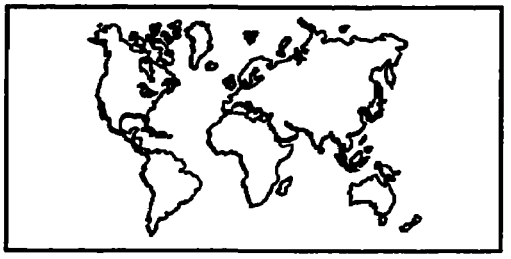
Environmental Assessment/Analysis Reports



Report E0024

Mozambique - Gas Engineering Project

EA Category B

Environment Report

October 1993

This report has been prepared by the Borrower or its Consultant

ENVIRONMENTAL REPORT
PANDE ENH EXPLORATION AREA

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Bazaruto Archipelago
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ENVIRONMENTAL REPORT: PANDE ENH EXPLORATION AREA

1. Terms of reference:

To provide ecological information for the World Bank/ IFC/M.I.G.A. to augment the Smedvig report done on belhalf of ENH in the Pande area of the Inhambane Province of Moçambique.

2. Specific details required:

- present situation of vegetation i.e. habitats
- list of dominant plant species
- present status of wildlife
- list of dominant wildlife species
- surface hydrology
- total area lying fallow
- total area under cultivation
- types of crops

3. Locality and general description of the Pande exploration area:

The area is situated on the eastern littoral of the Inhambane Province extending up to the Save River, 200km south of Beira city and 600km north of the capital city of Maputo (Figure 1).

The climate is transitional between moist and arid tropical environments with an annual rainfall less than 800mm (Atlas Geográfica de Moçambique 1980).

The surface geology is derived from the tertiary/quaternary period when sands were transported by major river systems which once drained the interior (i.e. present day Botswana). The soils are mainly sandy. Soils with a higher clay fraction support hydromorphic grasslands and seasonal pans (depessions) which retain rain water.

Coastal sand dunes, supporting salt and wind tolerant pioneer plant species, abut onto sandy beaches dissected by dendritic mangrove estuaries. Inland the vegetation ranges from hydromorphic grassland to savanna and closed canopy woodland giving the area its vegetational mosaic character.

4. Historic background:

Early exploratory investigations of the area by various foreign interests indicated the presence of substantial reservoirs of natural gas. During this period, gas field number 4 ignited and burnt for 18 months, between October 1965 and 14 April 1966 (Mario Marques pers comm.).

Subsequent wells were sunk up to the present and these are presently supplying gas to Vilankulo, a coastal development node 100km to the south.

The local people are part of the Shangaan ethnic group whose language is Xitswa.

