahar	13	585	3,941	1,110	2,387	3,300	838
	Bharatpur	0	165	2,497	0	1,516	1,294	521
	Jagannath	0	18	1,962	0	1,169	1,962	517
	Lakhanpur	9	89	1,010	156	567	865	293
	Samleswari	0	112	1,655	232	988	0	414
NCL Opencast	Jhingurdah	0	0	460	460	234	247	63
CCL Opencast	KD Hesalong	0	30	198	153	81	198	47
	Parej East	0	108	354	236	133	286	53
SECL Opencast	Bisrampur	323	323	878	329	443	0	125
	Dhanpuri	0	1	239	211	131	0	49
	Dipka	0	0	1,516	994	655	1,302	288
	Gevra	0	0	568	260	279	475	91
	Kusmunda	0	0	176	75	83	115	23
SECL Underground	Behraband	0	0	16	0	9	0	3
	Churcha West	0	0	5	0	1	0	1
	Pandavpara	24	24	249	186	120	0	40
	Singhali	0	0	299	208	177	0	56
	Total	**369**	**1,455**	**16,708**	**4,610**	**9,428**	**10,044**	**3,579**

Source: Coal India Ltd

Institutional arrangements

3.42 In order to ensure effective implementation of Coal India's resettlement and rehabilitation policy, Coal India has agreed to strengthen the implementing organisational structure. However, to build in-house capacity in each subproject with resettlement and rehabilitation may not be universally the best solution. Some mines may not have on-going resettlement and rehabilitation issues over the entire length of the project. It is therefore envisaged that institutional strengthening takes place at the Coal India level and at the area level. Coal India has agreed to provide the General Manager (Resettlement and Rehabilitation)'s office with sufficient resources and manpower to guide, support and monitor the implementation of the new Coal India policy. In addition, Coal India is in the process of hiring one consultant, with social science background and 'hands-on' field experience in community develop-

Table 3.4 Number of people affected by the Coal Sector Rehabilitation Project, 1994 to 2003

Company	*Mine*	*Land to be acquired (ha)*	*Land to be possessed (ha)*	*Total PAPs*	*Tribal PAPs*	*Entitled PAPs >18 years*	*PAPs to be resettled*	*Total affected families*
MCL Opencast	Ananta	0	0	685	0	455	0	147
	Belpahar	25	659	3,941	1,110	2,387	3,300	838
	Bharatpur	127	306	2,497	0	1516	1,294	521
	Jagannath	0	18	1,962	0	1,169	1,962	517
	Lakhanpur	9	140	1,010	156	567	865	293
	Samleswari	0	150	1,655	232	988	0	414
NCL Opencast	Jhingurdah	0	0	460	460	234	247	63
CCL Opencast	KD Hesalong	0	30	198	153	81	198	47
	Parej East	0	237	1,172	467	528	1,170	257
SECL Opencast	Bisrampur	323	323	878	329	443	0	125
	Dhanpuri	1	1	239	211	131	0	49
	Dipka	0	0	1,629	1,069	705	1,302	320
	Gevra	0	0	1,154	530	574	475	185
	Kusmunda	0	0	176	75	83	115	23
SECL Underground	Behraband	0	0	16	0	9	0	3
	Churcha West	0	0	5	0	1	0	1
	Pandavpara	24	24	249	186	120	0	40
	Singhali	0	0	299	208	177	0	56
	Total	**509**	**1,887**	**18,225**	**5,186**	**10,168**	**10,928**	**3,899**

Source: Coal India Ltd

ment and income generation, for the whole project period. Additional use of external consultants may be required for specific tasks, such as periodic evaluation surveys, case studies to identify self-employment opportunities and diagnostic studies to identify problems of integration at resettlement sites.

3.43 The major responsibility for implementation of the Resettlement Action Plans lies with the subsidiary and area level management. Dedicated resettlement and rehabilitation staff are present in several subprojects and/or at area levels. Coal India has agreed to ensure that they will receive necessary and relevant training in area where this is needed.

3.44 Coal India has agreed to hire social scientists who will be posted at the area level and be responsible full-time for resettlement and rehabilitation activities for those projects that require the most assistance for self-employment. A total of ten professional social scientists will be engaged in the project, with a minimum of one in each subsidiary where resettlement and

Table 3.5 Entitled persons according to Coal India classification, 1994 to 2003

Company	*Mine*	*A. Landowners*			*B. Landless*			*All*
		losing agric. land	*losing homestead*	*losing both*	*laborer, tenants, etc.*	*tribals losing forest*	*losing homestead*	*entitled PAPs >18 years*
MCL Opencast	Ananta	455	0	0	0	0	0	455
	Belpahar	0	0	1,290	8	86	1,003	2,387
	Bharatpur	650	103	730	33	0	0	1,516
	Jagannath	0	10	1,159	0	0	0	1,169
	Lakhanpur	0	0	482	29	6	50	567
	Samleswari	646	0	0	289	53	0	988
NCL Opencast	Jhingurdah	21	10	6	171	0	26	234
CCL Opencast	KD Kesalong	0	0	81	0	0	0	81
	Parej East	0	0	255	4	0	269	528
SECL Opencast	Bisrampur	125	0	0	318	0	0	443
	Dhanpuri	0	19	99	0	0	13	131
	Dipka	11	6	285	379	20	4	705
	Gevra	105	9	446	3	0	11	574
	Kusmunda	13	0	15	55	0	0	83
SECL Underground	Behraband	3	0	0	6	0	0	9
	Churcha West	1	0	0	0	0	0	1
	Pandavpara	117	0	0	3	0	0	120
	Singhali	141	0	0	36	0	0	177
	Total	**2,288**	**157**	**4,848**	**1,334**	**165**	**1,376**	**10,168**

Source: Coal India Ltd

rehabilitation is required. Non-governmental organisations (NGOs) will be engaged to assist in specific tasks, such as training for self-employment and community development work. The selection of the NGOs is crucial and has to be done with great care. The NGO must have a proven record of dedicated community development and income generating activities. The Resettlement and Rehabilitation Cell of Coal India must be involved in the selection procedure and must approve the selected NGO.

3.45 Coal India has agreed that key resettlement and rehabilitation staff will, as a general rule, not be transferred within the first three years of the project.

3.46 The implementation chart for resettlement and rehabilitation at the subsidiary and area levels is shown in Figure 3.1.

Table 3.6 Rehabilitation Action Plans 1994 to 1998 - an overview of 16 projects requiring plans

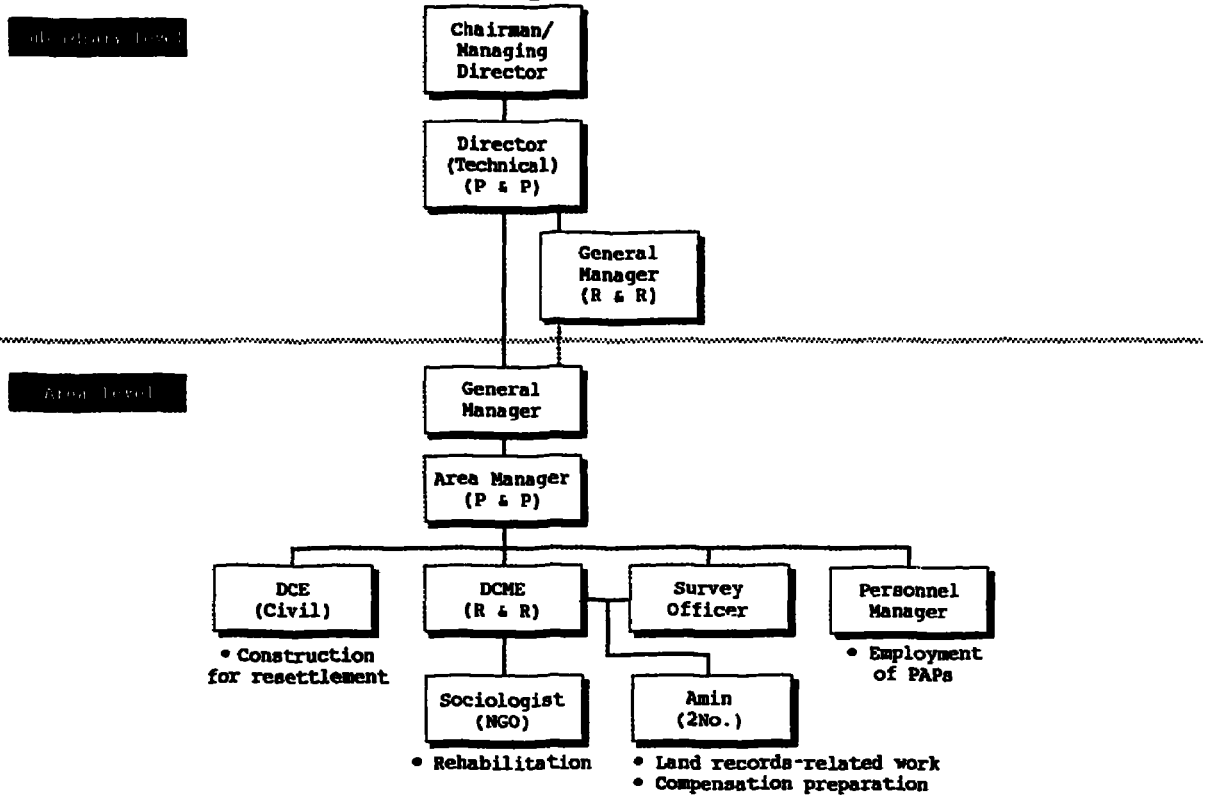
Company	*Mine*	*Families affected by project*	*Persons to be relocated*	*Persons entitled to rehab.*	*Jobs to be provided in mine*	*Jobs to be sought w/ contractors*	*Entitled to self-employ assist.*	*Proposed fulltime R&R staff*
MCL Opencast	Ananta	147	0	455	0	20	435	0
	Belpahar	838	3,300	2,387	50	19	2,318	2
	Bharatpur	521	1,294	1,516	808	260	448	1
	Jagannath	517	1,962	1,169	680	30	459	1
	Lakhanpur	293	865	567	78	61	428	1
	Samleswari	414	0	988	22	8	958	1
NCL Opencast	Jhingurdah	63	247	234	46	165	23	1
CCL Opencast	KD Hesalong	47	198	81	14	0	67	0
	Parej East	53	286	133	15	0	118	1
SECL Opencast	Bisrampur	125	0	443	124	0	319	1
	Dhanpuri	49	0	131	37	10	84	0
	Dipka	298	1,302	655	502	100	53	1
	Gevra	91	475	279	205	50	24	0
	Kusmunda	23	115	83	24	0	59	0
SECL Underground	Pandavpara	40	0	120	57	3	60	0
	Singhali	56	0	177	141	40	0	0
	Total	**3,575**	**10,044**	**9,418**	**2,803**	**766**	**5,853**	**10**

Source: Coal India Ltd

Participation and consultation of project-affected people

3.47 The strategy for the continued participation and consultation of project-affected people has two aspects. One aspect is the formation of a two tier committee structure in which project-affect people are represented. At the project level, a coordination committee will be essentially responsible for planning and implementation. At the area (or subsidiary) level, a monitoring committee will be responsible for approvals, monitoring and grievance procedures. In both committees, it is envisaged that two project-affected people (preferably one man and one woman) will have seats. These committees each consist of five people (six if a host community exists). This set-up aims at institutionalising the participation of project-affected people. The second aspect of the participation strategy is to break down the planning process into half-yearly periods. The project level coordination committee is the body that formally submits the half-yearly detailed plans of implementation to the monitoring committees. The formulation of half-yearly detailed plans of implementation makes it possible for experiences gained in one period to be incorporated into the next plan, and allows for substantial input from the affected

Figure 3.1 Implementation chart of resettlement and rehabilitation at subsidiary and area level



Source: Coal India

Note : Amin - a lower level revenue-cum-survey assistant

population. Besides this more formalised participation, it is envisaged that the day-to-day interaction between project-affected people and project officers and NGOs involved in resettlement and rehabilitation will provide opportunities for consultation and participation. Figure 3.2 illustrates the committee structure.

3.48 During the preparation of the Rehabilitation Action Plans, the affected people were consulted in various ways:

- Since every household was visited by the interviewers, this created an opportunity for consultation. The survey contained questions regarding affected people's perceptions of issues related to land acquisition, compensation, benefits of the project displacing them, and the relocation site and the host community.
- All consultants had more unstructured interaction with the project-affected people than the officials of Coal India. Most of the consultants organised focus group sessions for various groups in the villages, such as women, landless and tribals. This information was used to formulate a strategy for involvement of the project-affected

people in the Rehabilitation Action Plan, and for their active participation in the resettlement and rehabilitation process.

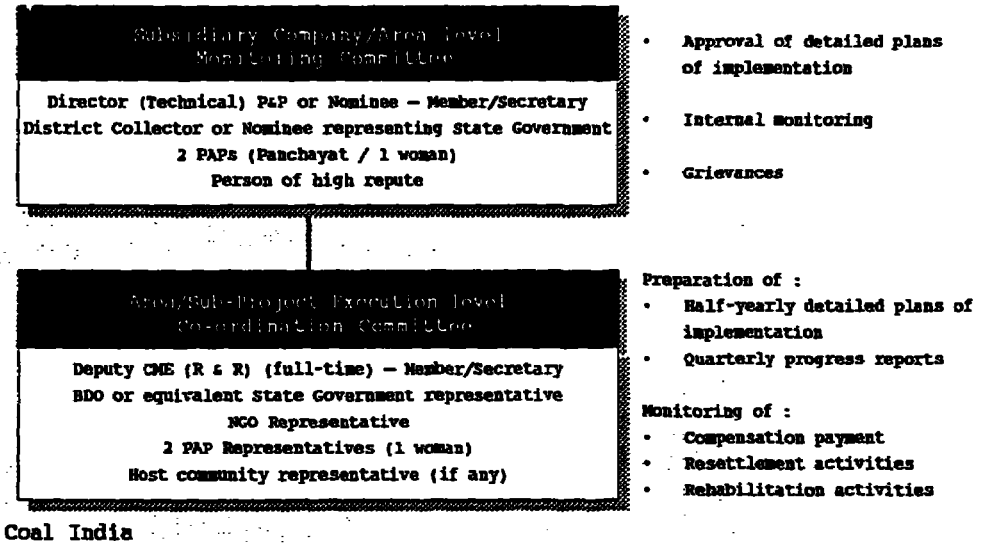
3.49 As a further step in informing the project-affected people of their entitlements, both the policy of Coal India and the Rehabilitation Action Plans are in the process of being translated into relevant local languages. Generally Coal India has issued press statements to newspapers in the affected areas and in the major cities for the wider dissemination of the policy change.

Tribal issues

3.50 The project-affected people classified as tribals constitute 5,186 persons, or 28% of all project-affected people (18,225 people). This covers a large variety, from six mines with no tribal persons to one mine where 100% (460 persons) are classified as tribals (Jhingurdah, NCL, in Singrauli). In Madhya Pradesh most (8 of 11) of the SECL mines with residual resettlement and rehabilitation issues proposed for inclusion in the project have a tribal population varying from 37% to 88% of the project-affected population. Similarly in Bihar, the two CCL mines with residual resettlement and rehabilitation issues proposed for the project have tribal populations of 77% and 42% of the total number of project-affected people.

3.51 The official classification of social and/or ethnic groups, and of the land where they were residing, rest on principles established in 1890, and has not been changed substantially since. This means that what is classified as forest area may have been converted into farming land; and that tribal groups,

Figure 3.2 Committee structure for resettlement and rehabilitation



Source: Coal India

originally living a migratory life, may have changed their way of living into a sedentary, agricultural lifestyle.

3.52 With the exception of one mine (Jhingurdah), all the tribal project-affected population are settled in mixed villages, among caste Hindus and scheduled caste Hindus. They are predominantly engaged in agriculture on fixed plots (as opposed to slash and burn cultivation) or crafts related to agriculture (blacksmith, carpentry, etc.). As described in several of the baseline studies, several of the tribal groups have a special affinity to the local nature, such as forest and hills and use this in their daily lives, although this affinity and use is often shared with other groups in the village. All the tribals speak the local dialect of Hindu as their first language (except in Orissa, where they all speak Oriya, the majority language).

3.53 Most of the tribal population is integrated into the Indian rural society and have been in contact with mining operations for the past 20-30 years. Their contact to the 'outside world' is not new and does not consititute a new threat to the survival of their identity. In places like Madhya Pradesh, tribals constitute the majority of the local workforce in the mines and have done so for more than 20 years. The Jhingurdah mine started operating in 1965 and out of the 63 project-affected families (460 persons), 26 families have persons already employed by NCL.

3.54 In all mine areas (except one) the project-affected population constitutes a mix of scheduled tribes and other social groups (i.e. of different castes). The implementation of the mitigation plans for these areas require a community (village) focus, rather than an ethnic group focus, in order not to create conflict between social groups who have been living in the same mixed village for several decades.

Community issues

3.55 The emphasis of the subsidiaries has been on providing the resetttlement sites/villages with facilities and infrastructure, and in many places this has been done in excess of the requirements of the State Government guidelines. Socially oriented community development will be introduced at the resettlement sites in order to improve the relationship between the different villages brought together and the host communities (if any).

Implementation issues

3.56 The major challange for the implementation of the new policy is to make the self-employment option an attractive and viable alternative to a job with the subsidiary. There is no global solution to this. One lesson that has been learned is that training in itself is not enough, even when it is followed by

loans or grants. The majority of project-affected people are farmers or agricultural laborers, and the transition into another profession probably requires a great deal of follow-up involving business planning assistance and extension services.

3.57 One of the first activities to be taken up in the subprojects is determining the persons who are eligible for rehabilitation assistance, popularly know as 'the closing of the list.' The censuses carried out by the consultants and NGOs for preparation of the Rehabilitation Action Plans are fairly accurate, and will form the basis on which the list of entitled persons is to be determined. In order to ensure that nobody takes undo advantage of the situtation, and that every entitled person is informed of his or her entitlements, information campaigns will be carried out on a house-to-house basis by the Resettlement and Rehabilitation Officer of the subsidiary with the assistance of NGOs. This will include the distribution and reading of a brochure explaining who is entitled to what assistance. A simple identity card (with a photo of the entitled person) will be issued by the subsidiary. The details of this procedure have been developed. This procedure is adopted in order to ensure that people are aware of the scope and limitations of the entitlements.

3.58 The community focus and the emphasis on alternative rehabilitation options to jobs in the mines are both complex and difficult tasks. In order to ensure that experiences gained are subsequently utilised, implementation of the new policy will be done in two phases:

a. immediate and focused attention on four pilot projects and
b. by September1995, including the remaining 12 subprojects.

3.59 From the operational plans for resettlement and rehabilitation it is clear that the impact of land acquisition for the majority of the project-affected people will take place in 1995. The selection of pilot projects has given priority to subprojects with imminent or ongoing resettlement and rehabilitation needs (Jagannath (MCL), Jhingurdah (NCL), Parej East (CCL) and Kusmunda (SECL)). The selection of suitable NGOs could take considerable time, and the search for NGOs which should be involved in the pilot projects has already been initiated.

3.60 Technical guidelines for the implementation of the policy will be produced by the Rehabilitation and Resettlement Cell of Coal India based on the initial experience in the four pilot subprojects. They will contain operational details, such as rationale and procedures for verification of the identities of project-affected people, how to conduct information campaigns, how to carry out the alternative rehabilitation entitlements, and the time limitations of the entitlements.

3.61 Technical assistance, mainly by local consultants and intense supervision by the Resettlement and Rehabilitation Cell of Coal India, is of prime importance to the successful implementation of the resettlement and rehabilitation policy.

Supervision, monitoring and evaluation

3.62 The resettlement and rehabilitation activities to be carried out in Coal India are complex, and the successful outcome depends on the timely and coordinated efforts of many people in the implementation of the Rehabilitation Action Plans. Therefore, close supervision and monitoring and evaluation is essential.

3.63 Supervision and internal monitoring will be the responsibility of the Resettlement and Rehabilitation Cell of Coal India. Based on the yearly plans of operation and the half-yearly plans to be submitted, they will guide and assist the subsidiaries and the resettlement and rehabilitation field staff in the implementation. They will provide formats for quarterly reporting of resettlement and rehabilitation to be submitted to Coal India, and they will visit the field for verification and to provide feedback.

3.64 The aim of the internal monitoring is to ensure that implementation is carried out with a minimum of adverse effects on the project-affected people and that the process of rehabilitation is progressing timely and satisfactorily.

PART IV. OCCUPATIONAL HEALTH AND MINE SAFETY

Introduction

4.01 Concern for safety at the workplace and the health of mine workers in the Indian coal industry has a long and checkered history. The first framework of mining legislation, the Mines Act, came into force in 1901. This Act mandated the employment of competent managers in mines and the appointment of Government Mines Inspectors empowered to enter and inspect mines and to inquire into mining accidents. The Mines Act and the subordinate legislation framed thereunder have been periodically updated to absorb technical advancements and the recommendations of International Labor Conferences, the findings of investigations into mine disasters or the awareness about the causes of frequent accidents.

4.02 Legislation governing the safety and health aspects in the coal industry include the Mines Act (1952), Coal Mines Regulation (1957), Mines Rules (1955) and the Indian Electricity Act (1956). The Mines Act is the enabling statute for the establishment and enforcement of regulations and standards governing the mines' safety and the workers' health and welfare. The Act defines the powers and responsibilities of mine inspectors, mine owners, agents and managers; establishes committees representing all parties to recommend on rules, inquire into accidents, decide on appeals and health and safety prescriptions and hours and limitations of employment; establishes procedures for enforcement and penalties for noncompliance; and has the power to make regulations and set standards. The Indian Electricity Act sets standards for the safe use of electricity, safe electrical circuitry and flameproof enclosures in hazardous gassy atmospheres.

4.03 The Coal Mine Regulations cover, among other things, competency certifications for mine managers and other supervisory staff; duties and responsibilities of various parties; maintenance of mine plans; maintenance of safe access to and exit from the mines; safe transport of men and material; the regulation of ventilation, lighting and us of explosives; and precautions against gas, dust, noise, fire, water inrush, etc. The Mine Rules contain procedures for setting up committees, courts of inquiry, medical examinations by certifying surgeons, mine safety committees, etc. Besides the above, advisory circulars are issued by the Directorate General of Mine Safety (DGMS) on specific safety issues relating to the use of the plant and equipment or mining practices. Specific measurable standards have been established for airborne dust, noise, and lighting for both underground and opencast mines, and for ventilation and temperature in underground mines (Box 4.1).

Box 4.1 Selected occupational health and safety standards for Indian coal mines

Respirable dust

Free respirable silica	*Standard*
less than 5%	3 mg/m³
greater than 5%	15% of free silica mg/m³

Noise

Level	*Exposure*	*dB(A)*
Warning level	(8 hr. exposure)	85
Danger limit	(8 hr., unprotected ears,	
Compulsory protection	8 hr.	115
	impulse	130
No-work limit	impulse	140

Lighting (opencast mines)

Place	*Lux*
General working area	0.2
General machinery working area	5.0 horizontal 10.0 vertical
Drill rig area (to full height of rig)	10 vertical
Dozer operating area (at track level)	10.0
Manual work areas	5.0 horizontal 5.0 vertical
Unloading/transfer points	3.0 horizontal
Operators' cabins of machines	30.0
Hand picking areas (surface of conveyor)	50.0
Truck haul roads/rail haul	0.5 horizontal
Roadway and footpaths between benchs	3.0 horizontal
Permanent pathways	1.0 horizontal

Lighting (underground mines)

Place	*Lumens/ft²*
Pit bottom	1.5 to 3.0
Main junctions	1.25
Roadways	0.4
Haulage engines/ haul drum control gear.	1.5

Ventilation (underground mines)

Air	*Standard*
Quantity	6 m³/minute/person or 2.5 m³/minute/daily on output, whichever is larger.
Quality	Oxygen: not less than 10%. Carbon dioxide: not more than 0.5%. Inflammable gas: not more than 1.25%. No noxious gas in amounts detrimental to human health.
Temperature	Not to exceed wet bulb reading of 33.5°C. If greater than 30°C, air velocity must not be less than 1.0 m/sec.

Source:

4.04 Application, inspection and enforcement of the Mines Act and its subordinate legislation are the responsibility of the Director General of Mine Safety (DGMS) under the Ministry of Labor. The country is divided into eight zones, each with a Deputy Director General of Mine Safety. Zones are further subdivided into regions and sections, headed by Directors and Deputy Directors, respectively. Besides regular inspection of mines, DGMS officials organise inquiries into all fatal accidents collect a wide variety of statistics about the opening and closure of mines, manpower employment at different places of work, cases of fatal and serious accidents, and occurrences of gas, explosion, fire and inrush of water etc.

4.05 Accident statistics are compiled from the notice of accidents submitted to the DGMS and from the reports of the officers who inquire into accidents. Fatal accidents are defined as those in which at least one death is involved and serious accidents are those which cause serious bodily injury to one or more persons. Serious bodily injury is defined as "any injury which involves or in all probability will involve, the permanent loss of any part or section of a body the use of any part or section of the body, or the permanent loss of, or injury to the sight or hearing of any person or any permanent physical incapacity or the fracture of any bone of one or more joints or bones or any phalanxes of hand or foot".

4.06 Table 4.1 shows, in line with international norms, the trend in fatal and serious accidents in coal mines expressed as frequency per 100,000 man shifts and 1000 persons employed, and also the fatality rate per million tons of coal production. These statistics reveal that there has been an impressive decline in terms of fatality rates per 1000 persons. More recent statistics between 1986 and 1993 show that the rate per 100,000 man shifts has not shown any improvement. The data would indicate that the accident rate (per 1000 persons employed) for fatalities and serious injuries, has reached a plateau.

Table 4.1 Trend in fatal and serious accidents

Year	No of accidents			Accident freq.	No. of persons		Per 1000 employees		Death rate
	Fatal	Serious	Total	(per 1000 employees)	seriously injured	killed	death rate	serious injuries	(per million tons)
1986	180	1,167	1,347	0.74	214	1,199	0.39	2.20	1.25
1987	162	910	1,072	0.63	176	946	0.32	1.72	0.93
1988	159	771	930	0.56	175	815	0.32	1.51	0.88
1989	156	899	1,055	0.63	177	946	0.32	1.73	0.86
1990	151	893	1,044	0.62	166	983	0.30	1.75	0.78
1991	138	803	941	0.56	143	854	0.26	1.54	0.60
1992	165	810	975	0.58	183	894	0.33	1.61	0.77
1993	159	792	951	0.57	181	934	0.32	1.50	0.75

Source: Director General of Mine Safety, India and Coal India Ltd.

4.07 Analysis of the causes of fatal accidents shows that roof or side falls (caving in of roofs or material falling from the roofs of work faces in underground mines) account for the largest number of accidents; this is followed by accidents caused by 'wheeled trackless transportation equipment' (mostly dumpers and trucks) and accidents caused by rope haulage and other machinery. Although the fatalities from roof or side falls show a declining trend in absolute terms, they still account for 42% of all fatal accidents. This shows clearly that greater attention needs to be paid to the proper and adequate implementation of roof control measures, such as steel supports and 'roof bolting.'

4.08 Table 4.2 presents data on the safety in opencast mines between 1975 and 1993. Eighty percent of accidents in opencast mines can be attributed to heavy earth moving equipment, and of those, about 75% are caused by wheeled trackless transportation machinery. Nearly 90% of these accidents are accounted for by negligent or unauthorised driving, unauthorised riding and being hit by vehicles while reversing or while crossing haul roads. Many of these accidents could be prevented through proper training, provision of audiovisual signals during reversing of trucks, provision of walkie-talkie sets to dumper operators and spotters, adequate illumination after dark and in smog, improved (wide angle) visibility from the driver's cabin and adequate maintenance of brakes. Far too many of these accidents are attributed to 'human error' such as poor judgment, misinterpretation of signals, forgetfulness, misadventure and foolhardiness which underscore the imperative need for safety education and training for behavioral change.

Table 4.2 Fatalities in underground and opencast mines of Coal India

Year	*Total no. of fatalities*	*Fatalities in underground mines*	*Fatality rate per million ton opencast mines*	*Opencast fatality as % of total*
1975	233	6	0.288	3
1980	129	25	0.779	19
1985	153	29	0.412	19
1990	131	27	0.226	21
1991	120	36	0.225	30
1992	150	42	0.189	28
1993	132	33	0.162	25

Source: Coal India Ltd.

4.09 Table 4.3 presents an overview of major causes of accidents, the current efforts of the industry in combating them and recommendations for a strategy to improve mine safety.

Table 4.3 Major safety hazards in Indian coal mines and measures for combatting the hazards

Major Hazards by causes	*Current measures*	*Recommended measures*
1. Fall of roof (28% of all accidents in 1992/93)	a. Progressive use of steel supports supplanting timber. b. Extended use of roof bolting. c. Mechanisation of operations to reduce the number of men at risk. d. Safety audit for roof management.	a. Largescale adoption of roof bolting/rock reinforcement systems. b. Improved hardware and software for roof bolting systems. c. Development of diagnostic tools for roof/rock quality. d. Use of continuous miners for face mechanisation. e. Massive training programs and creation of a cadre of Strata Control Engineers. f. Hazards mapping of roof using clasification systems supplemented by geophysical tools.
2. Hazards from wheeled transport machinery (dumpers/trucks/ tippers) which account for 60% of opencast fatalities.	a. Enforcement of traffic rules. b. Improved haul roads.	a. New training aids for operators using simulators. b. Audio-visual alarms on all vehicles. c. Improved lighting. d. Improved communication systems, including provision of walkie-talkie sets to driver and spotter.
3. Hazard from mine fires (17 cases of spontaneous heating belowground in 1991 and New Kenda disasters in 1994).	a. Compliance with the provision of Coal Mine Rules (1957). b. Efforts at combatting underground fires by inertisation with nitrogen.	a. Urgent need to develop strategy for combatting hazards of mine fires by i. management of spontaeous combustion risk, ii. development of diagnostic tools, iii. classification of coal seams according to risk, and iv. use of Emergency Control Advisory System) or similar expert system package. b. Emergency preparedness for dealing with underground fires, including training with simulation exercises.

Source: Directorate General of Mine Safety.

4.10 International comparisons of mine safety need to be interpreted with some care for several reasons. Definitions of the severity of injuries vary from country to country; some countries express fatality or injury rates in terms of man shifts worked, others in terms of man hours worked; there are also substantial differences in the geological mining conditions, extraction methods (longwall or bord and pillar), and the level of experience of the work force. Accident profiles of European countries that employ predominantly the

longwall system cannot be compared with bord and pillar systems because accidents due to falls of roof have virtually been eliminated in longwall with the use of powered supports.

4.11 In the Republic of South Africa, the rate is defined as the number of fatalities or injuries that have occurred in one year among 1000 people 'at work', whereas in other countries it is 'on roll.' Such marked differences in the statistical bases of computation of accident rates notwithstanding, it may be revealing to compare the available fatality rates in different coal-producing countries of the world as presented in Tables 4.4a, 4.4b and 4.4c. On an overall basis, the rates achieved in Indian coal mines compare favorably with most other major coal producing countries. Even though the fatality rate per million tons of production may not be a valid measure of exposure to risk, Indian figures reveal that there is no room for complacency.

Table4.4a Fatality rates per 1000 persons employed

Year	*Australia (NSW)*	*France*	*India*	*US*	*W. Germany*	*United Kingdom*
1986	0.40	0.25	0.39	0.47	0.26	0.12
1987	0.10	0.14	0.32	0.37	0.20	0.09
1988	0.18	0.34	0.32	0.31	0.17	0.21
1989	0.18	0.20	0.32	0.43	0.21	0.26
1990	0.23	0.09	0.30	0.41	0.23	0.18
1991	n/a	0.26	0.26	0.38	0.17	n/a

Note: Figures for UK are on a financial year basis.
Source: Director General of Mine Safety, India and Coal India Ltd.

Table 4.4b Fatality rates per 300,000 manshifts worked

Year	*Australia (NSW)*	*France*	*India*	*US*	*W. Germany*	*United Kingdom*
1986	0.54	0.27	0.38	0.58	0.51	0.15
1987	0.14	0.16	0.31	0.46	0.41	0.12
1988	0.23	0.38	0.30	0.30	0.35	0.24
1989	0.22	0.24	0.32	0.40	0.43	0.30
1990	0.26	0.09	0.30	0.38	0.29	0.21
1991	n/a	0.18	0.24	0.35	0.30	n/a

Note: Figures for the UK are on a financial year basis.
Source: Director General of Mine Safety, India and Coal India Ltd.

Table 4.4c Fatality rates per million tons of coal produced

Year	Australia (NSW)	France	India	US	W. Germany	United Kingdom
1986	0.10	0.42	1.25	0.12	0.48	0.17
1987	0.02	0.26	0.93	0.08	0.39	0.11
1988	0.04	0.60	0.88	0.06	0.34	0.21
1989	0.03	0.38	0.86	0.07	0.41	0.24
1990	0.04	0.15	0.78	0.06	0.26	0.15
1991	n/a	0.33	0.58	0.06	0.32	n/a

Note: Figures for the UK are on a financial year basis.
Source: Director General of Mine Safety, India and Coal India Ltd.

4.12 The background of mine workers in India and South Africa are similar. They come from rural backgrounds and do not have a long tradition as mine workers. Most of them are semi-literate. Table 4.5 presents a comparative picture of fatality and injury rates per 1000 mine workers in Indian and South African coal industries. Even though there are some basic differences in the definition of injury rates in the two countries, the Indian coal industry shows a higher safety record. In the state owned mines in China, the average number of mine workers killed per million tons of coal production in 1980 was 4.53; this figure has been brought down to 1.43 in 1990, as safety has been given a high priority by the Chinese Government. For the Indian coal industry, the fatality rate per million tons in 1990 was 0.78 and in 1993 was 0.75.

Mine safety organisation in the Indian coal industry

4.13 There are currently three main routes through which safety in the coal mines is being promoted: (a) the enforcement agency of the Government, (b) the coal industry's own safety organisation and (c) various promotional measures and initiatives. For administering the provisions of the Mines Act, the Government of India has set up the Office of the Director General of Mines Safety (DGMS), which is the principal enforcement agency. For improvement of safety in mines, a number of measures have been taken. They include:

a) drawing the attention of mine management to violations of mine safety and health statutes;
b) withdrawal of statutory permission to operate a mine or part of a mine;
c) serving an improvement notice;
d) imposition of a prohibitory order;
e) suspension of the statutory certificate of competency held by managerial and supervisory personnel, in cases where they have been negligent in the discharge of their duties; and
f) prosecution of person(s) responsible for accidents.

Table 4.5 Fatality and injury rates in Indian and South African coal mines
(per 1,000 persons)

Year	India		South Africa	
	Fatalities	Injuries	Fatalities	Injuries
1981	0.36	2.36	1.05	9.00
1982	0.35	2.23	1.15	7.20
1983	0.36	2.18	1.56	9.40
1984	0.32	2.24	0.71	8.32
1985	0.36	1.92	0.46	7.60
1986	0.39	2.20	0.36	7.35
1987	0.32	1.71	1.58	6.53
1988	0.32	1.51	0.57	5.08
1989	0.32	1.73	0.50	4.90
1990	0.30	1.79	n/a	n/a
1991	0.26	1.54	n/a	n/a
1992	0.33	1.61	n/a	n/a
1993	0.32	1.50	n/a	n/a

Note: The basis for reporting injuries in India and South Africa are different. In terms of the South African Mines and Works Act and Regulations (1977), 'an injury that either incapacitates the injured person from performing his normal or similar occupation for a period of 14 days or more, or that causes the injured person to suffer the loss of a limb or part of a limb, or sustain a permanent disability' is reportable. In the case of India, please see paragraph 6 above.
Source: Chamber of Mines, South Africa and Director of Mine Safety, India.

4.14 Besides overseeing compliance of existing legislation through inspections, inquiries into accidents and dangerous occurrences and other safety promotional initiatives, the DGMS has also the responsibility of according approval of mine safety equipment, materials and appliances; development of safety legislation and standards; and conduct of examinations for the grant of competency certificates. Among new initiatives launched by the DGMS are the more intense inspection of accident prone mines and identification of corrective measures, extending technological support through science and technology research and human resource development through structural training at the newly opened Mines Safety and Health Academy under CMPDI.

4.15 Coal India has a substantial safety organisation integrated into the management structure. There are also consultation and workers' participation through the twin instruments of Pit Safety Committee at the mine level and the system of 'Workmen's Inspector'. At the subsidiary company level there are several formal and ad-hoc tripartite committees which take stock of safety status on a regular basis. The Coal India Safety Board, with representatives of management, workmen, DGMS and a nominee of the Ministry of Coal, meets twice a year to review safety performance of the companies. There is addition-

ally a standing committee on safety for Coal Mines which is an apex committee headed by the Union Minister for Coal.

4.16 The Internal Safety Organisation of Coal India is the principal organ of the coal industry in matter of safety. The thrust on safety is supported by the coal industry's massive program of training and retraining for supervisory staff and workmen. Besides the initial, refresher and specialised training of mine workers at vocational training centers, as provided under the Mines Vocational Training Rules (1966), the coal industry has an extensive network of training institutions, supervisory development institutes and mining training schools.

4.17 The recently formulated training policy aims to integrate occupational safety and health, and environmental awareness in all human resource development activities. New training modules for basic training of surface (opencast) and underground workers varying from 12 to 48 days have been finalised, they provide a comprehensive training of new mine workers. Among other promotional initiatives for spreading the safety movement, the industry conducts safety campaigns (safety weeks) in different coalfields using wide range of techniques to inculcate safety awareness among workers to stimulate inter-colliery competition. Such annual events also help in upgrading the level of housekeeping during the safety week. There are also first aid and mine rescue competitions held in different coalfield to recognise the importance of speed, efficiency and preparedness. While strenuous efforts are being made to upgrade the work pl safety, unless there is ability to identify current hazards and the skill to productively deal with them, the goals for higher safety cannot be attained.

4.18 Mine emergency plans have been prepared under the Government of India's 1957 Coal Mine Regulations. Technical assistance will be provided under the proposed programme to review and, if necessary, update these plans.

Occupational health hazards

4.19 As some 80% of all diseases are environment-induced, if safe water supplies and good sanitation facilities could be provided, a large majority of the environment induced diseases could be prevented. Section 19 of the Mines Act (1952) stipulates the provision of adequate quantities of cool and wholesome drinking water close to the workplace, and Section 20 lays down the requirements for sanitary conveniences. Under Section 25, the diseases which have been notified as being connected with coal mining operations pneumoconiosis is the major scourge that has blighted the coal miners.

4.20 The Coal Mines Regulations (1957) stipulate that the permissible standard of respirable dust at 3mg/m^3 of air for coal dust containing up to 5%

free silica. There has been considerable interest in the incidence of pneumoconiosis among coal worker since 41 cases were detected in a sample of 259 cases in 1956. Table 4.6 presents the statistics of coal workers' pneumoconiosis between 1978 and 1991. The apparently increasing number of cases is not due to actual incidence, but because of the requirement of statutory medical examination since 1978. The 8th Conference on Safety in Mines called for stricter medical surveillance to conform to ILO Convention Numbers 155 and 161 on occupational health services with particular reference to prevention of occupational diseases. Special efforts are currently underway for diagnosis of pneumoconiosis among coal workers through radiological screening at 60 centers in different subsidiaries of Coal India. At present, the percentage of coal workers with pneumoconiosis ranges from 8.1% to 17% in underground mines and 1.8% to 3.1% in opencast mines.

Table 4.6 Pneumonoconiosis cases reported in Indian coal mines

Year	*No. of cases*
1978	5
1979	24
1980	21
1981	70
1982	86
1983	72
1984	60
1985	96
1986	154
1987	54
1988	81
1989	96
1990	33
1991	29

Source: Director General of Mine Safety, India

4.21 Changing technology has introduced new hazards in the mine environment such as noise, toxicological hazards and psychiatric problems. Noise, as a major health risk, has merited scrutiny in the coal industry. Based on the ILO Code of Practice, the DGMS has recommended the following noise standards:

warning (action) level	85dB(A)
danger limit for unprotected ears	90dB(A)
entry only with ear protection	115dB(A)
entry to be prohibited	140dB(A)

Audiometry is currently being introduced as a part of mandatory medical examination for new entrants and for persons engaged in operations/areas where noise level exceeds 90dB(A). While noise surveys conducted in the coal mines have confirmed that the noise problem is not a serious issue, medical examina-

tions of mine workers showed that slightly more than 50% of the workforce seems to have some degree of hearing impairment. The cause is more likely the relatively high average age of miners than noise at the workplace..

4.22 Responsibilities for occupational health at the corporate level are shared by the Chief of Medical Health Services, Coal India and the newly - created Institute of Occupational Medicine and Hygiene at CMPDI, Ranchi. The roles of the Chief of Medical Health Services are to liaise with organisations of the Central Government on national occupational health policy and to monitor the quality and implementation of worker health programs in the subsidiary companies. The major responsibilities of the new CMPDI institute will be to carry out extensive monitoring of worker health and maintain a data bank on employees, to initiate long-term research into the health aspects of coal mining, and to provide advice and consultancy services to coal companies on occupational health, industrial hygienic and ergonomics.

4.23 An Occupational Health Wing, headed by a Deputy Chief Medical Officer, has been established at the central hospital of each subsidiary company. The responsibility of these units is to provide regular medical screenings and diagnostic examinations of company employees, to regularly report to company management on the incidence of occupational diseases amongst mine workers, to train regional hospital staff in the detection and treatment of occupational diseases, and to provide ongoing care for employees requiring specialised treatment.

4.24 As per Mines Rules 29B, periodic medical examination, (after the initial medical examination at the time of appointment) of every person employed in the mine is carried out at intervals of not more than 5 years. About one-fifth of the employees are medically examined every year in rotation. Coal India has started a computerised health record system, which will cover all employees by December 1996. Radiology, cardiopulmonary, audiometry, ergonometry and psychiatric diagnostic capability will be strengthened at both the corporate and subsidiary company levels.

Mine rescue program

4.25 Subsequent to the assumption of mine rescue responsibilities by coal India in 1985, two commissions were established by the Government of India to recommend priorities for modernisation and the broad types of rescue equipment that should be procured. A comprehensive modernisation plan for mine rescue services has now been prepared and is being implemented based on the reports of these commissions. Four new mine rescue stations are being established and equipped, and the two existing stations upgraded to the same standard. Training facilities are being constructed to give a realistic approximation of the actual conditions encountered in actual rescue and recovery work.

Welfare measures: Coal India as an instrument for socio-economic change

4.26 In the pre-nationalisation era, the were a number of provisions which aimed at providing a modicum of facilities for health, water supply and other amenities in the coalfields. For instance, the Mines Boards of Health were set up in major coalfields as municipal agencies for managing the civic affairs of urban center in coalfields and also for providing support services for improving support services for improving the living conditions. Starved of funds, the impacts of such organisations were only marginal. The Coal Mines Labor Welfare Fund Act (1947) set up the Coal Mines Labor Welfare Organisation which provided an umbrella organisation for medical facilities. There was also a plethora of welfare-related legislative measures for canteens, creches, pit-head baths, etc., but little progress was made in the implementation of these measures due to lack of support from the mine owners as well as lack of enthusiasm to utilise the facilities by the workers.

4.27 As a result of the nationalisation of coal mines, there has been a sea of change in the level of funding and resource inputs for welfare of coal mines (through the creation of a massive social infrastructure) with vastly upgraded facilities for housing, water supply and medical care. The nationalised coal sector has also ably discharged its social responsibilities by building schools and colleges, canteens, promoting cooperatives and provisioning for recreational facilities such as playgrounds, stadiums and gymnasiums. Coal India's expenditure on workers welfare has registered a steep increase from Rs200 (US$6.5) million in 1974-75 to Rs5000(US$161) million in 1992-93 reflecting the industry's commitment to welfare activities. Table 4.7 shows the achievements in physical terms since nationalisation (1975) in improving the quality of life in the coal mining areas.

Table 4.7 Social welfare facilities developed since nationalisation

	At the time of nationalisation	*As of 1/11/93*
Housing Satistics		
% of population	21.70	54.36
(Number of people)	(118,366)	(357,478)
Population covered under water supply schemes	227,300	2,186,497
Quantum of water supply (milgal/day)	12	92
Hospitals	49	87
Hospital Beds	1,482	5,333
Dispensaries	197	409
Ambulances	42	622
Schools & colleges	287	1,238
Canteens	210	405
Co-operatives	177	305
Bank branches/ Extension counters	0	226
Playgrounds	0	230
Stadiums	0	30
Gymnasiums	0	7

Source: Coal India Ltd.

ANNEX 1 PROJECT DESCRIPTION

1. This annex consists of an overview table which contains a brief description of each subproject, including type of operation, current production and production goals, premining land uses, status of environmental and social issues, and the related project costs.

2. The following abbreviations have been used in the table:

CCL	Central Coalfields Ltd.
MCL	Mahanadi Coalfields Ltd.
NCL	Northern Coalfields Ltd.
SECL	Southeastern Coalfields Ltd.
WCL	Western Coalfields Ltd.
EAC	Environmental Appraisal Committee
EAP	Environmental Action Plan
EMP	Environmental Management Plan
MP	Madhya Pradesh
MOEF	Ministry of Environment and Forest
PAP	project-affected person
R&R	resettlement and rehabilitation
UP	Uttar Pradesh

Detailed project description

Company/ Mine	Location	Mine profile	Status of environmental clearance	Cost of environ. action	Total PAPs	Persons to be resettled	Cost of R&R action
NCL (opencast)							
Bina	Singrauli coalfield, Sonebhadra, UP	Opencast mine in operation since 1986 with draglines. Production is 5.5 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1284ha consist of about 50% forest and shrublands. The balance is dry agricultural land, unoccupied land and small villages.	Mine pre-dates environmental clearance requirement, however EMP has been prepared.	2.47	-	-	-
Dudhichua	Singrauli coalfield, Sidhi, MP and Sonebhadra, UP	Opencast mine in operation since 1981 with draglines, shovels and trucks. Production is 4.0 million tonnes per year. The mine requires replacement of equipment to maintain production and additional equipment to raise production to 10.0 million tonnes per year. Premining land uses of 1694ha consist of about 46% forest and shrublands. The balance is dry agricultural land and unoccupied land.	EMP prepared and cleared by MOEF on July 3, 1990.	2.50	-	-	-
Jayant	Singrauli coalfield, Sidhi, MP	Opencast mine in operation since 1975 with draglines, shovels and trucks. Production is 8.0 million tonnes per year. The mine requires replacement of equipment to raise production back to the planned level of 10.0 million tonnes per year. Premining land uses of 2464ha consist of about 47% forest and shrublands. The balance is dry agricultural land, unoccupied land and small villages.	EMP prepared and cleared by MOEF on December 4, 1992.	3.25	-	-	-
Jhingurda	Singrauli coalfield, Sidhi, MP	Opencast mine in operation since 1965 with shovels and trucks. Production is 3.0 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1200ha consist of about 62% forest and shrublands. The balance is dry agricultural land, unoccupied land and small villages.	Mine pre-dates environmental clearance requirement, however EMP has been prepared.	8.58	460	247	0.38
Nigahi	Singrauli coalfield, Sidhi, MP	Opencast mine in operation since 1988 with draglines, shovels and trucks. Production is 2.9 million tonnes per year. The mine requires replacement of equipment to maintain production and additional equipment to raise production to 8.0 million tonnes per year. Premining land uses of 3036ha consist of about 40% forest and shrublands. The balance is dry agricultual land and unoccupied land.	EMP prepared and cleared by MOEF on October 8, 1987.	3.52	-	-	-

Company/ Mine	Location	Mine profile	Status of environmental clearance	Cost of environ. action	Total PAPs	Persons to be resettled	Cost of R&R action
MCL (opencast)							
Ananta	Talcher coalfield, Angul, Orissa	Opencast mine in operation since 1989 with shovels and trucks. Production is 4.0 million tonnes per year. The mine needs additional equipment to raise production to 5.5 million tonnes per year. Premining land uses of 810ha consist of 25% forest and shrublands. The balance is Government and tenancy lands.	EMP was prepared and cleared by MOEF in July 1988.	2.51	685	-	0.59
Belpahar	Ib Valley, Sambalpur, Orissa	Opencast mine in operation since 1982 with shovels and trucks. Production is 2.0 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1601ha consist of 40% forest and shrublands and 33% dry agricultural land. The balance is unoccupied land and small villages.	EMP was prepared and cleared by MOEF in September 1985 and March 1992.	2.40	3,941	3,300	0.94
Bharatpur	Talcher coalfield, Angul, Orissa	Opencast mine in operation since 1985 with shovels and trucks. Production is 3.5 million tonnes per year. The mine requires replacement of equipment to maintain production and additional equipment to raise production to 5.0 million tonnes per year. Premining land uses of 841ha consist of about 25% forest and shrublands. The balance is Government land, agricultural land and small villages.	EMP was prepared and cleared by MOEF in January 1992. (72ha of forest was cleared by MOEF on November 11, 1991.	2.91	2,497	1,294	0.78
Jagannath	Talcher coalfield, Angul, Orissa	Opencast mine in operation since 1971 with shovels and trucks. Production is 5.0 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 793ha consist of about 8% forest and shrublands. The balance is Governmental and tenancy lands.	Mine pre-dates environmental clearance requirement, however EMP has been prepared.	2.43	1,962	1,962	0.45
Lakhanpur	Ib Valley, Sambalpur, Orissa	Opencast mine under development since 1992; to operate with shovels and trucks. The mine has produced 700,000 tonnes to date. Mine requires additional equipment to reach target production of 5.0 million tonnes per year. Premining land uses consist of about 17% forest and shrublands. The balance is Government land, agricultural land and small villages.	EMP was prepared and cleared by MOEF in September 1991.	3.33	1,010	865	1.47
Samleswari	Ib Valley, Sambalpur, Orissa	Opencast mine under development since 1993; to operate with shovels and trucks. The mine has produced 1.7 million tonnes to date. Mine requires additional equipment to reach target production of 3.0 million tonnes per year. Premining land uses of 906ha consist of about 66% forest and shrublands and 34% dry agricultural land and small villages.	EMP was prepared and cleared by MOEF in September 1991.	2.64	1,655	-	0.19

Company/ Mine	Location	Mine profile	Status of environmental clearance	Cost of environ. action	Total PAPs	Persons to be resettled	Cost of R&R action
WCL (opencast)							
Durgapur	Wardha Valley, Chandrapur, Maharashtra	Opencast mine in operation since 1981 with shovels and trucks. Production is 1.6 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 812ha consist of about 33% forest and shrublands. The balance is dry agricultural land and unoccupied land.	Mine pre-dates environmental clearance requirement, however EMP has been prepared.	0.41	-	-	-
Nilijai	Wardha Valley, Yeotmal, Maharashtra	Opencast mine in operation since 1991 with shovels and trucks. Production is 2.3 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1148ha consist mainly of dry agricultural land and a small percentage of unoccupied land.	EMP prepared and cleared by MOEF on February 13. 1987.	0.15	-	-	-
Padmapur	Wardha Valley, Chandrapur, Maharashtra	Opencast mine in operation since 1985 with shovels and trucks. Production is 1.0 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 557ha consist mainly of dry agricultural land and unoccupied land.	EMP prepared and cleared by MOEF on December 13, 1991.	0.21	-	-	-
Sasti	Wardha Valley, Chandrapur, Maharashtra	Opencast mine in operation since 1985 with shovels and trucks. Production is 1.8 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 739ha consist of more than 90% agricultural land. The balance is unoccupied land and small villages.	EMP prepared and cleared by MOEF on April 3, 1989.	0.41	-	-	-
Umrer	Wardha Valley, Chandrapur, Maharashtra	Opencast mine in operation since 1963 with draglines, shovels and trucks. Procuction is 2.2 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 807ha consist mainly of dry agricultural land and unoccupied land.	Mine pre-dates environmental clearance requirement, however EMP has been prepared.	0.41	-	-	-

Company/ Mine	Location	Mine profile	Status of environmental clearance	Cost of environ. action	Total PAPs	Persons to be resettled	Cost of R&R action
CCL (opencast)							
KD Hesalong	N. Karanpura, Ranchi, Bihar	Opencast mine in operation since 1968 with shovels and trucks. Production is 2.0 million tonnes per year. Mine requires additional equipment to raise production to to 4.5 million tonnes per year. Premining land uses of 551ha consist of 50% forest and shrublands. The balance is dry agricultural land, unoccupied land and small villages.	EMP prepared and cleared by MOEF on October 29, 1992.	2.57	198	198	0.27
Parej East	West Bokaro, Hazaribagh, Bihar	Opencast mine under development since 1992; to operate with shovels and trucks. Mine requires additional equipment to reach target production of 1.8 million tonnes per year. Premining land uses of 495ha consist of about 25% forest and shrublands. The balance is dry agricultural land, unoccupied land and small villages.	EMP prepared and cleared by MOEF on November 23, 1992.	1.56	1,172	1,170	1.44
Rajrappa	Rangarh coalfield, Hazaribagh, Bihar	Opencast mine in operation since 1973 with shovels and trucks. Production is 2.3 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1857ha consist of about 42% forest and shrublands. The balance is dry agricultural land, unoccupied land and small villages.	EMP prepared and cleared by MOEF on November 23, 1992.	2.25	-	-	-

Company/ Mine	Location	Mine profile	Status of environmental clearance	Cost of environ. action	Total PAPs	Persons to be resettled	Cost of R&R action
SECL (opencast)							
Bisrampur	Bisrampur coalfield, Surguja, MP	Opencast mine in operation since 1960 with draglines, shovels and trucks. Production is 1.1 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1472ha consist of 33% forest and shrublands. The balance is dry and irrigated agricultural land and bodies of water.	Mine pre-dates environmental clearance requirement. EAP has been prepared.	1.96	P78	-	0.66
Dhanpuri	Sohagpur coalfield, Shahdol, MP	Opencast mine in operation since 1979 with shovels and trucks. Production is 1.1 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1122ha consist of 66% forest and shrublands and 34% dry agricultural land and small villages.	EMP prepared and cleared by MOEF in September 1988.	0.88	239	-	0.13
Dipka	Korba coalfield, Bilaspur, MP	Opencast mine in operation since 1987 with shovels and trucks. Production is 2.2 million tonnes per year. The mine requires replacement of equipment to maintain production and additional equipment to raise production. Premining land uses of 1552ha consist of 10% forest and shrublands. The balance is unoccupied dry agricultural land and small villages.	EMP prepared and cleared by MOEF on July 10, 1985.	1.25	1,629	1,302	0.44
Gevra	Korba coalfield, Bilaspur, MP	Opencast mine in operation since 1985 with shovels and trucks. Production is 14.0 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 2946ha consist of dry and irrigated agricultural land, small villages and bodies of water.	Mine pre-dates environmental clearance requirement. EAP has been prepared.	3.00	1,154	475	0.31
Kusmunda	Korba coalfield, Bilaspur, MP	Opencast mine in operation since 1979 with shovels and trucks. Production is 4.7 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1544ha consist of 32% dry agricultural land and 60% irrigated agricultural land. The balance is small villages.	EMP prepared and cleared by MOEF on July 10, 1986.	1.79	176	115	0.88
Manikpur	Korba coalfield, Bilaspur, MP	Opencast mine in operation since 1966 with shovels and trucks. Production is 2.0 million tonnes per year. The mine requires replacement of equipment to maintain production. Premining land uses of 1652ha consist of 33% forest and shrublands. The balance is dry agricultural land, unnoccupied land and small villages.	Mine pre-dates environmental clearance requirement, however EMP has been prepared. been prepared.	1.18	-	-	-

Company/ Mine	Location	Mine profile	Status of environmental clearance	Cost of environ. action	Total PAPs	Persons to be resettled	Cost of R&R action
SECL (underground)							
Bangwar	Shagpur, Shahdol, MP	Semi-mechanised bord and pillar mine in operation since 1987. Production is 300,000 tonnes per year. The mine requires additional equipment to reach target production of 650,000 tonnes per year. Premining land uses of 450ha consist of 92% forest. The balance is dry agricultural land and bodies of water.	EMP prepared and cleared by MOEF on July 5, 1985.	0.25	-	-	-
Behraband	Hasdeo, Shahdol, MP	Semi-mechanised bord and pillar mine in operation as a pilot since 1986. Production is 230,000 tonnes per year. The mine requires additional equipment to reach target production of 600,000 tonnes per year. Premining land uses of 249ha consist of dry agricultural land, small villages and bodies of water.	Mine pre-dates environmental clearance requirement, however EMP has been prepared.	0.35	16	-	-
Churcha West	Baikunthpar, Sarguja, MP	Mechanised bord and pillar mine in operation since 1970. Production is 320,000 tonnes per year. The mine requires additional equipment to reach target production of 600,000 tonnes per year. Premining land uses of 558ha consist of 33% forest and shrublands. The balance is dry agricultural land and small villages.	EMP prepared and cleared by MOEF on February 17, 1995.	1.34	5	-	-
Kurja	Hasdeo, Shahdol, MP	Slope and shaft mine under development since 1988. Production is 70,000 tonnes per year. The mine requires additional equipment to reach target production of 400,000 tonnes per year. Premining land uses of 469ha consist mainly of agricultural land and unoccupied land.	EMP prepared and cleared by MOEF on March 17, 1993.	0.35	-	-	-
Pandavpara	Baikunthpur, Sarguja, MP	Manual bord and pillar mine under development since 1990. Production is 210,000 tonnes per year. The mine requires additional equipment to reach target production. Premining land uses of 1104ha consist mainly of forest and shrublands.	EMP prepared and cleared by MOEF on January 30, 1995.	0.63	249	-	0.18
Singhali	Korba, Bilaspur, MP	Semi-mechanised bord and pillar mine under development since 1989. Production is 240,000 tonnes per year. The mine requires additional equipment to reach target production. Premining land uses of 942ha consist of about 33% forest and shrublands. The balance is dry agricultural land and small villages.	EMP prepared and cleared by MOEF in February 1995.	0.30	299	-	0.14

ANNEX 2 COAL MINING TECHNOLOGIES

Occurrence of coal

1. Coal occurs as a layer (called a coal seam) in sedimentory rocks. It is buried under other layers of rocks and alluvium on the top. Often a sequence of alternating layers of coal and intervening sedimentary rocks (called parting) occurs. The coal seams have varying thickness and are generally inclined from the horizon dipping at varying inclinations from nearly flat to high steeping seams. There are two methods of extracting a coal seam: the opencast method and the underground method.