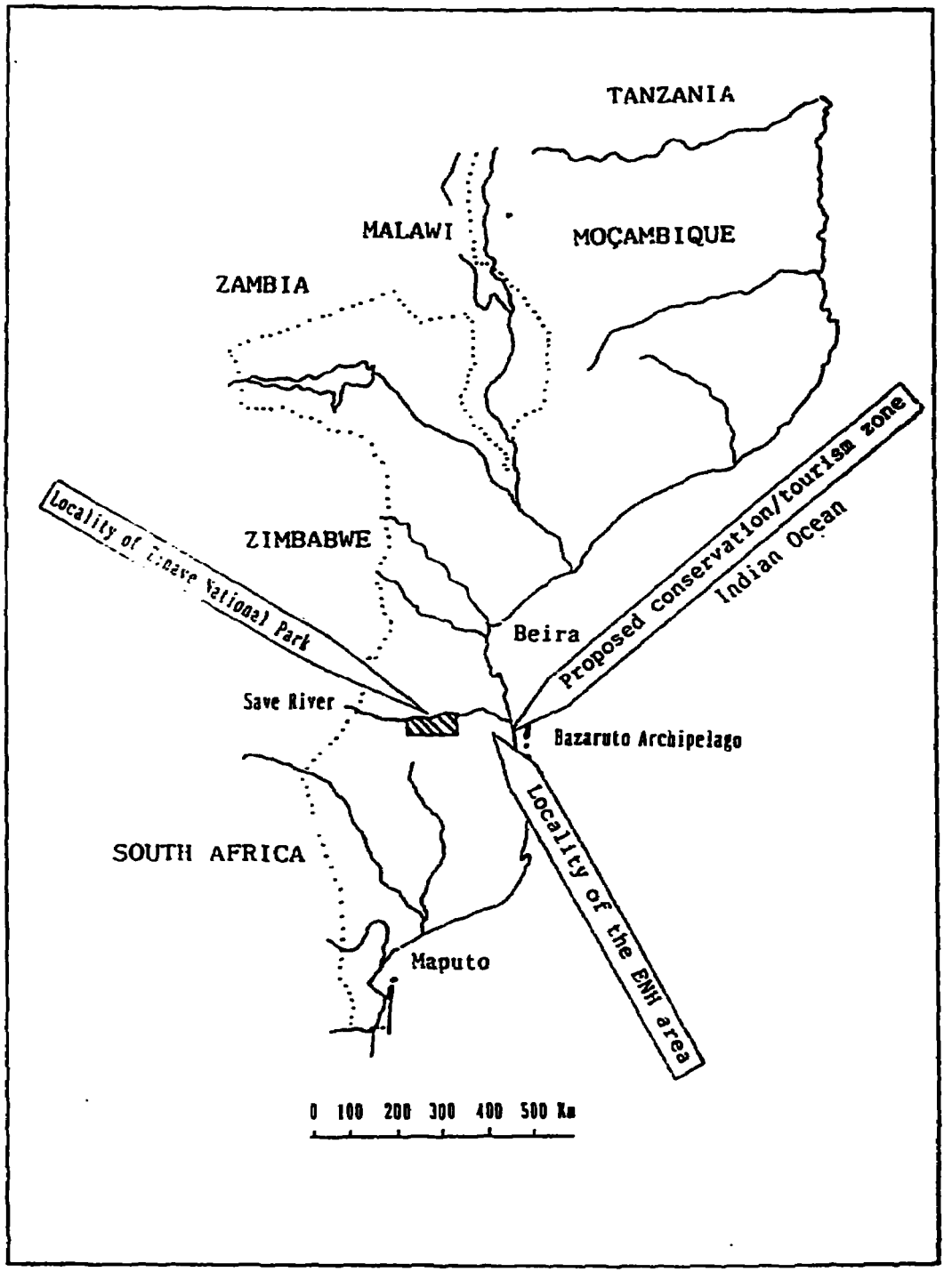

Figure 1: Map of Moçambique indicating ENH's exploratory area, Parque Nacional do Zinave and the proposed coastal conservation/tourism zone..

5. Vegetation or habitats (Wild & Fernandes, 1967; Palgraves, 1983):

There are twelve distinct habitats in the area, viz;

- coastal littoral with mobile sand dunes supporting sparse salt and wind tolerant vegetation (photo 1)
- mangrove estuaries (photo 2)
- Save river and associated floodplain
- hydromorphic grasslands with palm and termitera thickets (photos 3)
- seasonal pans (small depressions with rain fed water)(photo 4)
- savanna grassland (photo 5)
- deciduous miombo/dambo* woodland (photo 6)
- mesic miombo/dambo woodland
- Mopane Colophospermum mopane woodland
- Cimbiri Androstachys johnsoni woodland
- blow-out area caused by 1965 gas explosion (photo 7)
- fallow slash and burn agricultural fields (machambas) (photo 8)

* miombo/dambo is a Zambian term for Brachystegia woodland and associated high water table grasslands and pans.

5.1. Mobile coastal sand dunes with sparse, salt and wind tolerant vegetation:

Coastal dune pioneers are represented by Scaevola thunbergii, Ipomoea brasiliensis, Canavalia maritima merging with the dune sedge Cyperus maritima and grass Sporobolus virginicus. These species are replaced by shrubs such as Helichrysium kraussii, Pavetta edentula, Mundulea sericea, Ochna beirensis, Euclea schimperi, and thence to more robust trees such as Annona senegalensis, Dovyalis longispina, Mimusops caffra etc.

5.2. Mangrove estuaries:

The coast contiguous to the exploration area has extensive areas of mangrove swamps, comprising at least six species:

Indian mangrove Ceriops tagal
Red mangrove Rhizophora mucronata
Black mangrove Bruguiera gymnorrhiza
White mangrove Avicennia marina
Sonneratia Sonneratia alba
Springtide mangrove Lumnitzera racemosa

5.3. Save river and associated floodplain:

The Save river is broad, mainly dry during winter, with intact riverine forest dominated by Syzygium guineense, Ficus sycomorus, Mimusops obtusifolia, Trichilia emetica, Rauvolfia caffra, Diospyros mespeliformis and Kigelia africana. The lower banks are protected by a dense growth of the shrub Grewia sulcata.

The associated aluvial floodplain resembles open parkland with large specimens of Sterculia rogersii, Kigellia pinnata, Lonchocarpus capassa and Acacia albida.

Summer rains cause the river to overspill its banks to fill depressions along its margins. These depressions or pans support water lilies Nymphaea sp. and emergent vegetation and are excellent habitat for water fowl. The non-indigenous floating aquatic Salvinia, which is creating problems in neighbouring countries, has invaded many of the shollower depressions.

5.4. Hydromorphic grassland with palm and termitera thickets:

Soils, more clay than sand, support grassland with large knob thorn acacia trees Acacia nigrescens and isolated clumps of palm thickets comprising Hyphaene crinata and Phoenix reclinata. Areas of high salinity support grass species such as Sporobolus virginicus, sedge Juncus kraussii, and salt plant Salicornia perrieri.

5.5. Savanna:

The majority of the exploration area is dominated by savanna reprenting a wide variety of robust tree species such as baobob or mbondeiro Adansonia digitata and others like Cordyla africana, Sterculia rogersii, Kigellia pinnata, Lonchocarpus capassa, Sideroxylon inerme, Sclerocarya caffra, Albizia versicolor, and Combretum imberbe. Smaller edible fruit bearing trees include the monkey apple Strychnos spinosa, S. innocua, and the toad tree Tabernaemontana elegans. In winter, a striking feature of the savanna is the burning bush creeper Combretum paniculatum with its profusion of red flowers.

This savanna habitat produces some of Moçabique's most valuable hard woods such as massassa Pterocarpus angolensis, panga panga Millettia stuhlmannii, pod mahogany or chamfute Afzelia quanzensis, blackwood Dalbergia melanoxylon, and sandalwood Spirostachys africana. Unfortunately this valuable resource is being exploited without consideration for its its sustainablity. Furthermore, export of uncut logs is being favoured instead of first satisfying the national woodworking industry which provides employment opportunities and extended export earnings.

Another feature of the savanna are the thickets on termite mounds (photo 9) dominated by tall trees such as wild tamarind Tamarindus indicus, Diospyros mespeliformis and Mimusops obtusifolia. The base of these termiteria thickets support dense clusters of Salvadora persica a plant which the local people use as an inhalant for relieving asthma.

Dominant tall grass species of the savanna understory are Cymbopogon sp. and Hyparrhenia sp. and form the principal source of combustible material to feed fires which frequently rage through the savanna.

5.6. Miombo/dambo woodland:

Two species of trees Brachystegia speciformis and Julbernadia globiflora with canopies of even height (> 10m) dominate this type of woodland. This habitat is characterized by deciduous or evergreen foliage depending upon the soil's water retention capacity.

A major feature of miombo are the dambos or seasonal pans (small lakes) (photo 4) which are remnants of larger water bodies resulting from past periods of higher rainfall. These pans support a great variety of water birds and provide drinking water for most of the area's wildlife.

5.7. Mopane Colophospermum mopane woodland:

This type of habitat, on impervious soils of high sodic content, is dominated by this one species.

5.8. Cimbiri Androstachys johnsonii woodland:

Like the previous habitat, one species dominates. These mono-specific patches occur on calcium rich, red sandy soils.

5.9. Gas well No. 4 crater:

Explosion, ignition and subsequent flooding of No. 4 well resulted in a depression approximately 40m deep and 100m in diameter. The subsequent fire, which burnt for 18 months, totally denuded the vegetation over an area of about 250 000m^2 and sterilized the surrounding soil (photo 10). However, natural plant succession is taking place (photo 11) by plants such as Sesbania sp., Asclepias sp., Grewia sp., Cyperus sp., and the dangerous invader weed Lantana camara which is associated with disturbed soil. Grasses are represented by Urochloa mosambicensis, Dactyloctenium aegyptium, Panicum natalense, Melinis nerviglumis, Cymbopogon excavatus, Chloris sp. and Andropogon sp.