Opencast mining

2. Open pit or opencast mining as it is more familiarly known, involves extraction and removal of the overlying materials (overburden) to expose the coal seam, which can then be excavated. The operations of excavation of the overburden and its temporary removal to allow access to the coal seam are often carried out by large mechanical excavating shovels teamed with appropriately sized off-highway trucks to cart away the overburden clear of the coal-bearing area. Another favoured system involves the use of draglines, large machines which are capable of excavating overburden and casting and dumping it a distance of up to 200 metres, clear of the coal seam. Since draglines work without the aid of dumptrucks they can move overburden at considerably less cost per cubic metre, but there are limitations in their application compared to shovels and trucks, both as to total depth of excavation and the distance over which overburden can be carried.

3. It is rarely necessary to remove all overburden from the coal seams over the whole mine area at one time. Normal practice requires the removal of overburden only from an area large enough to allow room for the mine's excavators and truck fleet to work safely and efficiently while exposing enough coal for, say, one or two months market requirement. Should the end-user of the coal be a thermal power plant, however, the need for exposed and thereby immediately available coal is normally much larger, in order to safeguard the generation potential of the power plant, in which case the working-room, or void as it is normally known, has to be proportionately greater. In consequence, the overburden heaps have to be much larger.

4. The major factor controlling the viability of an opencast coal mine is the ratio of overburden to coal, measured in terms of cubic meters of overburden to metric tons of coal. Usually, operation of an opencast mine is commenced where the coal occurs nearest to the ground surface and where the ratio of overburden to coal is at its lowest value, in order to minimize both the

amount of overburden to be removed and the unit cost of initial coal production. As the depth of the coal and its working ratio increase, however, the working void and the resultant overburden dumps become larger and larger. The initial dumps are placed outside the area of the coal to be worked since it would not be sensible to place them over a coal-bearing area where they would have to be moved yet again to access the coal beneath. As soon as sufficient space within the mining area has been cleared of coal, dumping of overburden can commence within the mined out areas. Coal India uses a large fleet of small excavators and trucks that are indigenously available. This program supports Coal India's efforts to optimise the mine design and equipment configuration to yield the best results.

5. In India the opencast mines tend to be very large and eventually reach great depths. The greater the depth of a mine the greater is the size of working void and the larger is the area of the overburden dumps. Since some opencast mines in India have planned production lives of fifty years and more, it would be too costly to plan on eventual replacement of the dumped overburden material into the mined out areas after mine exhaustion. However, in newer mines the external overburden is created only in the first 5 - 7 years and later on the waste rocks are dumped in areas previously stripped of coal. Coal India's subsidiary companies carry out afforestation of their overburden dumps in order to mitigate their visual impact and dust generating potential. However, little or no measures are taken to contour them or to stabilise their slopes prior to planting of the seedlings.

6. Overburden rock has to be broken into smaller sizes. This is done by drilling multiple vertical holes (between six and twelve inches in diameter) into the overburden, 'loading' the hole with industrial explosives and blasting the explosives in a programmed sequence. This technique considerably reduces the shock-waves generated by blasting. It is also necessary to blast the thick coal seams typical of Indian mines. Once broken, the coal is loaded into trucks in exactly the same manner as used in overburden excavation. On large mines it is then transported to a coal handling plant where it is crushed to a size acceptable to customers and stored in silos for rapid loading into railcars.

7. Opencast mines generate airbourne dust which is difficult to eliminate even in countries cooler and wetter than India. Dust suppression can be effective, however, with 'good- housekeeping' practices, provided that the necessary water and equipment are available. Noise also can be kept to acceptable levels by appropriate design of perimeter overburden dumps and well-maintained noise suppression devices on the mining equipment. Water pollution must also be avoided or mitigated, since the exposed rock surfaces of the mine overburden and coal are less absorbent than the original surface soils and rainwater runoff is much accelerated, carrying with it far more silt than before. Sub-

soil water regime is seriously disturbed by opencast mining and the rain water runoff from the overburden dump tends to pollute the local water channel.

8. While most of the excavated overburden in a typical Indian opencast mine is dumped within the areas previously stripped of coal, little effort, until recently, had been expended in grading (smoothing) the dumped material to a final surface capable of being used for any purpose more demanding than elementary forestry. The surface produced normally does not allow access and/or use of any machinery other than tracked equipment. Effective restoration of an opencast mine means considerable added expense and under the current coal pricing structure is not considered cost effective. Under existing regulations the land has eventually to be handed over to the Government at the end of mine life without financial compensation, either for the land itself or for the extra work involved in restoration. It should also be bourne in mind that a typical Indian low-ratio thick seam mine, when finally exhausted, will have an average ground level which is inevitably much lower than before, after the removal of perhaps a hundred or more million cubic meters of coal.

Underground mining

9. Generally, opencast operation is restricted to a depth where the cost of removing the overburden is economical. If the deposit is not suitable for opencast mining but is still near the surface, it is accessed through level tunnels (as adit in the hillside) or through inclined tunnels (slopes) when below the ground. If the depth of coal seam is still excessive, inclined tunneling becomes uneconomical. In such cases, the coal seam is reached through vertical shaft or pit. In many cases in India, mines start with incline slopes, and later, shafts are sunk at the deeper parts to economise on men and material transport cost and to improve the access of fresh air nearer the working places.

Board and pillar

10. The bord and pillar method of underground mining is the most prevalent mining technology in India. It involves formation of large (18-36m) square blocks (pillars) of solid coal by driving two sets of narrow (4-5m wide) intersecting roads (bord) like city blocks. The size of the square blocks of the pillars depend upon its depth from the surface and the width of roads around them. Pillars are formed as the mine property is developed from the entrance towards the boundary and they are extracted during retreat from the boundary. If the roof strata is weak, the roadways are supported at regular intervals by wooden supports. As the development advances, rail tracks and conveyors are laid up to the face for the supply of material to the face and for evacuation of coal from the face. Fresh air is constantly coursed throughout the mine to dilute noxious gases, ventilate machinery and provide fresh air to workers.

11. Most of the production in the bord and pillar system is obtained by drilling and blasting in the solid coal face. The broken coal is manually or mechanically loaded into mine cars or chain conveyors. Side discharge loaders (SDLs) dig up the broken coal in a bucket and load it into a mine car or chain conveyor laid on the floor, very close to the face. Load haul dumpers (LHDs) dig up the broken coal, haul it over some distance and discharge it into a conveyor. In the latter system, it is not necessary to keep the mine car track or chain conveyor always extended close to the face. Due to their flexibility, LHDs are becoming more popular in India. A few other mechanised coal loading techniques are also followed. Coal loading underground is mainly performed by piece rated workers, who have to perform a minimum workload per shift and are paid by volume of coal loaded. The job entails removing the loose coal at the face after blasting, making the place safe, and shoveling coal into mine cars or chain conveyors.

12. During final extraction process, a pillar is subdivided into four smaller squares by dividing it in the middle. These squares are then further reduced in size by drilling and blasting. The roof at the void created by extraction of coal is systematically supported by wooden props and chocks (crib) erected at very close intervals. Supports are withdrawn at an appropriate time and the roof stone is allowed to cave in to fill up the void. If the surface property above (road, rail line, buildings, water course, water reservoir, etc.) is to be protected, solid pillars of coal are left intact below or the void is packed with sand piped in from the surface as slurry mixed with water. Due to the presence of wooden supports set at very close intervals during the extraction of pillars, it is not convenient to practice mechanised loading of coal, manual methods are more prevalent. Experiments are in progress to replace some of the wooden supports with roof bolts (a well known practice in the US) and thus create a wider space between the props for successful operation of mechanical loaders. Coal India proposes to introduce the technology in a major way for achieving higher productivity. Even after extraction of pillars, not more than 50% of *in situ* reserves can be successfully exploited. Loss of coal is more severe in thicker seams. Conventional manual bord and pillar system accounted for more than 95% of underground production in 1985, but its share has already declined to about 78% in 1993.

13. Drilling and blasting in the solid coal produce a lot of fine and shatter the roof and floor strata, weakening them. Experiments are proposed to be conducted with mobile equipment which combines the function of both cutting and drilling. Similarly, SDLs/LHDs are being combined with a roof bolting machine for the roadway support. Coal India feels confident that this equipment will be more popular and find wider application as miners get trained. They are also more economical than the manual coal loading and they can also perform 'roof bolting' with suitable attachment. Roof bolting can reduce the need for erection of wooden or steel supports which are manual intensive and

more expensive. However, mechanised loading accounted for 22% (12.4 million tonnes) of underground production in 1993. This program supports Coal India's efforts to mechanise more coal loading and reduce deployment of unskilled workers.

14. Favourable geo-mining conditions of multiple thick seams (2-20m) lying at shallow depth, competent roof and floor strata, and abundant labour at low wages encouraged the system of manually intensive bord and pillar mining system to continue in India long after it became obsolete in other parts of the world. Since the extraction of thick seam pillars causes very severe subsidence and environmental problems at the surface, the same favourable geo-mining conditions turn into disadvantages when it comes to the extraction of pillars thus formed. The low unremunerative government regulated coal price structure in the past also did not encourage adoption of any capital intensive mechanised technology either for development or for extraction of pillars. There are about 1,800 million tons of coal standing in pillars now, and more are being added every year. It would take several decades to liquidate these reserves even if it were technologically feasible. The problem has been posed to many foreign consultants and equipment manufacturers. No economically and environmentally viable methods have been found to date.

Longwall mining

15. Another important method of underground mining is longwall. The adaptability of longwall method of mining to varying degrees of mechanisation, and the high productivity and rate of recovery of *in situ* reserves has made it a popular coal mining technology in the world. Today it is practised in most of the coal producing countries with high degree of success.

16. A normal longwall panel is developed by driving a pair of roadways 150 to 200m apart in a coal block for a distance of 600 to 2,000m. At the end of drivage the two roadways are connected by a straight road, which is called the longwall face. From here the longwall face retreats toward the starting point of the drivage. The face is equipped with coal winning, transportation and roof support equipment. The equipment consists of three major components: steel plated armoured face conveyor, coal cutting and loading machine (called shearer) and self-advancing hydraulically powered supports. The shearer rides on the conveyor traveling back and forth shearing webs of coal and loading it into the conveyor. A series of articulated steel canopies or beams held up by hydraulically adjusted steel props provide support at the workplace. As the extraction proceeds, the conveyor and supports automatically move forward close to the face and the void behind is filled by caving of the roof stone. Most of the coal (95%) between the two roadways are extracted. If the coal seam is more than 3m thick, the extraction is done in two or more slices. A

continuous stream of fresh air is coursed through the face to dilute the noxious gases, ventilate the machinery and provide fresh air to the workmen.

17. Coal India has been experimenting with this technology for about 15 years. The current production is about 1.5 million tons per year. The geo-mining conditions in India are more akin to those in Australia, South Africa and the United States where the mechanised longwall mining has been highly successful. Since technical assistance for the introduction of longwall in India mainly came from Europe, where geo-mining conditions are very different from India, longwall face equipment imported from Europe did not yield the desired results. Since the gestation period of a longwall face is quite long, no longwall equipment has been incorporated in this project.

ANNEX 3 REVEGETATION OF OVERBURDEN DUMPS

Species used in project planting

Botanical name	*Local name*	*Native*	*Nitrogen fixing*	*Uses*
Mine reclamation				
Acacia auriculiformis	-		*	wood, fuel
A. catechu	khair	*	*	fuel, fodder
A. mellifera	-		*	fuel, fodder
A. nilotica	babool	*	*	fuel, fodder
Adina carifolia	haldu	*		wood
Ailanthus excelsa	mahaneem			wood, fuel
Albizia lebbek	kalasiris	*	*	fuel, fodder
A. procera	safed siris	*	*	fuel, fodder
Azadiracta indica	neem	*		fuel, fodder
Cassia siamea	-		*	wood, fuel
Cassurina equisitifolia	-		*	wood, fuel
Dalbergia sisso	sisso	*	*	wood
Dendrocalamis strictus	bans bamboo	*		construction
Eucalyptus spp.	niligiri			wood, fuel
Gmelina arborea	gumhar	*	*	fuel
Grevillea pteridifolia	-			fuel
Leucaena leucocephala	subabul		*	fodder
Madhucia indica	mahua	*		fodder
Progania pinnata	karani	*		fuel
Prosopsis julifolia	vilayati babul	*	*	fodder
Samanea saman	raintree	*		fodder, wood
Shorea robusta	sal	*		wood
Tectona grandis	sagon (teak)	*		wood
Terminalia arjuna	arjun	*		fodder
Terminalia belirica	bahara	*		fodder
Windbreak, avenue and greenbelt plantings				
Ailanthus excelsa	muhaneem			
Albizia amara	-		*	
A. lebbek	kala siris	*	*	fodder
A. procera	safed siris	*	*	fodder
Azadiracta indica	neem	*		fodder
Bombex ceiba	-	*		-
Cassia siamea	-		*	-
Dalbergia sisso	sisso	*	*	-
Eucalyptus spp.	nilgiri			-
Gmelina arborea	gumbar	*	*	-
Grevillea pteridifolia	-			-
Hardwickia binata	anjau	*		-
Leucaena leucocephala	susabul		*	fodder
Michelia champaca	champa	*		-
Tectona grandis	sagon (teak)	*		-
Terminalia arjuna	arjun	*		fodder
Zizyphs mauritiana	jujuba			fodder

Source: Coal India Ltd.

Table 10 Recommended native shrubs for consideration in reclamation planting

Botanical name	*Local name*	*Nitrogen fixing*	*Uses*
Anogeissus latifolia	dhawa		fuel, gum
Bauhinia variegata	kanchan	*	fuel
Bridelia verrucosa	-		fodder, fuel
Calotropis gigantea	akanda		fuel
Capparis decidua	kurrel		fuel
C. horrida	asaria		fodder, fuel
Carissa carandas	karanda		fuel
C. spinarum	karanda		fuel, fodder
Cassia auriculata	tarab	*	fuel, green manure
C. occidentalis	kalkasunda	*	fuel, green manure
Cleistanthus collinus	karada		fuel
Desmodim gyroides	-		fodder
Diospyros melanoxylon	tendu		soil stabilization
Dodonaea viscosa	-		fuel
Flacourtia indica	bhanber		fuel, fodder
Grewia tiliifolia	dhamin		food, fuel, fodder
Hibiscus subdariffa	lal-ambari		food, fibre, fuel
Holarrhena antidysenterica	kurchi		fuel
Indigofera oblongifolia	vilayata jhojun		fodder, green manure
Ixora arborea	kota gandhal		fuel
Lagerstroemia parviflora	lendia		fodder, gum
Mallotus phillippinensis	rohindi		fuel
Murraya koenigii	curry-pata		fuel, food
Nyctanthes arbor-tristis	har singhar		fuel
Randia dumetorum	menphal		fuel, fodder
Rhus parviflora	khag-bhalayo		food, fuel
Sesbania bispinosa	dhacincha	*	fodder
Woodfordia fruticosa	dawi		soil stabilizaer
Zizyphus mauritiana	ber		food, fuel, fodder

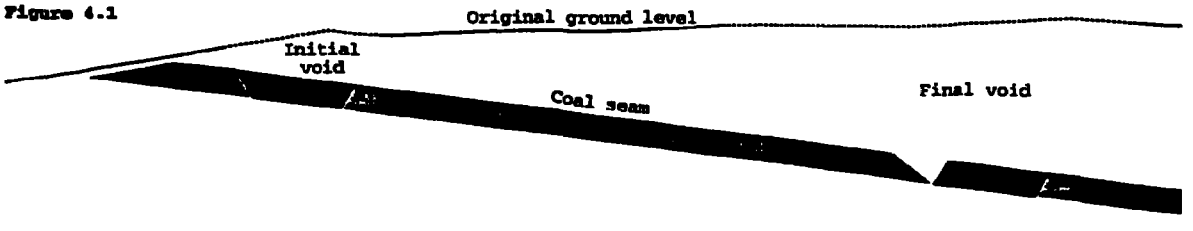
Source: Banerjee, A.K. 1989 Shrubs in Tropical Forest Ecosystems: Examples from India. World Bank Technical Paper No. 103.

ANNEX 4 OVERBURDEN HANDLING IN OPENCAST COAL MINES

1. The opencast mining of a coal seam involves the excavation and removal of its overlying strata (overburden) to enable access to the coal itself. In most cases the coal seam is exposed and excavated only a section at a time. The size of such a section is determined by many factors, the most important of which is the necessity to allow the separate excavating-equipment teams (for overburden and coal) the space to operate without interference while maintaining a buffer-stock of in-situ coal adequate to ensure regular supplies to customers.

2. The economics of opencast coal mining are governed by several factors. A factor having major influence on the design of the mine itself is the amount of overburden which has to be removed to yield a tonne of coal. This figure is known as the working- or stripping-ratio and is expressed in cubic meters of overburden compared to a metric tonne of coal. Commonly an opencast mine is sited in an area where the coal seams are exposed at the surface (the outcrop) and slope downwards from there, becoming deeper with distance from the outcrop. The working-ratio, in such a case, increases as the depth of overburden increases. In consequence, the size of the working void, i.e. the 'hole' that it is necessary to create above the in-situ coal buffer-stock, is increased (see Figure 4.1).

Figure 4.1



A simplified cross-section of a theoretical opencast coal mine showing, in black, equivalent buffer-stocks of in-situ coal at the beginning and end of the mine's life. Shown above, in white, are the corresponding minimum working voids, emphasizing the increase in volume made necessary during the life of the mine.

3. An opencast mine has a mining (coal-bearing) area and surrounding areas for associated buildings, haul roads, settling ponds, external overburden dumps, etc. Regardless of the type of equipment used, there is always a need to strip an initial area of coal and dump its associated overburden outside the mining area. As mining progresses into deeper areas, it is sometimes necessary to add overburden to the external dump as the working ratio increases. The most common method of opencast mining used in India is employs large electrical excavating shovels and diesel-engine trucks to strip and haul away the overburden, thus exposing the coal. It makes economic sense to keep the length of haul to a minimum to reduce truck requirement and operating costs. In all cases, therefore, it is logical to dump excavated overburden in areas within

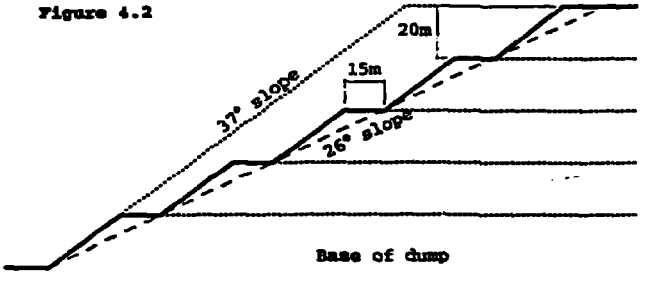
the mine once coal has been extracted from those areas. While it is necessary to ensure that an adequate area of land dedicated only to out-of-pit storage of overburden is acquired prior to the commencement of mining operations, it is equally important to ensure that, during operations, no overburden is placed outside the mined-out area unless it is absolutely necessary to do so.

4. Loose, excavated overburden material, when dumped, will assume a natural angle of repose dependent upon its basic mechanical characteristics. When first dumped the type of overburden material encountered in most Indian mines assumes a natural angle of repose of around 37° from the horizontal—for a time, and given a solid base. If, however, the dump is allowed to remain for many years without any treatment, it will almost certainly slump to a flatter angle.

5. Apart from the safety considerations involved in overburden dumping there are other, practical long-term considerations. While a 37° slope can be constructed to the safer overall effective angle of, say, 26° by forming 15 meter wide terraces at every 20 meters of dump height, the intervening 37° slopes are still incapable of being traversed by agricultural or forestry equipment (see Figure 4.2). The terraces effectively slow rainwater run-off and thus reduce erosion due to that cause but the slopes are good only for the manual planting and harvesting of whatever crop will flourish there.

6. It is extremely dangerous to attempt to use bulldozers to form terraces after establishing a dump to its final height since they are susceptible to sliding and overturning when working on loose material at the slope angles (ca

Figure 4.2

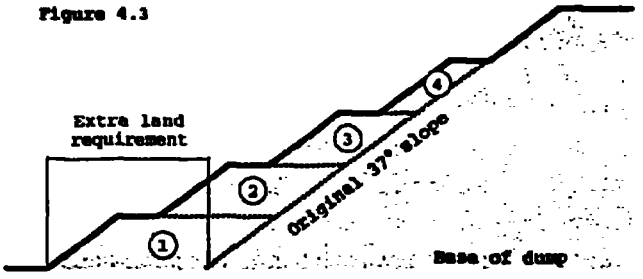


The overburden dump should be formed in predetermined layers corresponding with desired levels of proposed terraces. The dimensions shown are merely indicative of the relationship between terrace width and layer depth at the angles shown.

37°) which form naturally during dumping. If it is intended at the design stage that the dump is to be terraced, then it must be formed in successive horizontal layers corresponding to the proposed terrace levels. Should this not be done and terracing is subsequently necessary, then this has to be formed by additional dumping carried out beyond the established toe of the dump, start .g at the base level and working upwards (see Figure 4.3).

7. In the reverse case, the case where there is no opportunity to extend the toe of the dump outwards due to the impossibility of acquiring more land,

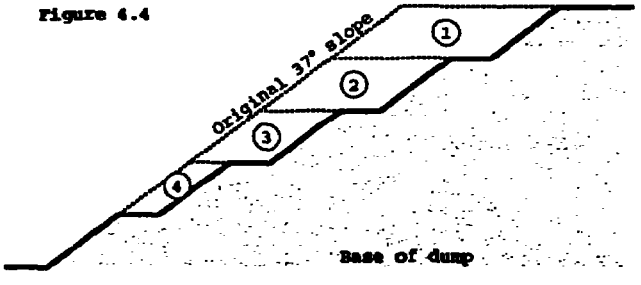
Figure 4.3



Here the overburden dump has initially been formed in a single layer at a slope of 37°. In order to terrace it, supplementary dumping has had to be added in layers 1, 2, 3 and 4, as shown and in that order, around the perimeter of the dump. In fact, the uppermost terrace would not be wide enough for trucks to operate on as shown and therefore would have to be made wider still, thus increasing the land requirement yet again.

material would have to be removed from the slope of the dump and placed elsewhere. Figure 4.4 shows the sequence of operation which would have to be adopted. It has to be emphasised that this is a more expensive operation than adding to a slope (as in Figure 4.3) and possesses an element of danger. The material on the slope of a dump is unconsolidated and is likely to be incapable of supporting the weight of a large electric shovel on the terraces shown without collapsing. If the operation were to be attempted, a large wheeled loader would be more appropriate equipment to load the necessary trucks. The cost of re-excavating, hauling and dumping material in such a case is likely to be around $2.00 per cubic meter and could involve as much as five million cubic meters on a large mine.

Figure 4.4



Here again the overburden dump has initially been formed in a single layer at a slope of 37°. However, in this case the land to extend the toe of the dump is not available and in order to terrace it to an overall slope of 26° the sections 1, 2, 3 and 4, as shown and in that order, around the perimeter of the dump. have to be re-excavated, transported and dumped elsewhere.

8. What the foregoing implies is that the original mine design must take account of all factors, not merely of the mining itself but those applying to final restoration and rehabilitation of the land. Bank engineers' observations have consistently shown that little or no attention is given in Coal India to the design of out-of-pit dumps at project planning stage. This situation is never permissible, even in an improbable scenario having no restrictions on land acquisition. If adequate land is not known to be available for out-of-pit dumping at the planning stage then the design of the mine itself must be modified.

9. After a large volume of coal is removed from a mine it might be thought that there would remain a void equal to that volume. However, the associated volume of overburden increases in bulk when loose, thus negating part of the

void. Overburden can 'bulk' by as little as 10% and as much as 50%, depending upon its nature and upon the methods used to dump it. On a mine with a ratio of, say, 7 to 1 and an overburden which bulks by 12%, a perfect balance exists, where the original ground contour could be re-established on completion by replacing all the overburden in the void created by the removal of coal. In countries like the UK, mining regulations insist on the replacement of all overburden on mine exhaustion, whether or not a balance exists. In the US, where opencast mines are generally much larger than in the UK and take much longer to exhaust, out-of-pit overburden dumps must be contoured to slopes (certainly much less than the 26° previously mentioned) which can be worked by normal agricultural equipment and covered with recovered topsoil or soil-making material. The expenditure involved in such work is taken into account at the planning stage and inevitably affects the mine design, primarily by reducing the 'cut-off ratio', i.e. the maximum working ratio at which coal can be economically mined. In both countries, the after-use and geometry of the mined-out areas are regarded as having immense importance at the planning stage and during operations.

ANNEX 5 FIVE YEAR CORPORATE ENVIRONMENTAL ACTION PLAN, 1995/96 TO 1999/2000

Introduction

Coal is India's most important resource of commercial energy, and because of its efficiency, opencast mining will dominate mining operations. The location of mining operations is largely determined by the location of coal reserves and the relative cost of extracting coal. In a densely populated country, such as India, mining (in particular opencast mining) affects the lives of increasing numbers of people, directly, through the acquisition of their land and houses, and indirectly, through the adverse effects of coal mining on the environment they live in.

For the foreseeable future, India has little choice but to rely on its coal reserves to meet the rapidly growing demand for energy. With the exception of some isolated cases, coal remains India's least expensive commercial energy resource, even if all environmental and social cost are taken into account. More than two-thirds of India's annual coal production is converted into electric energy. This gives even the most distant locations access to commercial energy. Until other, more efficient means of transporting commercial energy are available, coal-based electric power generation will remain the cornerstone of India's energy strategy.

In recent years it has become increasingly evident that Coal India Ltd. (Coal India) has to gain the support of the people affected by its operations. This support is critical in situations where Coal India wants to acquire land or resettle people in order to be able to expand their operations; it is also important if Coal India wants to avoid disruptions by people whose lives are disturbed by mining operations (e.g. dust, damage to houses due to ground vibration from blasting or dry wells due to a drop in the water table). It is no longer considered sufficient to provide the compensation prescribed by the various laws for land acquisition, to compensate people for the damage to their houses (that have been damaged due to blasting operations) or provide them with drinking water (if their wells run dry), mining operations have to be designed so as to minimise adverse affects on people living nearby.

Coal India is mindful of the fact that the mitigation of adverse environmental effects and assistance to people who have been affected by land acquisition affect the profitability of investments in coal mines; and also has a bearing on other enterprises operating (or planning to invest) in the same area, since the same benefits would need to be extended to all people living in the area. Any other approach would be divisive and, in the end, counterproductive. Coal India therefore has to strike a balance between the social and environmental mitigating measures dictated by its own interests and

the broader regional developmental concerns. Therefore, it supports regional initiatives aimed at containing and reducing the adverse environmental effects of industrial activities and at improving the living conditions of the people in the region.

As a first step of developing a corporate strategy on environmental issues, Coal India carried out a review of the implementation of environmental regulations and the conditions of environmental clearances. The results of this review, which was based on a sample of about 30 mines showed considerable delays in the implementation of environmental regulations and conditions. Mine managers tend to give the highest priority to issues that have direct bearing on coal output and the safety of operations. Environmental issues are usually only dealt with if they lead to protests from people living in nearby communities.

Coal India recognizes that an effective corporate strategy on environmental issues would need to embody two elements: strengthening of Coal India's capacity (a) to design coal mining operations in a way that minimizes adverse impacts on the environment and (b) to ensure that these operations are implemented and operated in line with prevailing environmental standards, regulations and (mine-specific) conditions of consent letters. This will require additional staff (with appropriate skills) at the Coal Mine Planing and Design Institute (CMPDI) and its regional offices, which provide design and planning support to the subsidiary companies; it will also require an increase of environmental staff at the various levels of the coal producing subsidiaries. Once this is achieved, it will put Coal India in a position to shift towards mine designs and operations that are environmentally benign and, at the same time, bring its existing operations into compliance with environmental regulations and the conditions stipulated in the letter of approval (consent letter) issued by the MOEF.

Coal India is currently in the process of formulating a corporate strategy on environmental issues. This annex provides an overview of the main elements of this strategy, in particular Coal India's plans to strengthen its capacity to deal with environmental issues.

Objectives

Coal India is committed to comply with all environmental laws, regulations and the conditions contained in MOEF's environmental clearance letters. More specifically, Coal India's corporate environmental policy aims at:

- integration of mine design and environmental impact management to allow the company to meet environmental standards, laws and regulations efficiently and with the least adverse impact on the ambient environment and the people living near mining operations;

- mitigation of adverse impacts that cannot be avoided;
- implementation of measures that would ensure productive use of the land after mining activities have been completed.

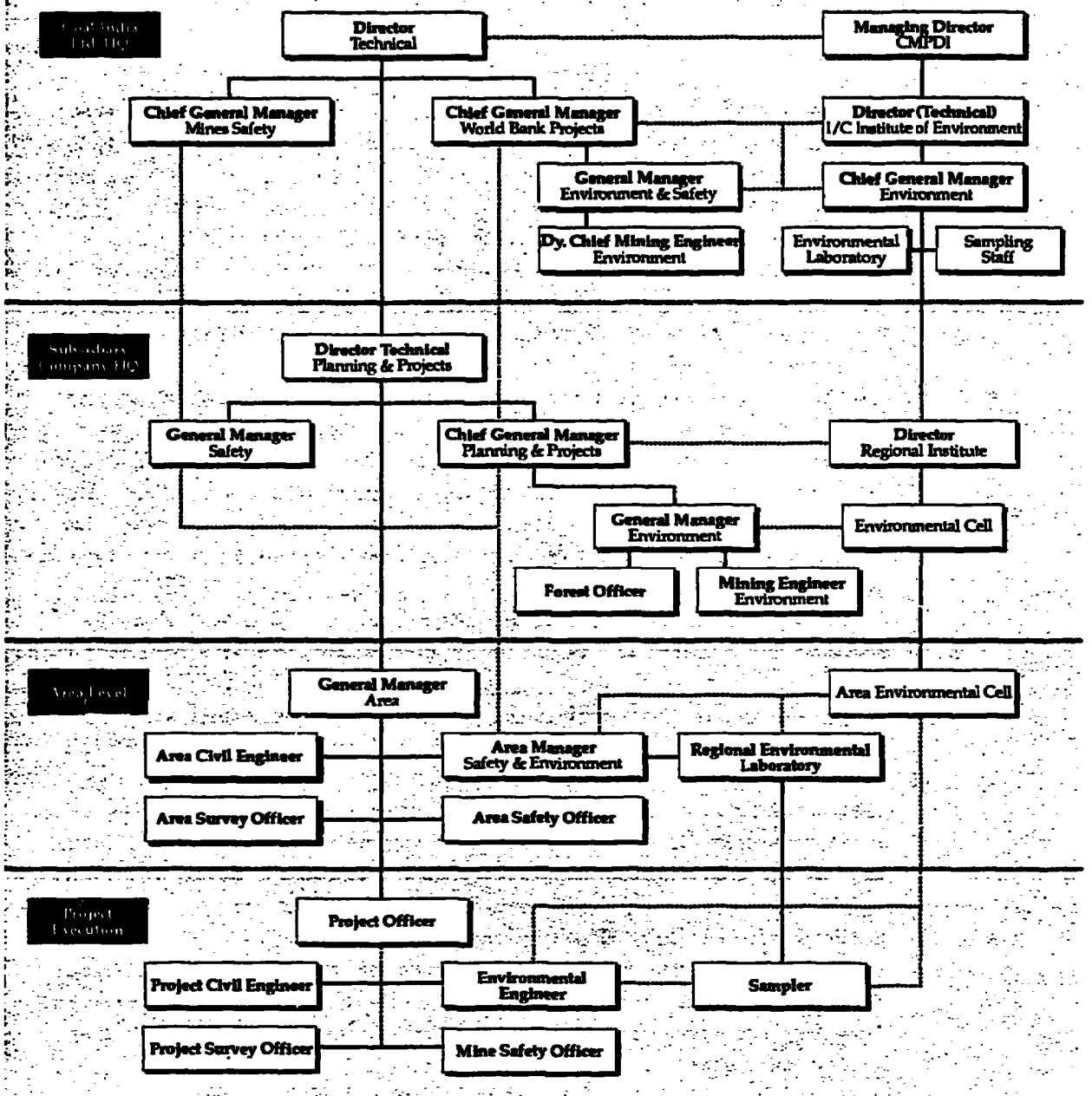
Strategy

To achieve these objectives, Coal India will take the following steps:

- Strengthen Coal India's capacity to deal with environmental issues.
  - Assess the training needs of its staff to deal with environmental issues.
  - Implement appropriate training programs. (Coal India has requested IDA financing for an extensive training program of its environmental supervision staff.)
  - Supplement training of Coal India staff with hiring of people with specialized skills.
- Ensure that environmental rules and regulations are followed and conditions of Letters of Consent are implemented.
  - Review the existing environmental monitoring and auditing systems and, if necessary, introduce appropriate changes to ensure that all environmental rules and regulations (as well as the conditions in consent letters) are implemented in a timely manner.
  - Construction of environmental laboratories by CMPDI and the subsidiary companies. Coal India has requested IDA financing for this.
  - Preparation of environmental action plans for mines where delays in the implementation of environmental measures have created safety or health hazards.
  - Coal India will make a systematic effort to raise the awareness of its managerial staff about the importance of environmental issues by introducing this subject in training courses in the university(ies) for executives and non-executives.
- Integrate mine design and environmental management.
  - Review current mine design and planning practices and identify changes that would allow for full integration of environmental (impact) management and reclamation objectives with efficient mining operations.
  - Coal India will initiate a review of its experience with current mitigation practices with MOEF with a view to improve their effectiveness and cost. The views of NGOs and representatives of people living in mining areas will be sought.

To implement the steps outlined above, Coal India will strengthen its environmental organisation. The functions and responsibilities of the various elements of this organisation are described below.

Figure 1 Coal India's environmental and safety organization



Source: Coal India

Note: Solid lines indicate reporting arrangements. Broken lines indicate information flows

Environmental organisation

Corporate environmental cell

The Corporate Environmental Cell, which will be located at Coal India headquarters in Calcutta, will have the following major responsibilities:

- Drafting of Coal India's corporate environmental policy.
- Liaison (jointly with the CMPDI Institute of Environment) with central government agencies, such as the Ministry of Environment and Forests, the Ministry of Coal and the Central Pollution Control Board, on environmental policy issues that affect the entire coal industry.
- Submission of quarterly reports to senior management about the progress in the implementation of environmental management and action plans with assistance from the Institute of Environment, Ranchi.

Environmental cells at subsidiary headquarters

Coal India has established environmental cells at the headquarters of each of its seven coal producing subsidiaries. Their main functions and responsibilities are to:

- Develop strategies to implement the corporate policy.
- Formulate environmental action plans for projects not covered by EMPs, jointly with area and CMPDI's regional environmental cells.
- Assist the regional CMPDI environmental cells in the preparation of environmental management plans (EMP).
- Coordinate, with assistance from regional CMPDI environmental cell, activities related to obtaining forest and environmental clearances and Letters of Consent from central and state agencies.
- Monitor the implementation of environmental management and action plans as well as compliance with environmental regulations throughout the company, and submit quarterly reports to the corporate environmental cell.
- Ensure company-wide consistency in environmental monitoring programs. Seek the assistance of CMPDI's regional environmental cells in this effort.
- Coordinate with State Pollution Control Boards and Special Area Development Authorities (where they exist), implementation of mine-specific environmental management plans as well as compliance with regional environmental management plans.
- Interact and consult with local public and NGOs on environmental issues.

Area-specific environmental cells

Coal India is also in the process of setting up environmental cells at area levels. Their main functions and responsibilities are:

- Preparation and supervision of the implementation of multi-year environmental (operational) action plans.
- Scheduling of heavy equipment dedicated to mine reclamation.
- Management of afforestation and revegetation programmes, including seed procurement and plant propagation facilities.
- Setting-up of permanent ambient and project monitoring stations. Decisions on the location of these stations will be made in close cooperation with the CMPDI's regional environmental cells and the SPCB in order to ensure the most effective siting of these monitoring stations.
- Carrying out of regular environmental compliance inspections and "spot-checks" with portable instruments.
- Ensuring that project staff respond to environmental problems and incidences of noncompliance.
- Compiling and submission of the half yearly implementation reports required by the Ministry of Environment and Forests for projects, where this is required.
- Interact regularly with the environmental cells at the subsidiary company level and the mine level .

Environmental cells at the mine

Coal India is in the process of establishing environmental cells at the mines. Their main functions and responsibilities are:

- Implementation of the project-specific EMP and multi-year (operational) environmental action plans.
- Application for and processing of consent applications for air emissions and water discharges.
- Ensuring project compliance with conditions of the environmental clearance and pollution Letters of Consent.
- Supervision of on-site physical and biological reclamation activities.

Institute of Environment at CMPDI headquarters

In addition to the environmental cells that Coal India has or is in the process of setting up, Coal India has also established in January 1993 an Institute of Environment at CMPDI's headquarters in Ranchi. The main functions of this institute are to:

- Ensure consistency and quality of services among CMPDI's regional environmental cells. (CMPDI has or will establish a regional environmental cell in each of the seven coal producing companies).
- Cooperate with the corporate environmental cell on national environmental policy issues with Central Government agencies including the MOEF, CPCB and SPCB.
- Identify programme priorities for research and development on aspects of environmental management and occupational health in the coal industry and undertake those programmes approved by the CMPDI's Board of Directors.
- Establish sampling and analytical standards and procedures for operational project monitoring;
- Carry out regular monitoring for CCL mines and special analysis requested by subsidiaries, as a reference laboratory for Coal India,
- Carry out regular quality control/quality assurance tests on laboratories at the regional environmental cells.

CMPDI's regional environmental cells

CMPDI's regional environmental cells will:

- Prepare mine designs that facilitate the mitigation of adverse environmental impacts, the implementation of environmental rules, regulations and conditions contained in consent letters as well as the most cost-effective reclamation option.
- Prepare Environmental Management Plans in consultation with company and area environmental cells.
- Assist company environmental cells in the preparation of Environmental Action Plans for projects/mines not covered by an EMP.
- Assist company environmental cells in obtaining environmental clearances and Letters of Consent.
- Organise, in consultation with the area environmental cell, all routine ambient environmental monitoring for air, water and laboratory analysis in accordance with standards laid down by MOEF/CPCB/SPCB.
- Assist the area environmental cells in the preparation of the regular (half-yearly) compliance reports required by the MOEF.
- Assist the company environmental cell in preparing its annual compliance and implementation report to corporate headquarters by compiling and evaluating ambient monitoring data and
- Assist Institute of Environment at CMPDI (HQ) in completing quarterly monitoring reports for corporate cell.

Staffing, training and technical assistance

Cadre descriptions

ENVIRONMENTAL MANAGEMENT PLANNERS. Planning a coal mine project involves inputs from various engineers and technical personnel e.g. geologists, mine planners, electrical and civil engineers, mine safety engineers and environmental engineers. Environmental considerations need to be built in to the planning process of a project. Experienced engineers from disciplines such as environment, mining, civil, geology etc. have backgrounds that will facilitate their training as environmental management planners. Coal India believes that executives with experience in coal mining will be best suited for this job after suitable training and exposure. Their primary responsibility will be to ensure that project designs are 'environmentally benign', integrate production and environmental management objectives and facilitate the intended reclamation goals. Training will be provided at Coal India's facilities in Ranchi and on site.

POLLUTION CONTROL ENGINEERS. Without appropriate mitigating measures, mining operations can result in extensive air and water pollution. Control measures for preventing and mitigating pollution of these two vital natural resources is a must in the coal projects. These can be drawn from PHE, Civil or Environmental disciplines. With suitable exposure, formal training and association with pollution control agencies this cadre could be developed.

EXECUTIVE CHEMISTS. This executive shall be needed to manage the environment laboratories being established in the CMPDI's regional environmental cells.

ENVIRONMENTAL MONITORING ENGINEERS. Their main task is to manage teams that carry out field sampling for monitoring of air, water and noise standards. The engineers can be from any suitable engineering discipline, trained for three months in environmental engineering courses suitable for coal industry and then can be deputed for this field sampling jobs.

RECLAMATION ECOLOGISTS. The reclamation of mine-out areas and overburden dumps need expertise and sustained efforts of dedicated personnel. Scientists with a background in botany, plantation, agriculture, forestry or ecology etc. will be suited to carry out this exercise. They are termed as Forestry Officers or Ecologists. These scientists will be supported by landscaping engineers for designing suitable land uses.

SUPPORT STAFF. The environmental specialists mentioned above will need support of staff, both, of technical and nontechnical type. The technical staff will be assisting in planning, laboratory analysis, field sampling and plant nursery development etc. Nontechnical staff will be needed to carry out assistance in the field, laboratory and office.

CURRENT STAFFING LEVELS AND PROJECTED FIVE YEAR REQUIREMENTS. The following tables show the current staffing levels and projected staffing requirements for the various environmental cells. The executive staff grades referred to in the tables are as follows:

M3	Chief General Manager (E9)
M2	Chief Engineer (E8)/Chief Mining Engineer
M1	Additional Chief or Deputy Mining Engineer (E7/E6)
E5	Senior Executive Engineer, Mine Manager, etc.
E4	Executive Engineer
E3	Assistant Engineer, Assistant Mine Manager, etc.
E2	Assistant Engineer, Mine Under Manager (graduate entry level)
E1	Apprentice Engineer

Corporate cell

Staff type/ skill	*Grade*	*Currently in place*	*To be added by 2000*	*Placement schedule*				
				95-96	*96-97*	*97-98*	*98-99*	*99-00*
Executives								
General Manager(Env)	M_2	1	-	-	-	-	-	-
Senior Super. Engr.(Env)	E_5	-	1	1	-	-	-	-
Ex. Engr.(Env)	E_3	-	1	1	-	-	-	-
Private Secretary	E_3	1	-	-	-	-	-	-

Source: Coal India Ltd.

Subsidiary company headquarters

Type of staff/ skills	*Currently in place*	*To be added by 2000*	*Placement schedule*				
			95-96	*96-97*	*97-98*	*98-99*	*99-00*
Executives							
General Manager(Env)	4 (CCL,WCL, SECL,MCL)	1 (NCL)	1	-	-	-	-
Deputy Chief Mining Engr/ Deputy Chief Engr. (E_6)	3 (CCL,NCL,SECL)	2 (WCL,MCL)	2	-	-	-	-
Civil Engr. (E_5/E_6)	2 (WCL,SECL)	3 (CCL,NCL,MCL)	1	2	-	-	-
Env. Engr. (E_4)	3 (SECL,WCL,CCL)	2 (NCL,MCL)	2	-	-	-	-
Forestry Officer(E_3/E_4)	-	5	-	5	-	-	-
Private Secretary	1 (CCL)	3 (SECL,MCL, NCL,WCL)	2	2	-	-	-
Staff							
Surveyor	-	5	-	5	-	-	-
Sr.PA	2	3	-	3	-	-	-
Data entry	-	5	-	5	-	-	-
Driver	-	10	5	5	-	-	-
Chainman/ survey staff	-	5	-	5	-	-	-
Peon/messenger	1	4	2	2	-	-	-
Equipment							
Vehicle	-	10	-	5	5	-	-
Computer	-	10	-	5	5	-	-
Photocopier	-	5	-	3	2	-	-

Source: Coal India Ltd.

Area cells [CCL-3, SECL-7, MCL-3, WCL-4, NCL-5, Total-22]

Staff type/ skills	*Grade*	*Currently in place*	*To be added by 2000*	*Placement schedule*				
				95-96	*96-97*	*97-98*	*98-99*	*99-00*
Executive								
Deputy Chief Engr. (Env/ Mining/Civil)	M_1	-	22	10	12	-	-	-
Civil Engr	M_3	-	22	-	10	12	-	-
Staff								
Sr. PA		-	22	5	17	-	-	-
Driver		-	22	-	10	12	-	-
Peon		-	22	10	12	-	-	-
Equipment								
Vehicle		-	22	-	10	12	-	-
Computer		-	22	5	12	5	-	-

Source: Coal India Ltd.

Project cells (CCL-3, SECL-12, MCL-6, WCL-5, NCL-5, Total-31)

Staff type/ skills	*Grade*	*Currently in place*	*To be added by 2000*	*Placement schedule*				
				95-96	*96-97*	*97-98*	*98-99*	*99-00*
Executive								
Env/Mining/ Civil Engr	E_1/E_2	12	19	9	10	-	-	-
Staff								
Forestry Asst.		-	31	-	31	-	-	-
Stenographer		-	26	-	16	10	-	-
Plantation Helper		-	31	-	31	-	-	-

Note: Stenographer is not required in NCL.
Source: Coal India Ltd.

Central mine planning & design institute (CMPDI)

Institute of Environment (CMPDI-Headquarters)

Type of staff/ skills	*Currently in place*	*To be added by 2000*	*Placement schedule*				
			95-96	*96-97*	*97-98*	*98-99*	*99-00*
Executive							
CGM(Env)	1	-	-	-	-	-	-
GM(Env)	1	-	-	-	-	-	-
Dy.Chief Engr (Env)	1	1	-	1	-	-	-
SE(Env/Lab)	2	-	-	-	-	-	-
Forestry Officer(E_3)	1	-	-	-	-	-	-
Engr.(Env-E_3)	6 (ETP-1, AIR-1, SP-1, LAB-1, Field-2)	4 (Reports-1, Lab-1, Field-2)	1	3	-	-	-
Secy to CGM/GM	1	1	-	1	-	-	-
Staff							
Office Supdt.	1	-	-	-	-	-	-
Head Surveyor	1	-	-	-	-	-	-
Chief Draughtsman	1	-	-	-	-	-	-
Lab Analyst	2	3	1	2	-	-	-
Data entry	-	1	-	1	-	-	-
Steno/Typist	1	-	-	-	-	-	-
Chainman	2	-	-	-	-	-	-
Sampling Asst.	7	-	-	-	-	-	-
Lab Asst.	3	-	-	-	-	-	-
Driver	2	1	1		-	-	-
Peon	1	-	-	-	-	-	-
Equipment							
Vehicle	3	-	3	-	-	-	-
Computer	3	-	3	-	software purchase	-	-

Source: Coal India Ltd.

Regional CMPDI environment cells*

Type of staff/ skills	*Currently in place*	*To be added by 2000*	*Placement schedule*				
			95-96	*96-97*	*97-98*	*98-99*	*99-00*
Executive							
Chief/Addl. Chief Engr(Env)	3(RI-III, IV,VI)	2(RI-V,VII)	-	2	-	-	-
SE (EMP formulation)	4(RI-III, IV,V,VII)	1(RI-VI)	-	4	-	-	-
Env. Engr,E_4 (EMP formul)	4(RI-III, V,VI,VII)	1(RI-IV)	1	-	-	-	-
SE(Env. Lab)	-	4 (RI-IV,V,VI,VII)	1	2	1	-	-
Env Engr for Field Moni-toring (E_2/E_3)	3 (RI-V,VI)	2 (RI-IV,VII)	-	2	-	-	-
Staff							
Lab Analyst	2 (RI-V)	3(RI-IV, VI,VII)	-	3	-	-	-
Lab Asst.	1 (RI-V)	4(RI-III, IV,VI,VII)	2	2	-	-	-
Field Sampling Asst.	2(RI-V), 1(RI-VI)	7	3	4	-	-	-
Data Entry	-	4	1	2	1	-	-
Driver	-	5	2	3	-	-	-
Peon	-	5	2	3	-	-	-
Equipment							
Vehicle	-	5	2	3	-	-	-
Computer	-	5	1	2	2	-	-

Note: 5 Cells are required to serve 5 subsidiary companies. Since CMPDI(HQ) will be doing the laboratory job for CCL, 4 regional cells will be developed.
*Regional Institutes of CMPDI are abbreviated as RI through RVII. These abbreviations represent the following Institutes: RI - ECL, RII - BCCL, RIII - Ranchi, RIV - Nagpur, RV - Bilaspur, RVI - Singrauli, RVII - Orissa.
Source: Coal India Ltd.

Summary of executive requirements

Executives	*Corporate*	*Company headquarters*	*Area*	*Project*	*CMPDI headquarters*	*Regional CMPDI*	*Total*
Chief GM	-	-	-	-	1	-	1
GM (Env)	1	5	-	-	1	-	7
Chief/Addl. Chief Engr (Env)	-	-	-	-	-	5	5
Dy.Chief Engr(Env.)		5	22	-	2	-	29
SE(Env)/Lab.	1	-	-	-	3	9	13
SE(Civil)	-	5	-	-	-	-	5
Civil Engr (E_3)	-	-	22	-	-	-	22
Engr(Env) E_4	-	5	-	-	-	5	10
Env Engr. E_3/E_3	1	-	-	31	10	5	47
Forestry Officer	-	5	-	-	1	-	6
Secy (CGM/GM)	1	5	-	-	2	-	8

Source: Coal India Ltd.

Summary of executive placement

Executives	*Currently in place*	*To be added by 2000*	*Placement schedule*				
			95-96	*96-97*	*97-98*	*98-99*	*99-00*
Chief GM	1	-	-	-	-	-	-
GM(Env)	6	1	1(NCL)	-	-	-	-
Chief/Addl.Chief	3	2	2	-	-	-	-
Dy.Chief Engr(Env)	3	26	12	14	-	-	-
SE (Env-Lab)	4	9	5	4	-	-	-
SE(Civil)	2	3	2	1	-	-	-
Civil Engr E_3	-	22	10	12	-	-	-
Env Engr, E4	-	10	2	8	-	-	-
Env Engr, E_3/E_3	21	26	21	5	-	-	-
Forestry Officer	1	5	-	5	-	-	-
Secy to CGM/GM	3	5	2	3	-	-	-

Source: Coal India Ltd.

Summary of staff requirements

Non-executives	*Corporate*	*Company headquarters*	*Area*	*Project*	*CMPDI headquarters*	*Regional CMPDI*	*Total*
Surveyor	-	5	-	-	1	-	6
Office Supdt.	-	-	-	-	1	-	1
Chief Draughtsman	-	-	-	-	1	-	1
Lab Analyst	-	-	-	-	5	5	10
Sr.PA/PA	-	5	22	-	-	-	27
Data Entry	-	5	-	-	1	4	10
Steno/Typist	-	-	-	31	1	-	32
Chainman	-	5	-	-	2	-	7
Lab Asst	-	-	-	-	3	5	8
Sampling Asst	-	-	-	-	7	8	15
Driver	-	10	22	-	3	5	40
Peon	-	5	22	-	1	5	33
Forestry Asst	-	-	-	31	-	-	31
Plantation Asst	-	-	-	31	-	-	31

Source: Coal India Ltd.