6. Surface hydroloy:

The area's main source of surface fresh water emanate from:-

- Rio Save which is reduced in winter to about 1% of its normal summer flow, November to March, rises in Zimbabwe.
- floodplain lakes which derive their water when Rio Save spills its banks, November to March.
- Rio Govuro which maintains a constant flow of water throughout the year from an underground fossil river system.
- Dambos (wetlands) in the savanna and miombo which are maintained by rain water.

7. Wildlife:

The wildlife situation in the general area is in a critical state having been the main source of red meat protein for the various military factions for the past 15 years (photo 12). Elephants, buffalo and hippo, once common in the region, have been hunted to near extinction. Likewise, species considered rare in Moçambique such as giraffe, roan, tsesebe, Niassa wildebeest and ostrich are, from recent accounts and preliminary surveys (Dutton & Ramsay, 1993) critically threatened with extinction. Military weapons, widely dispensed during this tragic period of conflict, have been the main cause of destruction.

Parque Nacional de Zinave, which abuts on the western limit of the ENH exploration area (Figure 1), once supported a rich biodiversity in wildlife species. Zinave, with a luxury camp, attracted lucrative international tourism. Furthermore, wildlife, apart from its tourism value, provides the local population, using traditional hunting methods (photo 13), with its main source of protein.

Predators such as lion, leopard, hyena, jackal are all recorded for the area, but now all are severely depleted because of hunting pressure and the paucity of prey species.

Probably the last remaining population of dugong (the mythical mermaid) Dugong dugon on the entire east African coast occur in the shallow marine environment east of the ENH exploration area (Dutton & Zolho 1990).

On the positive side, the area, in general, is still ecologically viable and with proper management and control of resource use, can be rehabilitated to its former richness in biodiversity (refer recommendations).

The following list of 104 mammal species have are recorded for the general area (Smithers & Tello 1976, Smithers 1983):

Fourtoed elephant shrew Petrodromus tetradactylus
Shortsnouted elephant shrew Elephantulus brachyrhynchus
Lesser red musk shrew Crocidura hirta
Yellow golden mole Calcochloris obtusirostris
Wahlberg's epauletted fruit bat Epomophorus wahlbergi
Peters epauletted fruit bat Epomophorus crypturus
Angola freetailed bat Tadaria condylura
Little freetailed bat Tadarida pumila
Schreiber's longfingered bat Miniopterus schreibersi
Lesser longfingered bat Miniopterus fraterculus
Schlieffens' bat Nycticeius schlieffeni
Banana bat Pipisstrellus nanus
Great brown bat Scotophilus gigas
Yellow house bat Scotophilus nigrita
Lesser yellow house bat Scotophilus viridis
Damara wooly bat Kerivoula argentata
Ethioian slitfaced bat Nycteris aethiopica
Egyptian slitfaced bat Nycteris thebaica

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Ethioian slitfaced bat Nycteris aethiopica
Egyptian slitfaced bat Nycteris thebaica

Hildebrandt's horseshoe bat Rhinolophus hildebrandti
Lander's horseshoe bat Rhinolophus landeri
Bushveld horseshoe bat Rhinolophus simulator
Commerson's leafnosed bat Hipposideros commersoni
Sundevall's leafnosed bat Hipposideros caffer
Persian trident bat Triaenops persicus
Bushbaby Galago crassicaudatus
Nightape G. senegalensis
Chacma baboon Papio ursinus
Samango monkey Cercopithecus albogularis
Vervet monkey C. pygerynthrus
Pangolin Manis temmincki
Spotted hyaena Crocuta crocuta
Cheetah Acinonyx jabatus
Leopard Panthera pardus
Lion P. leo
Caracal Felis caracal
Serval F. serval
Wildcat F. libyca
Hunting dog Lycaon pictus
Sidestriped jackal Canis adusus
Clawless otter Aonyx capensis
Honey badger Mellivora capensis
Striped polecat Ictonyx striatus
Civet Viverra civetta
Largespotted genet Genetta tigrina
Large grey mongoose Herpestres ichneumon
Slender mongoose H. sanguineus
Whitetailed mongoose Ichneumia albicauda
Water mongoose Atilax paludinosus
Banded mongoose Mungos mungo
Dwarf mongoose Helogale parvula
Antbear Orycteropus afer
Elephant Loxodonta africana
Tree hyrax Dendrohyrax arboreus
Dugong Dugong dugon (coastal)
Burchell's zebra Equus burchelli
Bushpig Potamochoerus porcus
Warthog Phacochoerus aethiopicus
Hippopotamus Hippopotamus amphibius
Giraffe Giraffa camelopardalis
Grey duiker Sylvicapra grimmia
Red duiker Cephalophus natalensis
Suni Neotragus moschatus
Oribi Ourebia ourebi
Steenbuck Raphicerus campestris
Sharp's grey buck Raphicerus sharpei
Kudu Tragelaphus strepsiceros
Nyala Tragelaphus angasi
Bushbuck Tragelaphus scriptus
Impala Aepyceros melampus
Reedbuck Redunca arundinum
Waterbuck Kobus ellipsiprymnus
Sable Hippotragus niger
Eland Taurotragus oryx
Buffalo Syncerus caffer

Blue wildebeest Connochaetes taurinus taurinus, C.t. johnstoni
Lichtenstein's hartebeest Alcelaphus lichtensteini
Scrub hare Lepus saxatilis
Cape hare Lepus capensis
Hottentot molerat Cryptomys hottentotus
Porcupine Hystris africaeaustralis
Spring hare Pedetes capensis
Rock dormouse Graphiurus platyops
Dormouse Graphiurus murinus
Sun squirrel Heliosciurus rufobrachium
Bush squirrel Paraxerus cepapi
Red squirrel Paraxerus palliatus
Greater cane rat Thryonomys swinderianus
Creek rat Pelomys fallax
Spiny mouse Acomys spinosissimus
Single striped mouse Lemniscomys griselda
Moçambique forest mouse Thamnomys cometes
Forest mouse T. dolichurus
Pygmy mouse Leggada minutoides
Rudd's mouse Uranomys ruddi
Multimammate mouse Praomys natalensis
Blacktailed tree rat Thallomys paedulcus
Red veld rat Aethomys chrysophilus
Lesser gerbil Gerbillurus paeba
Peters' gerbil Tatera leucogaster
Giant rat Cricetomys gambianus
Pouched mouse Saccostomus campestris
Grey pygmy climbing mouse Dendromus melanotis
Lesser chestnut climbing mouse D. mystacalis
Fat mouse Steatomys pratensis

8. Avifauna:

A total of 424 different birds are reported to occur in the general area (Maclean 1985).

The following is a preliminary bird checklist of indicator species for the habitats previously described.

8.1. Coastal littoral:

White pelican Pelecanus onocrotalus
Pinkbacked pelican P. rufescens
Reed cormorant Phalacrocorax africanus
Greater flamingo Phoenicopterus ruber
Lesser flamingo P. minor
African fish eagle Haliaeetus vocifer
Osprey Pandion haliaetus
Turnstone Arenaria interpres
Crab plover Dromas ardeola
Greyheaded gull Larus cirrocephalus
Caspian tern Hydroprogne caspia
Swift tern Sterna bergii
Mangrove kingfisher Halcyon senegaloides
Wetlands (excluding the Save River):
Dabchick Tachybaptus ruficollis

White pelican Pelecanus onocrotalus
Pinkbacked pelican P. rufescens
Whitebreasted comorant Phalacrocorax carbo
Grey heron Ardea cinerea
Goliath heron A. goliath
Great white egret Egretta alba
Little egret E. garzetta
Openbilled stork Anastomus lamelligerus
Saddlebilled stork Ephippiorhynchus senegalensis
Yellowbilled stork Mycteria ibis
Sacred ibis Threskiornis aethiopicus
Hadeda ibis Bostrychia hagedash
African spoonbill Platalea alba
Whitefaced duck Dendrocygna viduata (1 000 counted 24/9/93)
Whitebacked duck Thalassornis leuconotus (400)
Egyptian goose Alopochen aegyptiacus
Hottentot teal Anas capensis
Redbilled teal A. erythrorhyncha
Pygmy goose Nettapus auritus (400)
Knobbilled duck Sarkidiornis melanotos
Spurwinged goose Plectropterus gambensis (500)
African fish eagle Haliaeetus vocifer
African marsh harrier Circus ranivorus
African jacana Actophilornis africanus
Lesser jacana Microparra capensis
Blacksmith plover Vanellus armatus
Moorhen Gallinula chloropus
Ethiopian snipe Gallinago nigripennis
Pied kingfisher Ceryle rudis