Summary of staff placement

Non-executives	*Currently in place*	*To be added by 2000*	*Placement schedule*				
			95-96	*96-97*	*97-98*	*98-99*	*99-00*
Surveyor	1	5	-	5	-	-	-
Office Supdt.	1	-	-	-	-	-	-
Chief Draughtsman	1	-	-	-	-	-	-
Lab Analyst	1	6	1	5	-	-	-
Sr.PA/PA	2	25	5	20	-	-	-
Data Entry	-	10	-	7	3	-	-
Steno/Typist	1	31	16	15	-	-	-
Chainman	2	5	-	5	-	-	-
Lab Asst	4	4	2	2	-	-	-
Sampling Asst	9	6	4	2	-	-	-
Driver	4	36	2	10	17	-	-
Forestry Asst	3	30	20	10	-	-	-
Plantation Asst	-	31	-	31	-	-	-

Source: Coal India Ltd.

Staff training and technical assistance

The build up of technical expertise for effective compliance of environmental provisions needs training of the involved personnel. There are four clear training facets leading to achievement of the objectives:

- Environmental planning to be integrated with the Project Report Preparation.
- Execution of mitigational measures for controlling pollution.
- Monitoring and evaluation of planning and execution of the mitigational measures and
- Suitably modifying the planning and execution guidelines for better results, if required.

To make environmental personnel responsive, responsible and committed to environmental safeguards, training on all the above facets is required. Besides classroom training, on site training on demonstration projects by involving the experts from within the country and from abroad will be provided. The framing up of suitable training schemes and their effective implementation in the classroom and field situation is quite a specialised job for which suitable consultants (from within and outside the country) will be engaged.

Coal India wishes to use part of the technical assistance component of the proposed coal sector loan to develop practical training programs for existing and inducted staff and new recruits. Programmes for immediate training needs are:

- An environmental and social impact appreciation short-courses for senior management on environmental regulations, objectives and standards, and management's responsibilities in the management of environmental and social impacts;
- The design, construction and operation of minesite surface water control and treatment schemes; for the engineers at the project/area levels;
- The design, construction and recontouring of overburden dump systems for stability and eventual reclamation;
- Reclamation plant species selection and revegetation techniques;
- The effective design and operation of air and water quality and noise monitoring networks; and
- Environmental inspection and compliance auditing techniques.

Five-Year Plan of environmental facilities and equipment needs

Buildings and facilities

OFFICE ACCOMMODATIONS AND STORAGE BUILDINGS. The office accommodation for cells at different levels from Coal India's corporate cell to subproject cells are

housed in the main offices of the units. No separate office accommodation is called for except perhaps at the project level. For constructing an office with 300m² floor area, provision is being kept for all the subprojects. For construction of office at project level, a period of two years (i.e. 1995-97) is envisaged at a construction cost of Rs.4,000/m².

ENVIRONMENTAL LABORATORY FACILITIES. Coal India has decided that CMPDI will develop these facilities under their Regional Institute to cover the subprojects with effective environmental monitoring. Five laboratories are to be established, two in SECL and one each in MCL, WCL and NCL. The environmental laboratories at Institute of Environmental (CMPDI- HQ) shall cater to CCL and will render specialist services to the five Regional Laboratories being set up in the Regional Institutes. The construction cost of four laboratories with 400m² floor area for each laboratory will be Rs.1,600,000.

PLANT PROPAGATION AND NURSERY FACILITIES. Each area will develop a nursery facility for plant propagation. Generally, however, the sapplings are purchased from State forest department and large scale facilities are not required to be developed. Therefore, to start with, a plant Nursery facility will be developed with an outlay of about Rs.600,000 in each area under this project.

Equipment and supplies

OFFICE AND DATA MANAGEMENT. The following office tools and utilities will be provided for the offices being developed at:

1) Project Level
   a) 1 Type writer — Rs.70,000
   b) 1 set of Furniture — Rs.100,000
2) Area level
   a) 1 Vehicle — Rs.400,000
   b) 1 Computer — Rs.150,000
   c) 1 set of Furniture — Rs.150,000
3) Company level
   a) 2 Vehicles — Rs.800,000
   b) 2 Computers — Rs.300,000
   c) 2 Photocopiers — Rs.150,000
   d) 2 sets of Furniture — Rs.300,000

ENVIRONMENTAL MONITORING AND LABORATORY ANALYSIS. The CMPDI regional laboratories to be opened for the four companies will be provided with laboratory Instruments and other infrastructure worth Rs.2.00 million. This will be over and above the field kits to be used by area level cells in their own areas for surprise and spot checks. The field kits for each area will cost Rs.150,000.00.

EARTH MOVING AND LAND RECLAMATION. The items of machinery or contractual expenses for land reclamation etc. have been included in the 5 year EAP for individual subprojects.

Estimates of Infrastructure and Training Expenditures

Expenditure	*Units*	*Cost per unit (Rs million)*	*Total cost (Rs million)*
Office & Lab. Buildings			
Project level	26	1.20	31.20
Area level	-	-	-
Company(HQ) level	-	-	-
CMPDI, RI.Labs	4	1.60	6.40
Office & Lab Support			
Project level	26	0.17	4.42
Area level	22	0.70	15.40
Company(HQ) level	5	1.55	7.75
CMPDI, RI.Labs	4	0.50	2.00
Instrumentation			
CMPDI, RI Labs	4	1.50	6.00
Area level field kits	22	0.15	3.30
Plant propagation*	31	0.60	18.60
Training expenses**			20.00

* Development of Nursery and other plant propagation facility at project level.

** The environmental training package is to be developed by expatriate experts. It has been spelt out in the technical assistance part of the proposed loan. The consultants/ experts expenses, as estimated, come to about Rs.20 million. The expenses incurred on trainees for undertaking the training will be met from normal HRD budget of the companies.

Source: Coal India Ltd.

ANNEX 6 ENVIRONMENTAL ACTION PLANS

1. This annex consists of the 31 mine-by-mine Environmental Action Plans and a map of each of the mines.

2. The following abbreviations are used in the Plans:

ATPS	Amarkantak thermal power station
BDL	Below detection level
BALCO	Bharat Aluminium Company
BSEB	Bihar State Electricity Board
CHP	Coal Handling Plant
CTPS	Chandrapur thermal power station
GM	General Manager
MGR	merry go-round
MPCB	Maharashtra Pollution Control Board
MSEB	Maharashtra State Electricity Board
MPEB	Madhya Pradesh Electricity Board
NALCO	National Aluminum Company
NTPC	National Thermal Power Corporation
OPGC	Orissa Power Generation Corporation
RTPS	Renusagar thermal power station
SSTPS	Singrauli Super Thermal Power Station
STPS	Super thermal power station
Strip ratio	Figures indicate cubic metre per tonne
TPS	Thermal power station
VSTPS	Vindhychal super thermal power station

BINA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Bina
Company:	NCL
State:	Uttar Pradesh
Coalfield:	Singrauli
Year of sanction:	1973
Operational startup:	1974
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Annual production:	5.5 million tonnes
Capacity:	4.5 million tonnes
Mine life:	30 years
Residual life:	16 years
Number of coal seams:	2 (Thickness: 11 & 20.8m)
Ash content:	25-40%
Strip ratio:	2.2:1
Max. quarry depth:	165m
Coal destination:	Obra, Renusagar and other northern India's thermal power stations

Current environmental status

Environmental setting

The Bina project is located on hilly terrain forming a plateau on the west and southwest, whereas towards the east and northeast, the area is gently undulating. General elevation in the mining area varies from 275m to 400m above sea level. The mining area lies in between Marrak block on the south and Kakri opencast project in the north. The drainage of the area is controlled by seasonal streams which discharge into Gorbanda nallah and ultimately drain into Gobinda ballav pant sager in the south. Parasi village and Panjreh villages are located nearby. There are four thermal power plants within 10km radius of this project: VSTPS, SSTPS, ATPS, and RTPS.

Baseline monitoring

Because of the age of this project, no true baseline information exists. However, for preparation of the EMP environmental quality data was generated in 1987. Air quality stations were established at the mine site and colony, noise level stations at mine site and colony and water quality stations at main sump and reservoir near the mine. All the results were found within the permissible limits. In 1990, however, NCL undertook a regional monitoring programme as a benchmark to establish future trends in environmental quality.

For this study 30 air quality stations, 24 noise stations and 44 water quality stations were established.

Mine planning and design

The general strike of the project is north to south with a westerly dip of 2° to 5°. The angle of the dip generally increases from south to north. Considering the prevailing geomining condition, techno economics and environmental impacts, the combination of dragline and shovel/dumper has been envisaged as the method of mining in Bina project. The total volume of overburden to be handled is 238.7 million m^3 out of which 30 million m^3 (12.6%) is external dump and the remaining 208.7 million m^3 will be backfilled in the decoaled area. The external dumping area is 60ha. No further external dumping is proposed to be done. Areas of the leasehold occupied by mine facilities to the end of the current five year period 1995-96 to 1999-2000) and anticipated to the total 30 year mine life are as follows:

Leasehold area - Bina

(All figures in hectares)

	External dump	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	60	471	88	77	135	453	1,284
Life	60	877	95	77	135	40	1,284

Project monitoring, auditing and evaluation

Presently air quality information is collected at the mine site near the VTC building, colony and adjoining the proposed mine site, Bina Mine-II. Water quality data is collected from mine sump, workshop effluent, siltation pond, tap water in the colony and Gorbanda nallah. Noise level monitoring is done at the mine site, workshop and colony. The monitoring results are within permissible limits.

Hydrology and water quality management

Water from the pit sump is discharged, along with surface runoff from the CHP etc., to the Gobind ballabh pant dam. Problems with coal fines contamination have been experienced with this discharge. Therefore, the discharge water is passed through a settling tank near the GM office. At the present time, about 10.5km of garland drain has been constructed. Settling tanks have been constructed to treat effluent of the vehicle washing shop. The workshop has been provided with an oil and grease trap. Analytical results from the water samples show that all parameters are within the permissible limit.

Air quality and noise management

At present the temporary CHP (capacity 1.8 million tonnes per year) is generating some airbourne dust. A water spraying system has been installed at all transfer points, the crusher and the loading points. All conveyors are covered. The permanent CHP of 4.5 million tonnes per year is likely to start by June 1995. A misting system with chemical additives is being installed in the permanent CHP. All conveyors will be fully enclosed. All pit roads are regularly watered. Main haul roads are metalled and permanent service roads are paved. Greenbelts have been established around the colony and along most of the service roads. As a result of these dust control measures suspended particulate levels regularly comply with air quality objectives.

Disturbed land reclamation

There are seven external dumps. All but one, which is 47m high, are below 30m in height. Regrading, leveling and resloping of all the dumps is in progress. In place of top soil spreading, planting is being done by putting top soil in the pits dug for the plants. Technical reclamation is expected to be completed by March 1996. Well organised internal backfilling is taking place with modest resloping and approximately to original contours. Extensive tree plantings have been established on the tops of external overburden dumps, and some recontouring and planting has been undertaken on some internal dumps.

Regional cumulative environmental impacts

The concentration of industrial activities in the Singrauli area must lead eventually to the need for regional approaches to environmental monitoring, management and land use planning.

Project monitoring, auditing and evaluation

The existing air monitoring stations have been considered adequate. For frequency of air sampling, samples are drawn on a 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality stations have also been considered adequate. Water quality and levels of wells/bore wells will be monitored quarterly in one of the villages adjacent to the mining operation. No change in the noise monitoring programme is envisaged. Monitoring stations will be reorganised after notification of CPCB guidelines for coal industry.

Hydrology and water quality management

The sediment trap at the washing plant will be cleaned regularly. Studies to determine the adequacy of sewage disposal to ground in the colony area will be completed by December 1996. The remaining 3km of garland drain will be completed by March 1996.

Air quality and noise management

Up until March 1995 planting in 468ha of land has been completed. The current dust and noise suppression programme will continue.

Disturbed land reclamation

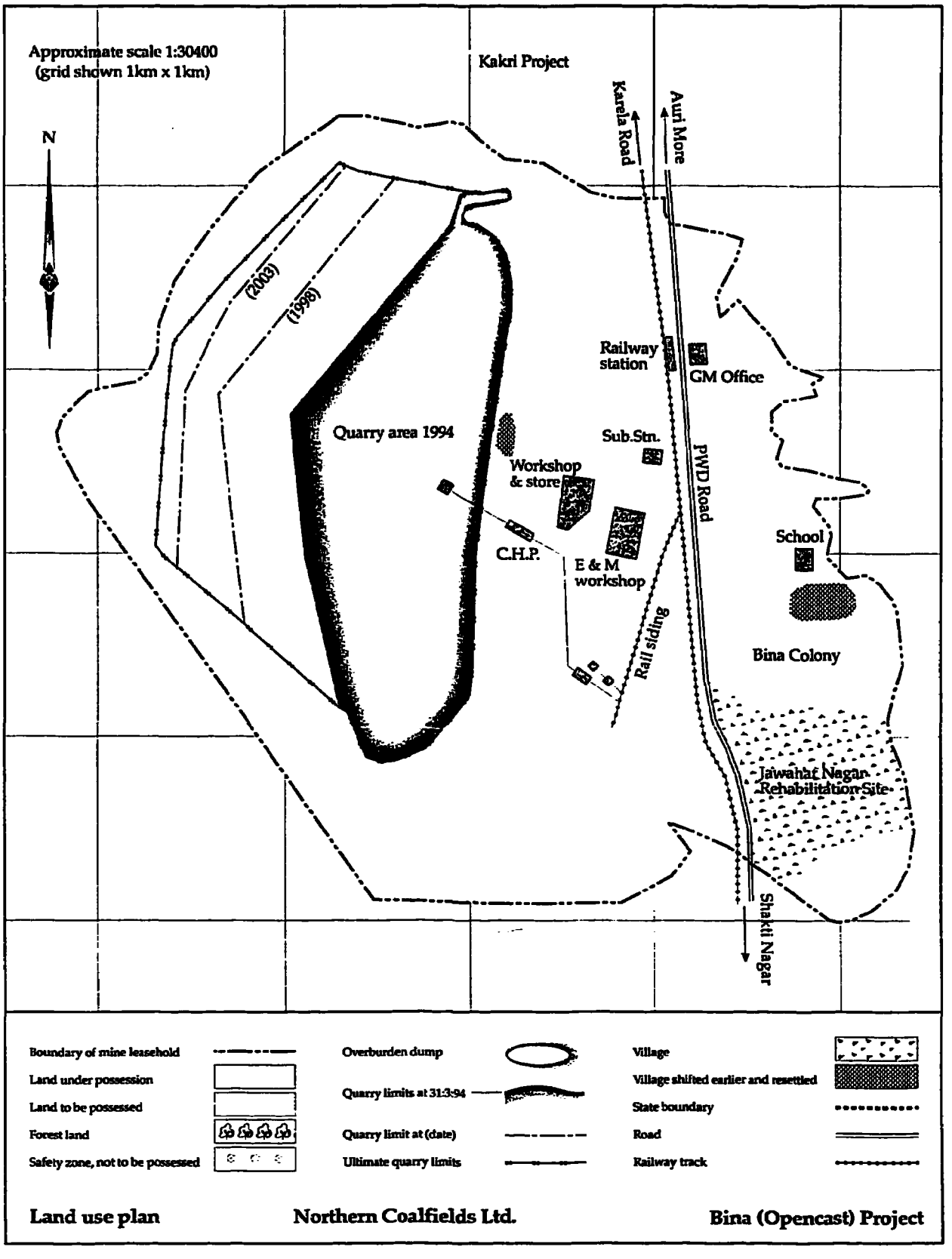
The current backlog of reclamation is 310ha and during the next five years 84ha more backfilled area will be available. The backlog will be reclaimed at a rate of 74ha in 1995-96 and 80ha per year from 1996-97 to 1999-2000. The average reclamation cost for the five years will be Rs20.6 million in 1995-96 and Rs22.3 million per years from 1996-97 to 1999-2000.

Five year annual budget summary - Bina

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	1.80	0.00	2.00	0.00	2.20	0.00	2.40	0.00	2.70
Air quality & noise	0.40	2.70	10.40	3.00	0.60	3.30	0.60	3.80	0.70	4.00
Water quality & hydrology	0.00	0.10	0.50	0.40	0.20	0.10	0.00	0.10	0.00	0.70
Land reclamation	22.00	20.59	0.25	22.26	0.00	22.26	0.00	22.26	0.00	22.26
Total	**22.40**	**25.19**	**11.15**	**27.66**	**0.80**	**27.86**	**0.60**	**28.56**	**0.70**	**29.66**

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Northern Coalfields Ltd.** **Bina (Opencast) Project**

DUDHICHUA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Dudhichua
Company:	NCL
State:	Madhya Pradesh
Coalfield:	Singrauli
Year of sanction:	1980
Operational startup:	1981
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Annual production:	5.0 million tonnes
Capacity:	10.0 million tonnes
Mine life:	45 years
Residual life:	32 years
Number of coal seams:	3 (Thickness: 8, 9.5 & 18.8m)
Ash content :	20-35%
Strip ratio:	3.3:1
Max. quarry depth:	235m
Coal destination:	Western India power houses (Wanakbari, Kota) and Vindhyachal super thermal power station of NTPC

Current environmental status

Environmental setting

The minesite is situated on a low plateau bordered on its south side by a steep, approximately 60m high, escarpment. Colony areas and mine infrastructure are located below the escarpment. Five villages (Chilkadand, Dudhichua, Kanwar, Churidah and Madhouli) are affected by mining activities. In the premining stage, the run off from mine area was partly flowing into Bijul nallah and partly into Ballia nallah. In the post mining stage, run off from the whole minefield will flow into Gobind ballabh pant sagar through Ballia nallah. The Project is located between Jayant opencast project on the west and Khadia opencast project on the east. There are four thermal power plants within a 10km radius (VSTPS, SSTPS, ATPS, RPTPS). The premining land uses of the 1,694ha leasehold consisted largely of forest (779ha) and unoccupied scrubland (805ha) used for rough grazing, minor dryland cropping (90ha), and dwelling sites(20ha).

Baseline data

No true baseline information exists as the project started in 1980. However, for preparation of the EMP, environmental data was generated in June

1988. Air quality stations were at mine site and colony; for noise at the mine, workshop and colony; and for water quality, at mine sump, workshop and Ballia nallah. The results were found within permissible limits, except for TSS concentration in workshop effluent. In 1990, however, NCL undertook a regional monitoring programme as a benchmark to establish future trends in environmental quality. This study involved the establishment of 36 air quality stations, 24 noise stations and 44 water quality stations.

Mine planning and design

The general strike of the project is NW-SE and dip is towards the north-east which varies from 1 in 20 to 1 in 25 (2° to 3°). Considering the geomining conditions, deployment of two draglines in tandem for stripping of the main bench over the Turra Seam were envisaged and deployment of shovel/dumper combination for the parting between Turra and Purewa seams has been planned. The total volume of overburden to be handled is 1133 million m^3, out of which 134 million m^3 (11.8%) is external dump and the remaining (999 million m^3) will be backfilled in decoaled areas. The coal from the face is transported to the crushing plant and CHP. It is dispatched to SSTPS through MGR system. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the total 45 years mine life are as given below:

Leasehold areas - Dudhichua

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Un-occupied*	*Total area*
5 years	152	215	80	95	120	1,032	1,694
Life	152	945	275	95	120	107	1,694

Project monitoring, auditing and evaluation

Air quality information is collected at the mine office, the colony rest house and a local village (Madhauli). Water quality data is collected from the pit sump discharge and in the Ballia nallah upstream and downstream of the minesite. Noise is measured at the CHP, Madhauli village and the colony. The monitoring results are within permissible limits.

Hydrology and water quality management

Water from the pit sump is discharged, along with surface runoff from the coal handling plant, to the Ballia nallah. Problems with coal fines contamination have been experienced with discharge. Concrete settling tanks have

been constructed to treat washwater. The maintenance shop has a well functioning oil and grease trap.

Air quality and noise management

Dust control in the coal handling plant is very comprehensive. Misting systems with chemical additives have been installed at all transfer points, the crusher and the loading silo. All conveyors are totally enclosed. All pit roads are regularly watered. Main haul roads are metalled and permanent service roads are paved. Green belts have been established around the colony and along most of the service roads. Up to March 1995, planting of 1.2 million plants on 450ha has been completed. As a result of these dust control measures, suspended particulate levels regularly comply with air quality objectives.

Disturbed land reclamation

Out of 134 million m^3, 70.49 million m^3 has been dumped as an external dump in Uttar Pradesh. Part of this material, covering an area of 63ha, has been reclaimed. Old external overburden dumps are amongst the highest and steepest observed on any project, being 60-70m high with slope angles of approximately 40° and much evidence of mass wasting. Well organised internal backfilling is taking place with modest resloping. Extensive tree planting has been established on the tops of external overburden dumps and some recontouring and planting has been undertaken on some internal dumps.

Regional cumulative environmental impacts

The concentration of industrial activities in the Singrauli area must lead eventually to the need for regional approches to environmental monitoring and management and land use planning.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

The existing air monitoring stations are considered adequate. For frequency of air sampling, the samples are being drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present, CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality stations are also considered adequate. Water levels and quantity of wells/borewells will be monitored quarterly in one of the villages adjacent to the mining operation. No change to noise monitoring programme is envisaged.

Hydrology and water quality management

Grease and sediment traps will be constructed to treat wash water and site drainage. Site drainage from the CHP will be collected and treated prior to discharge. It is anticipated that a common settling pond will treat both effluents. These systems will be operational by June 1996. The remaining 3.6km garland drain systems around the toe of the external dumps, linked to settling ponds, will be completed by December 1996. Studies to determine the adequacy of sewage disposal to ground in the worker and resettlement colonies will be undertaken and completed by June 1996.

Air quality and noise management

Current dust suppression activities will continue with the addition of another water tanker for haul road watering. A new effective misting system will be installed at the feeder breaker by December 1995. Planting will continue.

Disturbed land reclamation

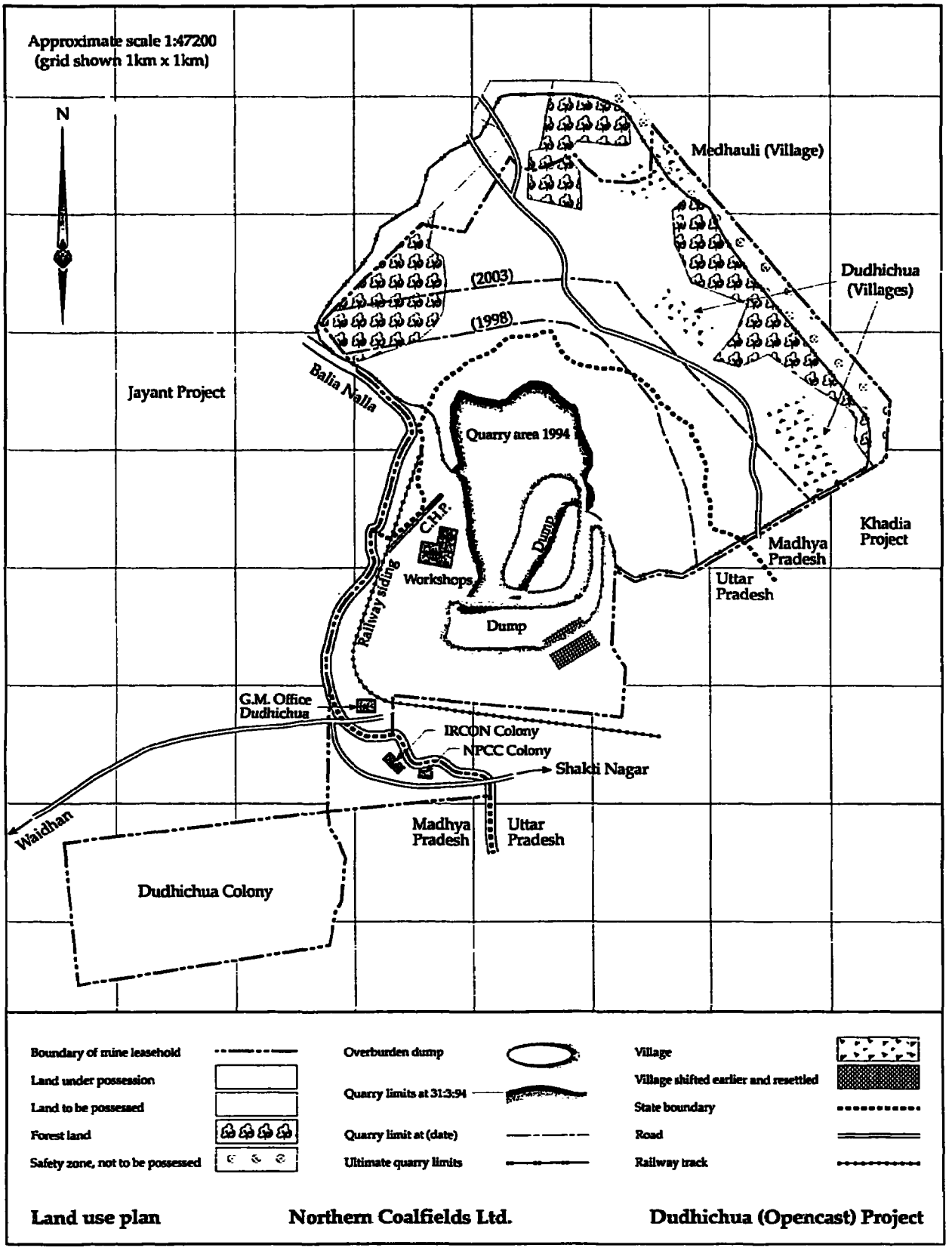
In view of the poor results to date in reclaiming overburden slopes at over 35°, in future, physical reclamation will achieve the maximum slope of 28° stipulated in the project's letter of consent before revegetation is carried out. An engineering study will be undertaken for stable slope for the old overburden dumps during 1995-96 and 1996-97. On the basis of the study result, the reclamation will be made from 1997-98 onward. Reclamation of backfilled area will continue.

Five year annual budget summary - Dudhichua

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	8.00	2.00	8.00	2.00	8.00	2.50	0.00	2.50	0.00	3.00
Water quality	1.60	0.40	1.60	0.40	0.00	0.40	0.00	0.20	0.00	0.20
Land reclamation	45.00	2.40	45.00	2.40	0.00	2.40	0.00	2.40	0.00	2.40
Total	54.60	5.10	54.60	5.10	8.00	5.60	0.00	5.40	0.00	5.90

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Northern Coalfields Ltd.** **Dudhichua (Opencast) Project**

JAYANT
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Jayant
Company:	NCL
State:	Madhya Pradesh
Coalfield:	Singrauli
Year of sanction:	1975
Operational startup:	1975
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	5.7 million tonnes
Capacity:	10.0 million tonnes
Mine life:	41
Residual life:	25
Number of coal seams:	3 (Thickness: 7, 10 & 17m)
Ash content:	17-45%
Strip ratio:	3.5:1
Max. quarry depth:	215m
Coal destination:	Singrauli TPS

Current environmental status

Environmental setting

The Jayant project is situated on a plateau with elevation varying from 375-425m above sea level except one hill on NW corner having an altitude of 500m. The most important stream around the area is Modwani nallah. The drainage of the area is controlled by seasonal streams which discharge into Modwani nallah and ultimately into Gobind ballabh pant sagar in the south. Panjeh and Parasi Villages are likely to be affected due to mining operations. The project is located between Dudhichua opencast project on the east and Nigahi opencast project on the west. There are four thermal power plants in the region (VSTPS, SSTPS, ATPS and RPTS).

Baseline data

No true baseline information exists as the project started in 1975. However, for the preparation of the EMP, environmental quality data was generated at the mine site and colony and water quality from the main sump. All results were within permissible limits. In 1990, however, NCL undertook a regional monitoring programme as a benchmark to establish future trends in environmental quality. For this study, 30 air quality stations, 24 noise stations and 40 water quality stations were established.

Mine planning and design

The strike of the coal seam is from east to west and its dip varies between 1° to 3° in a northern direction. In view of the prevailing geomining condition the use of the dragline with shovel dumper combination was adopted. It is planned that the dragline would handle the large volume of overburden just above the coal benches and backfill the void. The total volume of overburden to be handled is 907.3 million m^3 out of which 60 million m^3 (6.61%) is external dump and the remaining 847.3 million m^3 will be backfilled in the decoaled area. Coal is dispatched to NTPC through CHP by MGR system. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the 41 years mine life are as follows:

Leasehold area - Jayant

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Un-occupied*	*Total area*
5 years	119	452	80	210	106	1,498	2,465
Life	119	1,309	114	210	106	607	2,465

Project monitoring, auditing and evaluation

Air quality data is collected at the mine site, field workshop, CHP and CWS colony (Executive hostel). Water quality data is collected from the mine sump, workshop effluent, CHP effluent, drinking water tap and Modwani nallah. Noise levels are measured at the mine site, workshop and in the colony during day and night time. The monitoring results are within permissible limits.

Hydrology and water quality management

Water from the pit sump is discharged along with surface runoff from the CHP to Modwani nallah. Problems with coal fines contamination have been experienced with this discharge. Concrete settling tanks have been constructed and are operative in the washing plant. The workshop has a well functioning oil and grease trap. An adequately sized settling pond has been constructed to treat pit sump and CHP discharge. An 11km long garland drain has been constructed. The monitoring results are within permissible limits.

Air quality and noise management

Dust control in the CHP is very comprehensive. Misting systems have been installed at all transfer points, the crusher and the loading silo. All pit

roads are regularly watered. Main haul roads are metalled and permanent service roads are paved. Greenbelts have been established around the colony and along most of the service roads to keep the SPM level within limits.

Disturbed land reclamation

Old overburden dumps on about 119ha of land are have slopes of more than 35° and are above 40m in height. Extensive planting has been established on the tops of external overburden dumps and recontouring and planting has been undertaken on internal dumps. External dump slopes are extremely long and steep and cannot be reclaimed without substantial slope reduction and terracing.

Regional cumulative environmental impacts

The concentration of industrial activities in the Singrauli area must lead eventually to the need for regional approaches to environmental monitoring management and land area planning.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluations

The existing air monitoring stations are considered adequate. For frequency of air sampling, the samples are being drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present, CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality stations are also considered adequate. Water levels and quality of wells/borewells will be monitored quarterly in one of the villages adjacent to mining operation. No change to the noise monitoring programme is envisaged.

Hydrology and water quality management

One separate adequately sized settling pond will be constructed to treat the CHP discharge by December 1996. The sediments trap at the washing shop will be cleaned regularly and the sediments will be dumped in overburden dumps from October 1995. Studies to determine the adequacy of sewage disposal to ground in the colony areas will be completed by December 1996.

Air quality and noise management

Up to March 1995, 1.95 million saplings have been planted. The current dust and noise suppression program will continue.

Disturbed land reclamation

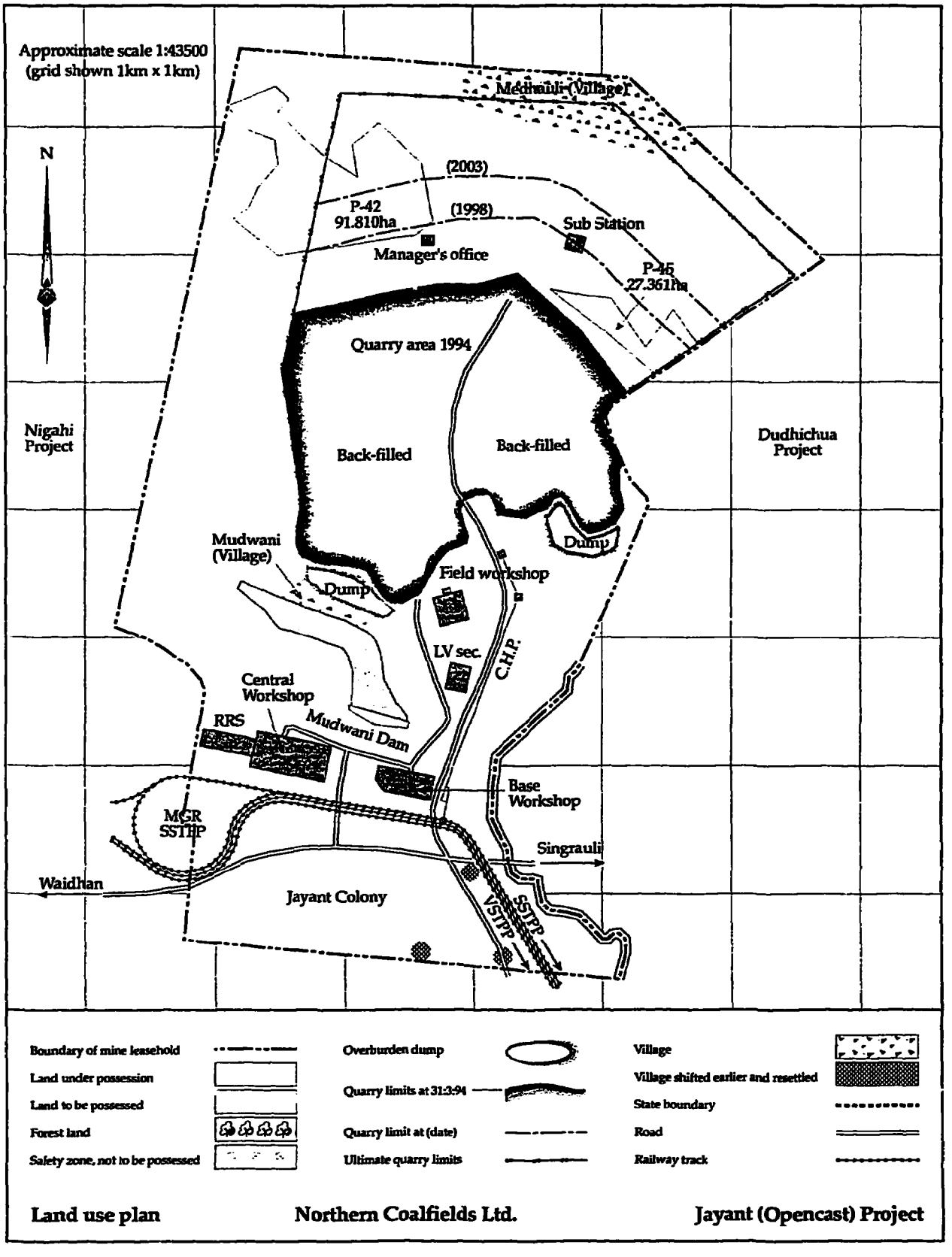
The slope stability of the old dumps having heights of more than 40m will be scientifically assessed. These studies will be completed by CMPDI by December 1996. Based on the findings, the resloping and biological reclamation for the dumps will be carried out.

Five year annual budget summary - Jayant

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	8.00	2.00	8.00	2.00	9.00	2.50	10.00	2.50	0.00	3.00
Water quality	1.60	1.00	0.50	0.50	1.00	0.50	0.00	0.00	0.00	0.00
Land reclamation	40.00	2.40	10.00	2.40	10.00	2.40	14.00	3.50	0.00	3.50
Total	**49.60**	**5.70**	**18.50**	**5.20**	**20.00**	**5.70**	**24.00**	**6.30**	**0.00**	**6.80**

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Northern Coalfields Ltd.** **Jayant (Opencast) Project**

JHINDURGA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Jhingurda
Company:	NCL
State:	Madhya Pradesh
Coalfield:	Singrauli
Year of sanction:	1977
Operational startup:	1965
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	3.4 million tonnes
Capacity:	3.0 million tonnes
Mine life:	50 years
Residual:	21 years
Number of coal seams:	2 (Thickness: 132-138m & 9-20m)
Ash content:	22-33%
Strip ratio:	1.5:1
Max. quarry depth:	290m
Coal destination:	Renusagar thermal power station

Current environmental status

Environmental setting

The incrop of the coal seam occurs in a crescent shape. The northern half of the sub basin was upthrown by a fault and deposits were washed away exposing the metamorphics on the north. Chatka nallah in the south of the quarry flows from east to west and joins Bijul nallah in the north. Bijul nallah ultimately flows into Sone river. Churki and Jhingurda villages are being affected due to mining activities. There are four thermal power plants in the Singrauli coalfields: namely VSTPS, SSTPS, ATPS, and RPTPS.

Baseline data

Because of the age of this project no true baseline information exists. However, for preparation of the EMP, environmental data was generated in 1989. Air quality stations were at the mine site and colony, noise level measuring stations at minesite and colony and water sampling stations at the mine sump and Chatka nallah. The results were found to be within permissible limits. In 1990, however, NCL undertook a regional monitoring programme as a benchmark to establish future trends in environmental quality. For this study, 30 air quality stations, 24 noise stations and 44 water quality stations were established.

Mine planning and design

The dip of the coal deposits is centripetal and varies from 9° to 11° Considering the geo-mining condition, deployment of a shovel/dumper combination, both for coal and overburden, was planned. The coal is dispatched by aerial ropeways to Renusagar Thermal Power station and by railways to other consumers. Due to the steep gradient of the coal seams (9° to 11°) and the possibility of mining of Jhingurda bottom seams, all overburden will be dumped outside the quarry area as external dumps. Since there is no internal dumping, the whole excavated area will remain as a void and will act as water body. The surface area of the water body at 350m above sea level is 205ha. Areas of the leasehold occupied by mine facilities to the end of the current 5 year period (1995-96 to 1999-2000) and anticipated to the total 50 years mine life are as follows:

Leasehold area - Jhingurda
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-Structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	214	0	195	216	120	455	1,200
Life	260	0	235	216	120	369	1,200

Project monitoring, auditing and evaluation

Air quality information is collected at the mine site, electric substation and officers' transit camp. Water quality data is collected from the mine sump, workshop effluent and from the channel leading to Chatka nallah. Noise is measured at the mine site, workshop and colony during day and night. The monitoring results are within permissible limits.

Hydrology and water quality management

Total runoff from the mine area is accumulated in the sump and is then discharged to Chatka nallah. Discharge from the CHP is accumulated into pits for slush accumulation and then it is reused. Concrete settling tanks have been constructed for the washing shop. The workshop has a well functioning oil and grease trap. Runoff from the northwestern and northern dumps will flow into Chatka nallah through a drain with a silt arrester. A 4.3km garland drain has been constructed. The monitoring results are within permissible limits.

Air quality and noise management

Dust control in the CHP is very comprehensive, an atomised dust suppression method is being practiced. Dust extractors have been installed for minimizing the dust fcrmation. All the pits are regularly watered. Main haul roads are metalled and permanent service roads are being paved. Greenbelts have been established around the colony and along most of service roads. As a result of these dust control measures, suspended particulate levels regularly comply with air quality objectives.

Disturbed land reclamation

Old overburden dumps of 44ha in the south side of the quarry area have been reclaimed and planted. At present there are three external dumps: north western, northern and eastern.

Regional cumulative environmental impacts

The concentration of industrial activities in the Singrauli area must lead eventually to the need for regional approaches to environmental monitoring management and land use planning.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

The existing air monitoring stations are considered adequate. For frequency of air sampling the samples are being drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality stations are also considered adequate. Water levels and the quality of wells/borewells will be monitored quarterly in one of the villages adjacent to the mining operation. No change to the noise monitoring programme is envisaged.

Hydrology and water quality management

Two adequately sized settling ponds are in place to treat pit sump and CHP discharges. The sediment trap at the HEMM wash facility will be cleaned out regularly and sediments disposed off in the open pit. Some 3km of garland drains will be completed by March 1996. Studies to determine the adequacy of sewage disposal to ground in the colony will be completed by December 1996.

Air quality and noise management

The current dust and noise control programme will continue. Up to March 1995, about 1.2 million saplings have been planted.

Disturbed land reclamation

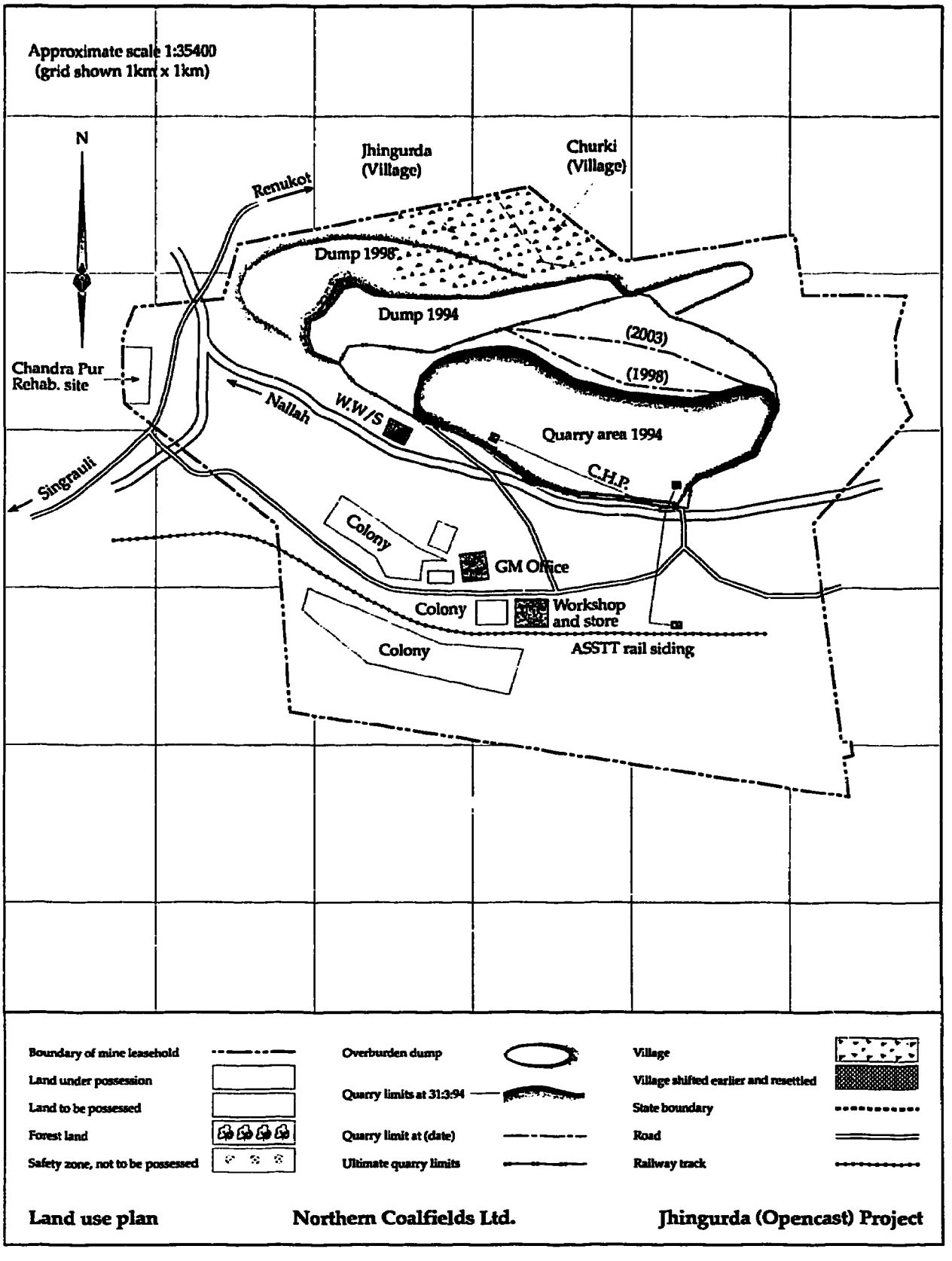
Reclamations of eastern and northern dumps will start in 1995-96. The northwestern dump will have five levels with the maximum dump top at a level of 490m. The eastern dump will have two levels with the maximum dump top at a level of 470m and the northern dump with a single level of 433m. The reclamation of the eastern dump will start during 1995-96, the northern dump from 1995-96 to 1997-98 and the northwestern dump in 1998-99.

Five year annual budget summary - Jhingurda

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	10.00	5.30	15.00	5.30	5.00	6.20	0.00	6.20	0.00	6.20
Water quality	9.00	2.00	9.00	2.00	9.00	2.00	0.00	2.00	0.00	2.00
Land reclamation	0.00	1.90	25.00	1.90	10.00	4.20	0.00	8.60	0.00	8.60
Total	19.00	9.50	49.00	9.50	24.00	12.70	0.00	17.10	0.00	17.10

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Northern Coalfields Ltd.** **Jhingurda (Opencast) Project**

NIGAHI
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Nigahi
Company:	NCL
State:	Madhya Pradesh
Coalfield:	Singrauli
Year of sanction:	1987
Operational startup:	1988
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	3.5 million tonnes
Capacity:	10.0 million tonnes
Mine life:	61 years
Residual life:	59 years
Number of coal seams:	4 (Thickness: 11-19.4m, 8.8-14.7m, 4.2-10.9m, 18.9-25.7m)
Ash content:	17-37.1%
Strip ratio:	3.8:1
Max. quarry depth:	240m
Coal destination:	Vindhyachal STPS of NTPC

Current environmental status

Environmental setting

The mine is situated on a hilly plateau with elevation of about 400-500m above sea level. Some relief elevations exceed 500m. In the western part, the plateau is pronounced by a steep escarpment. The elevation of escarpment at the top is 405m and at the base is 315m. Further to the south, the plateau turns into plain land with elevations of around 300m. The drainage of the area is divided in two sections: one flowing towards the north into Bijul nallah through Mehrauli/ Morwa nallah and the other towards the south into Gobind ballabh pant sagar through Modwani and Amjhore nallah. The mine lies between Jayant opencast project on the east and Amlohri opencast project on the west. Nigahi, Mehrauli Parewa, Muher, Amjhar and Gharauli villages are likely to be affected due to mining activities. There are four thermal Plants namely VSTPS, SSTPS, ATPS and RPTPS within a 10km radius.

Baseline data

No true baseline information exists. However, for the preparation of the EMP environmental data was generated in 1986. Air quality stations were at the mine site and colony; noise level stations were at the mine site and colony; and water quality stations were at the main sump and Morwa nallah. All the

results were within permissible limits. In 1990, however, NCL undertook a regional monitoring programme as a benchmark to establish future trends in environmental quality. For this study 30 air quality stations, 24 Noise stations and 44 water quality stations were established.

Mine planning and design

The strike of the project is east-west in the eastern part and swings slightly to the south in the western part. The seams are dipping at 1° to 4° to the north. In view of the geomining factors, the mine is being worked by dragline and shovel/dumper combination. The dragline is removing the parting between Turra and Purewa bottom seams and the shovel/dumper combination is deployed for coal and removing the parting between Purewa top and bottom seams. The total volume of overburden to be handled is 1850.8 million m^3, of which 1570.1 million m^3 (85%) will be dumped internally and 191.8 million m^3 and 88.1 million m^3 in the sourthern and western external dumps respectively. Overburden dumps will be formed in benches of 30m in height. The southern external dump will be formed in seven levels and the western external dump in five levels. The internal dump will have eight levels. The area occupied by external dump is 473ha. At present, well organised internal backfilling with modest slopes and approximate original contours is taking place. Area of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated mine life are as follows:

Leasehold area - Nigahi
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	313.0	285.0	20.0	107.0	220.0	2,091.4	3,036.4
Life	473.0	1,875.0	0.0	107.0	246.0	335.4	3,036.4

Project monitoring, auditing and evaluation

Air quality information is collected at the mine site, electrical sub-station, near the workshop, colonies and Meharauli Village. Water quality data is collected from the siltation pond, workshop effluent, openwell and domestic effluent. Noise is measured at the mine site, workshop and Mehrauli Village. The monitoring results are within permissible limits.

Hydrology and water quality management

Water from the pit sump is discharged along with surface runoff from the CHP to the settling pond. Concrete settling ponds have been constructed for

the washing shop. The workshops have a well functioning oil and grease trap. A 1.5km garland drain has been constructed. The monitoring results are within permissible limits.

Air quality and noise management

The CHP (under construction) will be provided with misting systems at all transfer points, crusher and loading silo. All conveyors will be totally enclosed. Along with this, dust extractors will also be installed. All pit roads are regularly watered. Main haul roads are metalled and permanent service roads are being paved. Greenbelts have been established around the colony and along most of the service roads. As a result of these dust control measures, SPM levels regularly comply with air quality objectives except at temporary loading arrangements where wagons are loaded by pay loaders.

Disturbed land reclamation

Since the mine was started in 1987, technical reclamation will start in 1995-96. Extensive tree planting will be done on the tops of external overburden dumps.

Regional cumulative environmental impacts

The concentration of industrial activities in the Singrauli area must lead eventually to the need for regional approaches to environmental monitoring management and land use planning.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluations

The existing air monitoring stations are considered adequate. For frequency of air sampling, the samples are being drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present, CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality stations are also considered adequate. Water levels and quality of wells/borewells will be monitored quarterly in one of the villages adjacent to the mining operation. No change to the noise monitoring programme is envisaged.

Hydrology and water quality management

Adequately sized settling ponds exist. The sediment trap at the HEMM wash facility will be cleaned out regularly and the sediments disposed off in the open pit.

Air quality and noise management

The current dust and noise suppression programme will be strengthened. Up to March 1995, the planting of 274ha has been carried out.

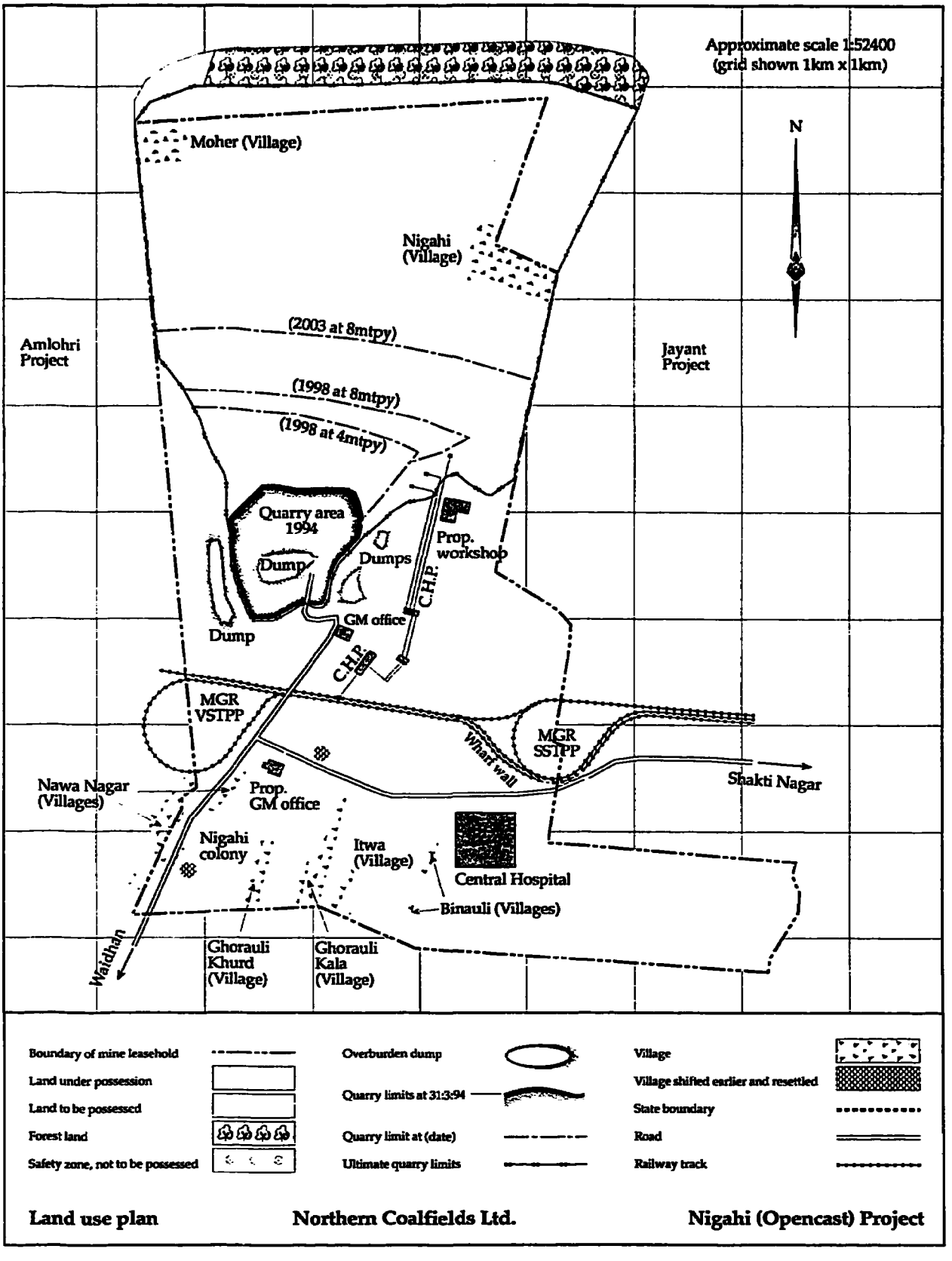
Disturbed land reclamation

Regular and proper land reclamation will be done from 1995-96.

Five year annual budget summary - Nigahi
(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.50	0.30	1.60	0.35	1.70	0.40	2.20	0.40	2.20	0.40
Water quality	1.00	0.10	1.00	0.10	1.50	0.20	1.50	0.20	1.50	0.20
Land reclamation	40.00	3.50	40.00	3.50	50.00	4.00	0.00	4.00	0.00	6.00
Total	41.50	4.20	42.60	4.25	53.20	4.90	3.70	4.90	3.70	6.90

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Northern Coalfields Ltd.** **Nigahi (Opencast) Project**

ANANTA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Ananta
Company:	MCL
State:	Orissa
Coalfield:	Talcher
Year of sanction:	1991
Operational startup:	1989 (On approved advance action plan)
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	3.9 million tonnes
Capacity:	5.5 million tonnes
Mine life:	32 years
Residual life:	26 years
Number of coal seams:	5 (Thickness: 7.5-23m)
Ash content:	21.7-45.7%
Strip ratio:	0.52:1
Max. quarry depth:	115m
Coal destination:	Captive power stations of Vishakhapatnam steel plant, Indian metals and Ferro-alloys of Orissa, Steel plant and other local consumers

Current environmental status

Environmental setting

The Ananta openast project is situated on a flat topography which slopes gently towards north. Surface water flows in north-easterly direction and drains into the Brahmani river, approximately 10km from mine boundary. Purunia and Nakhetrapur villages fall at a distance of about 300m from mining boundary. Hensmul village is situated 0.5km away from active mining area. Prior to mining, the leasehold area of 810ha consisted of 9.9ha village land, 237.1ha dry agriculture land, 195.5ha of degraded forest and shrub land used for grazing and fuel wood production, 227.5ha of industrial area, 11.5ha water bodies and 128.5ha unoccupied land.