8.2. Grassland:

Cattle egret Bubulcus ibis
Martial eagle Polemaetus bellicosus
Blackbreasted snake eagle Circaetus gallicus
Peregrine falcon Falco peregrinus
Dickinson's kestrel F. dickinsoni
Common quail Coturnix coturnix
Kori bustard Ardeotis kori
Blackbellied korhaan Eupodotis melanogaster
Marsh owl Asio capensis
Palm swift Cypsiurus parvus
Flappet lark Mirafra rufocinnamomea
Pinkthroated longclaw Macronyx ameline
Yellowrumped widow Euplectes capensis

8.3. Savanna:

Ostrich Struthio camelus
Cattle egret Bubulcus ibis
Marabou stork Leptoptilos crumeniferus
Secretarybird Sagittarius serpentarius
Hooded vulture Necrosyrtes monachus
Whitebacked vulture Gyps africanus
Tawny eagle Aquila rapax
Brown snake eagle Circaetus cinereus

Dark chanting goshawk Melierax metabates
Crested francolin Francolinus sephaena
Helmeted guineafowl Numida meleagris
Doublebanded sandgrouse Pterocles bicinctus
Redeyed dove Streptopelia semitorquata
Cape turtle dove S. capicola
Emeraldspotted dove Turtur chalcospilos
Brownheaded parrot Poicephalus cryptoxanthus
Grey lourie Corythaixoides concolor
Diederik cuckoo Chrysococcyx caprius
Wood owl Strix woodfordii
Giant eagle owl Bubo lacteus
Moçambique nightjar Caprimulgus fossii
Redfaced mousebird Colius indicus
Little bee-eater Merops pusillus
Greater honeyguide Indicator indicator
European swallow Hirundo rustica
Lesser striped swallow Hirundo abyssinica
Forktailed drongo Dicrurus adsimilis
Pied crow Corvus albus
Sombre bulbul Andropadus importunus
Whitethroated robin Cossypha humeralis
Blackheaded apalis Apalis melanocephala
Longtailed shrike Corvinella melanoleuca
Greyheaded bush shrike Malaconotus blanchoti
Glossy starling Lamprotornis nitens
Redbilled oxpecker Buphagus erythrorhynchus
Purplebanded sunbird Nectarinia bifasciata
Redbilled quelea Quelea quelea
Lemonbreasted canary Serinus atrogularis

8.4. Miombo/dambo/Mopane woodland:

Cuckoo hawk Aviceda cuculoides
Bat hawk Macheiramphus alcinus
Longcrested eagle Lophaetus occipitalis
Lizard buzzard Kaupifalco monogrammicus
Gymnogene Polyboroides typus
Bluespotted dove Turtur afer
African cuckoo Cuculus gularis
Pearlspotted owl Glaucidium perlatum
Pennantwinged nightjar Macrodipteryx vexillaria
Woodland kingfisher Halcyon senegalensis
Rackettailed roller Coracias spatulata
Little spotted woodpecker Campethera cailliautii
Blackheaded oriole Oriolus larvatus
Oliveheaded weaver Ploceus olivaceiceps (endemic)

8.5. Riverine:

Darter Anhinga melanogaster
Greenbacked heron Butorides striatus
Blackcrowned night heron Nycticorax nycticorax
Whitebacked night heron Gorsachius leuconotus
Hamerkop Scopus umbretta
Hadeda ibis Bostrychia hagedash

Yellowbilled kite Milvus migrans
Bat hawk Macheiramphus alcinus
Bateleur Terathopius ecaudatus
Natal francolin Francolinus natalensis
African finfoot Podica senegalensis
Whitefronted plover Charadrius marginatus
Water dikkop Burhinus vermiculatus
African skimmer Runchops flavirostris
Green pigeon Treron calva
Purplecrested lourie Tauraco porphyreokophus
Green coucal Ceuthmochares aereus
Burchell's coucal Centropus superciliosus
Pel's fishing owl Scotopelia peli
Narina trogon Apaloderma narina
Giant kingfisher Ceryle maxima
Trumpeter hornbill Bycanistes bucinator
Heuglin's robin Cossypha heuglini
Paradise flycatcher Terpsiphone viridis
African pied wagtail Motacilla aguimp
Chestnutfronted helmetshrike Prionops scopifrons

9. Freshwater fish:

The following is a partial list of fish recorded for the Save river, associated floodplain lakes and rain-fed seasonal depressions.

Cornish-jack Mormyrops deliciosus
Tiger-fish Hydrocynus vittatus
Spot-tail Alestes sp.
Minnow Barbus spp.
Red-spotted mudsucker Labeo rubropunctatus
Mudsucker L. spp.
Catfish or barbel Clarius spp.
Bream or kurper Tilapia mossambica
Redbreasted bream T. melanopleura
Makreel or silver barbel Eutropius depressirostrus
Squeaker Synodontis sp.
Freshwater eel Anguilla sp.
Indian ocean tarpon Megalops cyprinoides
Lung-fish Protopterus annectens brieni
Kill fish Nothobranchius rachovii

10. Herpetofauna:

Five species of marine turtle occur in the contiguous sea environment, three* of which nest on the nearby islands of the Bazaruto Archipelago.

Olive ridley turtle Lepidochelys olivacea
Loggerhead turtle Caretta caretta* (photo 14)
Hawksbill turtle Eretmochelys imbricata
Green turtle Chelinia mydas*
Leatherback turtle Dermochelus coriacea*

Crocodile Crocodylus niloticus, and water monito Veranus niloticus, the Eastern hinged terrapin Pelusios castanoides castanoides, and P. subniger occur in the river and lakes.

The terrestrial habitats support a large variety of other reptiles including;

Bush monitor lizard Varanus albigularus,
Black mamba Dendroaspis polylepis
Green mamba D. augusticeps
Python Python sebae
Puffadder Bitis arietans
Night Adder Causus rhombeatus
Forest cobra Naja melanoleuca

11. Agriculture:

11.1. Fallow agricultural fields (machambas):

The recent bush war caused most the population to abandon their slash and burn (shifting) type of agricultural lands in search of security. Now after 15 years the fallow fields have well developed secondary vegetation comprising mainly large leaf Combretum spp (photo 8). The total area lying fallow is small, covering approximately 1% of the ENH exploratory area.

11.2. New agricultural lands:

Residents (approximately 2 728 according to the current ENH survey) have only recently started returning to their lands, with the result that very little area is presently under cultivation (< 1%).

11.3. Crops:

Planted crops in the savanna habitat comprise mainly maize, millet, sorghum, and melons, while in the areas of high water table (nearer the coast) sweet potatoes, cassava, bananas, pawpaw and sugar cane are grown. However, the local residents have a long history of deriving food, medicine, and fibres from indigenous species.

Typical wild fruits are: mahlala Strychnos spinosa, kuakwa S. innocua, makanye Sclerocarya caffra, mbondeiro Adansonia digitata (photo 15), tjinzo Hyphaene natalensis, titjinzo Phoenix reclinata, tikuri Syzygium cordatum, madokomelo Landolphia kirkii, hlanzo Mimusops caffra and many others.

Alcoholic drinks are made from the sap (uchema) of the palm Hyphaene natalensis and fruits of makanye Sclerocarya caffra, mphimbi Garcinia livingstonei, titi Artabotrys brachypetalus and many other species.

"Toothbrushes" with anteseptic qualities are made from hangula Euclea schrimperi, and the hlehlu creeper serves as a shampoo or soap.

Indigenous plants with curative properties for treating physical and mental ailments are too numerous to list . For example Aloe leaves serve as a strong antiseptic, leaves of Salvadora persica relieve asthma, roots of Hyphaene natalensis neutralize the deadly sting of a stonefish Synanceia verrucosa.

Fibres derived from the palm Hyphaene natalensis and the Sterculia rogersii tree are utilized to produce rope, baskets, sleeping mats etc.

Robust water containers, bee hives and cloth are produced from the bark of the Bulbernadia globiflora tree.