Baseline data

The baseline environmental quality data was generated in 1987-88. Air sampling stations were located inside core zone, at Ekada Village and Karanpura Village. SPM, NO_x, SO_2 and dust fall rates were below permissible limit of CPCB standards. Water samples were collected from pond in Hensmul village, Nandira Jhara near Parang village, pond at Barajorda, pond at Balanda

Village, Bangaru Jhara on upstream of confluence with Katri Jhara, Bangaru Jhara on downstream of Katri Jhara and Katri Jhara near mine area. All these water were not fit for drinking purpose. Noise level measurements were conducted at the proposed mine area, proposed colony site, adjoining Bharatpur mine area, rehabilitation zone and infrastructural area. Noise levels in the proposed mine area and infrastructural area were within threshold limits 85-90 dB(A), but some readings in the proposed colony site and rehabilitation site were slightly higher.

Mine planning and design

Ananta block is predominantly soil covered and gently undulating, forming paddy fields. As with most new Indian surface coal mines, the Ananta project is designed for maximum backfill. Initial surface cut and external overburden dumps were undertaken from November 1988 to March 1989 entirely by truck/shovel operation. In 1991, pit backfilling commenced. Dump materials consist of pebbles, rocks, weathered sandstone and sandy silts. Coal is won by conventional drilling and blasting. Total coal is currently transported by truck up to a distance of about 3km to the railway siding for loading. Areas of leasehold occupied by mine facilities to the end of current five year period (1995-96 to 1999-2000) and anticipated to total 32 years mine life are as follows:

Leasehold area - Ananta
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	14.4	141.4	81.2	186.9	0.0	388.1	810.0
Life	29.2	226.3	138.7	186.9	39.0	189.9	810.0

Project monitoring, auditing and evaluation

Environmental monitoring has been carried out since the post-monsoon season of 1991. Air quality readings are taken at a sub-station (11KV) adjacent to main haul road, Dera U.P. School, Hensmul U.P. School and Pump House near the mine face. Water quality survey stations include mine pump discharge point at the western boundary of the mine, earth drain collecting run-off water from external dumps, earth drain collecting run-off from internal dumps downstream of Bangaru nallah, discharge point from dozer washing shed, dug well at Hensmul village and supply-tap at project office. Noise readings are taken near pit site office, CHP and maintenance office inside the mine and Hensmul new settlement. Monitoring stations and the frequency will be reorganised after the notification of CPCB guidelines.

Hydrology and water quality management

Water discharge from the industrial site is collected in two old mining voids in sequence. Positive discharge occurs only during the peak of the monsoon season. A length of 0.8km garland drain has been constructed on each side of the main haul road. Garland drains have not been constructed to control and treat run-off from the external dumps. CHP, workshop and vehicle washing areas have no waste effluent treatment facility.

Air quality and noise management

SPM levels in a sensitive zone such as the pump house inside the quarry, sub-station and readings taken by the side of the haulroad have been found exceeding prescribed limits by CPCB. At Hensmul U.P. School, air quality data are within standards in all seasons. The road leading to the railway siding and railway siding site are sources of dust and spot measurements indicate that SPM levels exceed the prescribed limits. Air quality at the project office and village site is regularly in compliance with appropriate standards in all seasons. At present 80 automatic water sprinklers mounted on 0.8km water supply network are spraying water on generated dust around the CHP. Two water tankers are engaged continuously along haul roads for water spraying in two shifts. Noise levels are studied day and night and are within CPCB limits at all stations. Workers have been provided ear-defenders to work in noise concentration zones. About 2.8km of avenue plantation has been carried out to reduce impacts of air and noise pollution.

Disturbed land reclamation

At present the total external dump area is 14.44ha. Some external dumps will also be formed at a later stage. External dumps have outer slopes of 35°-38° and heights varying from 20-30m. 2.1 million m^3 of external overburden and 13.1 million m^3 of internal overburden dumping have been completed so far. Internal overburden dumps extend over an area of 26.5ha. over 32,000 trees have been planted over 5.6ha of external dump areas, including 3.8ha of topsoil dump. The survival rate along dump slopes has been very poor. Leguminous grass has been planted along the slopes of dormant internal dumps.

Environmental management programmes 1995-1996 to 1999-2000

Project monitoring, auditing and evaluation

Three new air quality monitoring stations will be established by quarter ending June 1995 at the CHP, Hensmul village and railway siding. Present procedures for monitoring will continue for new stations. Water quality sampling stations will be increased to include tap water at the colony site. Two set-

tling ponds will be constructed at the western boundary and at the north of the external overburden dump to control and treat run-off water from internal dumps and external dumps respectively. Four other sampling stations will be established to monitor water quality at the discharge point of each settling pond and upstream and downstream side of the seasonal nallah flowing along the western edge of the mine. Quarterly data on quality and water level will be taken from at least one dug well of Hensmul village. The current noise monitoring programme will continue. One environmental laboratory will be established by 1996-97 at Talcher coalfield to serve all existing and proposed coal projects with the purpose of (i) generating data on baseline environmental quality, (ii) monitoring environmental quality to adopt suitable remedial measures, (iii) generating necessary environmental quality data for developing models for prediction of pollution, and (iv) monitoring the condition of coal stocks to prevent spontaneous heating.

Hydrology and water quality management

Approximately 2.4km of garland drain will be constructed by the end of 1996 to collect surface run-off from outer slopes of external overburden dumps and near the 33KV sub-station. Run-off from HEMM and vehicle washing areas will be passed through an industrial effluent treatment plant by end of 1996. Oil and grease traps will be established by December 1996.

Air quality and noise management

A length of about 1.2km of haul road connecting the mine entry point and time office will be blacktopped during 1996-97. Water tankers will be engaged for all shifts. 1.5km of a water supply network with automatic water sprinklers mounted on it will be installed around the CHP to improve upon the air quality by December 1996. Results will be monitored carefully and if improvement is not sufficient, chemical retardants will be contemplated during 1997-98. Three additional noise monitoring stations will be established near the workshop, Hensmul village and the colony area. 5.6km of plantation will be done around the workshop, CHP, each side of the balance road length encircling the industrial site and each side of the approach road to the colony.

Disturbed land reclamation

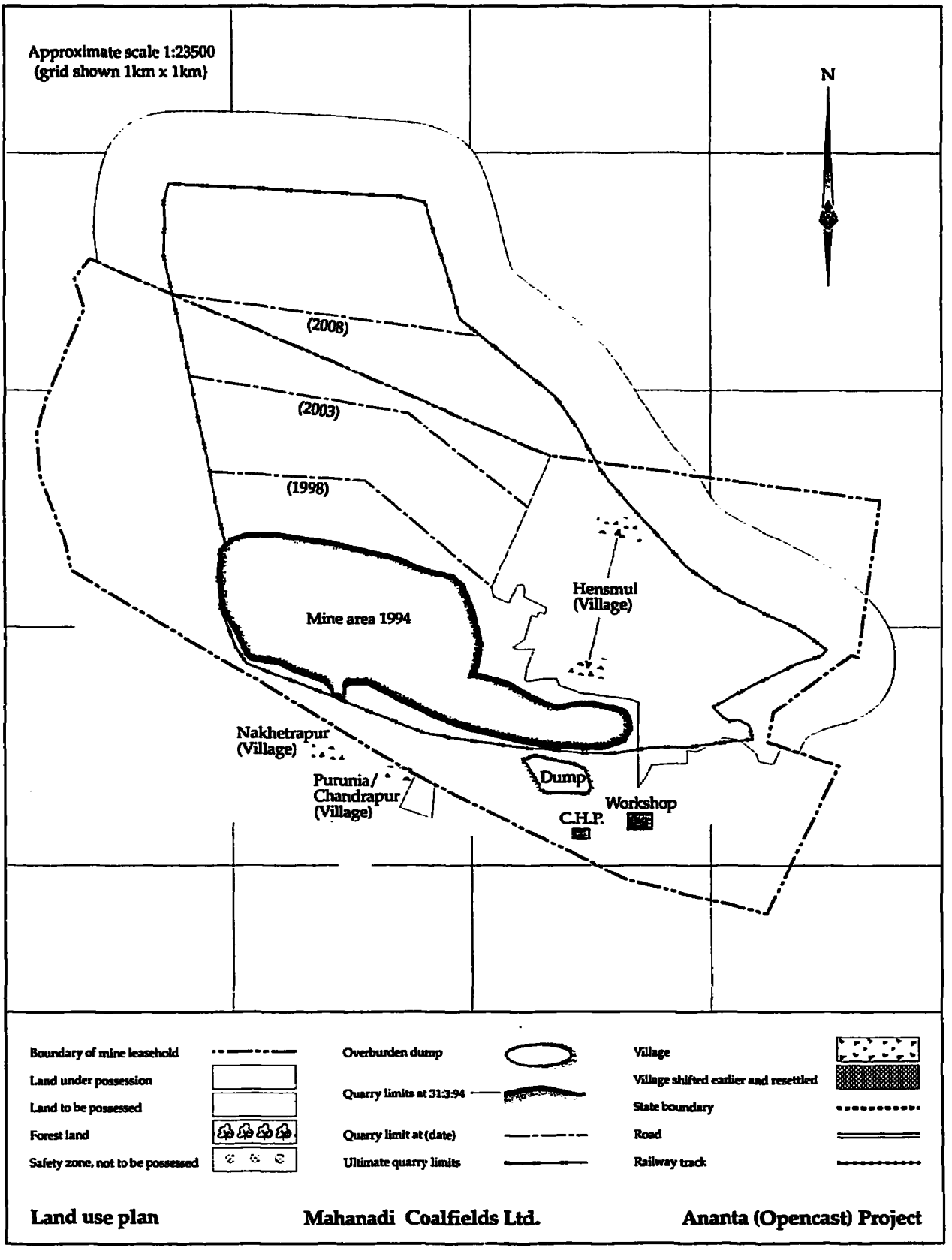
As the old external dumps are steep, an engineering study will be carried out to study the critical slope angle and length relationship for range of spoil types by December 1996. If necessary, the old dumps will be modified in accordance with study recommendations. The slope of future external dumps will be maintained at 28°. HEMM to be used in physical reclamation will be commissioned by 1996-97. Further, 28ha backfilled area will be available for reclamation during 1995-96 and 1996-97 and this will be reclaimed at a rate 8ha, 10ha and 10ha during 1997-98, 1998-99 and 1999-2000 respectively.

Five year annual budget summary - Ananta

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	1.22	0.20	0.84	0.25	0.00	0.41	0.00	0.41	0.00	0.41
Air quality & noise	0.40	0.00	3.01	0.05	0.80	0.10	0.00	0.18	0.00	0.18
Water quality	10.30	0.00	7.97	0.27	0.00	1.83	0.00	1.83	0.00	1.83
Land reclamation	1.09	0.00	48.93	0.09	0.00	9.76	0.00	9.76	0.00	9.76
Total	13.01	0.20	60.75	0.66	0.80	12.10	0.00	12.18	0.00	12.18

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Mahanadi Coalfields Ltd.** **Ananta (Opencast) Project**

BELPAHAR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Belpahar
Company:	MCL
State:	Orissa
Coalfield:	Ib Valley
Year of sanction:	1982
Operational startup:	1982
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	1.9 million tonnes
Capacity:	2.0 million tonnes
Mine life:	21 years
Residual life:	12 years
Number of coal seams:	2 (Thickness: 15m)
Ash content:	18.9-45.1%
Strip ratio:	2.31:1
Max. quarry depth:	67m
Coal destination:	Captive power plants of Bhilai, Rourkela and western India TPS

Current environmental status

Environmental setting

The Belpahar project is situated on a flat to moderately undulating plain, gently sloping towards the east.The drainage of the area is controlled by Lilari nallah, which joins Ib River about 4km away. Out of a total project area of 1601ha, the premining land use was 277.3ha of forest land, 518.0ha of agricultural land, 20.7ha home site and the rest was unoccupied.

Baseline data

Comprehensive baseline monitoring data had been generated for the project in 1989-90 for four seasons. The six air sampling stations were established at villages in the buffer zone, proposed resettlement sites, workshop and colony. SPM levels recorded varied from as low as 21µg/m³ during monsoon to 510µg/m³ during pre-monsoon period, against permissible CPCB standards of 200µg/m³ (residential and rural) and 500µg/m³ (for industrial and mixed use). SO_2 and NO_x were well within permissible limits. Water sampling points (6 no.) included a tubewell in Belpahar township, Lilari nallah, a pond in Chharla and Jorabaga village and Ib river. Water was generally not found fit for drinking except that from the tubewell. Noise monitoring was conducted at seven sta-

tions which included the workshop, township, CHP and the resettlement sites. Except for a few readings, noise levels were within permissible limits.

Mine planning and design

The mine is worked by dragline and shovel/dumper combinations. Nine external overburden dumps exist. Internal back filling started in 1989 and 16 million m^3 of overburden has been backfilled. Out of total pit area of 431.8ha, 50ha in the end will be developed as a water body and the rest will be reclaimed and afforested. Areas of the leasehold occupied by mine facilities to the end of this five year period (1995-96 to 1999-2000) and to the end of mine life are given below:

Leasehold area - Belpahar
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies villages*	*Unoccupied*	*Total area*
5 years	90.0	180.0	80.0	210.6	39.8	1,000.7	1,601.1
Life	90.0	356.6	81.2	210.6	39.8	828.9	1,601.1

Project monitoring, auditing and evaluation

Environmental monitoring is carried out during all seasons. Air quality readings are taken at the workshop and colony. Water sampling and analysis is being done for mine discharge water, a tube well in the township, village pond is Jorabaga and in water courses. Noise level monitoring is being done at the project office, residential colony, workshop and CHP. Readings are within permissible limits.

Hydrology and water quality management

Pit water accumulates in pit sump where the bulk of suspended matter settles. Pit water after settling is used for industrial purposes, such as dust suppression and fire fighting. During dry months pit water does not discharge into surface watercourses. During monsoon, pit water is pumped out and channeled to settling tanks on the surface. Industrial effluents from the workshop, after passing through grease and oil traps, also discharge into the settling tank. The overflow from the settling tank flows into surface watercourses. The mine discharge water is generally within permissible limits. However, the water from the ponds and nallah are not fit for drinking purposes due to contamination from seepage/inflows from areas which are under intensive domestic and industrial use.

Air quality and noise management

At the workshop the SPM is found to be within permissible limits (500µg/m³), but in the colony the permissible limit (200µg/m³) is occasionally exceeded. All service roads and coal transport roads to the siding are blacktopped. These inpit haul roads and other dust generating locations are regularly sprinkled with water. Tree planting has been carried out against the mine area, CHP and coal transport roads to protect the colony and other work sites from dust and noise. Air samples from working areas indicate SPM levels in excess of permissible limits (500mg/m³). In the rest of the locations SPM is generally within limits. Noise readings are also within permissible limits, except in some readings.

Disturbed land reclamation

Nine external dumps have been formed varying in height from 8- 25m and quantity varying from 0.6 to 3.3 million m³. The tops of overburden dumps, both external and (partly) internal have been extensively planted with a good mixture of indigenous and exotic trees. On the slopes however, the plantation is poor.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

One additional air sampling station in Chharla village is to be added. Water level and quality monitoring stations will include at least one well in Chharla village during 1995-96. The number of noise monitoring stations is found to be adequate.

Hydrology and water quality management

One additional settling tank will be constructed for treating pit/industrial waste water by April 1996. A garland drain around overburden and coal dumps and also for linking all water to settling tanks is to be completed before 1996 monsoon. The adequacy of the treatment of sewage from the colony area will be studied before the 1996 monsoon.

Air quality and noise management

The haul road inside the pit will be blacktopped. Automatic water sprinklers are planned for more effective dust suppression. Block planting and avenue planting is to be carried out.

Disturbed land reclamation

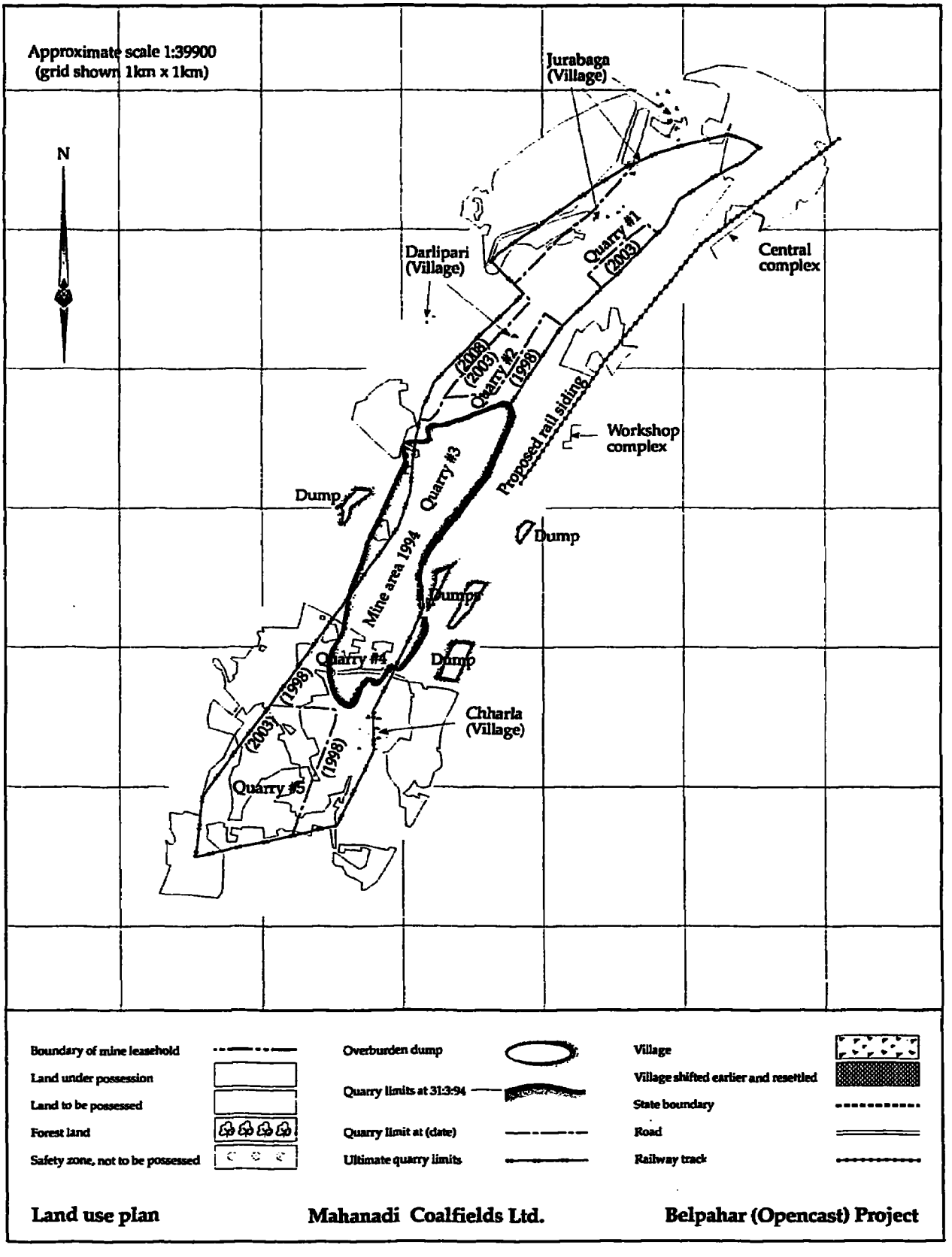
In future all physical land reclamation is to have a slope of less than 28°. For old external overburden dumps an engineering study is to be conducted and completed by December 1996 to determine a safe slope angle. If the study establishes a slope angle of more than 28° to be stable, relaxation for such steeper angle will be requested from MOEF. After the engineering study and relaxation from MOEF, resloping of the old dumps to the recommended slope angle will be commenced and completed in phases by 1999-2000. An area of approximately 15ha area will be available from backfilling for reclamation in each year.

Five year annual budget summary - Belpahar

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.32	0.15	1.28	0.19	0.00	0.45	0.00	0.39	0.00	0.30
Air quality & noise	2.80	0.00	3.70	0.50	3.20	0.88	0.24	1.06	0.20	1.06
Water quality	3.46	0.00	2.96	0.08	0.46	0.16	0.00	0.49	0.00	0.49
Land reclamation	23.30	0.00	88.95	0.00	0.60	9.61	0.60	9.61	0.60	9.61
Total	29.88	0.15	96.89	0.77	4.26	11.10	0.84	11.55	0.80	11.46

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Mahanadi Coalfields Ltd.** **Belpahar (Opencast) Project**

BHARATPUR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Bharatpur
Company:	MCL
State:	Orissa
Coalfield:	Talcher
Year of sanction:	1983
Operational startup:	1985
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	3.5 million tonnes
Capaicity:	5.0 million tonnes
Mine life:	50 years
Residual life:	30 years
Number of coal seams:	3 (Thickness: 25-35m)
Ash content:	35-42%
Strip ratio:	0.8:1
Max. quarry depth:	130m
Coal destination:	Captive power plant of Nalco and proposed power station at Vishakhapatnam

Current environmental status

Environmental setting

The Bharatpur opencast mine is situated on a flat plain which slopes gently towards the north. Surface water of the area drains into the Brahmani river which flows at a distance of 12.5km on the east side. Prior to mining, the leasehold area of 1237.2ha constituted about 258ha of natural forest and degraded forest, 895.2ha of dry agriculture and rained paddy fields and water bodies and 34ha of small villages. The remaining 50ha was industrial and water bodies.

Baseline data

Comprehensive baseline monitoring data was generated for this project in 1988-89. Air quality data was collected for all four seasons at the minesite, Jadunathpur village and at a school on the road to the thermal power station. Spot sampling during the winter season took place on four other stations. Water quality samples were taken from a local well and a nallah. Noise readings were taken within the proposed minesite, workshop and colony areas and near the regional hospital. All baseline information was within ambient objectives.

Mine planning and design

This project will eventually be developed as two quarries though only one is being worked at present. External dumps have very steep slopes, but internal backfilled dumps have been well recontoured to blend into surrounding landscapes. Two thirds of the pit area is expected to be backfilled, with the remaining one third to become a water body. A village, Jambubahali, is located very close to the edge of the quarry, within the safety zone. Backfilling started in 1988. Total area covered by external dump is 36ha which resulted from the initial truck and shovel operation. External dumps consist of mainly morrum and weathered sandstone. The project is operated with shovel-dumper combination. Coal production is currently transported by truck up to a distance of 2km to the crushing plant and then to MGR complex through covered conveyor. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the total 50 years mine life are as follows:

Leasehold area - Bharatpur
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	40.0	65.0	50.9	100.1	55.0	926.2	1,237.2
Life	50.0	277.1	130.9	172.1	104.0	503.1	1,237.2

Project monitoring, auditing and evaluation

Operational monitoring informations has been collected since the post-monsoon season of 1992. Air quality readings are taken at the minesite, the coal handling plant, a local village (Nehru Satabdi Nagar) and a school on the road to the thermal power station. All readings were within appropriate air quality objectives. Water quality sampling is undertaken on the pit sump discharge, a well in Jambubahali village and tap water in Nehru Satabdi Nagar. There has been no real ambient water quality monitoring. Noise readings are taken in the work zone, at the coal handling plant and at Nehru Satabdi Nagar. With few exceptions, readings are regularly within noise level objectives.

Hydrology and water quality management

Pit water is collected in an in-pit settling pond controlled by a dam and decant. The pit water is used for firefighting and dust suppression. Pit water is discharged only at the peak of monsoon and flows via a drainage ditch and two supplementary settling depressions to a nallah. A sewage water treatment plant in Nehru Satabdi Nagar is in operation.

Air quality and noise management

Dust suppression in the CHP is good. Most service roads and long-term haul roads are blacktopped and dirt haul roads are regularly watered using three water tankers. About 100 continuous automatic water sprinklers are mounted on 1.3km of water supply network for the coal stock pile area. About 5.0km of greenbelt has been established along haul roads, around the workshop and CHP and inside Nehru Satabdi Nagar. Gas canisters are supplied to all families in the colony to reduce smoke pollution.

Disturbed land reclamation

Out of 36ha external overburden dump area, 15ha of the top has been extensively planted. This planting has employed a very diverse mixture of exotic and indigenous tree species. However, slopes of these dumps are too unstable to support plant growth. Recontouring has taken place on approximately 23ha of internal backfilled dumps and about 5ha of this area has been planted.

Environmental management programmes 1995-1996 to 1999-2000

Project monitoring, auditing and evaluation

Three new air quality stations, one in the new colony, one in Jambubahali village and one between the existing school and the TPS, will be added to the network by September 1995. Frequency of air monitoring and thus annual costs, is presently uncertain pending the outcome of negotiations with government authorities over new monitoring requirements. Water quality will be monitored for all discharges from the minesite and in the receiving nallah upstream and downstream of all effluent discharges. Well water levels and quality will be monitored quarterly in two wells each in the Jambubahali and Nehru Satabdi Nagar. Current noise monitoring will continue. Monitoring stations and frequency will be reorganised after the notification of CPCB guidelines. One environmental laboratory will be established at Talcher coalfield to serve all existing mines by the end of 1996.

Hydrology and water quality management

Control and treatment of run-off, oil and grease from CHP and HEMM workshop will be established by December 1996. About 4.9km of garland drain system around all overburden dumps linking settling ponds will be completed by June 1996. A scientific study to determine the adequacy of sewage disposal to ground in the colony areas will be completed by June 1996.

Air quality and noise management

The present monitoring system is adequate. However, 13km of avenue plantation will be carried out around CHP, CCT, colony and on both sides of the approach road at a rate of 6.5km in 1996-97 and 1997-98. About 13km of barbed wire fencing will be established around this plantation to protect the young plants, at a rate of 6.5km in 1996-97 and 1997-98.

Disturbed land reclamation

The plant survival rate is poor on the slope of external overburden dumps, as the angle is more than 35°. An engineering study will be carried out to determine critical slope angle and length relationship for the range of spoil types by December 1996. Out of 23ha of dormant internal dumps, the balance of 18ha will be reclaimed: 10ha in 1996-97 and 8ha in 1997-98.

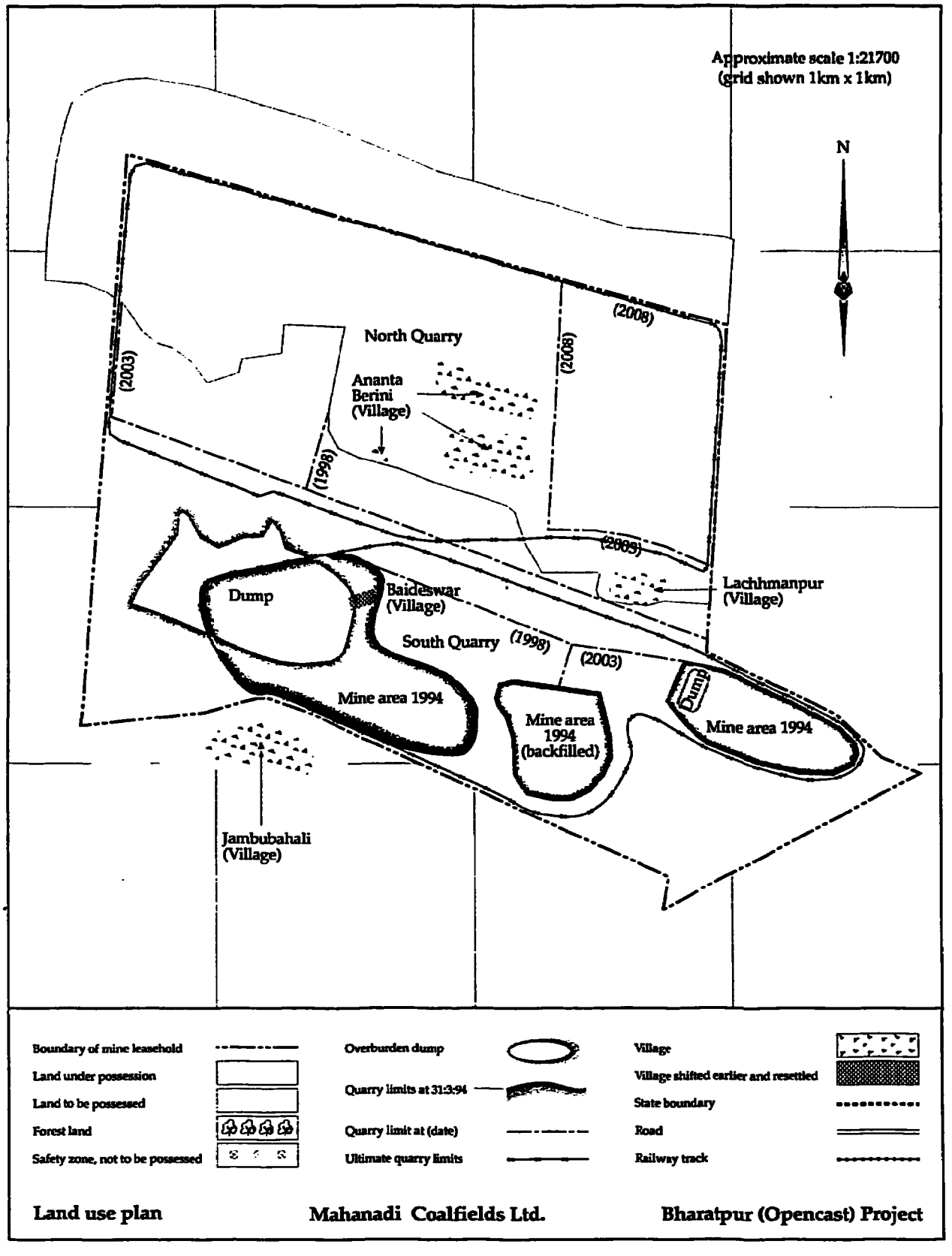
The balance of 21ha of external dumps of a total of 36ha, will be reclaimed as per the result of aforesaid study.

Five year annual budget summary - Bharatpur

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	1.10	0.20	0.58	0.22	0.00	0.31	0.00	0.31	0.00	0.31
Air quality & noise	0.50	0.00	1.54	0.05	1.04	0.13	0.00	0.35	0.00	0.35
Water quality	4.43	0.00	6.73	0.09	0.00	1.10	0.00	1.10	0.00	1.10
Land reclamation	0.00	0.00	0.60	0.00	48.64	0.06	0.71	9.73	0.65	9.80
Total	13.01	0.20	60.75	0.66	0.80	12.10	0.00	12.18	0.00	12.18

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Mahanadi Coalfields Ltd.** **Bharatpur (Opencast) Project**

JAGANNATH
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Jagannath
Company:	MCL
State:	Orissa
Coalfield:	Talcher
Year of sanction:	1962
Operational startup:	1971
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	5.5 million tonnes
Capacity:	4.0 million tonnes
Mine life:	41 years
Residual life:	18 years
Number of coal seams:	2 (Thickness: 2.7-15.4m & 1.4-46.8m)
Ash content:	34-43%
Strip ratio:	0.6:1
Max quarry depth:	50m
Coal destination:	Talcher TPS and south India power houses

Current environmental status

Environmental setting

The Jagannath Colliery area is predominantly soil covered and gently undulating, forming paddy fields. The topography of the area is more or less flat having northerly slope. The drainage of the area is controlled by the Brahmani river on the eastern side, flowing about 8.5km from the mine. Prior to mining, the leasehold area of 793.2ha consisted of 60.4ha forest land, 689.7ha dry agriculture land, 17.8ha village land, 2ha water bodies and 23.3ha unoccupied land.

Baseline data

This is an old operating opencast mine. No MOEF approved EMP is in force for the project, hence no baseline environmental quality survey was conducted. However, an EMP has been formulated for implementation of environmental measures.

Mine planning and design

A shovel and dumper combination mining system is being practised. Conventional drilling and blasting follow for coal winning. Total produced coal is currently transported by truck about 1.8km to the railway siding for load-

ing. The total area of external dumps is 36.5ha. Presently all overburden is used in backfilling. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and to the end of anticipated 41 years mine life are as follows:

Leasehold area - Jagannath

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	36.5	1220.0	110.0	30.0	0.0	496.7	793.2
Life	36.5	285.8	116.9	30.0	0.0	324.0	793.2

Project monitoring, auditing and evaluation

Environmental monitoring has been carried out on quarterly basis since December 1993. Air quality readings are taken at the project office, CHP, siding, working zone and coal stock yard. Water samples are taken from stations established at the workshop tap point (drinking), workshop discharge point and mine discharge point. Noise readings are taken from mine face, workshop and CHP.

Hydrology and water quality management

Mine discharge water is collected in the mine sump and then pumped out to 8.5km of garland drains along the quarry boundary. These drains open to two settling ponds, one near the eastern boundary and the other along the western boundary of the quarry. Sampling results indicate that the degree of pollution in both mine water and industrial water is within the permissible limits.

Air quality and noise management

Levels of suspended particulate matter at all air monitoring stations exceed maximum allowable standards prescribed by CPCB. Three water tankers are engaged in dust suppression along the haul road and the road connecting the siding with the mine. The noise levels measured at the workshop and CHP exceed the CPCB standard both during day and night time. Ear defenders have been provided to all industrial workers working near noise concentration zones. Avenue planting over a length of 2.8km has already been established around the CHP, railway siding and approach roads.

Disturbed land reclamation

Three external overburden dumps containing 12.9 million m^3 are spread over 36.5ha. The height of dumps is between 20m and 25m and the slope angle varies between 35° and 40°. The total area involved in backfilling is 49.5ha accommodating a volume of about 24.8 million m^3 of overburden. Tree planting has been completed on 52.5ha of external and internal dumps.

Environmental management programmes 1995-1996 to 1999-2000

Project monitoring, auditing and evaluation

Two more water sampling stations at the discharge end of the settling pond near the railway siding and at the discharge end of the embankment on the north of Quarry No. 7 will be added during 1995-96. Six additional water sampling stations will be established at dug/borewells of South Balanda, Dera, Anantaberini, Lachhmanpur, Purunia and Nakhatrapur to monitor water quality and water by the quarter ending September 1995. Monitoring stations and frequency will be reorganised after the notification of CPCB guidelines for the coal industry. One environmental laboratory will be established at Talcher coalfield to (i) generate baseline environmental quality data, (ii) monitor environmental quality in order to adopt suitable remedial measures, (iii) generate necessary environmental quality data models for prediction of pollution, and (iv) monitor coal stock to prevent spontaneous heating by end of 1996.

Hydrology and water quality management

An industrial water treatment plant will be constructed to treat waste water from workshop shed by December 1995. Runoff from CHP, HEMM and vehicle washing area will be conveyed to plant after initial treatment to remove grease and oil. An oil and grease trap will be constructed inside plant by June 1996.

Air quality and noise management

The present water spraying arrangement at dust generation points is not sufficient. Provision of an additional 2km of water supply network, with sprinklers/misters mounted on it, will be installed by December 1996. To reduce impacts of air and noise pollution, avenue planting over 1.5km will be established by December 1996 along both sides of the haul road and CHP site.

Disturbed land reclamation

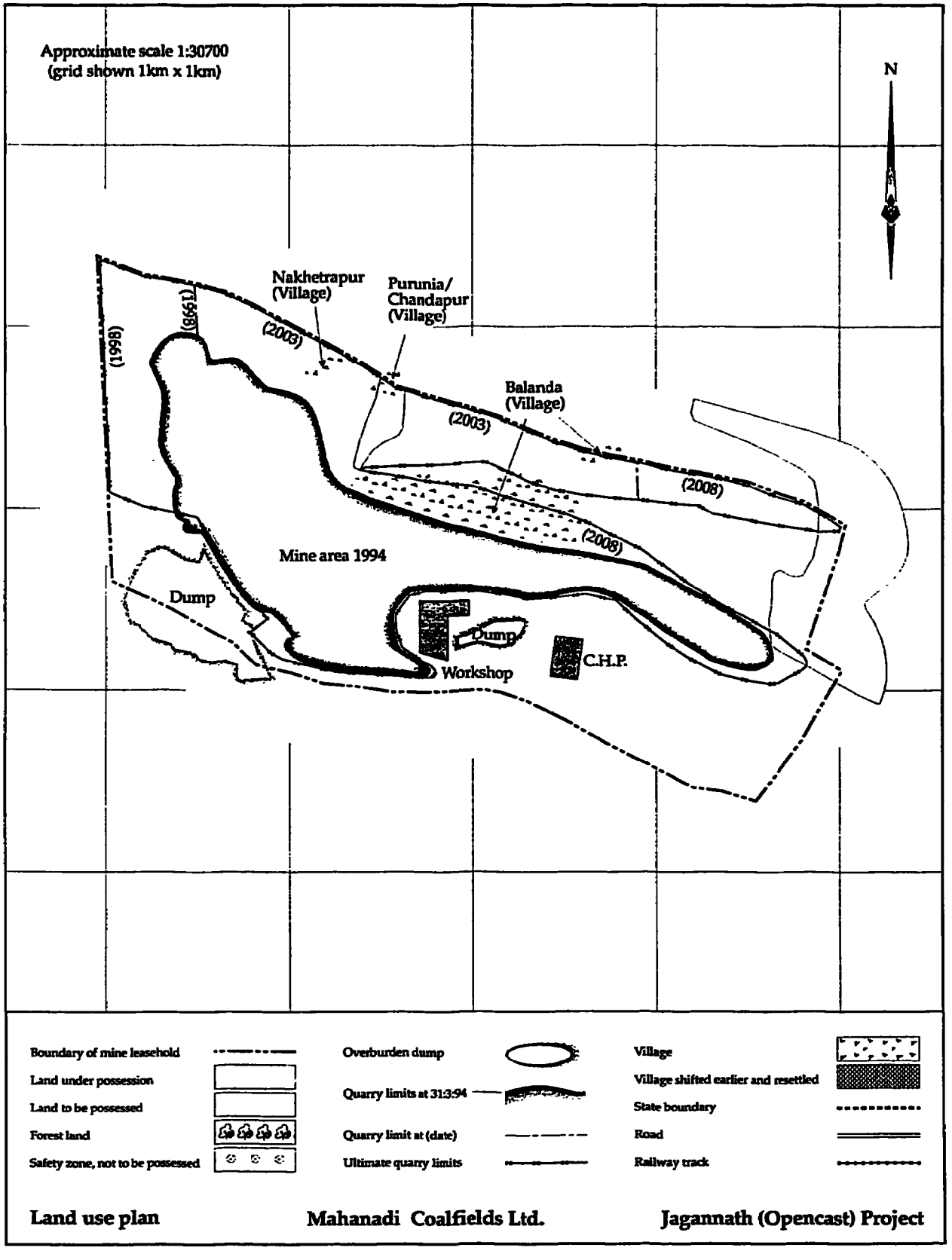
The slope angle of external overburden dumps varies between 35° and 40° with heights of 20-25m. An engineering study will be conducted by December 1996 to establish slope angle and length relationships. Out of total 49.5ha of backfilled area, a dormant area of 37.5ha will be reclaimed biologically by 1996-97, 10ha in 1997-98, 10ha in 1998-99 and 7.5ha in 1999-2000.

Five year annual budget summary - Jagannath

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.83	0.20	0.65	0.25	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.16	0.00	0.15	0.02	0.00	0.03	0.00	0.03	0.00	0.03
Water quality	1.50	0.00	0.95	0.01	0.00	0.01	0.00	0.01	0.00	0.01
Land reclamation	0.00	0.00	48.35	0.00	0.30	9.96	0.30	9.67	0.22	9.70
Total	2.49	0.20	50.10	0.28	0.30	10.30	0.30	10.01	0.22	10.04

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Mahanadi Coalfields Ltd.** **Jagannath (Opencast) Project**

LAKHANPUR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Lakhanpur
Company:	MCL
State:	Orissa
Coalfield:	Ib Valley
Year of sanction:	1992
Operational startup:	1993
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	1.44 million tonnes
Capacity:	5.0 million tonnes
Mine life:	21 years
Residual life:	19 years
Number of coal seams:	1 (Thickness: 20-25m)
Ash content:	36-40%
Strip ratio:	1.01:1
Max. quarry depth:	90m
Coal destination:	Ib thermal power station of OPGC

Current environmental status

Environmental setting

The general configuration of the area is plain, generally sloping towards the east and draining into the Ib River about 5km from the project through Lilari nallah. Premining land uses of 1413.8ha of project area were 233.4ha forest land, 551.5ha unoccupied waste land, 617.7ha dry agricultural land and 11.2ha homesites. The villages of Khairkuni, Banjipali and Tingismal are within the core zone.

Baseline data

Comprehensive premining baseline data for all four seasons has been generated. Air samples were drawn from five stations which included Sardamal village and the proposed colony area for Lakhanpur mine. SPM values in stations were higher than CPCB standards. Water samples were collected from nine locations including tubewells/dugwells/ponds in villages Khairkuni, Banjipalli, Ubuda, Kusuraloi, and Kirarama in the core zone and buffer zone. Samples from Lilari nallah were also taken. It is unfit for drinking in general. Noise levels were recorded at six stations including the market place, the proposed colony and infrastructure areas in the core zone and also in the buffer zone. In general, noise levels varied between 30 and 70dB(A) but, near the market place, a few values were higher than 90dB(A). In the buffer zone of

the mine site several coal mines, a refractory factory and a paper mill are in operation.

Mine planing and design

The project will eventually develop into five quarries. The mine is planned to work with shovel/dumper combination. Quarry No. 1 is being worked at present. External dumps, in places, have slopes exceeding 28°. Internal backfilling has not started. Out of a total 470.1ha of land which will be disturbed due to mining, 351.5ha will be back filled and reclaimed and 36.25ha will be developed as a water pool. Uses of the project area for different purposes to the end of current five year period (1 -96 to 1999-2000) plan and anticipated at the end of mine life are as follows:

Leasehold area - Lakhanpur
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	18.0	80.0	90.0	61.5	35.0	1,129.3	1,413.8
Life	18.0	351.5	119.0	61.5	35.0	828.8	1,413.8

Project monitoring, auditing and evaluation

Environmental monitoring information has been done since 1993. Monitoring stations exist at wells/ponds in nearby villages for the regular effective monitoring of water levels and quality. Samples are taken from wells of nearby villages Khairkuni and Banjhipali. Air and noise measurement data are within permissible limits, whereas water does not generally meet the standard, especially in TSS.

Hydrology and water quality management

Pit water is initially lodged in a pit sump to allow the settling of suspended matter. This water, after pumping, is used for various industrial purposes, such as dust suppression. During the monsoon, excess water from the pit sump is pumped out and channeled through natural depressions to the nearby Phuljhar nallah. A grease and oil trap for workshop effluent and a well-designed, compartmented settling tank is being constructed.

Air quality and noise management

Air quality is being monitored at the project office in the core zone, in nearby Girintola village in the buffer zone and constructed colony area and

in the buffer zone. At the project office SPM level is within permissible limits whereas at two other stations SPM level occasionally goes above permissible limits. Noise is being recorded within the mine area and at the rehabilitation site and CHP. Noise levels are found within permissible limits. Dust suppression in and around the CHP, haul roads and work places needs improvement. Planting has been done to act as barriers against coal transportation roads.

Disturbed land reclamation

All overburden produced has been placed in an external dump with two benches. The lower bench has a height of 15m and the upper one 10m. It occupies some 8ha. Regrading the slopes of this dump to 28° is in progress. Back filling of the pit has not started, but is planned to start from 1995-96. Biological reclamation of the external dump is in progress.

Environmental management programmes 1995-1996 to 1999-2000

Project monitoring, auditing and evaluation

The air monitoring points cover the important zones, thus no additional air monitoring stations are called for. Water quality and level monitoring stations will be added in one borewell/well/pond in Ghanmal village, nearest to the present working in 1995-96. Noise monitoring is also considered sufficient. Monitoring stations and the frequency will be reorganised after the notification of CPCB guidelines for the coal industry.

Hydrology and water quality management

The grease and oil trap is under construction for workshop effluent and a masonry settling tank is also under construction for treating other industrial water. The industrial effluent treatment arrangement will be completed and commissioned by December 1996.

Air quality and noise management

Workshop, office complex, other industrial activity zones outside mine area, villages and colonies are to be effectively isolated from heavy traffic roads, mine and CHP by thick greenbelts which minimise dust and noise in these areas. It is planned to blacktop haul roads and provide automatic sprinklers for effective dust suppression in CHP, haul roads and coal stock piles. These measures will keep dust level in ambient air within stipulated standards.

Disturbed land reclamation

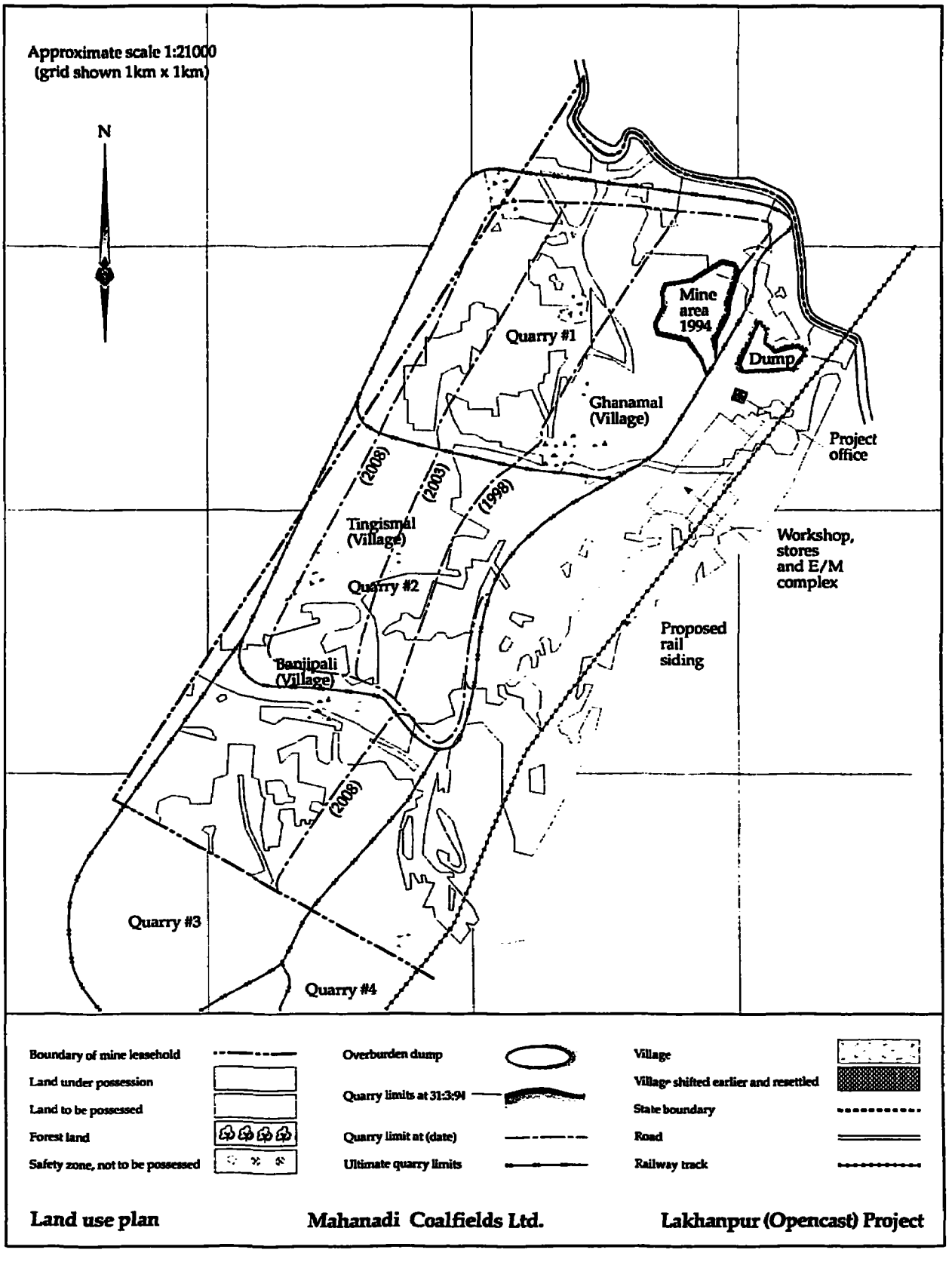
Dumps created in the future will have slopes of less than 28°. For existing dumps, an engineering study for slope stability will be carried out by December 1996 and relaxation for the stable slope angle in excess of 28°, if established, shall be obtained from competent authority. After the results of the study, if needed, the existing overburden dumps will be resloped. The current dormant disturbed area is 12ha of unreclaimed overburden dumps.

Five year annual budget summary - Lakhanpur

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	1.38	0.15	2.50	0.19	0.00	0.89	0.00	0.74	0.00	0.74
Air quality & noise	10.17	0.00	2.80	1.97	3.80	2.07	1.84	2.47	1.30	2.77
Water quality	1.96	0.00	1.86	0.08	1.86	0.14	1.80	0.20	0.20	0.86
Land reclamation	10.45	0.00	69.50	0.00	0.25	9.79	0.25	9.79	0.25	9.79
Total	23.96	0.15	76.66	2.24	5.91	12.89	3.89	13.20	1.75	14.16

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Mahanadi Coalfields Ltd.** **Lakhanpur (Opencast) Project**

SAMLESWARI
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Samleswari
Company:	MCL
State:	Orissa
Coalfield:	Ib Valley
Year of sanction:	1992
Operational startup:	1993
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	2.0 million tonnes
Capacity:	3.0 million tonnes
Mine life:	23 years
Residual life:	21 years
Number of coal seams:	1 (Thickness: 16-18m)
Ash content:	40-45%
Strip ratio:	0.87:1
Max. quarry depth:	69m
Coal destination:	Western India power houses

Current environmental status

Environmental setting

The topography of Samleswari mine is generally flat, gently sloping towards the south and southwest. Drainage of the area is controlled by Pondraine nallah in the southwest, which discharges into Lilari nallah in the south. Lilari nallah, in turn, joins the Ib river about 5km from the mine boundary. Out of a total 906.4ha of leasehold area, 348.5ha was forest land, 237.7ha unoccupied waste land and the rest cultivated land and settlements. Villages Lajkura, Kudopali and Orampara are situated about 0.6-0.7km from the rise-side boundary of the pit area. Mining is progressing away from these villages and the active mining area is at present more than 1km from the villages. The project site has coal mines, a paper mill and a refractory factory in nearby localities.

Baseline data

Comprehensive baseline monitoring data was generated by engaging three agencies in 1987-88. Air quality data was collected from five stations in both the core and buffer zones, which included Sardamal village. Air samples were collected for all four seasons. SPM values were observed to be higher than CPCB standards in two stations, including Sardamal village. SO_2 and NO_x were found to be well below CPCB permissible limits. Water samples were taken from

eight locations including ponds/wells in nearby villages (Lajkura, Kudopali), Lilari nallah and Ib river. Samples for all four seasons were collected. All samples in the monsoon period indicate high BOD, high fluoride and low D.O. and are unfit for human consumption. In well samples, parameters are within permissible limits and the water is fit for drinking purposes. Noise levels were measured at six stations at the core zone, proposed colony(2), Lajkura mine, proposed rehabilitation site, proposed CHP site and near the market place. Noise levels near Lajkura mine exceeded the threshold limit.

Mine planning and design

The mine is planned for dragline and shovel-dumper operation. Coal is transported to railway siding by truck. Though the backfilling has started, the formation of external overburden dumps will continue till 2000. Out of a total pit area of 285ha, 165.5ha is planned to be backfilled and 38.7ha is proposed to be finally developed as water pool. The rest will remain as a dip side slope. Areas of the leasehold occupied by mine facilities to the end of the current 5 year period (1995-96 to 1999-2000) and anticipated to the total 23 year mine life are as follows:

Leasehold area - Samleswari

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	49.0	61.0	90.0	206.0	55.0	445.4	906.4
Life	49.0	166.0	119.0	206.0	55.0	311.4	906.4

Project monitoring, auditing and evaluation

Environmental monitoring has been carried out since 1993. Air quality readings are taken adjacent to the project office, colony area and buffer zone. Water quality stations are at the mine discharge point, a pond of Kudopali village, and the confluence of Lilari nallah and Ib river. Noise levels reading are taken in the CHP area, proposed colony area, workplace and market place.

Hydrology and water quality management

Pit water first accumulates in a pit sump. During the monsoon, water from the pit sump is pumped out and then allowed to pass through a series of natural settling ponds before final discharge to nallah. Garland drains exist around the quarry. Around external overburden and coal dumps, drains are re-

quired. The water quality is within permissible limits except for the presence of coliforms.

Air quality and noise management

The coal transport road from the mine to rail siding is black topped, except for about 1km near the siding. Dust conditions near the railway crossing and in the siding need improvement. The main source of dust is coal spillage from trucks.

Disturbed land reclamation

During the initial two years, overburden was removed by shovel-dumper and external overburden dumps in a 15ha area were created. These dumps have slopes varying from 26°-35°. In 1992 a dragline was commissioned and external overburden dumps were created by it in a 5ha area with slopes around 45°. The height of external overburden dumps varies from 8-30m. Old external overburden dumps have been biologically reclaimed. Recent external dumps and internal backfilling are being physically reclaimed and prepared for biological reclamation. Trees have been planted in the old external overburden dumps with excellent survival. Dense planting in these dumps exists both at dump tops and also on slopes. Planting has not been done in newly created external dumps and in backfilled areas.

Environmental management programmes 1995-1996 to 1999-2000

Project monitoring, auditing and evaluation

Three new air monitoring stations will be added to the network, one in Kudopali village, one near the railway crossing in Gopi vihar colony and one in the siding. Water quality will be monitored from the final discharge of mine water, after the settling tank, before this discharge joins the nallah and also at Lilari nallah before it joins Ib river. Water level and quality in one dugwell/ borehole each in Kudopali and Lajkura village will be monitored. A noise station will be added in Gopi vihar. Monitoring stations and the frequency of monitoring will be reorganised after the notification of CPCB guidelines for the coal industry.

Hydrology and water quality management

About 2km of garland drain will be constructed before June 1996 around external overburden and coal dumps. Runoff from the CHP, HEMM and vehicle washing areas will be treated initially with oil and grease traps. A masonry settling tank will be constructed in 1995-96.

Air quality and noise management

Two new water tankers will be acquired in 1995-96 for dust suppression on haul roads and in pit and plant areas. An automatic water sprinkler system will be installed during 1995-96 and 1996-97 at the CHP, weigh bridge and railway siding. After monitoring the result,s the system will be further strengthened by additional sprinklers and the use of chemical retardants during 1997-98, 1998-99 and 1999-2000.

Disturbed land reclamation

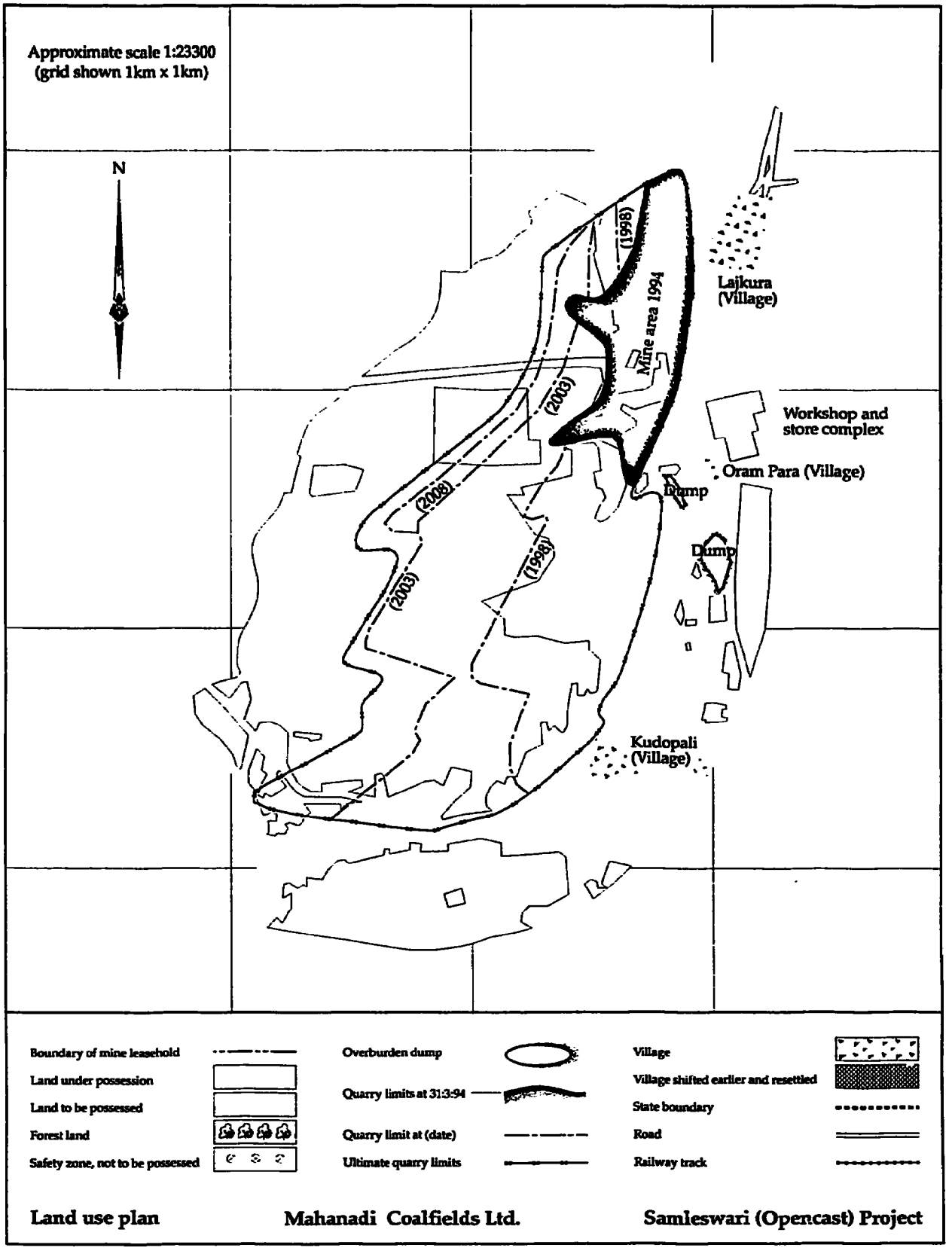
The tops of external overburden dump tops have excellent plantations; only about 15% of slope areas will need regrading if found unstable. Some of the overburden is now being used in backfilling. Back filled areas will be regularly reclaimed as per approved EMP stipulations. For all external overburden dumps, an engineering study for stable slope angles will be carried out by December 1996 and unstable slopes, if any, will be resloped in a phased manner.

Five year annual budget summary - Samleswari

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Proj. monitoring	0.32	0.15	1.19	0.19	0.00	0.43	0.00	0.28	0.00	0.28
Air quality & noise	12.47	0.00	4.30	2.31	4.30	2.69	1.94	2.97	1.90	3.17
Water quality	2.06	0.00	3.36	0.10	1.76	0.16	0.20	0.50	0.20	0.54
Land reclamation	12.90	0.00	74.55	0.00	0.30	9.79	0.30	9.79	0.40	9.79
Total	27.75	0.15	83.40	2.60	6.36	13.07	2.44	13.54	2.50	13.78

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Mahanadi Coalfields Ltd.** **Samleswari (Opencast) Project**

DURGAPUR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Durgapur
Company:	WCL
State:	Maharashtra
Coalfield:	Wardha Valley
Year of sanction:	1978
Operational startup:	1981
Type of mine:	Opencast
Mining method:	Trucks & shovel
Current production:	1.87 million tonnes
Capacity:	1.80 million tonnes
Mine life:	22 years
Residual life:	9 years
Number of coal seams:	1 (Thickness: 14-17m)
Ash content:	26-30%
Strip ratio:	3.5:1
Max. quarry depth:	105m
Coal destination:	Chandrapur thermal power station of MSEB

Current environmental status

Environmental setting

The Durgapur mine is situated on moderately plain terrain in Chandrapur district of Maharashtra State. Worker colonies are concentrated between the minesite and Chandrapur TPS. In addition, one long-established village (Durgapur) is located about 1.5 to 2km from the mine to the north and north-east of the mine area. Prior to mining, the leasehold area of 821.0ha consisted of 422.5ha of dry agricultural land, 273.9ha of degraded forest and 124.6ha barren government land. .

Baseline data

Baseline information was not needed in 1978-81. However, an environmental quality assessment was done in 1988. Air quality stations were at Durgapur colony, Sumitra nagar and Sinhala village. Water samples were taken at the colony and upstream and downstream of Motaghat nallah. Noise levels were measured at the colony, project office, workshop and CHP. SPM levels were found to be well within permissible limit at all air stations. High TSS was found in water samples taken from Motaghat nallah. Other than in the workshop and CHP, noise levels were within the threshold limit.

Mine planning and design

Durgapur project is an ongoing project sanctioned by the Government of India in October 1978 for a target capacity of 1.8 million tonnes per year. There is only one thick composite coal seam (thickness range 14-17m) being worked by opencast mining. Top soil and weathered rock is removed by hydraulic shovels (3.8m^3) and dumpers (35 tonne). Hard overburden is removed by rope shovels (5.0 m^3) and dumpers (50 tonne). Coal and in-seam partings are removed by shovels (4.6-5 m^3) and dumpers (35 tonne) unloading the coal into the inpit feeder breaker conveyor system connected to the CHP. Conventional drilling and blasting is adopted for breaking overburden and coal. Coal production is currently hauled by conveyor to the Thermal Power Station. Current overburden production will be used mainly for backfilling the quarry voids and a small portion for dumping in external overburden dumps. The total area of external dumps will be 107.2ha. Dump material consists of mixture of sandstone and friable sandy silts. The area occupied by mine facilities to the end of the current five years and anticipated total 22 year life are as follows:

Leasehold area - Durgapur
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	107.2	92.1	126.1	22.0	42.0	429.6	821.0
Life	107.2	149.2	71.0	22.0	42.0	429.6	821.0

Project monitoring, auditing and evaluation

Environmental monitoring was started from the monsoon season of 1992. However, it was discontinued and has again been started from January 1995. Air quality readings are taken near the sub area manager's office, at Durgapur village and in the worker's colony. Water quality monitoring stations are at the mine sump, Motaghat nallah upstream and downstream. Noise readings are taken during day and night at the workshop, quarry and colony.

Hydrology and water quality management

Mine water is collected in a decoaled area in the pit. The water is then pumped out for various industrial and miscellaneous uses. Additional discharge from the sump is collected in large pond from where discharge occurs only during the peak of monsoon season and has regularly been in compliance with Government of India discharge standards. Garland drains and settling ponds are yet to be constructed to control and treat run-off from the external overburden dumps. The workshop and vehicle maintenance shops have as yet no waste water treatment facilities.

Air quality and noise management

Air quality monitoring is conducted near the quarry working area, office and worker/residential colonies and is in regular compliance with the appropriate standards in all seasons except pre-monsoon season, when some excursions do occur. Significant air pollution appears to be from CTPS which is upwind from the mine. Day time and night time noise levels around the HEMM workshop occasionally exceed the limits for industrial areas. Noise levels in the quarry, CHP and colony area are regularly in compliance with standards.

Regional environmental status

The level of operations and the pollutants generated from this mine are not likely to affect the regional air or water quality to any appreciable extent.

Disturbed land reclamation

Existing external dumps have outer slopes of 30° to 40° and heights varying from 10 to 40m. Planting on external overburden dumps has already been started in collaboration with National Environmental Engineering and Research Institute (NEERI) Nagpur. R&D studies using industrial organic waste and specially developed bio-culture have shown excellent results on some of the barren overburden dumps of more than 30° slope.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Three existing air quality monitoring stations will be relocated in 1995: one at the quarry near Singhla village, one at the residential colony and the third one between CTPS and the residential colony. For frequency of air sampling, the samples will be drawn on a 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present, CPCB is formulating standards for the coal industry which will be complied with after its notification. Three existing water quality sampling stations will continue. Quarterly samples of water quality and water level will be started at one domestic well in Singhala village. Water samples are proposed to be taken regularly in the well/tubewell in the residential colony to assess the impact of sewage treatment facilities. The three existing noise monitoring stations will continue.

Hydrology and water quality management

Approximately 8.5km of garland drains will be constructed by December 1996 to collect runoff from the slopes of the external overburden dumps and

convey it to a proposed settling pond. Waste water from the CHP, HEMM and vehicle maintenance shop will also be conveyed to this new settling pond, after initial treatment to remove grease and oil, which will be completed by December 1996. This settling pond will be designed to have no positive discharge except during the peak of monsoon season when it will have a minimum of 24 hours settling time. Studies to determine the adequacy of sewage disposal system on ground water will be completed by June 1996.

Air quality and noise management

Two water tankers are in operation to reduce the level of dust in and around areas. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in fiscal year 1997-98. Periodic noise problems in the HEMM workshop will be dealt with by providing hearing protection to exposed workers. The company will request the authorities of Chadrapur super thermal plant to enforce more effective particulate suppression in CTPS. However, WCL will participate in the regional air quality management programme as and when it starts.

Disturbed land reclamation

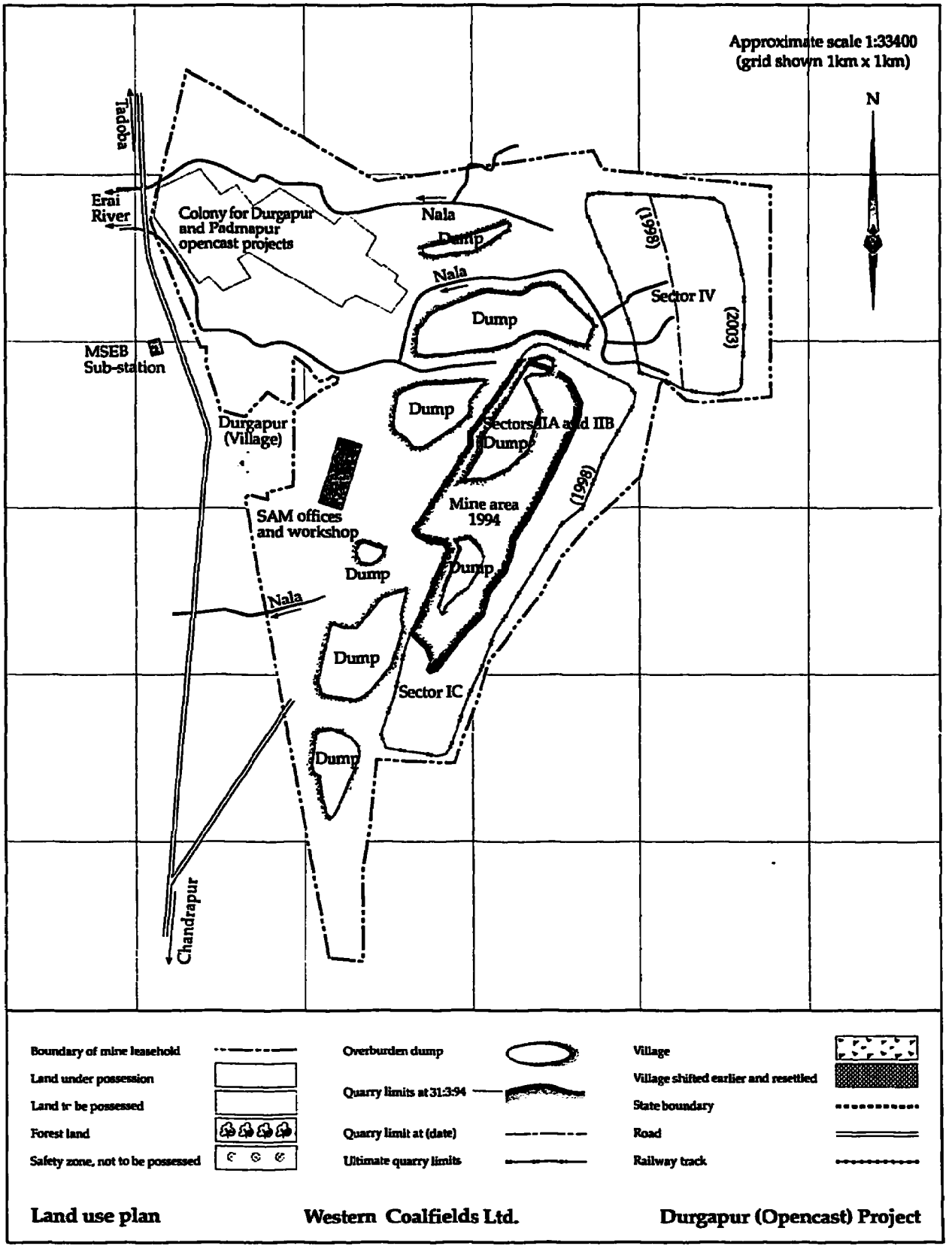
There is a backlog of 28ha disturbed land due to external overburden dumps. As this is an ongoing project, an EMP has not been formulated for clearance from MOEF. However, an engineering study is proposed to be conducted during 1995-96 and 1996-97 for slope stability of these overburden dumps. Depending on the outcome of the study, these dumps will be resloped to stable angles, if necessary, by rehandling of overburden. Otherwise, if found stable, these areas will be developed by biological reclamation of 7ha in 1997-98 and 12ha each in 1998-99 and 1999-2000. Reclamation of currently disturbed land will be under taken at the rate of 20.8ha per year with effect from 1995-96.

Five year annual budget summary - Durgapur

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.55	0.20	0.50	0.20	0.50	0.20	0.50	0.20	0.50	0.20
Water quality	1.80	0.15	0.30	0.15	0.00	0.15	0.00	0.15	0.00	0.15
Land reclamation	2.22	0.10	2.22	0.10	13.97	0.10	21.05	0.10	21.05	0.10
Total	4.57	0.75	3.02	0.75	14.47	0.75	21.55	0.75	21.55	0.75

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Western Coalfields Ltd.** **Durgapur (Opencast) Project**

NILJAI
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Niljai
Company:	WCL
State:	Maharashtra
Coalfield:	Wardha Valley
Year of sanction:	1987
Operational startup:	1991
Year of Env clearance:	1987
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	1.9 million tonnes
Capacity:	1.9 million tonnes
Mine life:	30 years
Residual life:	27 years
Number of coal seams:	1 (Thickness: 14-18m)
Ash content:	23.9-27.1%
Strip ratio:	3.1:1
Max. quarry depth:	110m
Coal destination:	MSEB's Chandrapur TPS (CTPS) and local industrial consumers

Current environmental status

Environmental setting

The Niljai mine is situated on a moderately undulated terrain in the Yeotmal district Maharashtra. The major part of the area is below HFL. Residential colonies are situated away from the minesite. Prior to mining, the leasehold area of 1147.8ha consisted 1079.8ha of dry land agriculture and 68ha of Government barren land. No forest land is involved in this project.

Baseline data

Baseline data was not generated in 1987. However, environmental quality information was collected in 1989-90. The data indicates that SPM levels at Niljai village had been exceeded in the winter season. Water quality in all the sampling stations was found to be within prescribed limits. Noise levels at all stations conformed to the standards.

Mine planning and design

There is only one composite seam being worked by opencast mining. Top soil and weathered rock is removed by hydraulic shovels and dumpers (35

tonne). Hard overburden is removed by rope shovels and dumpers. Coal and in-seam parting is removed by hydraulic shovels and dumpers. Conventional drilling and blasting is adopted for breaking overburden and coal. Current overburden production will be used for backfilling the quarry void and dumping on external overburden dumps which will continue until the end of project. Coal production is currently hauled by trucks to Ghugus railway siding, from where the coal is transported to CTPS of MSEB. The area of external overburden dumps for the project will be 307.8ha (including 102.8ha from embankment). Dump materials consist of a mixture of sandstone and friable sandy silts. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the total residual life of 13 years are as follows:

Leasehold area - Niljai
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	287.2	30.0	33.0	11.5	31.0	755.1	1,147.8
Life	307.8	72.0	126.7	11.5	31.0	578.8	1,147.8

Project monitoring, auditing and evaluation

Environmental monitoring was started with effect from the monsoon season of 1992. However, it was discontinued and started again in January 1995. Air quality readings are taken adjacent to the quarry, at the Niljai Village and in the worker residential colony. Water quality stations are the mine sump, a seasonal nallah upstream and downstream and a well in Niljai village. Noise readings are taken day and night at the quarry, CHP and colony.

Hydrology and water quality management

Mine water is collected in a decoaled area in the mine pit from where the water is pumped out for various industrial and miscellaneous purposes. Positive discharge from the final pit sump occurs only during the peak of monsoon season and has been in compliance with Government of India discharge standards. Garland drains and settling ponds have not yet been constructed to control and treat runoff from the external overburden dumps. The workshop and vehicle washing areas do not have oil and grease trap facilities as yet.

Air quality and noise management

Air quality monitored at all three stations is in compliance with the appropriate standards in all seasons except in pre-monsoon, when periodic

excursions occur. Day time and night time noise levels in the quarry, CHP and colony area are in compliance with standards.

Disturbed land reclamation

The existing overburden dumps, covering an area of about 20ha, have 28° slopes and will be maintained at the same angle. Tree plantation activities have been taken up on external overburden dumps with good survival rates.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Three air quality monitoring stations have been reorganised in the project network in 1995 at the following sites: the Niljai village, near Belsani village and near the project office. These air monitoring stations appear to serve the required purpose. For frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. Meanwhile CPCB is formulating standards for the coal industry which will be complied with after its notification. Four water quality sampling stations will continue. Quarterly samples of water quality and water level will be taken at one domestic well near the colony to assess the impacts of sewage treatment facilities. The noise monitoring station already fixed will continue.

Hydrology and water quality management

Approximately 6km of garland drains will be constructed by December 1996 to collect runoff from the outer slopes of the external overburden dumps and convey it to a proposed settling pond. Runoff from the CHP, HEMM and vehicle washing area will also be conveyed to this new settling pond (which will be completed by December 1996) after initial treatment to remove grease and oil. This settling pond will be designed to have no positive discharge except during the peak of the monsoon season when it will have a minimum retention time of 24 hours. Studies to determine the adequacy of the existing sewage disposal system will be completed by June 1996.

Air quality and noise management

Two water tankers are in operation to reduce the level of dust in and around mine areas. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in fiscal year 1997-98. If a noise problem is diagnosed in the HEMM workshop, suitable action will be taken to bring it within standards.

Disturbed land reclamation

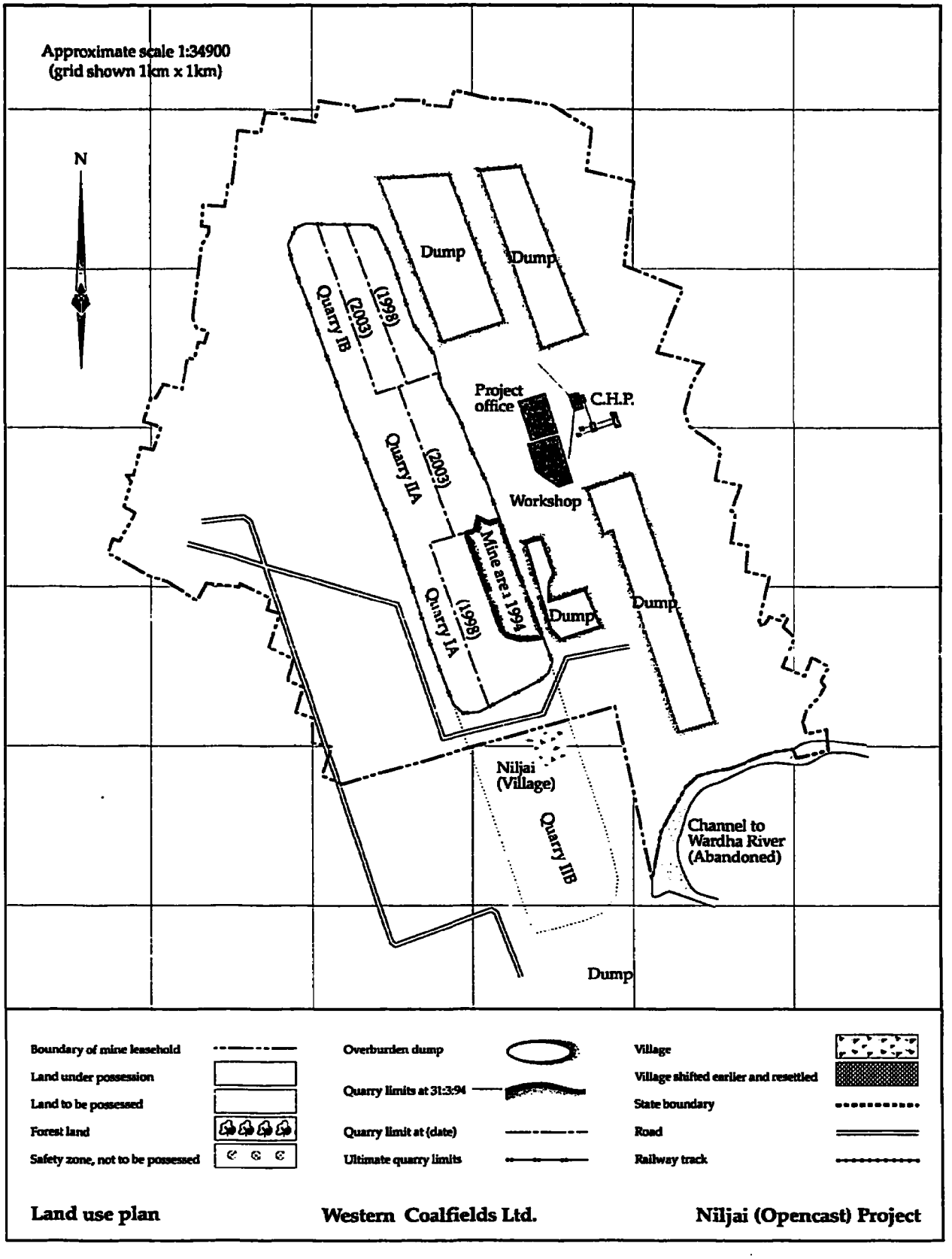
All the overburden dumps in this project are active dumps. There is no backlog of disturbed area due to external overburden dumps. These areas will be taken up for biological reclamation at the rate of 60ha per year starting from 1995-96 at an average cost per ha of Rs20,000 for grass and legume seeding, and Rs62,500 for tree planting. The annual reclamation costs will be Rs5 million every year for five years.

Five year annual budget summary - Niljai

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.55	0.20	0.50	0.20	0.50	0.20	0.50	0.20	0.50	0.20
Water quality	1.75	0.15	4.25	0.15	0.00	0.15	0.00	0.15	0.00	0.15
Land reclamation	4.95	0.10	4.95	0.10	4.95	0.10	4.95	0.10	4.95	0.10
Total	7.25	0.75	9.70	0.75	5.45	0.75	5.45	0.75	5.45	0.75

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Western Coalfields Ltd.** **Niljai (Opencast) Project**

PADMAPUR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Padmapur
Company:	WCL
State:	Maharashtra
Coalfield:	Wardha Valley
Year of sanction:	1984
Operational startup:	1985
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production :	1.1[illegible] million tonnes
Capacity:	1.25 million tonnes
Mine life:	38 years
Residual life:	29 years
Number of coal seams:	1 (Thickness: 17-23m)
Ash content:	26-35%
Strip ratio:	4:1
Max. quarry depth:	115m
Coal destination:	Chandrapur TPS (CTPS)

Current environmental status

Environmental setting

The Padmapur mine is situated on a flat plain. Worker residential colonies are concentrated on the southern side 2km away from the minesite. In addition, two villages (Mingaon and Padmapur) are located to the west and north of the mine area but outside the leasehold of the project, each approximately 1-2km from the active mining area. Prior to mining, the leasehold area of 557.3ha consisted of 20.8ha village land, 529.5ha of dryland agriculture, and 7ha of Government barren land. Padmapur is adjacent to Durgapur mine and is about 8km away from Chandrapur Thermal Power Station.

Baseline data

Mine operation was started in 1984 when baseline data was not required. However, for EMP formulation in 1989, an environment quality assessment was done. It indicated that air quality at all the four stations were within the prescribed limits. Water quality at Motaghat nallah was within the prescribed standards, except TSS. Noise levels were within threshold limits.

Mine planning and design

The seam is split into three sections (top, middle and bottom) by 2m thick stone bands. The top 10-12m of soil/subsoil is removed by scrapers and

dozers with ripper attachments. Overburden below the soil/subsoil layer is being drilled, blasted and excavated by 4.6/5m³ electric rope shovels from 10m high benches and transported by 35 tonne rear dumpers. Bench heights in the coal seam are limited to 6m to facilitate deployment of hydraulic shovels/ backhoes of 1.5-2m³ capacity. Non-coal bands within the coal seam are removed separately by hydraulic shovels/backhoes of 1.5-2m³ capacity. Coal production is currently hauled by belt conveyors to the CHP installed on the top surface and then to CTPC by conveyor. Present overburden production will be used for backfilling the quarry voids and part will go to external overburden dumps. Due to the steepness of the coal seam, part of the overburden will have to be dumped externally. The total area of external dumps of the project will be 117.7ha. Dump materials consist of a mixture of sandstone and friable sandy silts. Areas of the leasehold occupied by mine facilities to the end of the current five year period and anticipated to the total residual life of the mine (13 years) are as follows:

Leasehold area - Padmapur

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	102.5	28.5	61.5	15.4	0.0	349.4	557.3
Life	117.7	61.8	81.7	15.4	0.0	280.7	557.3

Project monitoring, auditing and evaluation

Environmental monitoring has been undertaken since the monsoon season of 1992. However, it was discontinued and started again in January 1995. Air quality readings are taken adjacent to the sub area manager's office, at Padmapur village and in the worker colony. Water quality stations are the mine sump and Motaghat nallah upstream and downstream. Noise readings are taken day and night at the workshop, quarry and colony.

Hydrology and water quality management

Mine water is collected in a decoaled area in the pit. The water is then pumped out for various industrial and miscellaneous uses. Additional discharge from the decoaled sump is collected in a large pond from which positive discharge occurs only during the peak of monsoon season and has regularly been in compliance with Government of India discharge standards. Garland drains and settling ponds have not yet been constructed to control and treat runoff from the external overburden dumps. The workshop and vehicle washing areas have as yet no waste water treatment facilities. A series of borewells on the dip-side of the quarry are used for partial dewatering and the water is used, after treatment, in colony for drinking purposes.

and convey it to the modified settling pond. HEMM and vehicle washings will also be conveyed to this settling pond after initial treatment to remove grease and oil which will be completed by December 1996. This settling pond will not have any positive discharge except during the peak of monsoon season when it has a minimum retention time of 24 hours. Studies to determine the efficacy of sewage disposal system on ground water quality will be completed by June 1996.

Air quality and noise management

Two water trucks are in operation to reduce the level of dust in and around mine areas. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas, avenue planting along the coal transport road, will be contemplated in fiscal year 1997-98. Periodic noise problems in the HEMM workshop will be dealt with by providing hearing protection to exposed workers by June 1996. The company will request the Chandrapur thermal power station for greater enforcement of particulate suppression in the CTPS. WCL will participate in the regional air quality management and programme as and when it starts.

Disturbed land reclamation

In view of the existing results to date in reclaiming overburden slopes at slopes over 35°, in future, physical reclamation will achieve the maximum slope of 28° before revegetation is carried out. There is a backlog of 34ha of disturbed land due to external overburden dumps. An engineering study is proposed to be conducted for slope stability of these overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the study, these dumps are proposed to be resloped to the safer angle, if necessary, by rehandling of overburden. Otherwise, if found stable, these areas will be developed by biological reclamation of 8ha in 1997-98 and 15ha each in 1998-99 and 1999-2000. Reclamation of currently disturbed land will be undertaken at the rate of 15ha per year with effect from 1995-96.

Five year annual budget summary - Padmapur

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.50	0.20	0.60	0.20	0.50	0.20	0.50	0.20	0.50	0.20
Water quality	1.80	0.15	0.30	0.15	0.00	0.15	0.00	0.15	0.00	0.15
Land reclamation	1.74	0.00	1.74	0.00	24.70	0.00	25.28	0.00	25.28	0.00
Total	4.04	0.65	2.64	0.65	25.20	0.65	25.78	0.65	25.78	0.65

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.

Air quality and noise management

Air quality monitoring results near the sub-area manager's office and residential colonies are generally in compliance with the appropriate standards in all seasons but pre-monsoon when periodic excursions occur. Significant air pollution appears to originate from CTPS which is upwind of the mine site. Day time and night time noise levels around the HEMM workshop occasionally exceed the limits for industrial areas. Noise levels in the colony area are regularly in compliance with standards.

Regional environmental status

The level of operations and the pollutants generated from this mine are not likely to affect regional air or water quality to any appreciable level.

Disturbed land reclamation

Existing external dump have outer slopes of 35°-40° and heights varying from 26-50m. There are four existing overburden dumps which slope up to 40°. Recontouring and regrading of the slopes has not been done. Some tree planting has been done on flat portions of the overburden dump after spreading of topsoil.

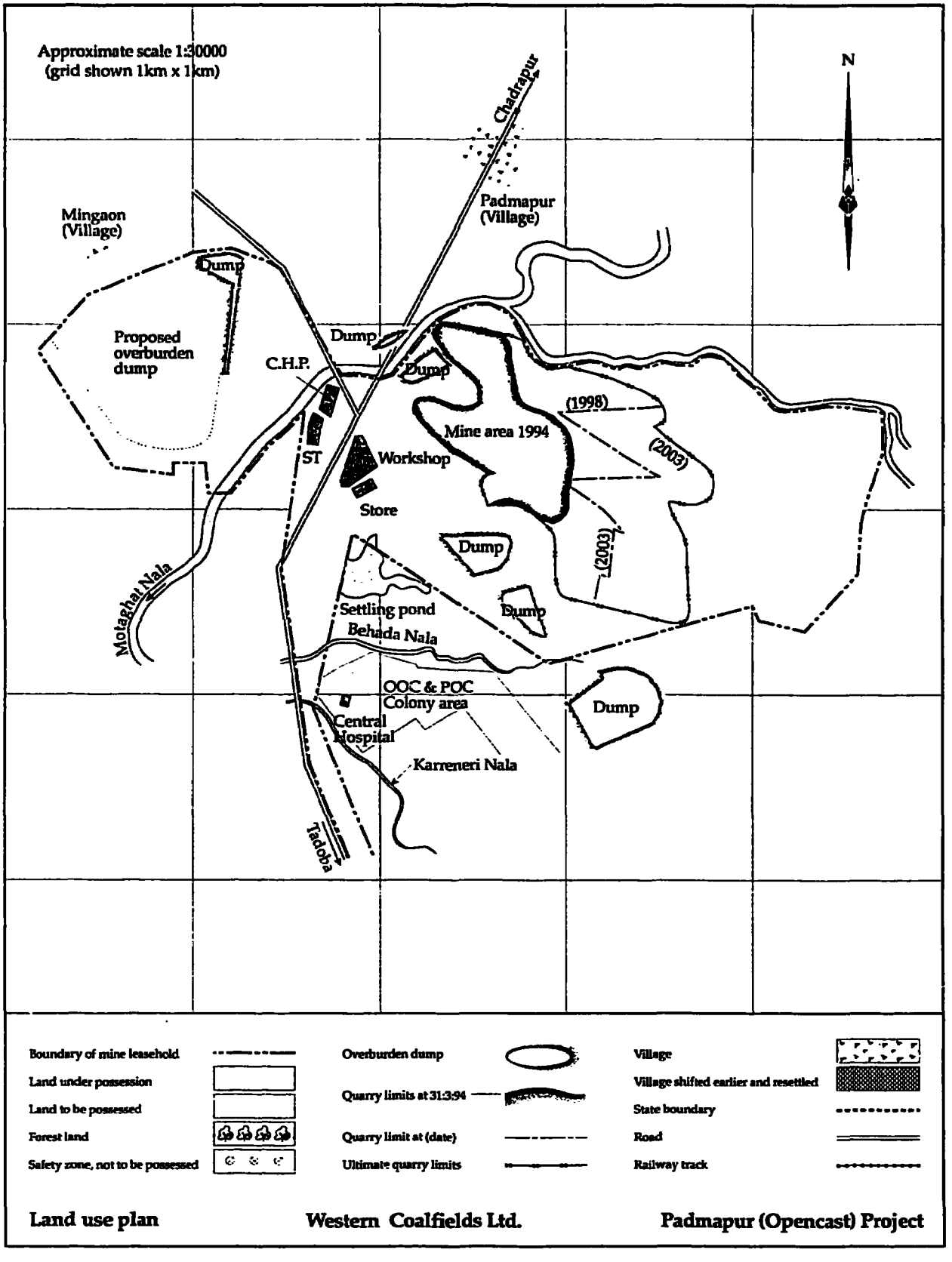
Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Three air quality monitoring stations have been reorganised in the project network in 1995 at the quarry, near Padmapur village and at the residential colony. One more station is proposed to be set up to monitor ambient air quality between CTPS and the mine area from post monsoon 1995. For frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. Meanwhile CPCB is formulating standards for the coal industry which will be complied with after its notification. Three water quality sampling stations will continue. Quarterly samples of water quality and water level will be taken at one domestic well in Padmapur village. One more water sample is proposed to be taken regularly in the well/tube well in the residential colony to assess the impacts of sewage on ground water. Three noise monitoring stations already fixed will continue for noise level monitoring.

Hydrology and water quality management

Approximately 8.5km of garland drains will be constructed by December 1996 to collect runoff from the outer slopes of the external overburden dumps



Land use plan **Western Coalfields Ltd.** **Padmapur (Opencast) Project**

SASTI
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Sasti
Company:	WCL
State:	Maharashtra
Coalfield:	Wardha Valley
Year of sanction:	1981
Operational startup:	1985
Year of Env. clearance	1989
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	1.25 million tonnes
Capacity:	1.00 million tonnes
Mine life:	23 years
Residual life:	14 years
Number of coal seams:	1 (Thickness: 17-18m)
Ash content:	25-31%
Strip ratio:	3.4:1
Max. quarry depth:	109m
Coal destination:	Cement plants, power houses and small consumers

Current environmental status

Environmental setting

The Sasti mine is situated on a flat to moderate undulating plain in Chandrapur district of Maharastra about 175km south of Nagpur. The major part of the area is below HFL. Workers' residential colonies are situated away from the minesite. Prior to mining, the leasehold area of 714ha consisted of 479.8ha of dry agricultural land, 20.2ha of Government barren land and a balance of unoccupied, undeveloped land and small villages. No forest land is involved. The mine is located about 3km southwest of the Wardha river.

Baseline data

The project was sanctioned in 1981, hence no baseline information was required. However, environmental quality data was collected in 1988 for formulation of the EMP. The data indicates that air quality at all air stations was within the standards. Water quality at the quarry and Gouri nallah conformed to the prescribed limits. Noise levels were within the threshold limits.

Mine planning and design

The seam is divided into top, middle and bottom sections by 2m thick stone bands. Due to the flat gradient and longer strike length, a dragline has been deployed in the quarry. The use of a dragline is, however, restricted to a 31m thick overburden just above the coal seam. Top soil, up to a depth of 10m, is removed by scrapers. Hard rock below the topsoil is blasted wherever necessary and excavated by 4.6m³ hydraulic shovels. Coal is won by 2m³ shovels in combination with 35 tonne rear dumpers. Conventional drilling and blasting is practised. Coal production is currently hauled by truck approximately 4km through the leasehold area to a rail line and loading facility at Sasti railway siding. Current overburden production will be used for backfilling the void as well as to create external overburden dumps. Dumping on external overburden dumps will be done until 2000, as sufficient voids are not available within the quarry for backfilling. After five years, all the overburden will be used in backfilling. The area of external overburden dump is 118.1ha. Dump materials consist of a mixture of sandstone and friable sandy silts. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the total residual life of 13 years of mine life are as follows:

Leasehold area - Sasti

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	118.1	43.2	32.2	1.9	0.0	518.6	714.0
Life	118.1	64.6	66.9	1.9	0.0	461.6	714.0

Project monitoring, auditing and evaluation

Environment monitoring was started with effect from the monsoon season of 1992. However, it was discontinued and started been in January 1995. Three air monitoring stations have been established: two in the core zone (near quarry site and manager's office) and one in buffer zone (in the colony). Water quality stations are the mine sump and Gouri nallah upstream and downstream of the project. Noise readings are taken day and night at the mine office, quarry site and colony.

Hydrology and water quality management

Mine water is collected in a decoaled area on the pit floor. Water is then pumped out for various industrial and miscellaneous purposes and has been in compliance with Government of India discharge standards. Garland drains and

settling ponds are yet to be constructed to control and treat runoff from the external overburden dumps. The workshop and vehicle washing area have as yet no waste water treatment facilities.

Air quality and noise management

Comprehensive dust suppression measures are being undertaken at the mine site. The coal handling plant is equiped with a water spraying arrangement. All the haul roads are regularly sprayed with water. Air quality at the mine office, quarry site and the colony is in compliance with the appropriate standards in all seasons but pre-monsoon, when periodic excursions occur. Day time and night time noise levels in the quarry, sub area manager's office and colony area are in compliance with standards.

Disturbed land reclamation

The existing external dumps have outer slopes of 28°-35° and heights that vary from 13-26m and appear to be stable. Tree planting activities have been carried out on external overburden dumps during 1994-95.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Three air quality monitoring stations have been reorganised in the project network in 1995 at the following sites: the quarry, near the sub area manager's office and residential colony. One more station will be set up to monitor the air quality at nearest village, Gouri. For frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. Meanwhile CPCB is formulating standards for the coal industry which will be complied with after it notification. Three water quality sampling stations will continue. Quarterly samples of the water quality and water level will be taken at one domestic well in Gouri village. Water quality will also be monitored in the dug well/ openwell in the residential colony to assess the impacts, if any, of the sewage disposal system. Three noise monitoring stations already fixed will continue.

Hydrology and water quality management

Approximately 7.8km of garland drains will be constructed by December 1996 to collect runoff from the external overburden dumps and convey it to a proposed settling pond. Effluents from the CHP, HEMM and vehicle washing area will also be conveyed to this new settling pond after initial treatment to remove grease and oil. Oil and grease traps will be completed by December

1996. Studies to determine the adequacy of sewage disposal to ground in the colony area will be complied by June 1996.

Air quality and noise management

Two water tankers are in operation to reduce the level of dust in and around mine areas. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in fiscal year 1997-98. If a noise problem in the HEMM workshop is diagnosed, suitable action will be taken to bring it within standards.

Disturbed land reclamation

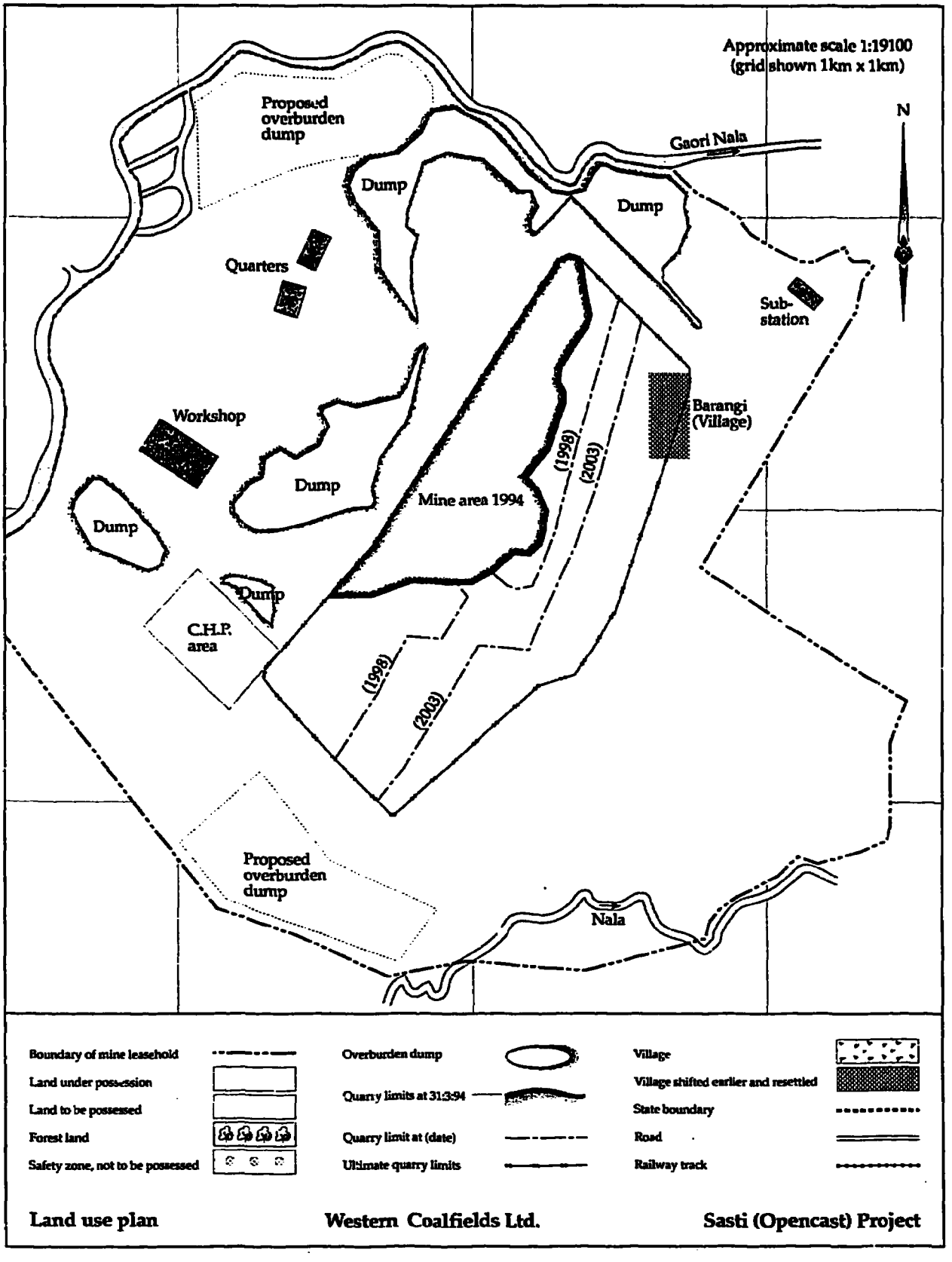
In view of results to date in reclaiming overburden slopes at slopes over 35°, in the future physical reclamation will achieve the maximum slope of 28° before revegetation is carried out. 41ha (on the top of the dump) of disturbed land is due to external overburden dumps. An engineering study is proposed to be conducted for slope stability of these overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the study, these dumps are proposed to be resloped to safer angle, if necessary, by rehandling of overburden. Otherwise, if found stable, these areas will be taken up for biological reclamation of 9ha in 1997-98 and 18ha each in 1998-99 and 1999-2000. Reclamation of currently disturbed land will be undertaken at the rate of 13.44ha (8.64ha in backfilled areas and 4.8ha in freshly created dump) per year with effect from 1995-96.

Five year annual budget summary - Sasti

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.55	0.20	0.50	0.20	0.50	0.20	0.50	0.20	0.50	0.20
Water quality	1.80	0.15	0.30	0.15	0.00	0.15	0.00	0.15	0.00	0.15
Land reclamation	1.61	0.10	1.61	0.10	10.07	0.10	19.03	0.10	19.03	0.10
Total	3.96	0.75	2.41	0.75	10.57	0.75	19.53	0.75	19.53	0.75

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Western Coalfields Ltd.** **Sasti (Opencast) Project**

UMRER
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Umrer
Company:	WCL
State:	Maharashtra
Coalfield:	Wardha
Year of sanction:	1962
Operational startup:	1963
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	2.05 million tonnes
Capacity:	1.84 million tonnes
Mine life:	30 years
Residual life:	9 years
Number of coal seams:	3 (Thickness: 3.4-27m
Ash content:	17-31%
Strip ratio:	1.8:1
Max. quarry depth:	100m
Coal destination:	Paras and Nasik thermal power station of MSEB and Satpura TPS of MPEB

Current environmental status

Environmental setting

The Umrer mine is located about 50km from Nagpur and is situated on flat plains which slope very gently towards the Amb River flowing along the southern boundary of the mine area. Workers' residential colonies are concentrated on the northern side of the project, away from the mine area. Prior to mining, the leasehold area of 807.3ha consisted of 733.5ha of dry agriculture land and 73.8ha of Government barren land. No forest land is involved in this project.

Baseline data

As the mine was started in 1963, baseline data was not required. However, an environmental quality assessment was done in 1989-90.

Mine planning and design

Umrer project is an on-going project. There are three workable coal seams: top (6.8-9.4m thick), middle (3.4-6.1m thick) and bottom (15-27m thick) being worked by opencast mining. Scrapers are used for removing top soil. Partings between the bottom and middle seam and the middle and top seam (up to 21m) is removed by dragline. The balance of overburden is removed by shovel-

dumper combination ($5m^3$ electric rope shovel and 35 tonne rear dumpers). Coal is removed by shovel-dumper system. Conventional drilling and blasting is adopted for breaking overburden and coal. Current overburden production is used entirely for backfilling the quarry voids. Coal production is currently hauled by truck 2km through the area. The area of external overburden dumps for the project will be 82ha. Dump materials consist of a mixture of rock and friable sandy silts. Areas of the leasehold that will be occupied by mine facilities to the end of the current five years (1995-96 to 1999- 2000) and at the end of mine life are as follows:

Leasehold area - Umrer

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	82.0	100.0	49.0	42.0	98.0	436.3	807.3
Life	82.0	104.2	68.8	42.0	98.0	412.3	807.3

Project monitoring, auditing and evaluation

Environmental monitoring was started during the monsoon season of 1992. However, it was discontinued and started again from January 1995. Air quality readings are taken at three stations including the workers' colony. Water quality monitoring stations are at the siltation pond and the upstream and downstream sides of Amb river. Noise readings are taken day and night at the workshop, CHP and residential colony.

Hydrology and water quality management

Mine water is collected in a series of ponds in the pit area and is pumped out for various industrial and miscellaneous uses. Positive discharge from the pit sump occurs only during the peak monsoon. Quality of this water has regularly been in compliance with CPCB discharge standards. Garland drains and settling ponds are to be constructed to control and treat runoff from the external overburden dumps. Waste water treatment plants for effluents from the coal handling plant, workshop and vehicle maintenance shop are also to be constructed.

Air quality and noise management

Air quality at three stations (the mine site, near the CHP and at workers' residential colonies) is in compliance with the appropriate standards. The CHP is well equipped with an effective water spraying system. Day time and night time noise levels around the CHP, workshop and residential colony are also in compliance with standards.

Disturbed land reclamation

Out of the total 82ha of external overburden dumps, only 25ha is yet to be vegetated. Most of these dumps are sloped at 30-40° and have heights of 40-50m. Massive tree planting has taken place on the balance of 57ha of external overburden dumps and the area has been converted into a recreation site.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Siting of the existing three air quality monitoring stations will be re-examined. One more station is proposed in the nearest village on the downwind side. Samples will be drawn on a 24 hourly basis for two days in a month or two days in a quarter depending on pollution load. At present, CPCB is formulating standards for the coal industry which will be complied with after its notification. Three existing water quality sampling stations will continue. Quarterly samples of water quality and water level will be taken at one domestic well in the Kanwah village. Three existing noise monitoring stations will continue.

Hydrology and water quality management

Approximately 4.3km of garland drains will be constructed by December 1996 to collect runoff from outer slopes of the external overburden dumps and convey it to a proposed settling pond. Runoff from HEMM and vehicle washing areas will also be conveyed to this settling pond after initial treatment to remove grease and oil which will also be completed by December 1996. Studies of adequacy of existing sewage disposal system will be completed by June 1996.

Air quality and noise management

Two water tankers are in operation for dust suppression in and around the pit and plant areas. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in 1997-98. If a noise problem is diagnosed in the HEMM workshop, action will be taken to bring it within standards. As a last resort, workers will be provided with protective gear.

Disturbed land reclamation

All external overburden dumps except for 25ha have been successfully vegetated. Areas of the internal dump will be gradually reclaimed. However, an engineering study is proposed to be conducted for slope stability of these overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the

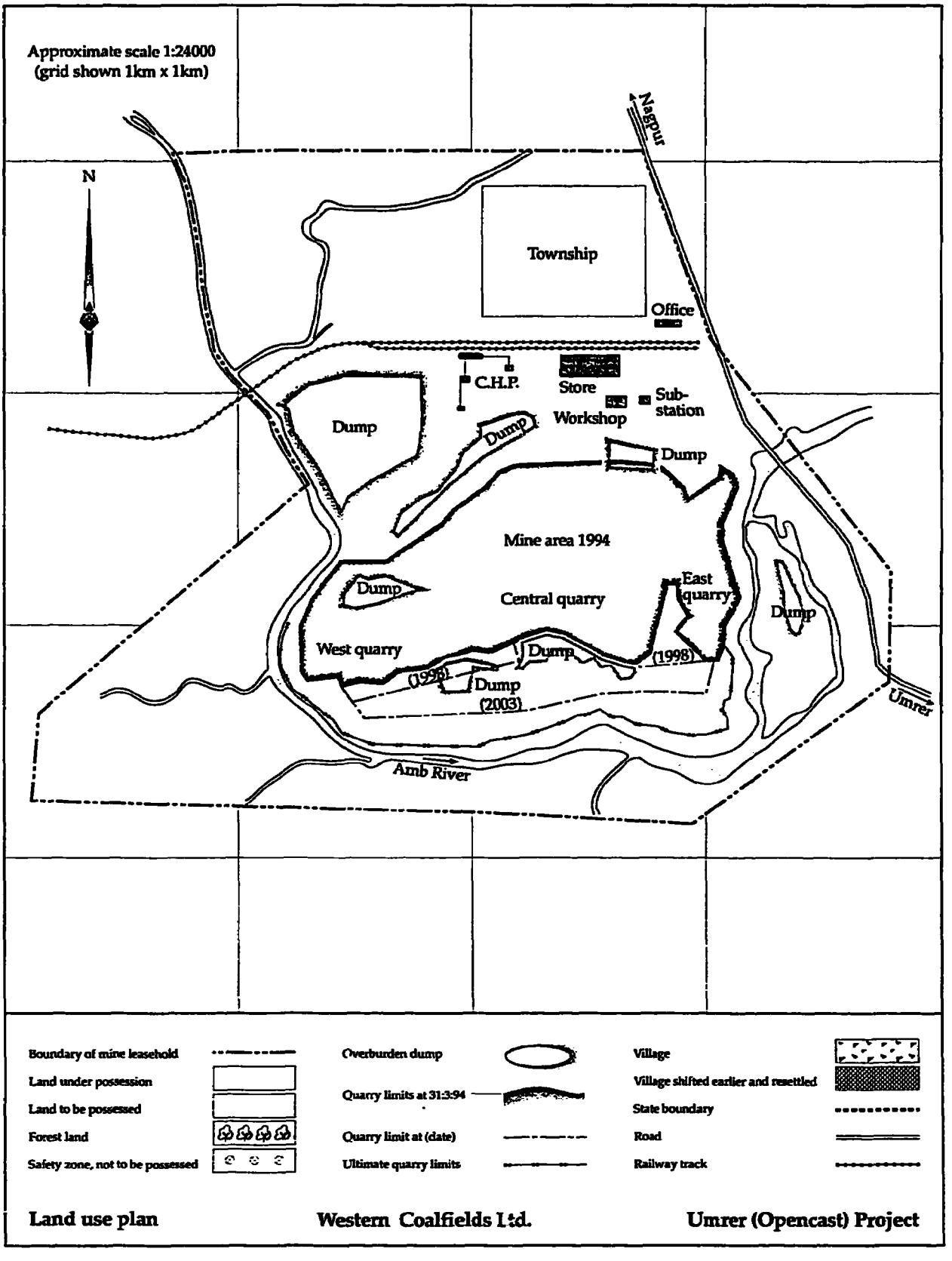
study, if required, these dumps may be resloped to stable angle by rehandling. Overburden, if found stable, will be developed by biological reclamation. Approximately 100ha backfilled area will be available up to the year 2000 at the rate of 20ha each year with effect from 1995-96. This will be technically and biologically reclaimed each year.

Five year annual budget summary - Umrer

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30	0.00	0.30
Air quality & noise	0.55	0.20	0.50	0.20	0.50	0.20	0.50	0.20	0.50	0.20
Water quality	1.70	0.10	4.20	0.10	0.00	0.10	0.00	0.10	0.00	0.10
Land reclamation	2.15	0.10	2.15	0.10	16.33	0.10	28.57	0.10	28.57	0.10
Total	4.40	0.70	6.85	0.70	16.83	0.70	29.07	0.70	29.07	0.70

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Western Coalfields Ltd.** **Umrer (Opencast) Project**

KD HESALONG
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	KD Hesalong
Company:	CCL
State:	Bihar
Coalfield:	North Karanpura
Year of sanction:	1968
Operational startup:	1968
Type of mine:	Opencast
Mining method:	Truck and shovel
Current production:	2.0 million tonnes
Capacity:	4.5 million tonnes
Mine life:	40 years
Residual life:	14 years
Number of coal seams:	7 (Thickness: averages 45m)
Ash content:	35-37%
Strip ratio:	1.2:1
Max. quarry depth:	120m
Coal destination:	Power Houses of Delhi, UP, Punjab and Haryana

Current environmental status

Environmental setting

The KD Hesalong project is located in an undulating terrain having a rolling topography. The project covers an area of 481ha and at its inception in 1968 it included 300ha of low density forest. Out of this, 170ha of forest land has been utilized in past mining activities. Some 130ha of forest land, falling in the proposed Quarry-II where work has yet to start, has already been degraded due to intermittent coal stocking and illegal felling by the local villagers. The Damodar river, which is the main drainage channel in the area, flows on the northern side of the project area. A cement factory at Khelari, which is about 5km southwest of the project, was working up to 1992-93. But for the last two years it has been closed. There are other coal mines surrounding this project.

Baseline data

The mine started functioning in 1968 and at that stage it was not required to generate baseline environmental data. This started only in 1987-88 for the formulation of the EMP for the expansion project report. For generation of air quality data, one station was located in the working zone and five stations were located in the buffer zone. The levels of SPM in the working

zone though high, were within prescribed levels as per Coal Mining Regulations, 1957. The levels of SPM in the buffer zone (ambient condition) were found to be within the prescribed limits. At all monitoring stations, levels of noxious gases were found to be below prescribed levels. Surface water was monitored in the Damodar river upstream and downstream of the project. As part of the baseline data generation, soil samples of the virgin area were also tested for their physical and chemical properties.

Mine planning and design

The mine is planned to be worked by opencast method with conventional truck and shovel combination. Presently the mine is working in the east quarry (Quarry-I). Working in Quarry-II will start within a few months. In course of mining in the past, a part of the overburden removed from the quarry was dumped outside at two locations. Part of it was used to construct the embankment against the Damodar River and the remainder was dumped in an external dump close to the northern boundary of Quarry-I. From 1988-89, all overburden materials removed from Quarry-I were used for backfilling of the decoaled pit. It is planned to continue the backfilling of Quarry-I and then subsequently start back-filling Quarry II. The backfilling in Quarry-I will leave a space of 50m from the mining face to facilitate future extension of the mine on the dip side. The profile of the backfilled area will merge with local landscape. The area of leasehold occupied by mine facilities at the end of current five year period (1995-96 to 1999-2000) and 40 years of mine life are as follows:

Leasehold area - KD Hesalong

(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	15	89	69	50	28	230	481
Life	15	228	73	50	28	87	481

Project monitoring, auditing and evaluation

Continuous environmental monitoring has been carried out since 1993. Air quality monitoring stations are located at the pit office, P.O. office and Dakra guest house. The first two stations are located in the working zone and the last one is located in the ambient zone. The water quality monitoring station covers mine water and Damodar river up and down stream of the project. Noise monitoring is being done at the project office, pit office and Dakra guest house.

Hydrology and water quality management

Mine water is collected in the mine at the pit floor and is subsequently pumped to a pond located on the northern side of the quarry. There is no overflow from this pond at any time of the year. This pond is actually an old abandoned pit. Presently, the CHP has no regular water treatment facility. The spent water flows to a nearby pond and is lost due to seepage and evaporation. In the workshop, a grease and oil trap has been constructed which treats the industrial waste.

Air quality and noise management

The level of gaseous pollutants have been found below the prescribed limit. The level of SPM has marginally exceeded the limit of 500mg/m^3 at one location (the pit office) in April 1994 and February 1994. This station is located in the working zone. At other stations, levels of SPM have been found to be below the prescribed limit. In monitoring excercises carried out before 1992, the level of SPM in the working zone was found to be high, but since 1992, when the cement plant was closed down, the SPM level has come down considerably.

Disturbed land reclamation

In the course of past mining activities, mine waste was utilised for construction of an embankment against Damodar river and also to form an external dump. The slope of the face of the embankment varies between 35° and 45° and has stabilized. The height of the dump is less than 25m. Part of the embankment (approx. 2ha) has already been biologically reclaimed. The environmental clearance letter does not require regrading of this dump. The external overburden dump located on the northern boundary of Quarry-I, measures approximately 10ha and its approximate height is 30m. This was formed during 1986-87. This area is yet to be reclaimed. The slope of the external dump varies between 40° and 45°. A total of seven internal dumps have already been made covering an area of about 45ha and all located within Quarry-I. They were formed during 1988-94. Two internal dumps have already been planted covering an area of about 17.6ha and one is partly planted. The remaining four internal dumps are yet to be reclaimed.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

From 1995-96, one air quality monitoring station will be established in the work zone at the pit office. Three monitoring stations will be located outside the mine area, one at Bukbuka colony on the eastern side, one in

Arungarha village in southeastern side and one at the subarea office. The air monitoring station at Bukbuka colony represents the nearest township and the air monitoring station at Arungarha represents the nearest village to the workzone. Air monitoring will be done on quarterly basis. If the level of the pollutants exceed the prescribed limit, the frequency will be increased to monthly basis. Surface water in Damodar river will be monitored at two stations, one upstream and one downstream of the project. Ground water will be monitored at Bukbuka colony and Arungarha village through sampling of well waters. Mine water and treated waste water from the workshop will also be monitored. Noise levels will be monitored at all air monitoring stations.

Hydrology and water quality management

It is proposed to provide a 1.2km garland drain on south side of Quarry-II to intercept the surface runoff and divert it to Kendua nallah on the western side. Mine water will be collected in a mine sump and subsequently pumped to a sedimentation lagoon to be located on the southwest side of Quarry-II. Overflow from the lagoon will flow into Kendua nallah. It is proposed to provide an oil and grease trap in the new workshop to treat industrial waste water generated in the workshop. The spent water from the CHP will be collected and diverted to a surface lagoon. The CHP is proposed to be located on the northeastern side of Quarry-I.

Air quality and noise management

In order to control dust generation from haul roads, a total of three water sprinklers are proposed to be procured, two in 1995-96 and one in 1996-97. Drills will be provided with dust collection facilities and a dust suppression system will be installed at the CHP. In addition, greenbelts/avenue planting will be provided at various locations within the mine area for dust suppression. This includes avenue planting along the haul road, other roads and the railway siding, greenbelts around the industrial area and quarry. Block planting will be done in vacant plots. A 30m wide green belt consisting of 10 rows of trees and shrubs will be provided around Arungarha village to protect it from dust pollution.

Disturbed land reclamation

The Environmental clearance for the project conveyed through letter No. J11015/35/84-Env.5/1A II(M) dt. 27/29th October 1993, laid down a condition that no further external dumping should be done. In compliance with this stipulation, it is proposed to place all overburden to be removed during future mining operations in the decoaled pit. It is proposed to continue to use the overburden to be removed from Quarry-II to backfill the remaining voids of Quarry-I, except for a 50m wide strip at the dip most side which is necessary

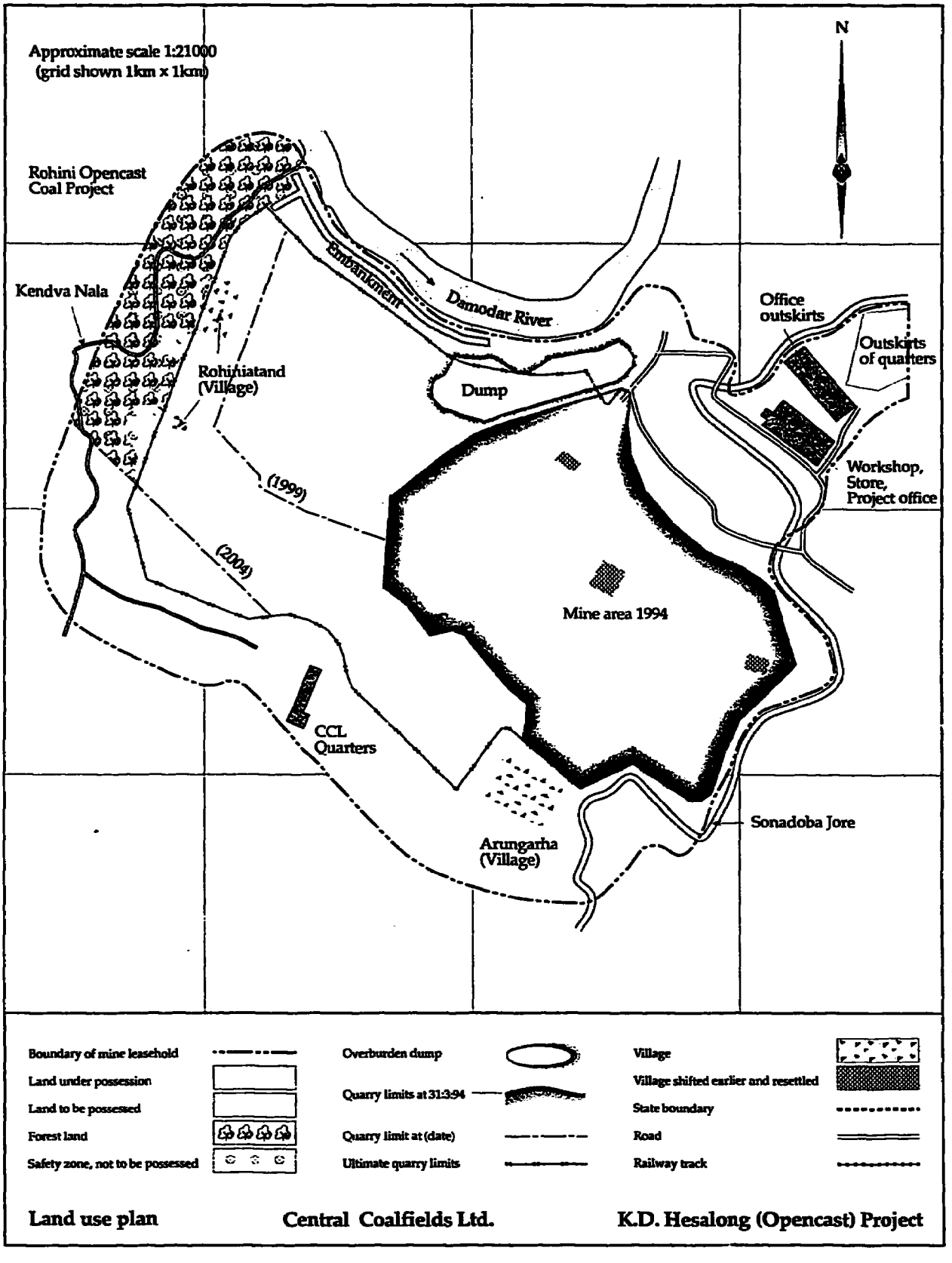
to facilitate mining of coal reserves available on the dip side beyond the boundary of present quarry. After the voids in Quarry-I are filled up to the required extent, backfilling of voids of Quarry-II will commence. The profile of the backfilled area will be such that it merges with prevailing landscape. Once the backfilling is over, the surface is to be dozed to render a proper slope to ensure drainage. Next, a layer of top soil is to be spread over the prepared surface. Finally, biological reclamation will follow over the physically reclaimed backfill area. It is proposed to reclaim 8ha, 18ha, 12ha, 12ha and 12ha during 1995-96, 1996-97, 1997-98, 1998-99 and 1999-2000 respectively. This will be confined to the backfilled area of Quarry-I and the existing external dump.

Five year annual budget summary - KD Hesalong

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.30	0.04	0.30	0.08	0.30	0.12	0.30	0.16	0.30	0.21
Air quality & noise	18.10	6.50	6.58	8.92	1.26	9.09	1.00	9.23	1.00	9.36
Water quality	6.50	1.28	6.27	2.55	0.50	2.62	0.00	2.62	0.00	2.62
Land reclamation	20.48	9.40	17.08	18.00	0.72	18.09	0.72	18.17	0.72	18.26
Total	45.38	17.22	30.23	29.55	2.78	29.92	2.02	30.18	2.02	30.45

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.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(grid shown 1km x 1km)
N
Rohini Opencast
Coal Project
Kendva Nala
Rohiniatand
(Village)
Embankment
Damodar River
Dump
Office
outskirts
Outskirts
of quarters
Workshop,
Store,
Project office
(1999)
(2004)
Mine area 1994
CCL
Quarters
Arungarha
(Village)
Sonadoba Jore
Boundary of mine leasehold
Land under possession
Land to be possessed
Forest land
Safety zone, not to be possessed
Overburden dump
Quarry limits at 31.3.94
Quarry limit at (date)
Ultimate quarry limits
Village
Village shifted earlier and resettled
State boundary
Road
Railway track
Land use plan
Central Coalfields Ltd.
K.D. Hesalong (Opencast) Project

PAREJ EAST
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Parej East
Company:	CCL
State:	Bihar
Coalfield:	West Bokaro
Year of sanction:	1993
Operational startup:	1993
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	0.35 million tonnes
Capacity:	1.75 million tonnes
Mine life:	27 years
Residual life:	25 years
Number of coal seams:	5 (Thickness: averages 27.6m)
Ash content:	33.5-34.5%
Strip ratio:	2.7:1
Max. quarry depth:	102m
Coal destination:	Linked to Parej Washery for supplying coking coal to various Steel Plants

Current environmental status

Environmental setting

Parej project, situated in an undulating terrain, has a rolling topography. Bokaro nallah flows close to the project area on the southern side and Chutua nallah flows on the northern side. The total project area measures 395.4ha which includes 57.6ha of forest of medium density, 74ha of dry agricultural land and the balance of land is Government land, mostly waste land. There are two villages within the mining leasehold (Parej and Dhurkusmar) which are to be shifted shortly. There are other coal projects in the area including Tapin colliery on the western side and West Bokaro colliery on the eastern side.

Mine plan and design

The mine is planned to be worked by opencast method with conventional truck and shovel combination, both for coal and overburden removal with maximum in-pit backfilling. Out of a total overburden volume of 114.8 million m^3, it is proposed to dump only 11.4 million m^3 as external dump and the balance of 103.4 million m^3 is to be used for backfilling the voids of decoaled pit. The external dump is to be completed and reclaimed by the end of the seventh year of mining operation. The coal produced from this mine is to be supplied

to the pit-head washery which is to be located on the north side of the mine. The coal will be transported by belt conveyor to the washery. The break-up of the area of the leasehold occupied by facilities at the end of 2000 and post-mining stage at the end of 27 years life is given below:

Leasehold area - Parej East
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	34.9	0.0	75.0	31.8	23.2	230.5	395.4
Life	34.9	122.4	98.3	31.8	23.2	84.8	395.4

Baseline environmental data

The pre-mining baseline environmental data was generated during 1989-90 for formulation of the project EMP. A total of eight air monitoring stations were fixed including one on the work zone (core zone) and seven outside the mine area (buffer zone) representing the ambient situation. Surface water quality was also monitored through two samples collected from Bokaro nallah and one sample from Chutua nallah. Noise level readings were also taken at air monitoring stations.

Project monitoring, auditing and evaluation

The project EMP was prepared based on the premining environmental scenario and has been approved by MOEF. As per the guidelines of MOEF, the environmental quality (including air quality, water quality and noise level) are being monitored regularly on a quarterly basis. Air monitoring stations are located at the site office and pump house, both of which are located within the mine boundary. Mine water is also being monitored. Noise readings are taken at the site office and pump house during the day and night. In all monitoring results, the levels of SPM and noxious gases have been found to be much below the prescribed level. The effluent quality also conforms to the standard laid down by CPCB. Noise levels have been found to be well within the prescribed level.

Hydrology and water quality management

Presently the mine water is being collected in the mine sump located on the mine floor and is being pumped out to a local depression on the surface in the eastern side which serves as a sedimentation lagoon. Due to the prevailing topography, garland drains have not been required so far. A CHP and workshop are under construction and hence waste water is not yet generated at those points.

Air quality and noise management

Presently a water sprinkler is being used to regularly spray water on haul roads to control the dust.

Disturbed land reclamation

The external dump is under formation and a stage has not reached by which a part of it can be reclaimed.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

From 1995, the air quality will be monitored at two additional locations, the residential colony and Dhurkusmar village. The two stations represent the ambient situation. Additionally, surface water quality will be monitored from Bokaro nallah and Chutua nallah. Well water will also be monitored from residential colony and Dhurkusmar village. Mine water will also be monitored on a regular basis and will be sampled from the sedimentation lagoon. In the workshop, the waste water after treatment will be monitored. The noise level will be monitored at all air monitoring stations. The monitoring programme will be on a quarterly basis.

Hydrology and water quality management

Approximately 1km of garland drain will be constructed during 1996-97 to intercept surface runoff flowing into the mine during the monsoon. Mine water will be collected in a central sump at the mine floor and will be pumped to a sedimentation lagoon to be located to the northeast side of the quarry. This lagoon will work up to the eighth year of mine operation and afterwards, another one will be constructed on the southeastern side. In the workshop, which is under construction, an industrial waste treatment plant is proposed. The industrial waste water will be treated at this unit and recirculated for washing purposes. The spent water from the CHP will be collected through a series of diversion channels conveyed to a separate lagoon. For external dumps, catch drains along the ramps and foot drains will be established to collect the surface runoff and diverted to a separate lagoon.

Air quality and noise management

Two water tankers will be procured for haul road spraying, one during 1995-96 and the other in 1996-97. In the CHP, a dust suppression and collection unit will be provided. Drills with a dust suppression and extraction system will be procured. Tree planting along the haul road and greenbelts

along the industrial area and along the CHP have also been planned. Green belts around villages will be established.

Disturbed land reclamation

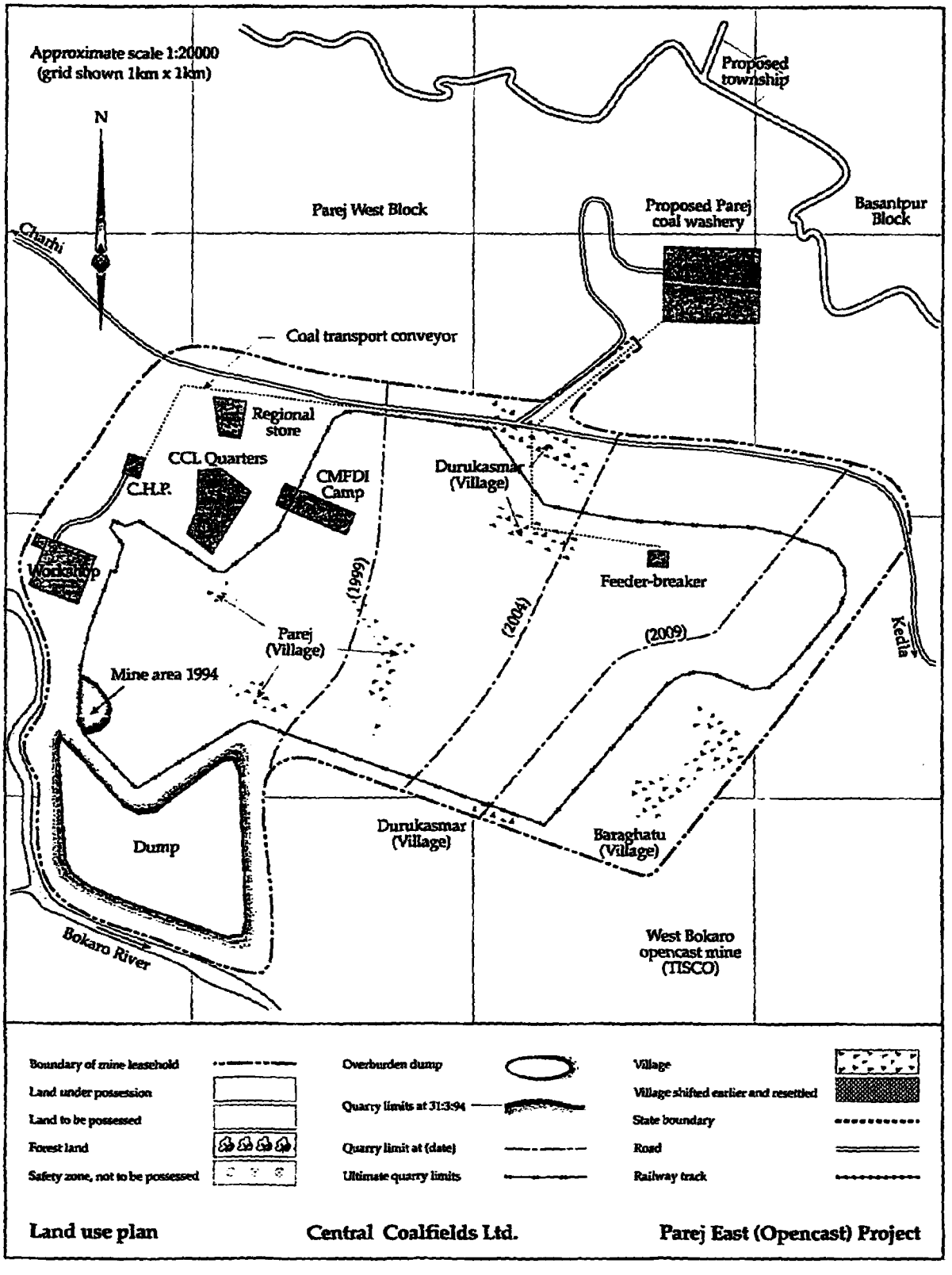
As per the plan, the external dump covering 34.9ha will accommodate 11.4 million m^3 of overburden. This dump is currently in the formation stage and will be completed within the next five years. Physical reclamation will start from the third year of mine operation and will be followed by biological reclamation. As per the stipulation of MOEF, the sloping face will be regraded to 28°. The entire external dump will be reclaimed by the seventh year. Afterwards, the backfilled area will be developed by both physical and biological reclamation. It is proposed to remove the top soil from the quarry and overburden dump site and conserve it for re-use during the biological reclamation stage.

Five year annual budget summary - Parej East

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.30	0.04	0.30	0.08	0.30	0.12	0.30	0.16	0.30	0.21
Air quality & noise	12.20	4.34	1.30	4.05	0.00	4.05	0.00	4.05	0.00	4.05
Water quality	1.60	0.35	1.87	0.73	0.20	0.96	0.50	1.21	0.20	1.44
Land reclamation	20.00	5.95	8.77	8.87	0.30	8.91	0.30	8.95	0.30	9.00
Total	34.10	10.68	12.24	13.73	0.80	14.04	1.10	14.37	0.80	14.70

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Central Coalfields Ltd.** **Parej East (Opencast) Project**

RAJRAPPA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Rajrappa
Company:	CCL
State:	Bihar
Coalfield:	Ramgarh
Type of mine:	Opencast
Operational startup:	1977
Year of sanction:	1976
Mining method:	Truck & shovel
Current production:	2.8 million tonnes
Capacity:	3.0 million tonnes
Mine life:	50 years
Residual life:	33 years
Number of coal seams:	3 (Thickness: 17m)
Ash content:	28%
Strip ratio:	2.9:1
Max. quarry depth:	75m
Coal destination:	Linked to Rajrappa Washery for supplying coking coal to various steel plants

Current environmental status

Environmental setting

Rajrappa opencast project is situated in an undulating terrain having a rolling topography. The Damodar river flows to the north of the project area and its tributary Bhera river flows on the eastern side. The project area covers 1417ha, including 775.3ha of forest land. The required land, including forest land, has been acquired. At the premining stage, non-forest land included 16ha of paddy land, 101ha of non-irrigated agricultural land and about 526ha of waste land. At present, mining and allied activities have already used a large area of land. Rajrappa Washery is located on eastern side of the project.

Baseline environmental data

The mine started functioning in 1977 and at that stage, baseline environmental data was not generated. However, environmental data was generated during 1987-88 for formulation of the EMP for the project. A total of six air monitoring stations were fixed including four stations in the work zone and two stations in the buffer zone, representing ambient condition. Surface water was monitored in the Damodar river at one location. Noise levels were moni-

tored at five locations including at colony, washery, workshop, haulage road and overburden dump. Top soil samples were also tested.

Mine planning and design

The mine was planned to work by opencast method with conventional truck and shovel combination. The project consists of two main quarries (Quarry-I and Quarry-II) with four auxiliary quarries (Sections Ia, Ib, IIa and IIb). The mine has been planned with maximum possible backfilling. The backfilling has been limited due to the unfavorable dip of the mine floor (about 11°). Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the 50 years of life are as follows:

Leasehold area - Rajrappa
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	170	47	181	26	68	925	1,417
Life	304	127	101	26	50	809	1,417

Project monitoring, auditing and evaluation

Regular environmental monitoring on a quarterly basis has been carried out since summer 1993. This monitoring programme covers air quality, water quality and noise levels. Air monitoring stations are located at the pit office, workshop and guest house. The first two stations represent the work zone area and the last one represents the ambient zone. Mine water is sampled from the mine-sump. Noise level monitoring stations are located at air quality monitoring stations.

Hydrology and water quality management

At present, mine water is collected at mine sump located in Quarry-I and Section IIb. Subsequently, it is pumped to a lagoon on the western side and is used for dust suppression and other industrial uses. Presently, waste water from the workshop is being collected in a pond located on the eastern side and is lost due to seepage and evaporation. An oil and grease trap is under construction and is likely to be completed within a couple of months. There is no CHP in the project. Surface runoff from external dumps is collected through a diversion channel and conveyed to a lagoon on the western side. Garland drains have been provided around working quarries on the western side. These intercept surface runoff and divert it to the natural drainage channels. Open

drains have been provided along haul roads to collect surface runoff and divert it to natural drains.

Air quality and noise management

In order to suppress dust from haul roads, the following arrangements have been made. A fixed water spraying system has been installed along the main haul road. In addition, one mobile water sprinkler has also been provided. Avenue planting along haul roads, other roads and block plantation has also been provided to check air pollution and help with noise abatement. The monitoring results have shown that levels of SPM and gaseous pollutants are below prescribed limits. Noise levels at various monitoring stations have been found to be below prescribed levels.

Disturbed land reclamation

In the course of mining during 18 years, 12 external dumps and six internal dumps have been formed. There are two major external dumps, one on the eastern side covering an area of 54ha and another on the western side which presently covers an area of 71ha. The eastern dump has been biologically reclaimed. The western dump is a live dump and reclamation has not yet been started. Of the ten remaining external dumps, two have been fully reclaimed, three are in the process of reclamation and on another three reclamation is yet to start. Two dumps are still in use. The slopes of all reclaimed dumps are now stable. The total reclaimed area of external dumps is 72.2ha and the area of unreclaimed dumps is about 19ha. The area of active external dumps is 78ha. The slopes of active dumps will be maintained at 28° in compliance with MOEF's stipulation contained in the environmental clearance letter. Presently, the area of internal dumps is 37ha, ot of which nearly 23ha has been fully reclaimed.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

From 1995-96, two more air monitoring stations will be added, one at Sidhu Kano nagar (the rehabilitation site), and the second at Koihara village. Surface water will be monitored at two more locations in Damodar river - one upstream and the other downstream of the project. Ground water will be monitored through samples from wells in the township, Sidhu Kano nagar and Koihara village. Mine water samples will be collected from the overflow point of the sedimentation pond. Treated industrial water will be collected for quality monitoring.

Hydrology and water quality management

In addition to existing garland drains around the working mine, it is proposed to construct an additional 550m long garland drain on the eastern side of Quarry II during 1995-96. One more lagoon will be provided on the western side of Quarry II to treat water from this quarry. It is expected that the oil and grease trap in the workshop, which is presently under construction, will be completed and commissioned before June 1995.

Air quality and noise management

It is proposed to procure one more water sprinkler during 1995-96 and the stationary water sprinkling system will be extended to the new haul road serving Quarry II. Avenue planting will be extended to cover the new haul road and other roads. Block planting will be done in open spaces within the mining area and also around Koihara village to protect it from air pollution.

Disturbed land reclamation

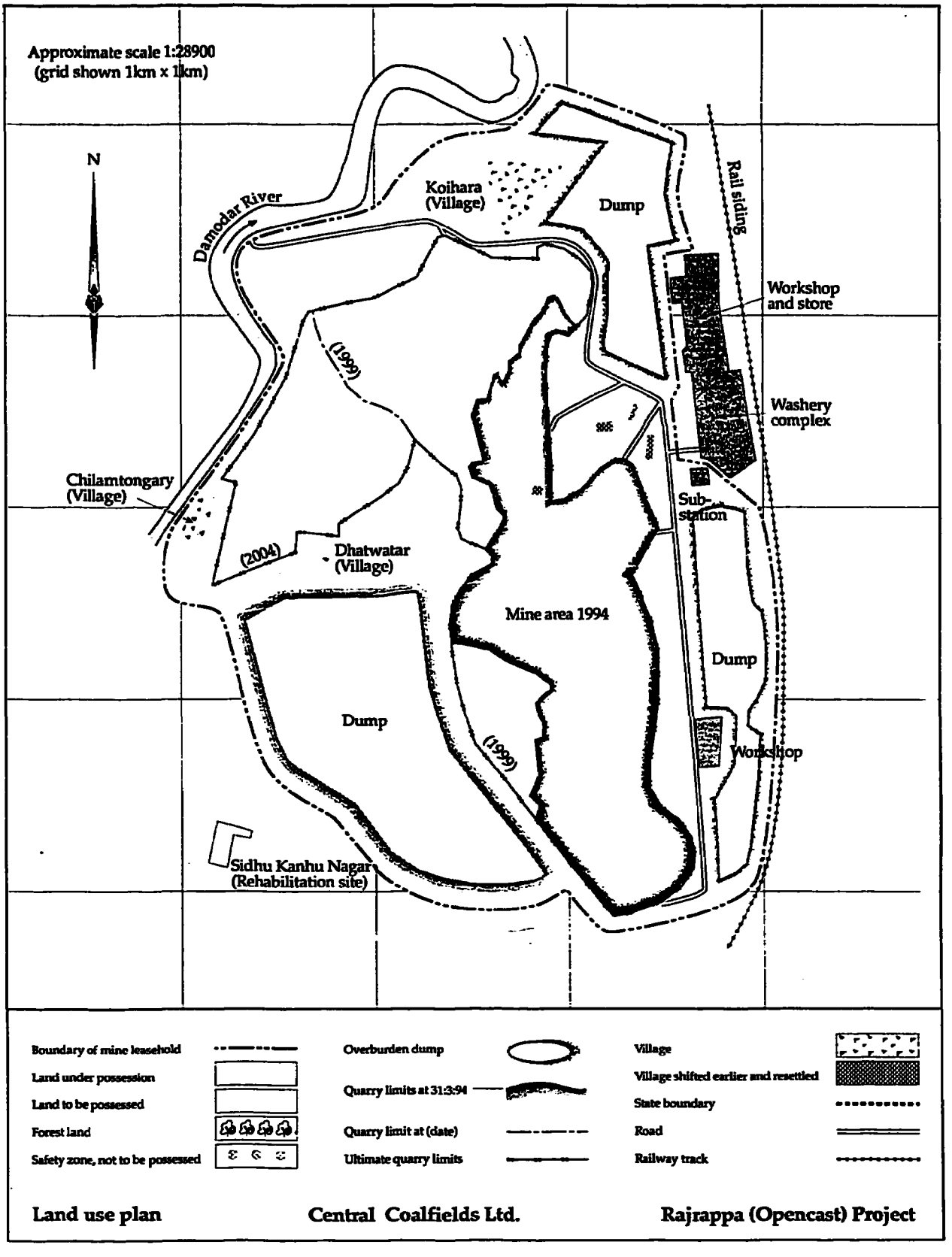
Three external dumps covering an area of 12ha are under various stages of reclamation. Their reclamation will be completed during 1995-96. Other unreclaimed external dumps covering an area of 6ha will be reclaimed during 1996-97. In the course of future mining operations, the overburden removed from Quarry I will be dumped in the western dump and the overburden removed from Quarry II will be dumped partly in the decoaled pit and partly in the northern dump. The internal dumps (covering an area of 12ha) will be reclaimed during 1996-97.

Five year annual budget summary - Rajrappa

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.30	0.04	0.30	0.08	0.30	0.12	0.30	0.16	0.30	0.21
Air quality & noise	11.30	4.73	3.70	5.30	2.40	5.75	1.50	6.09	0.00	6.09
Water quality	3.94	0.48	18.20	1.82	1.60	2.16	0.00	2.16	0.00	2.16
Land reclamation	23.00	8.89	1.08	8.95	1.08	9.02	0.36	9.04	0.36	9.06
Total	38.54	14.14	23.28	16.15	5.38	17.05	2.16	17.45	0.66	17.52

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Central Coalfields Ltd.** **Rajrappa (Opencast) Project**

BISRAMPUR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Bisrampur
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Bisrampur
Year of sanction:	1959
Operational startup:	1959-60
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	1.13 million tonnes
Capacity:	1.10 million tonnes
Mine life:	40 years
Residual life:	8 years
Number of coal seams:	1 (Thickness: 2-2.5m)
Ash content:	20-22%
Strip ratio:	6.5:1
Max. quarry depth:	34m
Coal destination:	Miscellaneous industrial users

Current environmental status

Environmental setting

Bisrampur opencast mine is situated on a gently undulating terrain surrounded by several nallahs. The main river (Rehar river) flows on the west of the mine area. Residential colonies are concentrated in the west between the mine site and Rehar river. The main drainage is Passang nallah which flows east to west and forms a tributary to Rehar river. There are many villages situated approximately 2 to 5km from the active mining area. Prior to mining, the leasehold area of 1472ha consisted of 983ha of agricultural land, 5ha of water bodies and 484ha of forest land used for wood production.

Baseline data

No baseline data is available for this project because it pre-dates the environmental legislation.

Mine planning and design

There is only one workable coal seam, Passang seam, which dips gently in a northeasterly direction. The Bisrampur project is designed for maximum backfill. The initial surface cut and external overburden dumps were undertaken from 1961 to 1964 entirely by dumper and shovel operation. In 1964, the

project commissioned a dragline in Quarry No.1 and another dragline in 1967 in the same quarry. These have carried out all subsequent overburden excavation and back filling. The two draglines are at present working in Quarry No. 8. A shovel and dumper combination is deployed in Quarry No. 9. Dump materials consist of a mixture of friable rock and loose sand. Coal production is currently hauled by dumpers up to 5km to a CHP for wagon loading. Areas of the leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the total 40 year mine life are as follows:

Leasehold area - Bisrampur
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	20	1,102	70	44	0	236	1,472
Life	20	1,190	72	44	0	146	1,472

Note: About 660ha of land is used for common colony of Bisrampur, Jainagar and Kunda Sub Area. This is not included in the figure given above.

Project monitoring, auditing and evaluation

Environmental monitoring was started in the post-monsoon season of 1991. Air quality readings are taken at four stations, i.e. near GM's office, CHP, Quarry No.8 and Keshav nagar village. Four water quality stations are located at CHP-washings outlet, Rehar river water (before filter), mine discharge water and open well water of Keshav nagar village. Noise readings are taken day and night at four stations, i.e. dragline operation point, workshop, near CHP and Keshav nagar village.

Hydrology and water quality management

Mine water is collected in the quarry bed and then released to Rehar river via Passang nallah. The settling pond for quarry water has not been constructed. Garland drains and settling ponds have not yet been constructed to control and treat runoff from the external overburden dumps. The coal handling plant, workshop and vehicle washing areas have, as yet, no waste water treatment facilities.

Air quality and noise management

Suspended particulate levels in the mine quarry regularly exceed the maximum allowable objective for industrial areas of 500µg/m^3. Air quality at the mine office and residential colonies is regularly in compliance with the

appropriate standard in all seasons except pre-monsoon, when periodic excursions do occur. Day time and night time noise levels around the HEMM and workshop occasionally exceed the limit for industrial areas. Noise levels around the quarry, CHP and colony areas are regularly in compliance with standards.

Disturbed land reclamation

The total area of external dumps is 20ha of which 2ha resulted from shovel/dumper combination and 18ha from dragline operations. External dumps have outer slopes of 35°-40° and heights vary from 20-30m. Prior to 1993-94, biological reclamation was done on part of the existing overburden dumps. The results achieved are encouraging. From 1993-94, resloping of internal and external overburden dumps has been taken up through Madhya Pradesh State Land Development Corporation. Tree planting with grass and legume seeding by Madhya Pradesh State Forest Development Corporation has also been started.

Regional cumulative environmental impacts

No other industry is nearby, so regional cumulative environmental impact is not envisaged.

Environmental management programmes 1995-96 to 1999- 2000

Project monitoring, auditing and evaluation

Four air quality monitoring stations are considered adequate. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. The number of water quality sampling stations (four) will be increased to include a settling pond for treating runoff from overburden dumps, upstream and downstream of Rehar river and a well/hand pump in the colony. Thus, there will be eight water quality monitoring stations after 1995. Quarterly water level measurements will be taken from one domestic well in colony and from a well in Keshav nagar village. The current noise monitoring programme at four stations is considered adequate.

Hydrology and water quality management

Approximately 7km of garland drains will be constructed by 1996-97 to collect runoff from the outer slopes of the external overburden dump and convey it to a new settling pond. Runoff from the CHP, HEMM and vehicle washings will also be conveyed to another settling pond after initial treatment to remove grease and oil.

Air quality and noise management

The water spraying system at the CHP will be made fully operational. This together with the present water spraying arrangement by tankers on haul roads etc., appears adequate. In addition, 100,000 trees will be planted during next five years, at a rate of 20,000 trees per year, along road sides and infrastructural areas. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in fiscal year 1997-98.

Disturbed land reclamation

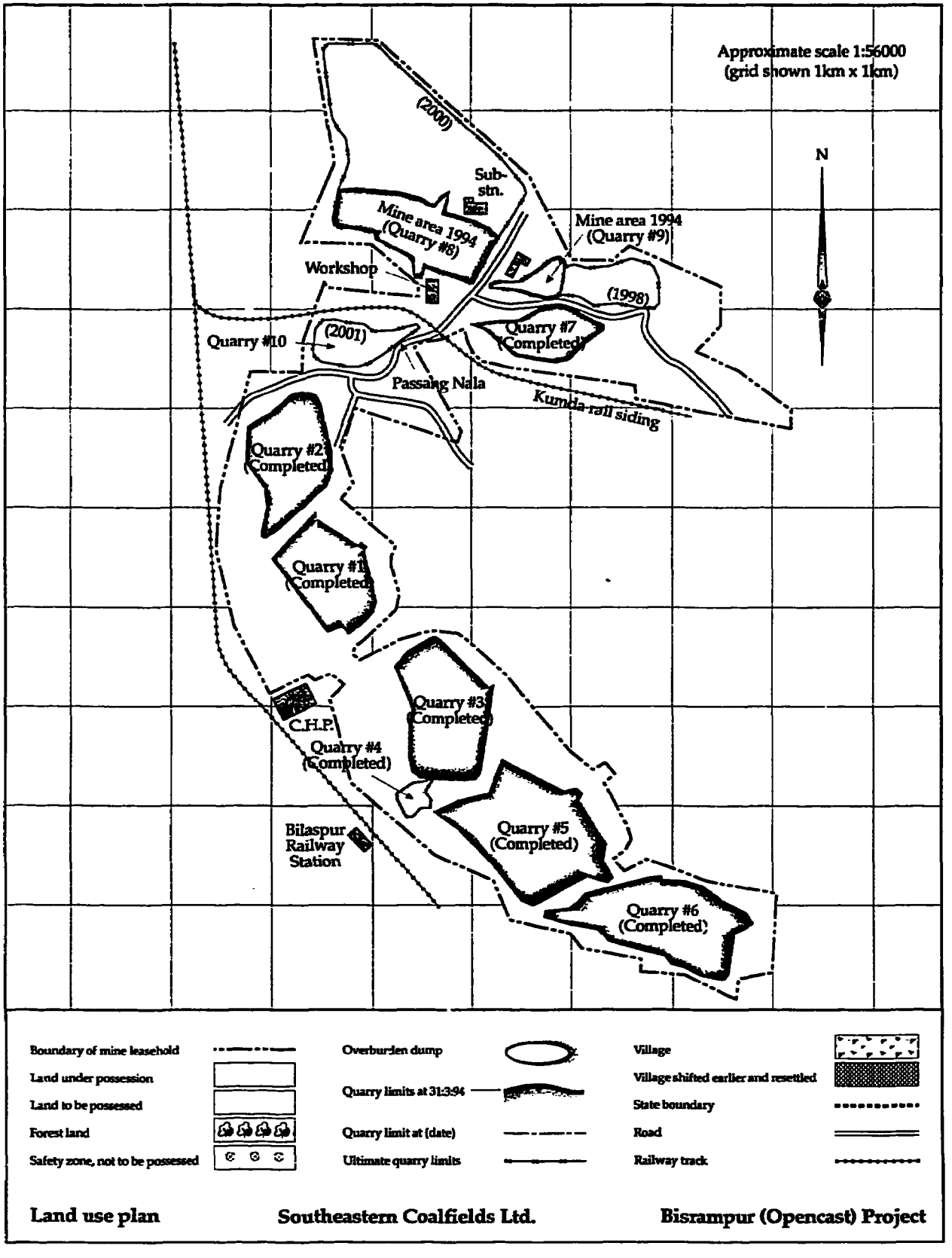
The current backlog of external overburden is 538ha. The backlog will be reclaimed at a rate of 158ha in 1995-96, 100ha in 1996-97, 100ha in 1997-98, 100ha in 1998-99, and 80ha in 1999-2000. In addition to this, during 1995-96 to 1999-2000, an additional area of 208ha in the backfilled pit will be available, giving a total of 208ha, 150ha, 150ha, 150ha, 120ha for reclamation during these 5 years. At an average cost per hectare of Rs21,600 for resloping, Rs21,600 for grass and legume seeding and Rs.52,400 (including maintenance cost) for tree planting, the annual reclamation cost for these five years would be Rs19.88, 14.34, 14.34, 14.34 and 11.47 million, respectively.

Five year annual budget summary - Bisrampur

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.92	0.00	1.00	0.00	1.11	0.00	1.22	0.00	1.34
Air quality & noise	0.91	1.76	0.41	1.94	1.41	2.13	2.91	2.83	1.41	3.07
Water quality	2.02	0.00	0.11	0.22	0.00	0.33	0.00	0.33	0.00	0.33
Land reclamation	19.88	0.00	14.34	0.00	14.34	0.00	14.34	0.00	11.47	0.00
Total	22.81	2.68	14.86	3.16	15.75	3.57	17.25	4.38	12.88	4.74

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Bisrampur (Opencast) Project**

DHANPURI
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Dhanpuri
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Sohagpur
Year of sanction:	1979
Operational startup:	1979
Type of mine:	Opencast
Mining method:	Dragline/Truck & shovel
Current production:	1.10 million tonnes
Capacity:	1.25 million tonnes
Mine life:	32 years
Residual life:	17 years
Number of coal seams:	1 (Thickness: averages 7.5m)
Ash content:	17-23%
Strip ratio:	4.1:1
Max. quarry depth:	70m
Coal destination:	MPEB (Amarkantak TPS) and local industrial consumers

Current environmental status

Environmental setting

Dhanpuri opencast mine is situated on gently undulating terrain which slopes in a southwesterly direction towards Baghaiya nallah, approximately 1.6km from the mine boundary. The workers' colony is situated about 5km from the mine site, whereas the resettlement colony at Silpari village is about 2km from the northern boundary of the mine. In addition, two villages, Deohara and Dhirol, are located to the southern side of the mine area but outside the leasehold, about 4km from the active mining area. Prior to mining, the leasehold area was 1122ha. Out of this, 376.1ha of land had been transferred to Amlai project. The balance 746ha consisted of 170ha of dry agricultural land, 44.1ha of irrigated agricultural land, 12.8ha village land, 6.5ha water bodies and 512.6ha of forest and shrub land used for rough grazing and fuel wood production.

Baseline data

No baseline data is available for this project as it predates the environmental legislation.

Mine planning and design

The project has a nearly flat seam which dips at 1 in 16 in a northerly direction from Baghaiya Nallah. The project is designed for maximum backfill. The initial surface cut and external overburden dumps were undertaken during 1979, entirely by dumper and shovel operation. The project acquired a 10/70 dragline in 1987 and deployed it for overburden excavation and pit backfill until 1989. The second dragline (20/90) was acquired by the project in 1989. To date, the two draglines have been working on overburden excavation and backfilling. Coal production is currently hauled by dumpers about 5km to the rail head where wagon loading facilities are available. The area of leasehold occupied by mine facilities to the end of the current 5 year plan and anticipated to the total 32 years mine life are as follows:

Leasehold area - Dhanpuri
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	36.9	156.5	26.0	24.8	43.8	458.0	746.0
Life	36.9	416.5	30.0	24.8	43.8	194.0	746.0

Project monitoring, auditing and evaluation

Regular environmental monitoring has been carried out since the winter season of 1991. Air quality readings are taken at five stations - around mine time keeper's office, the workshop, CHP, residential colony and nearby Deohara village. Water quality monitoring is done at five stations - mine discharge point, upstream and down stream of Baghaiya nallah, the residential colony and at a well of Deohara village. In addition to this, water levels are also taken at a well in Deohara village. Noise readings at five stations are taken day and night around CHP, project office, workshop, overburden dump area and Deohara village.

Hydrology and water quality management

Mine water is collected in mine sumps of the pit area. Discharge from the final pit sump has regularly been in compliance with discharge standards. The garland drain and settling ponds have not yet been constructed to control and treat runoff from the external overburden dumps. The coal handling plant, workshop and vehicle washing areas have, as yet, no waste water treatment facilities.

Air quality and noise management

Suspended particulate matter levels around the mine quarry have regularly been in compliance with maximum allowable objective for industrial areas of 500µg/m³. Air quality at the mine timekeeper's office, around the workshop, CHP, residential colony and nearby Deohara village is regularly in compliance with the appropriate standards in all seasons. Day time and night time noise levels around CHP, project office, workshop, overburden dump area and Deohara village are regularly in compliance with standards.

Disturbed land reclamation

The total area of external dumps is 36.9ha of which 12.4ha resulted from initial dumper/shovel operation and 24.5ha from dragline operation. External dumps formed by shovel and dumper have outer slopes of 50°-70° and heights from 20-25m to 30-40m for those created by dragline. Dump materials consist of a mixture of rock and sandy silts. Extensive tree planting has been done on external and internal overburden dumps with the help of Madhya Pradesh State Forest Research Institute and Madhya Pradesh State Forest Development Corporation. To date, about 500,000 saplings on about 200ha of external and internal overburden dumps have been planted. Survival rate is quite satisfactory.

Regional cumulative environmental impacts

No other industry is located nearby. Hence, regional cumulative environmental impact is not envisaged.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

The present five air quality monitoring stations are considerd adequate. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. One more water quality sampling station will be added bringing the total to six, to include discharges from the new settling pond treating runoff from overburden and mine facilities areas. Present noise monitoring programmes at five stations are considered adequate.

Hydrology and water quality management

Two settling tanks will be constructed during 1996-97 for treatment of mine discharge. Approximately 2km of garland drains will be constructed in 1995-96 to collect runoff from the outer slopes of the external overburden

dumps and convey it to a new settling pond. Runoff from the CHP, HEMM and vehicle washing areas will also be conveyed to another settling pond after initial treatment to remove grease and oil.

Air quality and noise management

Two new watering trucks will be acquired, one in 1995-96 and the other in 1996-97. In addition, 100,000 trees will be planted during the next five years, at the rate of 20,000 trees per year, along road sides and infrastructural areas. Results will be monitored carefully and if the improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in fiscal year 1997-98. As ambient noise levels are within standards, no remedial measures are called for.

Disturbed land reclamation

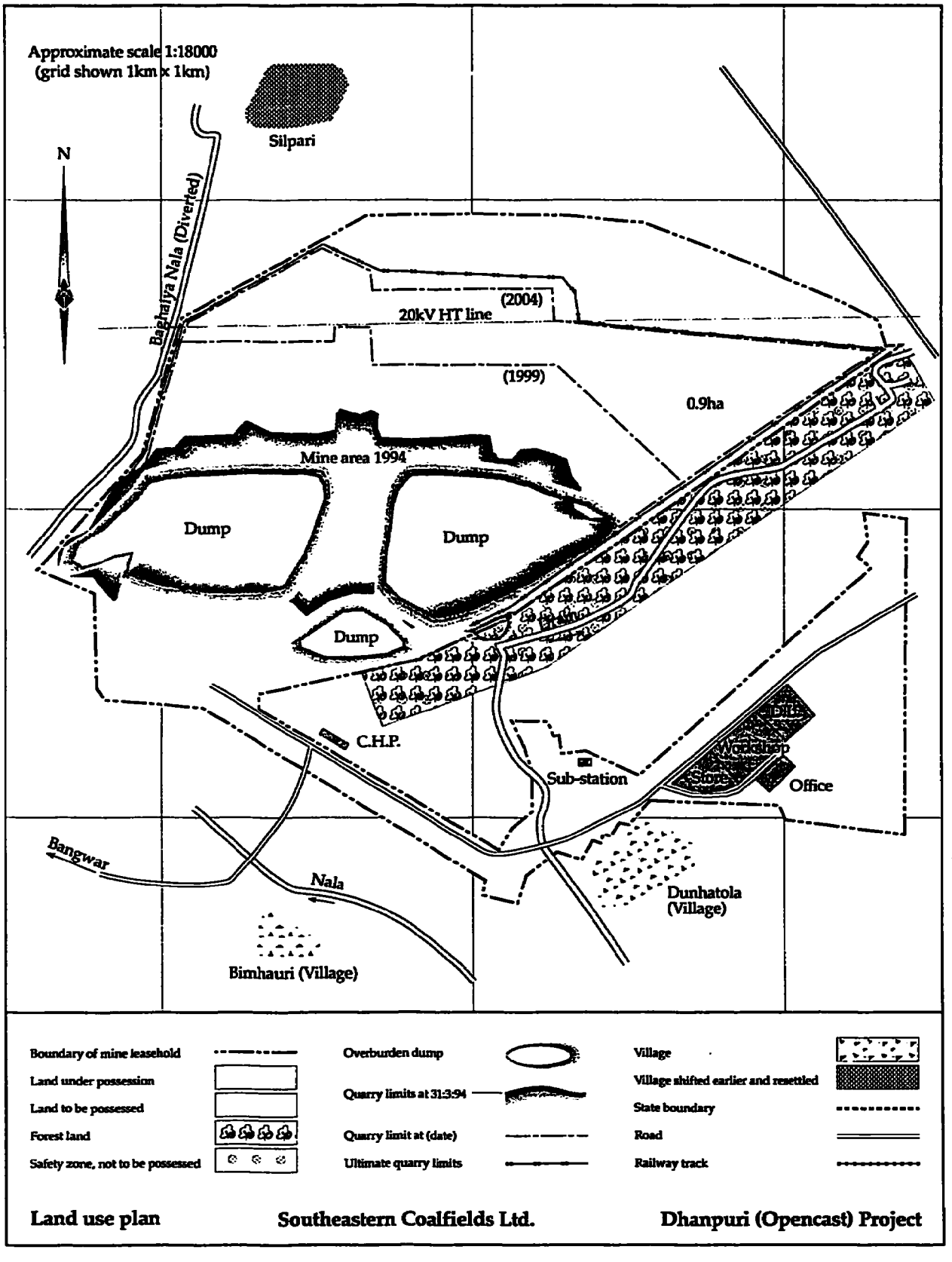
Biological reclamation has been done on existing overburden dumps. Results achieved are encouraging. However, resloping/recontouring and reclamation of internal and external overburden dumps will be done by a suitable agency. Tree planting with grass and legume seeding will be done through Madhya Pradesh State Forest Development Corporation. The current backlog of inactive disturbed areas is 20ha (to December 1994). An engineering study is proposed to be conducted for slope stability of these overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the study, if required, these dumps may be resloped to stable angle by rehandling. Overburden, if found suitable, will be taken up for biological reclamation.

Five year annual budget summary - Dhanpuri

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	1.11	0.00	1.22	0.00	1.34	0.00	1.47	0.00	1.62
Air quality & noise	2.91	0.68	2.91	1.37	1.41	1.37	2.91	1.75	1.41	1.95
Water quality	3.00	0.10	1.32	0.10	0.00	0.28	0.00	0.28	0.00	0.28
Land reclamation	0.00	2.10	0.00	2.10	0.00	1.15	0.00	1.15	0.00	1.15
Total	5.91	3.99	4.23	4.79	1.41	4.14	2.91	4.65	1.41	5.00

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Dhanpuri (Opencast) Project**

DIPKA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Dipka
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Korba
Year of sanction:	1985
Operational startup:	1987
Type of mine:	Opencast
Mining method:	Truck & Shovel
Current production:	3.5 million tonnes
Capacity:	10 million tonnes
Mine life:	120 years at 3.0 million tonnes
Residual life:	103 years at 3.0 million tonnes
Number of coal seams:	1 (Thickness: 58.2-68.3m)
Ash content:	30.8-45.1%
Strip ratio:	0.96:1
Max. quarry depth:	140m
Coal destination:	BALCO, BSEB, MPEB

Current environmental status

Environmental setting

Dipka opencast mine is situated on a flat terrain which slopes very gently in a southeasterly direction to the Lilagar river about 1 to 3km from the mine boundary. Two rehabilitation villages are in the process of establishment on the north side of the mine at a distance of 2.5km from the active mine area and one rehabilitation village (Nehru nagar) has been established about 3km northeast from the northern mine boundary. Prior to mining, the leasehold area of 1744.5ha consisted of 1234ha dry agriculture land, 154ha non agricultural land, 0.4ha Government waste land, 205ha land for grazing and miscellaneous use and 147ha forest land used for rough grazing and fuel wood production.

Baseline data

No baseline data is available for this project as its sanction predates the environmental legislation.

Mine planning and design

The coal seam dips gently in a southeasterly direction towards Lilagar river. The mine is designed for maximum backfill. From the beginning, a shovel

and dumper combination has being used for the initial surface cut and external overburden dumps. Coal production is currently by shovel and dumper combination and transported by tippers about 8km to the Gevra project CHP for loading and dispatch to NTPC and BALCO. Areas of leasehold occupied by the mine facilities to the end of current five years (1995-96 to 1999-2000) and the anticipated total 48 years mine life are as follows:

Leasehold area - Dipka
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	144.0	47.0	148.0	66.8	26.0	1,312.7	1,744.5
Life	191.0	440.0	117.0	165.8	26.0	804.7	1,744.5

Project monitoring, auditing and evaluation

Regular environmental monitoring was started in the pre-monsoon season of 1992. Air quality readings are taken adjacent to the mine, at the office and in the workers colony. Water quality stations are at the mine discharge point, colony water taps and wells in the nearby villages. Noise readings are taken during day and night at the workshop and quarry once in a quarter.

Hydrology and water quality management

The mine water is allowed to settle in a large sump in the pit itself. The positive discharge to the natural course (Lilagar river) takes place only during heavy monsoon. However, it always complies with Govt. of India discharge standards. Garland drains and settling ponds have not yet been constructed to control the runoff from the external overburden dumps. The workshop and vehicle washing areas have, as yet, no waste water treatment facilities.

Air quality and noise management

Suspended particulate levels in the mine quarry occasionally exceed the maximum allowable objective for industrial areas of 500µg/m^3. Air quality at the mine office and worker colonies is regularly in compliance with the appropriate standards in all seasons, but during pre-monsoon season periodic excursions do occur. Day time and night time noise levels around the HEMM workshop and quarry are regularly in compliance with the standards.

Disturbed land reclamation

The total area of external dumps is 52ha. External dumps have outside slopes of 35°-40° and heights up to 15-20m. Dump materials consist of black cotton soil and soft friable sand stone. Land reclamation is yet to start in this mine as neither inactive external overburden dump nor backfilled area is available for reclamation.

Regional cumulative environmental impacts

Air quality impacts from a number of industrial operations in the Korba field, particularly coal mining and power generation, now necessitate a regional approach to monitoring and management.

Environmental management programmes 1995-96 to 1999-2000

The three air quality monitoring stations appear to be adequate. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality sampling stations will be increased to include the discharge point of a settling tank under construction, the proposed settling pond for treating runoff from overburden dumps, upstream and downstream of Lilagar river and well/hand pumps of the colony. Water level will be taken from one well in the colony and another in a nearby village. The current noise monitoring programme is considered adequate.

Hydrology and water quality management

Approximately 4km of garland drain will be constructed in 1996 to collect runoff from the outer slopes of the external overburden dumps and convey it to a new settling pond. Runoff from the HEMM and vehicle washing area will also be conveyed to a new settling pond after initial treatment to remove grease and oil. This settling pond will be designed to have no positive discharge except during the peak of monsoon season.

Air quality and noise management

Three water tankers are in use for water spraying on haul roads. One more water tanker will be added in 1995-96 and will be used for further strengthening of water spraying on haul roads. About 100,000 trees will be planted along the coal transport road, around colony and infrastructure during 1995-96 to 1999-2000 for air quality improvement and to act as noise barriers. Results will be monitored carefully and if improvements are insufficient chemical retardants and fixed spraying system in specific working area will be

contemplated in the fiscal year 1997-98. Periodic noise problems in the workshop will be dealt with by requiring exposed workers to wear hearing protection.

Disturbed land reclamation

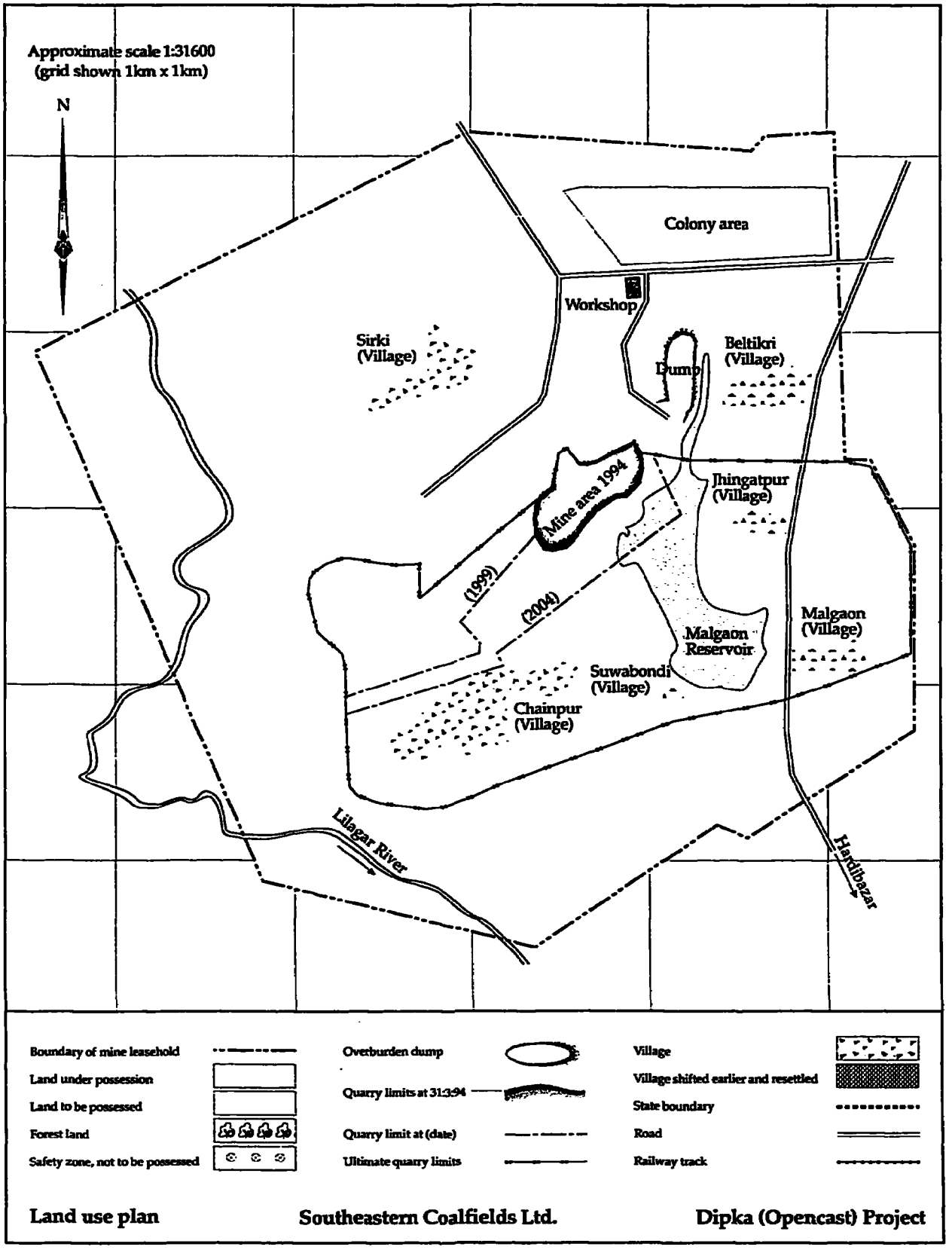
An engineering study is proposed to be conducted for slope stability of the overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the study, if required, these dumps may be resloped to stable angles by rehandling. Overburden, if found stable, will be taken up for biological reclamation. So far, no biological reclamation has been done on existing overburden dump. However, resloping and recontouring of external overburden dumps will commence from 1997-98, if necessary by engaging a suitable agency. Tree planting with grass and legume seeding will be done through M.P. State Forest Development Corporation. The current backlog of inactive external overburden dump as well as internal overburden dump is 52ha.

Five year annual budget summary - Dipka

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.71	0.00	0.78	0.00	0.86	0.00	0.94	0.00	1.04
Air quality & noise	2.91	1.18	0.41	1.30	1.41	1.43	2.91	1.96	1.41	2.15
Water quality	0.00	0.00	1.38	0.00	0.00	0.24	0.00	0.26	0.00	0.29
Land reclamation	0.00	2.96	0.00	2.96	0.00	2.96	0.00	2.96	0.00	2.96
Total	2.91	4.85	1.79	5.04	1.41	5.49	2.91	6.12	1.41	6.44

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.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(grid shown 1km x 1km)
N
Colony area
Workshop
Sirki
(Village)
Dump
Beltikri
(Village)
Mine area 1994
Jhingatpur
(Village)
(1999)
(2004)
Malgaon
Reservoir
Malgaon
(Village)
Suwabondi
(Village)
Chainpur
(Village)
Lilagar River
Handibazar
Boundary of mine leasehold
Land under possession
Land to be possessed
Forest land
Safety zone, not to be possessed
Overburden dump
Quarry limits at 31:3:94
Quarry limit at (date)
Ultimate quarry limits
Village
Village shifted earlier and resettled
State boundary
Road
Railway track
Land use plan
Southeastern Coalfields Ltd.
Dipka (Opencast) Project

GEVRA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Gevra
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Korba
Year of sanction:	1981
Operational startup:	1985
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	13.3 million tonnes
Capacity:	10.0 million tonnes
Mine life:	62 years
Residual life:	40 years
Number of coal seams:	2 (Thickness: 25-29m & 37-69m)
Ash content:	35-40m
Strip ratio:	0.98:1 to 1.5:1
Max. quarry depth:	180m
Coal destination:	NTPC, Korba, Western India power houses and local consumers

Current environmental status

Environmental setting

Gevra mine is situated on flat terrain which slopes very gently in a southeasterly direction towards the Laxman nallah, approximately 500m away from the mine leasehold. Three rehabilitated villages are located on the north side about 3-4km from the active mine area. Prior to mining the leasehold was 2945.6ha. Out of this 193.2ha has been recently transferred to the Dipka project. The remaining 2752.4ha consisted of 1008ha agricultural land, 800ha land occupied by villages and ponds, 599.4ha barren field/streams, public road and 345ha forest land used for rough grazing.

Baseline data

No base data is available for this project as it predates the environmental legislation.

Mine planning and design

The seam dips gently at 1:6 to 1:12 in a southeasterly direction towards Laxman nallah. The mine is designed for maximum backfill. Overburden excavation and coal winning are done by shovel and dumper. Coal production is cur-

rently transported by dumper 1-4km to feeder breaker and CHP for despatch to NTPC and other consumers by rail. The area of the leasehold occupied by the mine facilities to the end of current five year plan and anticipated to the total mine life of 62 years are as follows:

Leasehold area -.Gevra
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	223.0	111.0	545.4	356.0	134.0	1,383.0	2,752.4
Life	613.0	1,012.0	337.4	400.0	160.0	230.0	2,752.4

Project monitoring, auditing and evaluation

Evironmental monitoring was started in the pre-monsoon season of 1992. Three air quality stations are around the mine, residential colony and Vijay nagar village. Six water quality stations are at the mine sump, mine discharge point, two colony water taps, CHP discharge point, and at Vijay Nagar village well. Noise readings are taken day and night at three stations: around the workshop, at the CHP and in the colony.

Hydrology and water quality management

The mine water is allowed to settle in the large sump inside the pit itself. The positive discharge from the mine to the natural source (Laxman Nallah) takes place only during heavy monsoon and always complies with the standards. Garland drains and settling ponds have not yet been constructed to control runoff from external dumps. The CHP, workshop and vehicle washing areashave waste water treatment facilities. This water, after settling and initial treatment for grease and oil, is released out through pucca drain.

Air quality and noise management

Suspended particulate levels in the mine quarry occasionally exceed the maximum allowable objective for industrial areas of 500µg/m^3. Air quality at the mine office and residential colony is regularly in compliance with appropriate standards in all seasons except in pre-monsoon seasons when periodic excursions occur. Noise level readings are regularly in compliance with the standard.

Disturbed land reclamation

External overburden dump is about 203ha up to 1994, having outer slopes of 35° to 40° and heights from 20m to 40m Dump materials consist of black cotton soil and loose friable sand stone. Land reclamation was started in this mine in 1989. Sufficient tree planting has been carried out, the survival of which is considered satisfactory.

Regional cumulative environmental impacts

Air quality impacts from a number of industrial operations in the Korba field, particularly coal mining and power generation now necessitate a regional approach to monitoring and management of environmental ingredients.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

The present level of air monitoring at three stations is adequate. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. In 1995-96 four additional water sampling stations will be established (the well at the colony and Vijaynagar village and upstream and downstream of Laxman nallah). Water level in the well of the colony and Vijaynagar village will also be measured. The total number of water sampling stations will be ten.

Hydrology and water quality management

In 1995-96 and 1996-97 approximately 4km of garland drains will be constructed to collect runoff water from the outer slope of the external overburden dumps and convey it to a settling pond to be constructed.

Air quality and noise management

Nine water tankers fitted with spraying arrangements are being regularly used for haul road water spraying. Water spraying arrangements at the CHP and feeder breakers for dust suppression are considered adequate. In addition, 100,000 trees will be planted during the next five years at the rate of 20,000 trees per year along road sides and infrastructural areas. Results will be monitored carefully. If improvement is required, chemical retardents and fixed spraying system in specific working,areas will be installed in fiscal year 1997-98.

Disturbed land reclamation

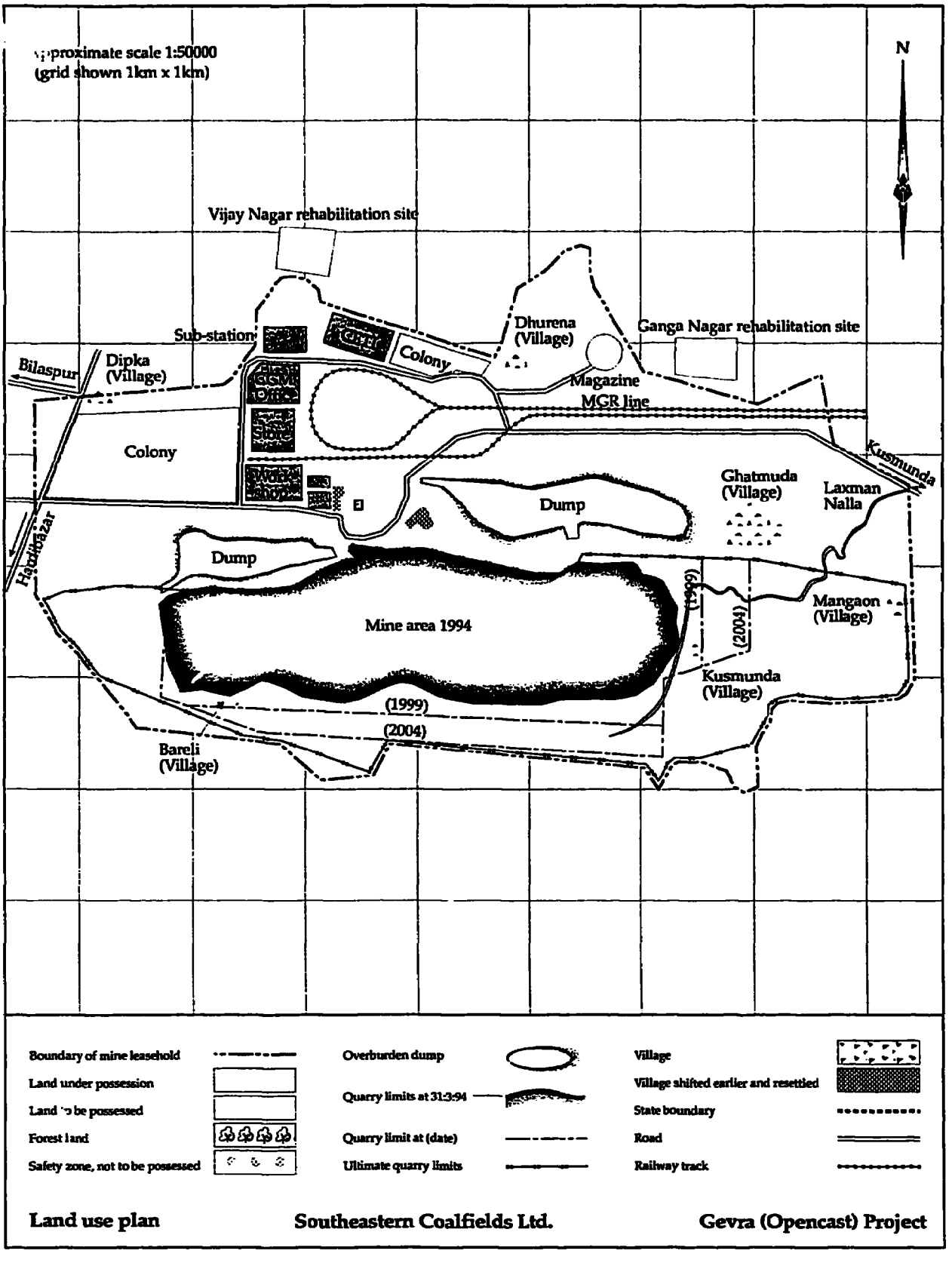
So far, biological reclamation has been done on existing overburden dumps. The result achieved is encouraging. However, an engineering study is proposed to be conducted for slope stability of these overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the study, if required, these dumps may be resloped to stable angles by rehandling. Overburden, if found stable, will be developed by biological reclamation. Tree planting with grass and legume seeding will be done by Madhya Pradesh State Forest Development Corporation.

Five year annual budget summary - Gevra

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.73	0.00	0.80	0.00	0.88	0.00	0.97	0.00	1.06
Air quality & noise	0.43	2.99	0.43	2.99	6.43	3.37	1.43	3.37	1.43	3.37
Water quality	0.66	0.07	0.06	0.18	0.00	0.19	0.00	0.21	0.00	0.23
Land reclamation	0.00	3.06	0.00	3.06	0.00	3.06	0.00	3.06	0.00	3.06
Total	1.09	6.85	0.49	7.03	6.43	7.50	1.43	7.61	1.43	7.72

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Gevra (Opencast) Project**

KUSMUNDA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Kusmunda
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Korba
Year of sanction:	1978
Operational startup:	1979
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	6.0 million tonnes
Capacity:	6.0 million tonnes
Mine life:	72 years
Residual life:	56 years
Number of coal seams:	2 (**Thickness:** 10-25m & 10-36m)
Ash content:	30-35% **Strip ratio:** 1.4:1
Max. quarry depth:	175m
Coal destination:	Korba thermal power station.

Current environmental status

Environmental setting

The Kusmunda mine has flat to gently undulating terrain. It lies approximately 0.5km west of the Hasdeo River. away. Staff and resettlement colonies lie about 2km to the north of the mining area. In addition, four villages (Gevra Basti, Barpali, Barkuta and Dullapur) are located to the south and southeast of the mine area, approximately 2-3km away from the active mining area. The mining activities are likely to approach these villages only after 15 years. Prior to mining the leasehold area of 1544ha consisted of 969ha dry and irrigated agricultural land and 575ha of Government waste land.

Baseline data

No baseline data is available for this project because it pre-dates environmental legislation.

Mine planning and design

The surface cut and external overburden dumps commenced in 1978 and will continue throughout the life of the mine by truck and shovel operation. Coal is won by shovel and dumper combination. Coal production is currently hauled by trucks 5-6km via haul roads to two coal handling plants for loading into railway wagons and on the belts transporting coal to MPEB. The Kusmunda

project is designed for approximately 50% external dump and 50% backfill. Areas of leasehold occupied by mine facilities to the end of the current five year plan and anticipated to the total 72 year mine life are as follows:

Leasehold Area - Kusmunda
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	172	93	402	207	73	597	1,544
Life	400	237	258	245	73	331	1,544

Project monitoring, auditing and evaluation

Environmental monitoring has been carried out since the winter season of 1992. Air quality readings are taken at four stations: around the active pit quarry, at the resettlement/workers' colony, at the CHP and at the workshop. Six water quality stations are at the mine sump, settling tank, raw water supplied to filter plant, drinking water from filter plant, colony well and at Gevra Basti well. Noise readings are taken day and night at four stations: at the workshop, quarry, coal handling plant and colony.

Hydrology and water quality management

Mine water is collected in a series of ponds in the pit area. Positive discharge from the final pit sump occurs only during the peak of monsoon and has regularly been in compliance with discharge standards. Garland drains are constructed around the external dumps and are cleaned every year before onset of monsoon. However, settling ponds have not yet been constructed to control and treat run-off from the external overburden dumps. The coal handling plant, workshop and vehicle washing areas have been provided with waste water treatment facilities.

Air quality and noise management

Suspended particulate levels in the quarry exceed the maximum allowable objective for industrial areas (500$\mu g/m^3$). Air quality at the CHP and worker/resettlement colonies is in compliance with the appropriate standards in all seasons except pre-monsoon season when periodic excursions do occur. Day time and night time noise levels around the CHP occasionally exceed the limit for industrial areas. Noise levels in the quarry, HEMM workshop and colony areas are in compliance with standards.

Disturbed land reclamation

The total area of external overburden dumps to date is 148ha (75ha inactive and 73ha active dumps). External dumps have outer slopes of 35° to 40° and heights varying from 45-50m. Dump material consists of a mixture of rock and friable sandy loam soil. Extensive tree planting has been done on external overburden dumps. However, except for the flat dump tops, there has been only 50% survival on these steeply sloping, coarse textured erodible spoils.

Regional cumulative environmental impacts

Air quality impacts from a number of industrial operations in the Korba field, particularly coal mining and power generation, now necessitates a regional approach to monitoring and management of environmental ingredients.

Environmental management programmes 1995-1996 to 1999-2000

Project monitoring, auditing and evaluation

The existing four air monitoring stations are considered adequate. As for the frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. Three more water quality sampling stations will be added to include a discharge point at a new settling pond where run-off water from external overburden dumps is to be collected and the ambient stations on the upstream and downstream of Hasdeo River. In all, there will be nine water quality monitoring stations. Quarterly measurement of the water level in a well at Gevra Basti will be taken. Current noise level monitoring at three stations is considered adequate.

Hydrology and water quality management

Approximately 2.5km of garland drains in 1995-96, 1.5km in 1996-97, 1km in 1997-98, 1km in 1998-99 and 1km in 1999-2000 will be constructed to collect runoff from the outer slopes of the external overburden dumps and convey it to the four new settling ponds. Two settling ponds will be constructed in 1995-96 and two in 1996-97.

Air quality and noise management

About 100,000 trees will be planted along the coal transport road and around the colony and infrastructure during 1995-96 to 1999-2000 for air quality improvement and to act as a noise barrier. Results will be monitored care-

fully and if improvements are insufficient, in specific working areas, chemical retardants will be contemplated in fiscal year 1997-98.

Disturbed land reclamation

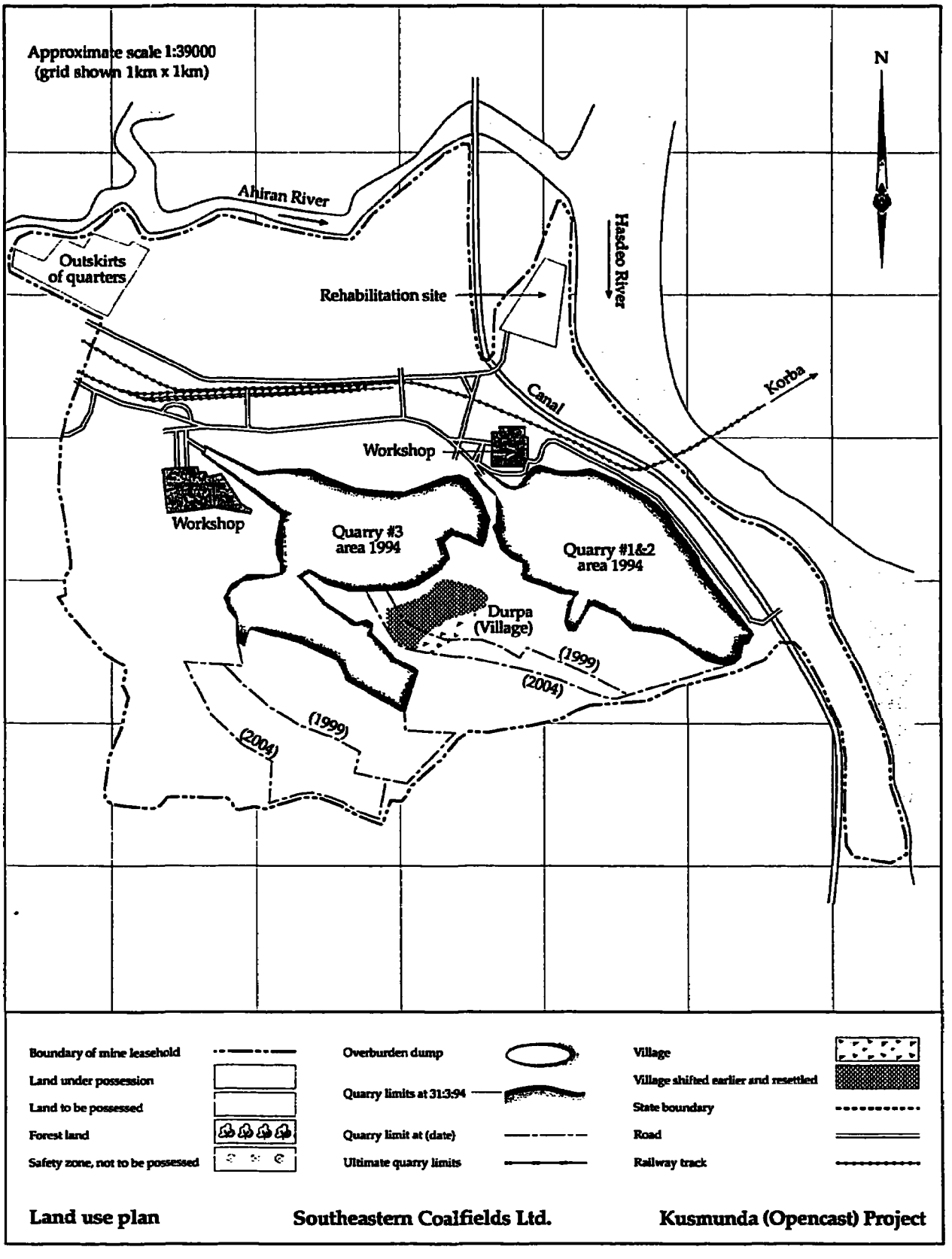
An engineering study is proposed to be conducted for slope stability of the overburden dumps during 1995-96 and 1996-97. Depending on the outcome of the study, if required, these dumps may be resloped to stable angle by rehandling. Overburden, if found stable, will be developed by biological reclamation. A programme will be made for reclamation of old dumps on the basis of the study report. Reclamation of internal dumps will continue.

Five year annual budget summary - Kusmunda

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.93	0.00	1.02	0.00	1.12	0.00	1.23	0.00	1.36
Air quality & noise	3.40	1.38	0.40	1.33	1.40	1.04	2.90	1.36	1.40	1.36
Water quality	1.28	0.00	1.25	0.13	0.03	0.22	0.03	0.25	0.03	0.28
Land reclamation	0.00	0.28	0.00	6.19	0.00	3.66	0.00	1.43	0.00	4.30
Total	4.68	2.59	1.65	8.67	1.43	6.04	2.93	4.27	1.43	7.30

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Kusmunda (Opencast) Project**

MANIKPUR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Manikpur
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Korba
Year of sanction:	1978
Operational startup:	1978
Type of mine:	Opencast
Mining method:	Truck & shovel
Current production:	1.94 million tonnes
Capacity:	1.24 million tonnes
Mine life:	35 years
Residual life:	18 years
Number of coal seams:	1 (Thickness: 23.7-27.9m)
Ash content:	40%
Strip ratio:	2:1
Max. quarry depth:	82m
Coal destination:	MPEB, Korba West Bank TPS

Current environmental status

Environmental setting

The Manikpur mine is situated on a gently undulating terrain with elevations ranging between 270m and 290m above sea level. Rapakhara nallah and Kachandi nallah flow northeast to west over the coal bearing area of this block and ultimately meet the Hasdeo river, which is adjacent to the mining lease area and is a perennial tributary of Mahanadi river flowing north to south, forming the main drainage outlet of the region. A residential colony is situated 2km from the active mine area but within the mining leasehold. The nearest village is Dadar, situated to the northeast, outside the mining lease area. Prior to mining, the leasehold area of 1651.8ha consisted of 883.7ha agricultural land, 107.6ha Government land, 22ha of home sites, 25.2ha of water bodies and 613.3ha of degraded and shrub land used for rough grazing and fuel wood production.

Baseline data

No baseline data is available for this project because it pre-dates the environmental legislation.

Mine planning and design

The mine is situated on the southern part of Korba coalfields, which contains predominantly argillaceous rocks interspersed with thick coal horizons. The mine was initially designed for a rated output of 1.0 million tonnes per annum and started in 1966. In June 1976, a feasibility report for the Manikpur expansion project was prepared; it was approved by Government of India in December 1978 for a rated output of 2.0 million tonnes per annum. The mine was developed as four separate pits because of faults and a major railway line. Overburden and coal are removed by shovel and dumper combination, since the start of the mine. Maximum backfilling in the project is envisaged. Coal is currently hauled by truck about 4km to a rail head situated within the mining lease area. Areas of leasehold that will be occupied by mine facilities to the end of current five year (1995-96 to 1999-2000) and anticipated to the total 45 years mine life are as follows:

Leasehold area - Manikpur
(All figures in hectares)

	External dumps	*Pit backfill*	*Pit void*	*Infra-structure*	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	134.0	28.0	244.0	271.1	25.0	949.7	1,651.8
Life	186.0	242.0	44.0	271.1	25.0	883.7	1,651.8

Project monitoring, auditing and evaluation

Environmental monitoring was started in the winter season of 1994. Air quality readings are taken at three stations: adjacent to the main haul road near the power sub station, in the active pit quarry near the pit office, and in the residential colony. Water quality is monitored at the mine sump and its discharge point. Noise readings are taken day and night at two stations: the pit office adjacent to the main haul road and residential colony.

Hydrology and water quality management

Mine water is collected in mine sumps. Positive discharge from sump occurs during the monsoon and has regularly been in compliance with discharge standards. Out of a total of 15,800m of garland drains, 1,215m around overburden dumps, 3,300m around the quarry and 5,000m on the sides of haul roads have been constructed to control runoff. In addition, 4km of garland drains around back fill area have been constructed. Settling ponds have not yet been constructed to control and treat runoff from the external overburden dumps. The coal handling plant, workshop and vehicle washing areas have, as yet, no waste water treatment facilities.

Air quality and noise management

Suspended particulate matter in the mine quarry exceeds the standards of 500µg/m³. Noise levels around the quarry and residential colony areas are in compliance with the standards.

Disturbed land reclamation

The total area of external overburden dumps is 186ha with outer slopes of 35°-40° and maximum heights of 35m. Dump materials consist of a mixture of sand stone and friable sandy soil. External overburden dumps are being planted with trees with the technical support of Madhya Pradesh Forest Development Corporation. The survival rate is about 80% and the trees are growing well. These measures will continue and it is envisaged that all the external dumps will be re-sloped, sown with grasses and legumes and planted with trees and shrubs during the project mine life.

Regional cumulative environmental impacts

Air quality impacts from a number of industrial operations in the Korba field, particularly coal mining and power generation now necessitate a regional approach to monitoring and management of environmental ingredients.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

One air monitoring station will be established in addition to the three air and noise sampling stations at present. As for the frequency of air sampling, the samples will be drawn on a 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied after its notification. Five more water quality sampling stations will be included to take water samples from upstream and downstream of Kachandi nallah of all the mine discharges, the colony hand-pump and one well each at Rapakera and Dadar villages. Thus, there will be seven water quality monitoring stations in total. Quarterly water levels will be measured in one well each of the two villages. Current noise level monitoring at two stations is considered inadequate and one more point will be added.

Hydrology and water quality management

Approximately 6km of garland drains will be constructed in 1995-96 to collect runoff from external dumps, around the quarry and along the haul road and convey it to a settling pond. Runoff from the CHP, HEMM and vehicle wash-

ing areas will also be conveyed to a settling pond after initial treatment to remove grease and oil.

Air quality and noise management

Two tankers have been provided for spraying water on haul roads. Water spraying arrangements have also been made for dust suppression in and around the pit, CHP and plant working areas. About 100,000 trees will be planted along the coal transport road and around the colony and infrastructure during 1995-96 to 1999-2000 for air quality improvement and to act as noise barrier. Result will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying systems in specific working areas will be contemplated in fiscal year 1997-98. In addition to this, metalling of haul roads (2km per year) is planned every year up to 1999-2000.

Disturbed land reclamation

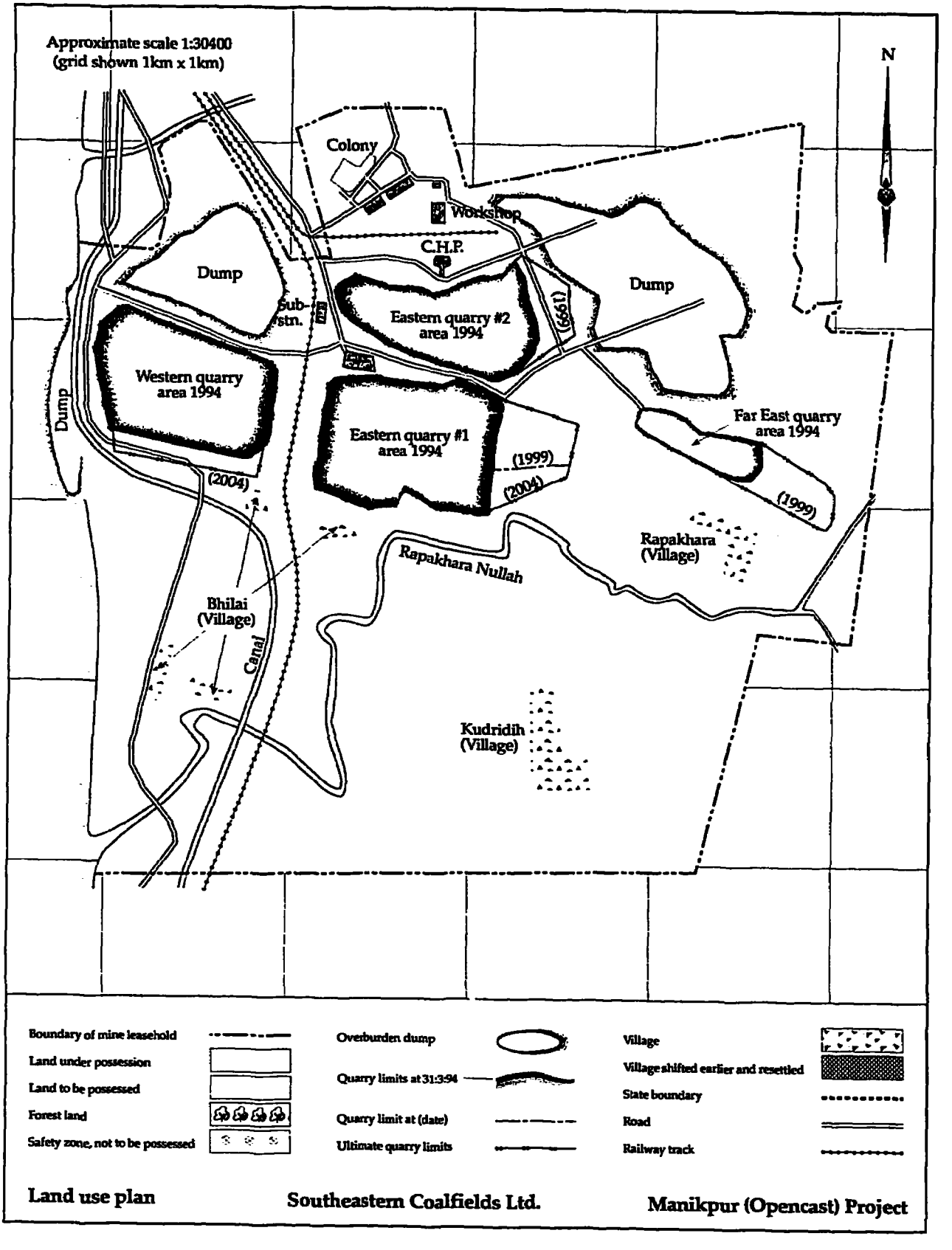
The current backlog of disturbed areas is 108.9ha which will be reclaimed at the rate of 43.5ha in 1995-96, 43.5ha in 1996-97, and 21.9ha in 1997-98. In addition, external dumps and backfilled areas created in the above years will be reclaimed simultaneously. Thus 55.2ha in 1995-96, 55.2ha in 1966-97, 33.3ha in 1977-98, 11.5ha in 1998-99 and 11.7ha in 1999-2000 will be reclaimed. Thereafter, 11.5ha created by production will be reclaimed every year till the end of mine life.

Five year annual budget summary - Manikpur

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.70	0.00	0.77	0.00	0.84	0.00	0.93	0.00	1.02
Air quality & noise	1.41	0.98	1.41	1.08	3.91	1.57	2.41	1.57	2.41	1.57
Water quality	4.53	0.00	0.00	0.40	0.00	0.44	0.00	0.48	0.00	0.53
Land reclamation	5.28	0.00	5.29	0.00	3.18	0.00	1.11	0.00	1.12	0.00
Total	11.22	1.68	6.70	2.25	7.09	2.85	3.52	2.98	3.53	3.12

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Manikpur (Opencast) Project**

BANGWAR
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Bangwar
Company:	SECL
Coalfield:	Sohagpur
State:	Madhya Pradesh
Year of sanction:	1985
Operational startup:	1987
Type of mine:	Underground
Mining method:	Bord & Pillar
Current production:	0.30 million tonnes
Capacity:	0.65 million tonnes
Mine life:	23 years
Residual life:	21 years
Number of coal seams:	3 (Thickness: 1.1-2.5m, 0.5-3.5m, 0.6-3.4m)
Ash content:	22.3%
Working depth:	16-137.8m
Coal destination:	Miscellaneous industrial consumers

Current environmental status

Environmental setting

Bangwar mine is situated on a gently undulating terrain which slopes in northerly direction to the Belha nallah approximately 20m from mine entry. A residential colony is about 2km from the mine. In addition, two villages - Bemhori and Bangwar - are located to the south of the mine area but outside the leasehold, each approximately 5 to 6km from the active mining area. Prior to mining, the leasehold area of 550ha consisted of 29.5ha of dry agricultural land, 513.3ha of forest and shrub land used for rough grazing and fuel wood production and 7.3ha of water bodies.

Baseline data

No baseline data is available for this project because its sanction predates the environmental legislation.

Mine planning and design

The project is an underground mine and has three coal seams, namely VII, VI top and VI bottom, dipping northerly towards Belha nallah. Coal winning is done by side discharge loaders and load haul dumpers and transport is effected with conveyor and rope haulages below ground and coal dispatch by railway.

Areas of leasehold occupied by mine facilities to the end of the current 5 year period (1995-96 to 1999-2000) and anticipated to the total 23 years of mine life are as under:

Leasehold area - Bangwar
(All figures in hectares)

	Infrastructure	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	29.5	17.1	453.4	550.0
Life	29.5	17.1	453.4	550.0

Project monitoring, auditing and evaluation

Environmental monitoring has been carried out since the winter season of 1991. Air quality readings are taken at five stations, i.e. around mine site office, fan house, mine canteen, residential colony and nearby Bemhori village. The water quality stations are at five stations, i.e. mine discharge point, upstream and downstream of Ghugara nallah, bore well of residential colony and well at Bemhori village. Water level of a well in Behmori village is also being observed. Noise readings are taken day and night at 5 stations i.e. workshop, CHP, Manager's office, residential colony and Bemhori village.

Hydrology and water quality management

Mine water is collected in large capacity sumps underground. Clear water from these sumps is pumped through the forest to natural water courses. Water quality has regularly been in compliance with discharge standards. The mini CHP and workshop have, as yet, no waste water treatment facilities.

Air quality and noise management

Suspended particulate matters around the mine premises is within the limits for Industrial areas, i.e. 500µg/m^3. Air quality parameters at all the reading stations are regularly in compliance with the appropriate standards. Day and night time noise levels are regularly in compliance with the standards. Extensive tree plantation has been done in and around the mine area, in the colony and both sides of the coal transportation road for the improvement of the environment in general.

Disturbed land reclamation

Land has not been disturbed due to subsidence, as depillaring operation has not yet been started.

Regional cumulative environmental impacts

There is no other industry in the area, so there is no regional cumulative environmental impact.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

The existing five air quality monitoring stations are considered adequate. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on the pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. Five existing water quality monitoring stations are considered adequate. Noise monitoring programmes at existing five stations are also considered adequate.

Hydrology and water quality management

As there is sumpage for mine water underground, the construction of settling tanks for mine discharge is not required. A settling pond will be constructed in 1996-97 to which effluents from CHP, workshop and vehicle washing area will be conveyed after initial treatment to remove grease and oil.

Air quality and noise management

One water sprinkler of 10kl capacity will be acquired during 1995-96 and will be used primarily along the internal coal transportation road and CHP. In addition, 100,000 trees will be planted during next 5 years at the rate of 20,000 trees per year, along road sides and infrastructural areas. Results will be monitored carefully and if improvements are insufficient, a fixed spraying system in specific working areas will be contemplated from the fiscal year 1997-98.

Disturbed land reclamation

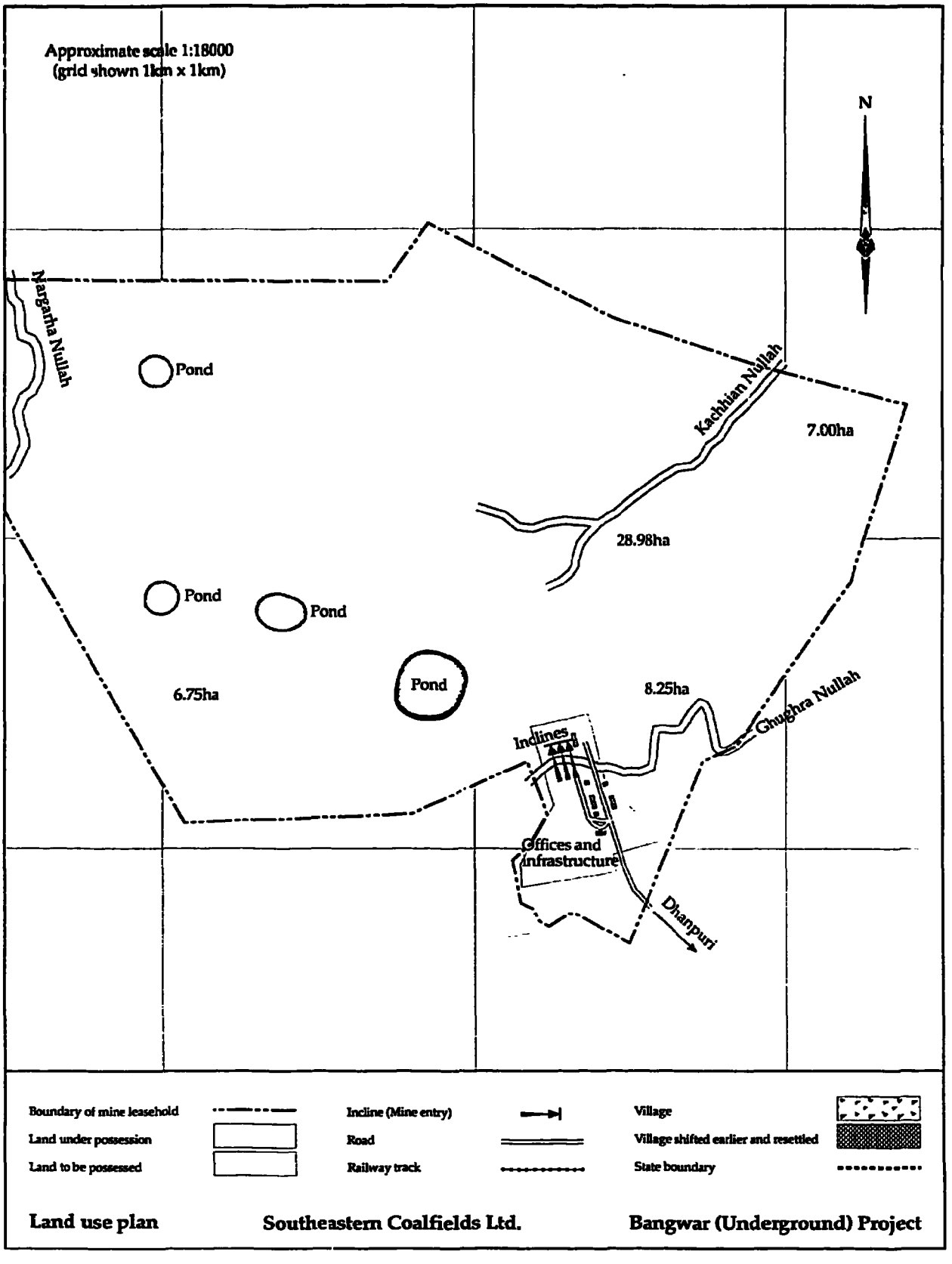
Land has not been disturbed due to subsidence, as depillaring operation has not yet been started. Subsidence will be monitored after the start of depillaring operations. Leveling and terracing will be done in subsidence troughs and tree planting will be done around these troughs. From 1997-98 onwards, 17ha of subsided land will become available per year which will be reclaimed at an average cost of Rs.30,000 per hectare for land restoration, greening and soil conservation etc.

Five year annual budget summary - Bangwar

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	1.10	0.00	1.21	0.00	1.33	0.00	1.46	0.00	1.60
Air quality & noise	1.01	0.50	0.41	0.55	0.61	0.99	0.41	1.13	0.41	1.25
Water quality	1.50	0.50	1.59	0.13	0.00	0.14	0.00	0.16	0.00	0.17
Land reclamation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	2.51	2.10	2.00	1.89	0.61	2.46	0.41	2.75	0.41	3.02

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Bangwar (Underground) Project**

BEHRABAND
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Behrabandh
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Hasdeo
Year of sanction:	1986 as pilot
Operational startup:	1993
Type of mine:	Underground
Mining method:	Bord & Pillar
Current production:	0.23 million tonnes
Maximum:	0.60 million tonnes
Mine life:	25 years
Residual life:	25 years
Number of coal seams:	1 (Thickness: 1.2-0.9)
Ash content:	18-22%
Working depth:	55-260m
Coal destination:	Coking coal for steel industry

Current environmental status

Environmental setting

The Behraband mine is situated on an undulating terrain which slopes very gently in southeast direction towards Kanhai river adjacent to the boundary of the mine. A residential colony is situated 5km in a southeasterly direction from the mine boundary. In addition to this, one established village named Benibahra is located to northeast about 3km away from the pit site. Prior to mining, the leasehold area of 600ha consisted of 179.5ha of village land, 186ha of agricultural land and 234.5ha of non-agricultural land.

Baseline data

Baseline data for 1990-91 is available for this project. Air stations were fixed at Sagnotola village near Kanhai nallah, Benibahara village, Katka Dongaria village and Kudri village. SPM levels were 242µg/m^3 and 267µg/m^3 during post monsoon and winter seasons respectively near Sagnotola village. Similarly, at Kudri village SPM levels were 281, 211 and 257 during pre-monsoon, monsoon and winter seasons, respectively. Noise levels measured at the above stations were within the prescribed limit. Water samples were taken at Behraband incline discharge, up and downstream of Kanhai nallah, Sagnotola pond and Bijuri mine discharge. Coliform was found to be present in the water of Kanhai nallah. Other parameters were within prescribed limits.

Mine planning and design

The project is an underground mine with one coal seam that dips gently at a slope of 1 in 14 from north to south. The mine has two inclines and a shaft, the latter one not yet completed. It is planned to drive a third incline in order to have separate inclines for men, material and coal clearance. Mechanised bord and pillar mining by deploying side discharge loaders (SDL) and chain conveyors, are proposed. Manual loading is proposed where seam thickness is less than 2m and loading by SDL onto chain conveyor where the thickness is more than 2m. The target production is to be achieved by operating five mechanised panels/districts. Coal production is currently hauled by belt conveyor from underground to surface and transported by trucks to distance of 6.5km from the mine site to a rail loading facility at the CHP of Bijuri mine. The total area of leasehold occupied by mine facilities to the end of current five year period (1995-96 to 1999-2000) and anticipated to the total 25 years of mine life are as follows:

Leasehold area - Behraband
(All figures in hectares)

	Infrastructure	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	22.5	179.5	398.0	600.0
Life	22.5	179.5	398.0	600.0

Project monitoring, auditing and evaluation

Environmental monitoring was started in January 1994. Air quality readings are taken at two stations, i.e. around the air shaft and Bhagta village. Four water quality stations are at the mine discharge, a well in Bhagta village, and upstream and downstream of Kanhai river. Noise readings are taken day and night at three stations, i.e. around the CHP, mine exhaust and in Bhagta village.

Hydrology and water quality management

Mine water is collected in a large standage capacity sump underground. After sedimentation, it is discharged regularly in compliance with discharge standards into surface channels. The CHP, work shop and vehicle washing area have, as yet, no waste water treatment facilities.

Air quality and noise management

Suspended particulate matter the in mine office area and Bhagta village are regularly in compliance with appropriate standards in all seasons. Day

time and night time noise levels around mine exhaust, CHP and village area are regularly in compliance with standards.

Disturbed land reclamation

No land subsidence is expected, hence land reclamation is not required.

Regional cumulative environmental impacts

There is no other industry in the area, so no regional cumulative environmental impact is envisaged.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

In addition to the two existing air quality monitoring stations, one more station will be established. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on the pollution load. Meanwhile, the CPCB is formulating standards for the coal industry which will be complied with after its notification. Four water quality sampling stations are considered adequate. Water level will be measured quarterly at two domestic village wells one each in Bhagta and Benibahra village. Present noise monitoring programmes at three stations are considered adequate.

Hydrology and water quality management

A settling tank will be designed and constructed by December 1995. Grease and oil traps will be constructed for waste water treatment from workshop and vehicle washing area by 1995-96. After initial treatment to remove grease and oil, the effluent will be released to a settling pond that will be constructed by 1995-96.

Air quality and noise management

One water tanker will be acquired in 1995-96. This will be used primarily along the road to suppress dust in and around the village area. About 100,000 trees will be planted along the coal transport road, around the colony and infrastructure during 1995-96 to 1999-2000 for air quality improvement and to act as a noise barrier. Result will be monitored carefully and if improvements are insufficient, chemical retardants and a fixed spraying system will be completed in specific areas in fiscal year 1996-97.

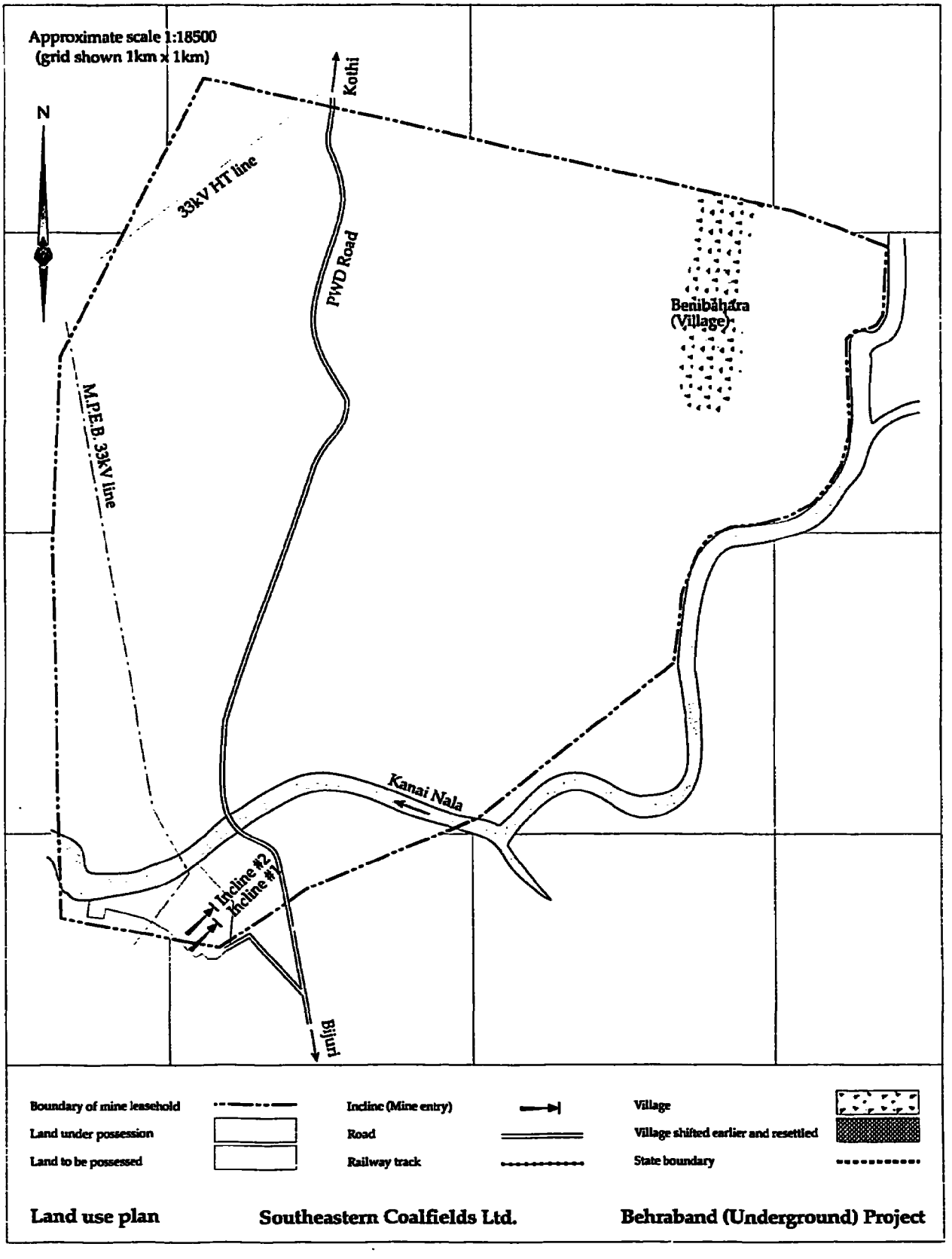
Disturbed land reclamation

No land up to 1999-2000 is expected to be disturbed due to subsidence, so no reclamation is necessary up to 2000.

Five year annual budget summary - Behraband
(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.68	0.00	0.75	0.00	0.82	0.00	0.90	0.00	0.99
Air quality & noise	1.01	0.50	0.41	0.55	0.46	0.61	0.41	0.67	0.41	0.73
Water quality	0.59	0.10	0.00	0.13	0.00	0.15	0.00	0.18	0.00	0.20
Land reclamation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.60	1.28	0.41	1.43	0.46	1.58	0.41	1.75	0.41	1.92

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Behraband (Underground) Project**

CHURCHA WEST
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Churcha West
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Baikunthpur
Year of sanction:	1990
Operational startup:	1990
Type of mine:	Underground
Mining method:	Bord & Pillar
Current production:	0.32 million tonnes
Capacity:	0.60 million tonnes
Mine life:	25 years
Residual life:	25 years
Number of coal seams:	1 (Thickness: 3.6-4.2m)
Ash content:	18-22%
Working depth:	55-260m
Coal destination:	Miscellaneous industrial consumers

Current environmental status

Environmental setting

The surface of the mine area is hilly and slopes to the south and west (770m to 700m above mean sea level). The drainage is by natural slope and through various nallahs to Jhumka water reservoir, approximately 3km away on the west from the mine incline. A residential colony and some of the mine infrastructure are located on flat terrain downhill from the mine site. There are three villages Anandpur, Katghori and Sirpur which are located to the northeast of the mine area at approximately 3km from the active mine area. Prior to mining, the leasehold area of 557.8ha consisted of 15.3ha agricultural land, 0.7ha Govt. land and 541.8ha forest land, used for timber and fuel wood production.

Baseline data

Baseline data is not available for this project because this is an extension of Churcha Main mine, which pre-dates the environmental legislation.

Mine planning and design

The project is an underground mine and consists of only one workable coal seam, dipping almost due north. The seam gradient varies from 1 in 10 to 1 in 18. Coal winning is being done by bord and pillar method with side dis-

charge loaders (SDLs). Coal is blasted off the solid and is loaded by SDLs on Pony conveyors. Belt conveyors are being used for trunk transportation. Coal is transported from mine top to the CHP by surface belt conveyors and then transported by railway wagons. The total area of leasehold occupied by mine facilities to the end of current five year period (1995-96 to 1999-2000) and anticipated to the total 25 years of mine life are as follows:

Leasehold area - Churcha West
(All figures in hectares)

	Infrastructure	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	17	11	530	558
Life	17	11	530	558

Project monitoring, auditing and evaluation

Continuous environmental monitoring was started in the monsoon season of 1993. Air quality readings are taken at four stations, i.e. near mine site office, vocational training centre, residential colony and Sirpur village. Four water quality stations are the mine discharge, colony drinking water before and after treatment, and Sirpur village well. Noise readings are taken at four stations, i.e. the project office, VTC, residential colony and Sirpur village.

Hydrology and water quality management

Mine water is collected in the mine sump and pumped out on the surface to discharge through a settling tank to the nearby Gagargodi nallah and finally to Jhumka water reservoir. Positive discharge from the final sump occurs only during the height of monsoon season and has regularly been in compliance with discharge standards excepting low pH value. The coal handling plant has been provided with a settling pond. Workshop and vehicle washing areas have, as yet, no waste water treatment facilities.

Air quality and noise management

Air quality at all the four reading stations is in compliance with the appropriate standards. Noise level at the four stations is also regularly in compliance with standards.

Disturbed land reclamation

Since no subsidence has yet taken place there is no need for land reclamation at present.

Regional cumulative environmental impacts

There is no industry nearby, so no regional cumulative environmental impact is envisaged.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Four each of air, water and noise sampling stations are considered adequate. As to the frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending upon the pollution load. Meanwhile, CPCB is formulating a standard for the coal industry. This will be complied with after its notification. Quarterly measurements of water level will be taken in a well of Sirpur village. The current noise monitoring programme at four stations is considered adequate.

Hydrology and water quality management

An acid treatment plant will be constructed by the end of 1996-97 to improve pH value and bring it into compliance with the statutory standards. An oil and grease trap cum settling pond will be constructed in the year 1995-96.

Air quality and noise management

In addition to the planting already done on all the available land, a further 100,000 (approx.) trees will be planted along the coal transport road, around the colony and infrastructure, during 1995-96 to 1999-2000 for air quality improvement and to act as a noise barrier. Current water spraying arrangements in CHP and cover of conveyor belt will be maintained. Results will be monitored carefully and, if needed, further dust suppression measures will be taken at specific areas in fiscal year 1997-98. Current noise level management is considered adequate.

Disturbed land reclamation

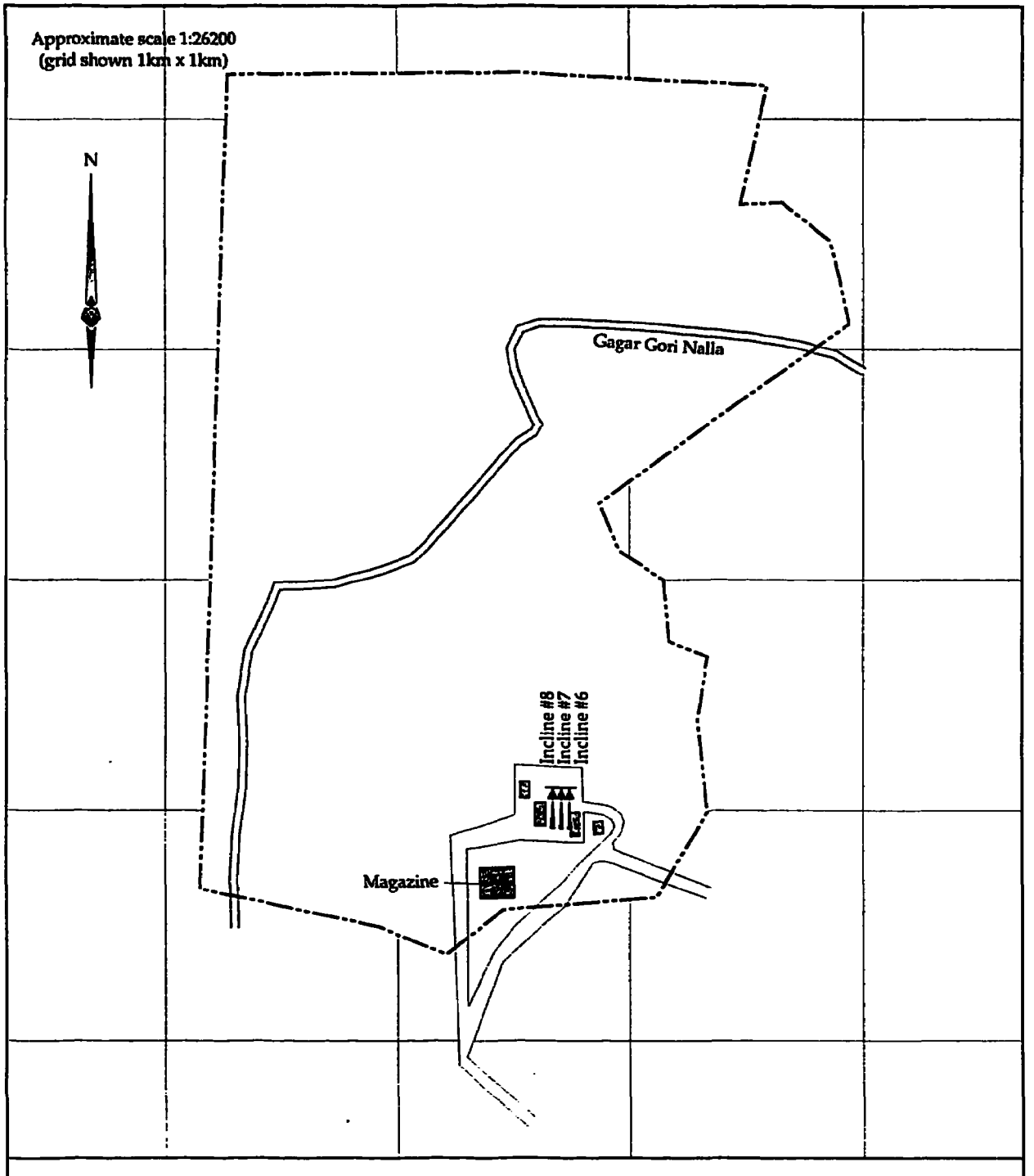
Since surface land will not be disturbed by subsidence no reclamation is necessary.

Five year annual budget summary - Churcha West

(Rs million)

	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.88	0.00	0.96	0.00	1.06	0.00	1.17	0.00	1.28
Air quality & noise	0.40	0.00	0.40	0.00	0.40	0.00	0.40	0.00	0.40	0.00
Water quality	5.05	0.00	5.00	1.32	0.00	1.45	0.00	1.60	0.00	1.76
Land reclamation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.45	0.88	5.40	2.28	0.40	2.51	0.40	2.77	0.00	3.04

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Boundary of mine leasehold		Incline		Village	
Land under possession		Road		Village shifted earlier and resettled	
Land to be possessed		Railway track		State boundary	

Land use plan **Southeastern Coalfields Ltd.** **Churcha West (Underground) Project**

KURJA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Kurja
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Hasdeo
Year of sanction:	1988
Operational startup:	1989
Type of mine:	Underground
Mining method:	Bord & Pillar
Current production:	0.13 million tonnes
Capacity:	0.40 million tonnes
Mine life:	20 years
Residual life:	17 years
Number of coal seams:	1 (Thickness: 1.2-2.5m)
Ash content:	10.7-28.7%
Working depth:	102-185m
Coal destination:	Miscellaneous industrial consumers

Current environmental status

Environmental setting

The Kurja mine is situated on an undulating terrain which slopes very gently in a westerly direction towards Kewai river which is approximately 8km from the boundary of the mine. A workers colony is situated 4km north of the mine boundary. In addition, two villages, Daldal and Parsapani, are located in the east within the leasehold approximately 1.5-2km from the active mine area. Prior to mining, the leasehold area of 469ha consisted of 20.5ha of village land and 448.5ha of dry agricultural land.

Baseline data

Baseline data from 1988 is available for this project. Air stations were fixed at the proposed mine site, Chanwaridand village, Bahiatola village and near Rajnagar stadium. SPM levels exceed the prescribed limit at all the stations in pre-monsoon season. Noise levels measured at these stations are found to be within the threshold limit. Water samples were collected in all seasons from 16 points including wells, village ponds and up and downstream of Hasdeo river, and analysed. Except the presence of coliform in some samples, all parameters were within prescribed limits.

Mine planning and design

The project is an underground mine and consists of one coal seam that dips gently at 1 in 29 in an easterly direction from Kewai river on the western side. Entry has been by a pair of inclines. After reaching the coal seam, the main trunk development is in progress. Conventional bord and pillar mining is proposed with manual shoveling onto a chain conveyor where seam thickness is less than 2m. Loading by side discharge loader (SDL) onto chain conveyor is envisaged where seam thickness is more than 2m. The production is to be achieved by operating three mechanised and one manual panels. Coal production is currently hauled by belt conveyor from underground to surface and transported by trucks 8-10km from the mine site to the rail line loading facility at the Rajnagar new CHP and West Jhagrakhand CHP, respectively. The total area of the leasehold occupied by mine facilities to the current five year period (1995-96 to 1999-2000) and anticipated to the total 20 years of mine life are as follows:

Leasehold area - Kurja
(All figures in hectares)

	Infrastructure	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	13.0	20.5	435.5	469.0
Life	13.0	20.5	435.5	469.0

Project monitoring, auditing and evaluation

Regular environmental monitoring was started in October 1993. Air quality readings are taken at two stations (the mine office area and Parsapani village). Four water quality stations are at mine discharge, a well in Paraspani village and upstream and downstream of a nearby seasonal nallah. Noise readings are taken day and night at three stations (around the CHP and mine exhaust and at Paraspani village.

Hydrology and water quality management

Mine water is collected in a large capacity sump underground and is discharged into surface drainage. No surface settling tank is required to be constructed for mine water. The coal handling plant, workshop and vehicle washing areas have, as yet, no waste water treatment facilities. The effluents from these will be guided, treated and then reused and/or discharged.

Air quality and noise management

Suspended particulate matter levels in mine office area and Paraspani village are regularly in compliance with appropriate standards. Day and night time noise levels are regularly in compliance with the standards.

Disturbed land reclamation

Because no land subsidence is expected, land reclamation is not involved.

Regional cumulative environmental impacts

There is no other industry in the area, hence no regional cumulative environmental impact is envisaged.

Environmental management programmes 1995-96 to 1999 2000

Project monitoring, auditing and evaluation

In addition to the two existing air quality monitoring stations, one more station will be established. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. One more water quality sampling station at Daldal village domestic well will be added in 1995, bringing the total to five. Quarterly water levels will be measured in domestic wells at Paraspani and Daldal village. The current quarterly monitoring of the full range of parameters will continue. The present noise monitoring programme at the three stations is considered adequate.

Hydrology and water quality management

As explained earlier, there is provision of sumpage in underground and only clarified water is pumped out. No settling pond is required at the surface. A system of oil and grease traps will be constructed for waste water treatment from the workshop and vehicle washing area by 1996-97. After initial treatment to remove oil and grease the effluent will be released to another settling pond, to be constructed by 1995-96, to clarify the effluent before discharge.

Air quality and noise management

One water tanker will be acquired in 1996-97. This will be used primarily along the road with particular attention to the road section near Daldal village to suppress the dust in and around the village area. About 100,000 plants will be planted along the coal transport road, and around the colony and infrastructure from 1995-96 to 1999-2000 for air quality improvement and to act as a noise barrier. Results will be monitored carefully and if improvements are insufficient, chemical retardants and fixed spraying system will be contemplated in specific areas in fiscal year 1996-97.

Disturbed land reclamation

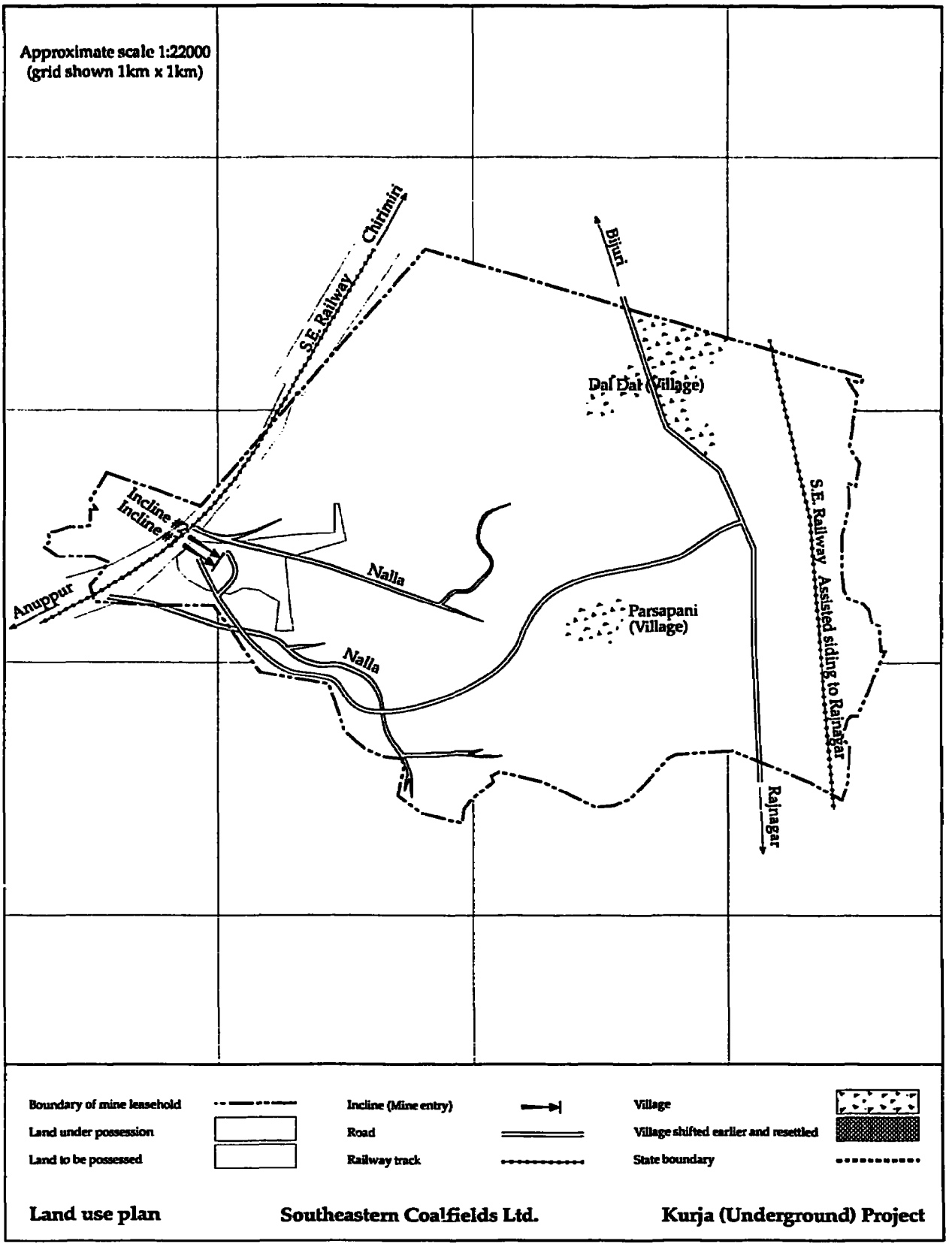
No land up to 1999-2000 is expected to be disturbed by depillaring, so no reclamation is necessary.

Five year annual budget summary - Kurja

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.68	0.00	0.75	0.00	0.82	0.00	0.90	0.00	0.99
Air quality & noise	1.01	0 50	0.41	0.55	0.46	0.61	0.41	0.67	0.41	0.73
Water quality	1.00	0.10	0.59	0.13	0.00	0.15	0.00	0.18	0.00	0.20
Land reclamation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	2.01	1.28	1.00	1.43	0.46	1.58	0.41	1.75	0.41	1.92

Note: 'Cap' refers to capital investments. 'Oper' refers to operations experditures.



Land use plan **Southeastern Coalfields Ltd.** **Kurja (Underground) Project**

PANDAVPARA
FIVE YEAR ENVIRONMENTAL ACTION PLAN

Mine:	Pandavpara
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Baikunthpur
Year of sanction:	1989
Operational startup:	1990
Type of mine:	Underground
Mining method:	Bord & Pillar
Current production:	0.05 million tonnes
Capacity:	0.21 million tonnes
Mine life:	40 years
Residual life:	39 years
Number of coal seams:	2 (Thickness: 1.2-2.0m, 1.2-2.1m)
Ash content:	9-12%
Working depth:	25-250m
Coal destination:	Miscellaneous industrial consumers

Current environmental status

Environmental setting

The mine surface is an undulating hilly terrain ranging from 587m to 737m above sea level. The area is drained by small feeder nallahs into the Kuluah nallah, which drains into the Gokni river 5km to the west of the mine area. Khond village and Sogra village are located on the east and southeast, respectively 2km away from the mine area. Prior to mining, the leasehold area of 1114.2ha consisted of 90.8ha of tenancy land, 10ha of Government waste land and 1013.3ha of forest land used for wood and fuel wood production.

Baseline data

Baseline data of 1988 is available for this project. Readings were taken for air and noise levels at four stations. Similarly water samples were taken from four points. The air, noise and water levels were within the prescribed limits.

Mine planning and design

Pandavpara is an underground project and consists of two workable coal seams (Seam III and Seam II). The gradient of the seams varies from 1 in 6 to 1 in 24 dipping from south to north. Seam III has been entered by a pair of inclines and Seam II will be approached by cross measure drifts. The project

is proposed to be worked by bord and pillar method. Coal winning will be done by blasting off the solid and hand shoveling onto low height coal tubs and hoisted by endless/direct rope haulages. Coal from Pandavpara project will be handled by a CHP near the incline. It will be transported to Katora railway siding (12km) by truck and then dispatched by railway wagon. The total area of leasehold occupied by mine facilities to the end of the current five year period (1995-96 to 1999-2000) and anticipated to the total 40 years of mine life are as follows:

Leasehold area - Pandavpara
(All figures in hectares)

	Infrastructure	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	9.8	33.8	1,070.6	1,114.2
Life	9.8	33.8	1,070.6	1,114.2

Project monitoring, auditing and evaluation

Monitoring of various environmental parameters was started during the monsoon season of 1994. Four air quality monitoring stations are near the mine site office, CHP, residential colony and nearby Sorga village. Four water quality sites are the mine discharge point, office borewell, Sorga village borewell and downstream of Kolha nallah. Noise readings are taken day and night at four stations: the CHP, residential colony, Khond village and Sorga village.

Hydrology and water quality management

Mine water is collected in the mine sump after sedimentation and is pumped out to discharge through a drain to Kulaha nallah. It has regularly been in compliance with discharge standards. The coal handling plant and mini workshop have, as yet, no waste water treatment facilities.

Air quality and noise management

Air quality as well as noise levels at all the four reading stations are in compliance with standards.

Disturbed land reclamation

Since no subsidence has yet taken place, no land reclamation is necessary.

Regional cumulative environmental impact

There is no other industry near the project area, so no regional cumulative environmental impact is envisaged.

Environmental management programmes 1995-96 to 1999-2000

Project monitoring, auditing and evaluation

Four air and noise sampling stations are considered adequate. As for frequency of air sampling, a sample will be drawn on 24 hourly basis for two days in a month or two days in quarter depending on pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. Three more water quality sampling stations will be added from 1995 to include upstream of Kolha nallah, colony water supply treatment plant and a well at Khond village. Thus, the total number of stations will be seven. Quarterly water level measurements will be taken in the well of Khond village. Current noise monitoring programmes at four stations are considered adequate.

Hydrology and water quality management

A settling tank will be constructed by 1995-96 to treat mine water which will be conveyed to a filter plant for use in the colony. A garland drain 100m in length will be constructed by December 1995 to collect run off from the CHP and convey it to a settling pond. Runoff from the workshop and vehicle washing areas will pass through an oil and grease trap which will be constructed by December 1996. This will then be conveyed to the new settling pond.

Air quality and noise management

One new water tanker will be acquired in 1995-96 to be used to upgrade the level of dust suppression in and around the project area. About 100,000 trees will be planted along the coal transport road and around the colony and infrastructure during 1995-96 to 1999-2000 for air quality improvement and to act as a noise barrier. Fixed water spraying arrangements at the coal handling plant will be made by December 1996. Results will be monitored carefully and if so needed, further dust suppression measures will be taken at specific areas in fiscal year 1997-98. Current noise level management is considered adequate.

Disturbed land reclamation

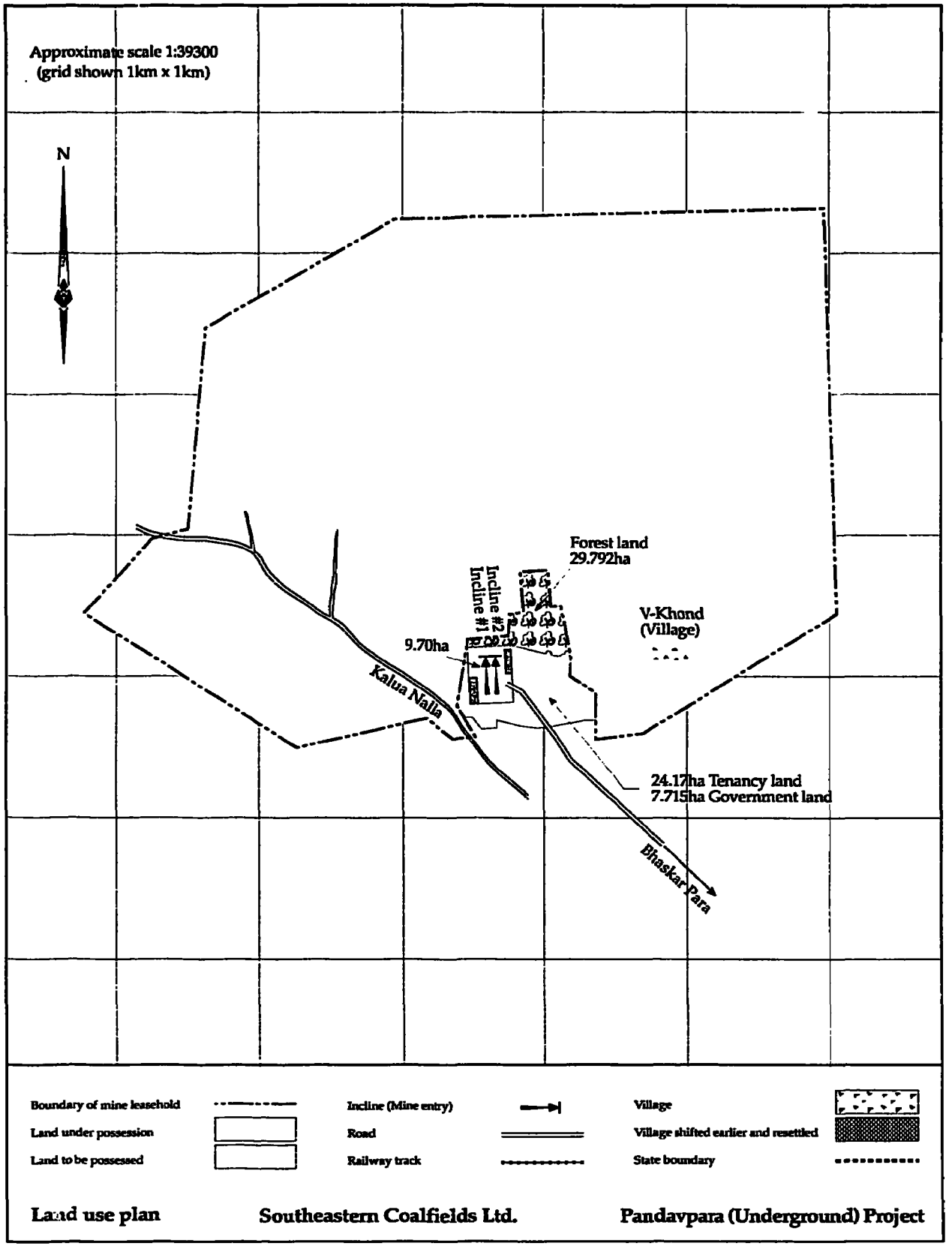
No land up to the year 1999-2000 is expected to be disturbed due to subsidence, so no reclamation is necessary.

Five year annual budget summary - Pandavpara

(Rs million)

	1995-96		1996-97		1997-98		1998-99		1999-2000	
	Cap	Oper	Cap	Oper	Cap	Oper	Cap	Oper	Cap	Oper
Project monitoring	0.00	0.91	0.00	1.00	0.00	1.10	0.00	1.21	0.00	1.33
Air quality & noise	1.00	0.63	0.90	0.93	0.50	1.17	0.40	1.17	0.40	1.17
Water quality	1.56	0.11	0.03	0.11	0.00	0.12	0.00	0.13	0.00	0.15
Land reclamation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	2.56	1.65	0.93	2.04	0.50	2.39	0.40	2.51	0.40	2.65

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Southeastern Coalfields Ltd.** **Pandavpara (Underground) Project**

SINGHALI
FIVE YEAR ENVIRONMENTAL ACTTION PLAN

Mine:	Singhali
Company:	SECL
State:	Madhya Pradesh
Coalfield:	Korba
Year of sanction:	1989
Operational startup:	1991
Type of mine:	Underground
Mining method:	Bord & Pillar
Current production:	0.03 million tonnes
Capacity:	0.24 million tonnes
Mine life:	48 years
Residual life:	47 years
Number of coal seams:	2 (Thickness: 1.5-3.0m, 1.2-2.5m)
Ash content:	19-24%
Working depth:	30-117m
Coal destination:	Miscellaneous industrial consumers

Current environmental status

Environmental setting

Singhali project is located on almost flat terrain with elevations ranging from 296-318m above sea level. Hasdeo river, with its tributary Kholar nallah flowing in a southerly direction adjacent to the mine boundary, forms the main drainage of the area. Two villages, Arda and Bheginara are located to the north and southeastern part of the mine area. Both are outside the leasehold area. While Bheginara village is located adjacent to the mine project site, Arda village is located about 3km from the mining area. Prior to mining, leasehold area of 862.3ha consisted of 246.2ha of agricultural land, 314.6ha Govt. land and 301.5ha of degraded forest and shrub land used for rough grazing and fuel wood production. Of this, 57.4ha of land has been acquired for the construction of the mine facilities.

Baseline data

Baseline data from 1990-91 is available for this project. Air stations were fixed at the proposed incline site, Jawali village, Harabhata village and Dhabdhab village. Air quality at all stations, in all seasons, was found to be within the prescribed limit. Noise levels measured at these stations were within the threshold limit. Water samples were drawn from local nallah of Bhejinara village, up and down stream of Kholar nallah and Banki mine dis-

charge. Faecal contamination was found in samples of Kholar nallah and Banki mine discharge. Other parameters were within permissible limits.

Mine planning and design

The project is an underground mine and consists of one workable coal seam that dips gently in a southerly direction. The method of mining is bord and pillar with caving system. Coal production is yet to start. Loading of cut coal will be by side discharge loaders and face transport will be by chain conveyor, endless haulage and belt conveyors. Coal produced will be transported by trucks 5-6km to a rail head, located at Banki Colliery. The total area of leasehold occupied by mine facilities to the end of current five year period (1995-96 to 1999-2000) and anticipated to the total 48 years of mine life, are as follows:

Leasehold area - Singhali
(All figures in hectares)

	Infrastructure	*Colonies & villages*	*Unoccupied*	*Total area*
5 years	57.4	0.0	804.9	862.3
Life	57.4	0.0	804.9	862.3

Project monitoring, auditing and evaluation

Environmental monitoring was started in the winter season of 1994. Air quality readings are taken at two stations (adjacent to the project office and at the project colony). Water quality stations are at two places (mine discharge from Incline No.I and II and a nearby pond). Noise readings are taken day and night at two stations (at the project office and in the colony).

Hydrology and water quality management

Mine water is collected in a settling tank and the clear water is discharged through the drain into the tributary of Kholar nallah and has been in compliance with discharge standards. The workshop and vehicle washing areas have, as yet, no water treatment facilities.

Air quality and noise management

Air quality at existing two reading stations is regularly in compliance with the standards. The noise levels at two stations are also regularly in compliance with standards.

Disturbed land reclamation

For the first nine years of project life, no depillaring operations are envisaged, so no reclamation is necessary up to the year 2000. A portion of the area which was damaged due to construction of mine entry, service buildings, approach roads and drains has been fully reclaimed and planting over 2ha of land has been completed.

Regional cumulative environmental impacts

No other industry is nearby, so regional cumulative environmental impact is not envisaged.

Environmental management programmes 1995-96 to 2000

Project monitoring, auditing and evaluation

Current air and noise sampling stations are considered inadequate. Hence, one additional air and noise observation station will be established during 1995-96. As for frequency of air sampling, the samples will be drawn on 24 hourly basis for two days in a month or two days in a quarter, depending upon the pollution load. Meanwhile, CPCB is formulating standards for the coal industry which will be complied with after its notification. Water quality sampling stations will include one well each in Singhali village and Harrabhata village. In place of water samples from Inclines I and II and the pond, samples from mine discharge after treatment in settling tank and one each from upstream and downstream of Kholar nallah will be taken. So from 1995-96, water sampling stations will be five in number. Quarterly water levels in these two wells will also be measured.

Hydrology and water quality management

Runoff from the workshop and vehicle washing areas will be conveyed to the drains constructed for outflow of settling tank after initial treatment to remove grease and oil. This drain will be made of brick masonry in the year 1995-96. A water sump will be created inside the mine by the year 1995-96 for mine discharge. Thus, clearer water will be discharged through the settling tank. Drinking water facilities will be extended by December 1996 to the adopted villages, Arda and Bheginara.

Air quality and noise management

The coal transport roads have been metalled from the mine site to the railhead at Banki. It is also planned to widen the Banki-Suttara road to facilitate coal movement and to restrict air pollution. A fixed water spraying

arrangement at the CHP will be made by December 1995. Social forestry is planned on 5ha of waste land near Bheginara and Arda villages to combat the air and noise pollution. In addition, 100,000 trees will be planted during next five years at the rate of 20,000 trees per year, along road sides and infrastructural areas. Results will be monitored carefully and if improvements are insufficient water spraying will be contemplated on roads near to the villages by 1997-98.

Disturbed land reclamation

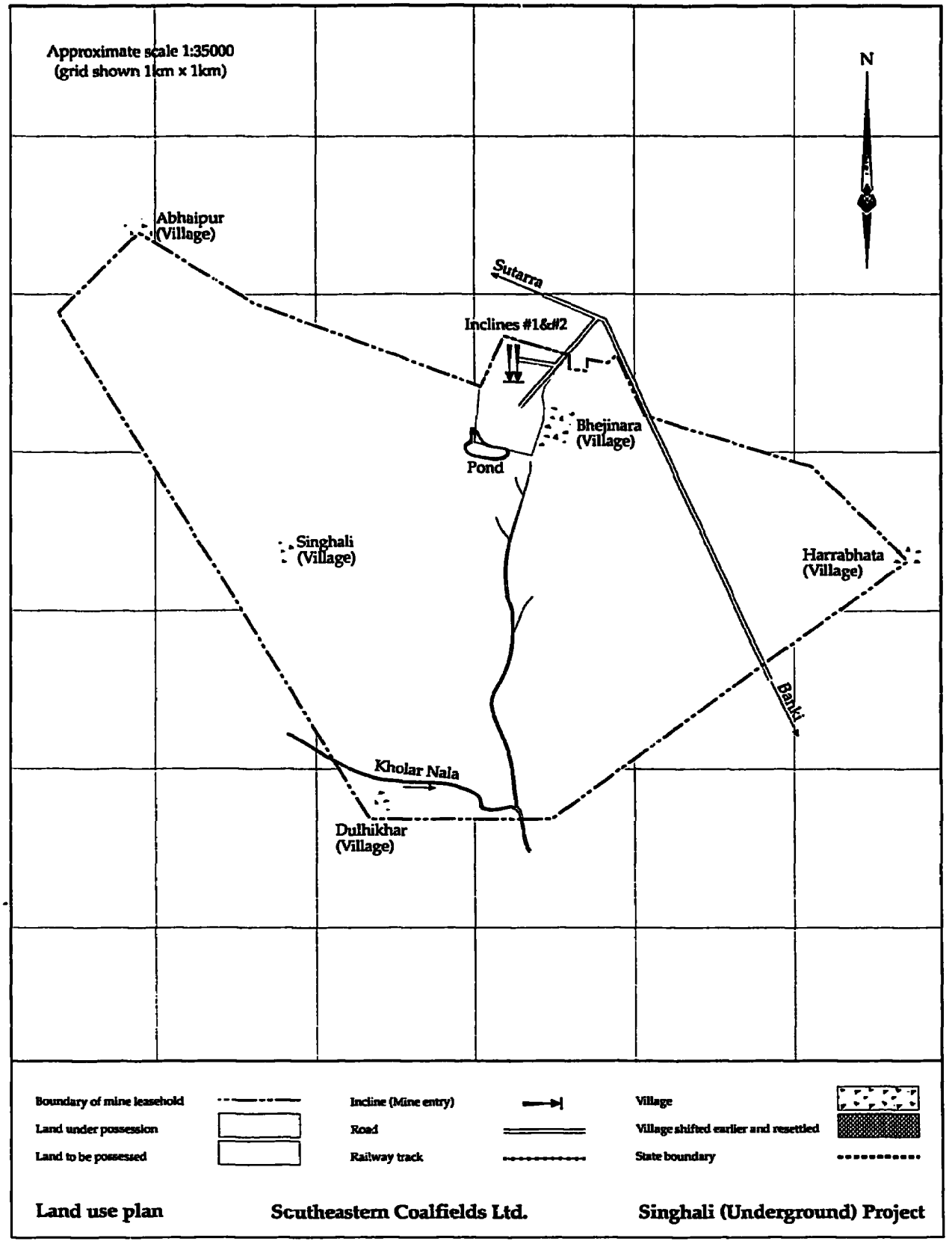
Damage to land surface due to subsidence has not been predicted, so no land reclamation is necessary up to the year 2000.

Five year annual budget summary - Singhali

(Rs million)

	1995-96		*1996-97*		*1997-98*		*1998-99*		*1999-2000*	
	Cap	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*	*Cap*	*Oper*
Project monitoring	0.00	0.48	0.00	0.53	0.00	0.58	0.00	0.64	0.00	0.70
Air quality & noise	4.76	0.98	0.40	1.08	0.40	1.19	0.40	1.31	0.40	1.44
Water quality	0.10	0.16	0.00	0.16	0.00	0.17	0.00	0.17	0.00	0.[illegible]
Land reclamation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.[illegible]
Total	45.38	17.22	30.23	29.55	2.78	29.92	2.02	30.18	2.02	30.45

Note: 'Cap' refers to capital investments. 'Oper' refers to operations expenditures.



Land use plan **Scutheastern Coalfields Ltd.** **Singhali (Underground) Project**

ANNEX 7 ISSUES RAISED DURING CONSULTATIONS ON EAPS (A REPORT ON THE WORKSHOP HELD AT HOTEL HINDUSTAN INTERNATIONAL ON 27TH AND 28TH OF MAY 1995)

Introduction

A workshop was held in Calcutta on 27 and 28 May, 1995 to discuss with project-affected people and non-governmental organisations (NGOs), the draft report on the 'Sectoral Environmental Assessment' for the Coal Sector Rehabilitation Project and the subproject specific Five-year Environmental Action Plans prepared by Coal India for submission to the World Bank.

Shri U. Kumar, Chairman, Managing Director, SECL opened the workshop by describing in detail the Coal Sector Rehabilitation Project and the benefits it would bring to the coal industry and to the people in and around the 31 subprojects, as well as the mitigational measures for possible adverse effects on the environment due to the operation of coal mines. This was done to brief the NGOs and project-affected people about the project.

The NGOs and project-affected people took active interest in the presentations that Coal India officials (Dr. S.K. Ghosh, Advisor, Coal India and Shri S.K. Varma, Chief General Manager (WBP)) made on different aspects of the Coal Sector Rehabilitation Project such as India's energy scenario, Coal India's responsibility and commitment to produce additional coal within the next five years to bridge the gap between demand and supply, mobilisation of funds through a loan from the World Bank in view of the Government's decision not to give any more funding to Coal India, and the fact that if constraints for mobilisation of funding are not removed, a declining trend of coal production will inevitably set in. The project-affected people and the NGOs present in the workshop unanimously supported the move taken by Coal India to take this loan for the Coal Sector Rehabilitation Project.

Coal India officials (Shri V.K. Singh, Chief General Manager (Environment) and Shri M.P. Roy, General Manager (Resettlement and Rehabilitation) also presented the draft Sectoral Environmental Assessment. They elucidated adverse effects on the environment (including social, occupational health and safety matters) due to coal mining operations and Coal India's proposal to implement the mitigational measures in a time bound programme within the next five years, to reduce these effects. This was explained to the congregation with the aim to invite suggestions, if any, from the NGOs and project-affected people for improvement of the environment in the 31 subprojects of the Coal Sector Rehabilitation Project.

The subproject specific Five Year Environmental Action Plans for the 31 subprojects presented by Shri A.N. Kheto, General Manager (Environment) generated a lot of interest and the gather subdivided into six groups to discuss the following issues:

- water pollution and hydrology,
- air quality, noise pollution and blasting vibration,
- afforestation and land reclamation,
- resettlement of villages,
- rehabilitation of project-affected people, and
- occupational health and safety.

Overview of the workshop

The workshop was attended by about 50 participants (NGOs, project-affected people and officers of Coal India and its subsidiary coal companies).

All the representatives of NGOs and project-affected people were individually invited to speak on the environmental issues concerning them. In addition six groups were formed for group discussion on the specialised topics listed above.

Many new ideas emerged on environmental issues, and slippages in implementation of EMPs were also noted. The resettlement and rehabilitation of project-affected people is very much inter-related to environmental issues. All the particpants felt that more active participation of project-affected people in planning, implementation and monitoring of the resettlement and rehabilitation and environmental protection activities can not only lead to a more effective implementation, but also lessen the misunderstandings that exist between Coal India officials and project-affected people.

Recommendations of group discussions on the environmental issues

Following are the important recommendations which emerged during the group discussions on the six specialised issues.

Water pollution and hydrology

a.) An awareness campaign (including leaflets in local languages) should be launched to educate project-affected people about the various aspects of water pollution and treatment. Periodic monitoring should be completed and suitability of the water for drinking and irrigation should be included (in writing) along with the test results. Project-affected people should be involved in the monitoring programme.

b.) The availability of underground and surface water should be scientifically ascertained before selecting any resettlement site. An

action plan for safe drinking and irrigation water should be prepared and implemented in the selected sites.

c.) Water conservation measures should be adopted for specific site conditions.

d.) Model farms and pisciculture on nearby areas using discharged water from mines should be promoted. This would increase the confidence of project-affected people and promote viable economic activity.

Air/noise pollution and blasting vibration

a.) An awareness campaign should also be launched for educating project-affected people about the noise and air pollution issues and the steps taken to minimise or contain them. Periodic monitoring should be done and Coal India officials should be encouraged to share the results with project-affected people.

b.) Periodic health camps should be organised in areas affected by noise and air pollution for medical check-ups that include lung related diseases.

c.) Tree planting should be encouraged in and around the villages to minimise the effects of noise and air pollution. Planting fruit trees and bamboo can be promoted because of the economic benefits associated with them.

d.) Transport roads should be metalled and cleaned regularly to minimise dust pollution.

Afforestation and land reclamation

a.) Regular monitoring of top soil conditions on reclaimed land should be done to ascertain its capacity to support vegetation.

b.) Agro-forestry involving indigenous tree species, which are more suited to local conditions, should be promoted and should serve as common property resources for project-affected people.

c.) Grass can be planted on slopes to prevent soil erosion. Leguminous cropping can be completed between tree plantings to increase nitrogen fixation.

d.) Opencast voids, reservoirs and other water harvesting techniques should be utilised for using mine discharge water in irrigating plantations.

Resettlement of villages

a.) An awareness campaign should be launched to publicise the resettlement and rehabilitation policies of Coal India and the Government.

b.) Representative bodies of project-affected people should be involved in the selection of resettlement sites. As mentioned earlier, studies should be conducted regarding the availability of water and the fertility of the soil before finalising the site.

c.) As far as practicable, entire blocks of villages should be acquired together to prevent fragmentation of holdings or assets of project-affected people. All acquired villages in a region should be re-settled simultaneously to avoid adverse impacts of inflation on compensation money.

d.) The compensation for the project-affected person's building should be at replacement cost and verified by an independent agency in addition to Coal India.

Rehabilitation of project-affected people

The project-affected people should be involved in the initial stage of planning as well as the implementation of the rehabilitation process.

a.) The objective of rehabilitation should not only be to regain the former standard of living, but to improve upon it.

b.) Regarding the issue of 'compensation for land and selection for jobs,' Coal India should deal directly with a representative body of project-affected people. Since only one member of the family is entitled to a job, often it causes bad blood in the family.

c.) The baseline survey required to prepare a detailed resettlement and rehabilitation plan for each family should be standardised across all Coal India projects. The survey should be action oriented, not purely academic.

d.) The project-affected person should be assimilated into the host community. This requires a sample baseline survey of the host community and some measures adopted to improve its standard of living.

e.) Coal India should devise attractive area-specific self-employment opportunities so that the pressure on receiving jobs can be reduced. These should include skill upgradation, finance and marketing.

Occupational health and safety

a.) Occupational health and safety should not only cover mine workers, but other people living in the impact zone.

b.) An awareness campaign should be launched in the impact area regarding various detrimental effects on health from mining and adopting safety procedures for them.

c.) Periodic health check-ups (three years) should be arranged more frequently and include tuberculosis and liver, lung and kidney related diseases.

ANNEX 8 RESETTLEMENT AND REHABILITATION POLICY OF COAL INDIA

Preamble

1. The location and quality of coal reserves, and their distance from major consumers, determine to a great extent the selection of mine sites. For reserves that are close to the surface, opencast mining has proven to be the most efficient mining method. While relatively inexpensive, opencast mines require large areas of land. Population growth, particularly in India's eastern region, make it increasingly difficult for the subsidiary coal companies (subsidiaries) to acquire the land they need for expanding their operations.

2. In the past, subsidiaries found it relatively easy to acquire land if they were able to offer jobs. Partly because of this practice, subsidiaries have built up a labor force beyond their needs. This has contributed to the heavy losses many mines incur and has eroded the competitiveness of the coal industry. The subsidiaries may still need to hire people in selected locations and continue to give preference to those whose livelihood will be affected by coal mining operations, however subsidiaries will need to develop other ways and means to compensate land owners and others adversely affected by their projects. Only proper resettlement and rehabilitation will elicit the cooperation of project-affected people, and make it possible for Coal India to acquire the land it needs.

3. The purpose of this statement is to set out the basic principles for the resettlement and rehabilitation of people affected by coal mining projects. As such, this statement attempts to streamline the different resettlement and rehabilitation practices that are being followed by subsidiaries and modify them in a way that allows subsidiaries to deal more effectively with resettlement and rehabilitation issues.

4. While Coal India's basic philosophy for compensating land losers and other project-affected people remains substantially unchanged, the statement emphasizes the need to cultivate and maintain good relationships with the people affected by Coal India's projects as early as possible; it also underscores that the subsidiaries have a responsibility towards the landless, whose livelihood is often taken away. On the other hand, subsidiaries need to protect themselves more effectively against unjustified claims. To this end, the statement proposes that subsidiaries prepare detailed Rehabilitation Action Plans that clearly identify ,at an early stage, the entitlements of the people affected by coal projects

5. The resettlement and rehabilitation policies followed by the subsidiaries have evolved over time and undergone numerous changes in response to

changing circumstances. As and when the Central or State Governments issue new guidelines for resettlement and rehabilitation, Coal India will review and modify its resettlement and rehabilitation policy taking into account the changing conditions in coal producing areas. However, as a matter of principle, the compensation and benefits offered to the people affected by coal projects of Coal India will be at least equal to and not less than those prescribed by the laws and guidelines of the Central and State Governments. In any case, Coal India's resettlement and rehabilitation policy has to be approved by the Ministry of Coal.

Objective of Coal India's resettlement and rehabilitation policy

6. In light of the growing difficulties many subsidiaries face in land acquisition, highest priority will be given to avoiding or minimizing disturbance of the local population. In their decisions to open new mines or expand existing ones, subsidiaries will explore alternative sites and project designs to minimize the need for resettlement. Wherever people are likely to be adversely affected by a project, the subsidiaries will prepare Rehabilitation Action Plans for the project.

7. Through the preparation of Rehabilitation Action Plans, subsidiaries will safeguard that project-affected people improve, or at least regain, their former standard of living and earning capacity after a reasonable transition period. The transition period is to be kept to a minimum, however the involvement of subsidiaries in resettlement and rehabilitation activities will continue until all the actions specified in the Rehabilitation Action Plan have been completed.

8. Involuntary resettlement is conceived and executed as a development program with project-affected people being provided sufficient resources and opportunities to share in a project's benefits. The efforts of subsidiaries are complementary to government schemes in rural development. To the extent that this is necessary, the concurrence, approvals and support from concerned Government authorities will be sought. In parallel, subsidiaries will work closely with non-governmental organizations, which are legally recognized and constituted and have the confidence of the project-affected people, in the preparation and implementation of Rehabilitation Action Plans.

Definition of project-affected people

9. Coal India recognizes that the acquisition of land in populated areas for mining purposes greatly affects the lives and livelihood of the local population. While the development of new mines brings job opportunities with the subsidiaries, associated contractors and ancillary industries, it also eliminates many traditional sources of income. The rehabilitation efforts of

the subsidiaries are designed to integrate the various groups of people affected by the project into the regional development process. The development of a new mine or expansion of mining activities tends to accelerate this process. By informing the potentially affected people, at the earliest possible stage, about the project and options for resettlement and rehabilitation, subsidiaries prepare the local population for the changes that are to come and ease the transition to new lifestyles.

10. It is Coal India's policy to recognize adult individuals as the unit of entitlement. In their rehabilitation efforts subsidiaries deal with a wide range of project affected people. They fall into the following categories:

A. Landowners, including those with whom government land is settled:
   i. persons from whom land is acquired including tribals cultivating land under traditional rights;
   ii. persons whose homestead is acquired; and
   iii. persons from whom land and their homestead are acquired.

B. Landless, who derive their livelihood from the land to be acquired for a minimum of three years prior to the date of notification (of intention to acquire land)
   i. sharecroppers, land lessees, tenants and day laborers;
   ii. tribals dependent on forest produce; and
   iii. persons whose homestead is acquired.

Eligibility and compensation

11. Table 1 shows the compensation and rehabilitation efforts subsidiaries will offer for each person or family affected by one of their projects. Evidence that a person is a legitimate project-affected person will need to be provided in the form of a written legal document or reference to a record, such as a revenue officer certificate, electoral roll, ration card or school record.

Rehabilitation efforts

Land for Land (Package B)

12. In many areas where subsidiaries expand their mining operations, land is scarce. It has been the experience of these companies that few project-affected people opt for acquiring land. Wherever possible and if so desired by the project-affected person who is a landowner, he will identify and purchase land with assistance from the subsidiary. The land and its area should be such so as to provide better, or at least the same, income to the project-affected person which he was deriving from his original land. The following modalities will be exercised to assist eligible project affected persons to acquire land, if they so wish:

Table 1 Compensation and rehabilitation policy

Category of persons affected by the project	*Compensation and rehabilitation entitlement options*
A.(i) Persons from whom land is acquired, including tribals cultivating land under traditional rights.	All landowners with titles will receive monetary compensation for the land acquired from them. The value of the land is determined on the basis of prevailing legal norms. In addition, a. if feasible, the subsidiaries will offer employment as per their own policies (Package A); b. project-affected people identify and purchase, with the assistance of the subsidiary, equivalent replacement land using their land compensation (Package B); c. the subsidiary will assist project-affected people to establish nonfarm self employment through the provision of infrastructures, petty ontracts or formation of cooperatives (Package C); d. if none of the other packages are available, project-affected people with less than two acres would receive rehabilitation assistance in the form of a subsistence allowance or grant to be used for productive investments provided that their income from other sources does not exceed Rs12,000 per annum (Package D).
A.(ii) Persons whose homestead is acquired.	The project-affected person will receive the replacement cost of his homestead and the structures on it. In addition, the subsidiaries acquiring his homestead will provide: a. an alternate house site measuring 100m² per family, b. assistance in designing the new house, if so desired by the project-affected person, and c. a shifting allowance to cover the full cost of transporting his belongings to the relocation site. (Package E).
B(i) Sharecroppers, land lessees, tenants, and day laborers.	Package C or jobs with contractors. Contractors will be persuaded to give jobs to eligible project affected people on a preferential basis, where feasible.
B(ii) Landless tribals	Package C or jobs with contractors. Contractors will be persuaded to give jobs to eligible project-affected people on a preferential basis, where feasible. In addition, the subsid iaries will shift the tribal community as a unit and provide facilities to meet the specific needs of the tribal community that will allow them to maintain their unique cultural identity.
B(iii) Persons whose homestead is acquired	Package E.

Source: Coal India Ltd.

i. A project-affected person who chooses this option, will not be entitled to any other rehabilitation option. However, shifting allowance, at market rate, to cover the full cost of transportation will be provided to the persons for moving to the new area; and
ii. he may purchase land on a 'willing buyer-willing seller' basis within a limited geographic area and specified time period.

Nonfarm self employment (Package C)

13. For project-affected people who opt for the nonfarm self employment package, the subsidiary will assist in developing such options as dairy and poultry production, shops, and petty contracts.

Rehabilitation assistance (Package D)

14. If none of the other options are available to affected people with less than two acres of land, the subsidiary would provide rehabilitation assistance to ensure that the affected people are able to regain their former standard of living or earning capacity. The assistance would be in the form of a subsistence allowance or a lump sum grant to be used against productive investments.

15. If the affected person chooses the lump sum grant, it will be calculated on the same basis as the subsistence allowance. During a three year period following the preparation of the Rehabilitation Action Plan, the person can select a productive investment. Until the payment is made, the grant would be held in an interest bearing account.

Women

16. Special attempts will be made to ensure that women will be given adequate access to income generating opportunities offered under this policy.

Jobs

17. Jobs will be given to eligible landless project-affected people on a preferential basis when outside recruitment becomes necessary.

Community facilities

18. The subsidiary will provide to the resettlement site a school, road with street light, 'pucca' drain, pond, dugwell and/or tubewell for drinking water supply, community center, place of worship, dispensary, grazing land for cattle and playground. Similar infrastructural facility, if necessary, will be extended to the host locality. The community facilities and services would be

available to all residents of the area, including the project-affected people and the host population.

19. The approach for operation of community facilities would be flexible and all efforts will be made to involve the State and local self-Government/ Panchayat for operating the facilities. To achieve this, subsidiaries will pursue with these agencies to ensure the same. The planning of the community facilities and the construction should be undertaken in consultation with the affected community.

Implementation, monitoring and evaluation, dispute mechanism

20. The rehabilitation action plan will address the following:

i. The project design, including an analysis of alternative designs aimed at avoiding or minimizing resettlement;

ii. socioeconomic survey and activities to ensure restoration of incomes of project-affected people in line with Coal India's resettlement and rehabilitation policy;

iii. description of the institutional and other mechanisms for provision of entitlements;

iv. timetable for the acquisition and preparation of the resettlement site(s);

v. the cost and budgets for the resettlement and rehabilitation of project-affected people;

vi. project-specific arrangements to deal with grievances of affected people; and

vii. timetables, benchmarks and arrangements for monitoring the resettlement and rehabilitation effort.

Socioeconomic survey

21. A baseline socioeconomic survey will be carried out to identify the project-affected people and ensure restoration of incomes in line with Coal India's resettlement and rehabilitation policy. This survey will be conducted, prior to notification under the relevant land acquisition Acts, by the subsidiaries with the help of reputed outside independent institutional agencies who are well versed with the social matrix of the area.

22. The basic objective of the socioeconomic study will be to generate baseline data on the social and economic status of the population who are likely to lose their means of livelihood or homestead to the acquisition of the land for the project. The database will be used to formulate a viable and practical Rehabilitation Action Plan for the affected persons in line with their entitlements.

Schedule of the census and formulation of the Rehabilitation Action Plan

23. Once the demographic and socioeconomic data is available, the Rehabilitation Action Plan will be formulated in consultation with the affected people and the State Government. It will be formulated as a simultaneous activity with the land acquisition process.

Monitoring and evaluation

24. The Rehabilitation Action Plan will be monitored and evaluated periodically after the completion of the land acquisition process.

i. The resettlement and rehabilitation activities are the responsibility of a separate group, both at the projects and corporate level, which will be constituted for planning, implementation, monitoring and evaluation of the Rehabilitation Action Plan. At the corporate level the group will be headed by a Senior Manager, whereas at the project, an executive of the rank of Manager will head the group. The project group should have at least one member with social science experience and/or skills.

ii. The project group will closely interact with the state authorities during the implementation of the Rehabilitation Action Plan. Although the subsidiaries will develop the plots and infrastructural facilities in the resettlement colony and actively implement the plan, assistance of State authorities will be taken for administrative services such as allotment of land. Implementation will be planned and monitored and corrective measures will be incorporated, if needed. In addition to the State Government, the project-affected people, the village leaders including the Pradhans and NGOs will be consulted and associated with the implementation of the plan.

iii. The Resettlement and Rehabilitation Cell at the corporate level will evaluate the implementation of the Rehabilitation Action Plan after its completion.

Mechanism for dealing with disputes

25. A committee comprising nominee(s) of the State Government, nominee(s) of the project general manager of the subsidiaries, a representative of the project-affected people and an independent party, such as a respected community leader, a retired judge or principal of a reputed local institution of higher education, will be constituted to examine the grievances of the affected person and propose corrective actions as required. The subsidiaries will make arrangements for establishing the Committee and bear the cost.