12. Recommendations:

Although not part of our brief we would like to make the following suggestions and recommendations:-

1. That ENH, as the principal developer in the area, play a pivotal role in assisting with the rehabilitation process and conservation of the wildlands resource by;

a) Facilitating environmental studies using regional experts, including Mocambique's biology and social science faculties of Universidade Eduardo Mondlane, who are familiar with African environments and social systems .

b) Assisting in the rehabilitation of Parque Nacional de Zinave (Figure 1) which is contiguous with their area of exploration.

c) Providing logistical and financial support for a conservation officer to assist the Direcção Nacional de Florestas e Fauna Bravia with conservation extension, and to control the poaching of wildlife and timber. Senhor André Chinoce Macuiane, member of the ENH staff, would be an ideal candidate for this important responsibility, because of his profound knowledge of the environment and its natural resources.

d) Creating a nature reserve which will include Lake Chemeja (boundaries to be established after proper ground surveys). ENH can develop a small rustic camp overlooking this outstanding lake (refer section 5.6) to accommodate visitors. Local residents living next to Lake Chemeja, such as Inocence Farieda, Nordim and Justino Eban, should be appointed trustees and beneficiaries (IUCN 1980; Cernia 1985; Tinley 1991; Brandon 1992; Wells 1992) of this proposed nature reserve.

e) Gas well No. 4 crater, we regard as posing no ecological threat to the immediate environment. In fact it should be promoted as a tourist attraction (photo 16). The rusting perimeter fence should be removed. Natural plant succesion should be allowed to re-vegetate the area. However, the invading Lantana weed should be removed from the environs of the crater and burnt.

A coastal strip, east of the ENH exploration area, of at least 5km wide including Rio Guvuro extending from the Save River to Inhassoro (Figure 1), should be designated and proclaimed a "Green belt" to accommodate conservation and recreational facilities.

ENH should urge the district authority to prohibit mechanized bush clearing operations similar to the one near Panda 1.

Physical and aesthetic impacts of the various wells on the natural environment are limited to relatively small areas once the drilling and capping operations have been completed (photo 17). However, this situation would change drastically if gas was to be laid on in the exploratory area. Careful planning for peri-urban development would then be a priority to avoid socio-ecological problems from developing. Supplying gas to the centres of Inhassoro and Vilankulo, to encourage development there, is a sound decision.

The main camp (area 1 should receive the attention of a regional landscape gardener to give it an environmental "face-lift". The use of local indigenous trees and plants, bird baths etc will give the camp a more tranquil character. Pleasant suroundings are known to improve the efficiency and well being of the people who work in this type of environment (Ramsay 1989).

Finally, ENH should include in its budgetry requirements from the World Bank, additional contingency funding to accommodate these conservation issues, as part of the Bank's Global Environmental Facility commitment.

Estimated expenditure for one year would be (SUS):-

Environmental and Resource Surveys	30 000
Logistical assistence for Parque Nacional do Zinave ..	25 000
Annual salary for principal conservation officer	10 000
Annual salary for asssistant conservation officer	5 000
Contigency expences	10 000
TOTAL	**$US 80 000**

13. Acknowledgements:

Our grateful thanks to Engineer Mario Marques for inviting us to do undertake this preliminary ecological study of the ENH exploration area.

Thanks also to production engineer Victor Julien and officer André Chinoce Machuiane for their assistance.

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Consultant Ecologist

Sheila Ramsay, MA
Social Scientist

Arquipelago do Bazaruto
29 de Setembro 1993

13. References:

Atlas Geográfico República de Moçambique. 1980. Vol.1. Ministerio da Educação.

Brandon. 1992. People and Parks. The World Bank, World Wildlife Fund and USAID. Washington, DC.

Cernea, M., ed. 1985. Putting people first: Sociological variables in rural development. New York in Wells, M. K.

Coates Palgrave, K. 1983. Trees of Southern Africa. C. Struik Publishers, Cape Town.

Dutton, T.P. and R. Zolho. 1990. Conservation Master Plan for sustainable development of the Bazaruto Archipelago. Report commissioned by WWF(International) for the Ministério da Agricultura. Moçambique.

Dutton, T.P. and S.A. Ramsay. 1993. Preliminary ecological survey of Parque Nacional de Zinave. Report for DNFFB.

International Union for Conservation of Nature and Natural Resources (IUCN). 1980. World conservation strategy: Living resource conservation for sustainable development in Wells, M. & K. Brandon. 1992. People and Parks. The World Bank, World Wildlife Fund, USAID.

Tello, J.L. & T.P. Dutton. 1979. Reconhecimento Ecologico da Regiao Povuma/Lugenda, em Vista a Creação de uma Parque Nacional/Internacional.

Maclean, G.L. 1985. Robert's Birds of Southern Africa. The Trustees of the John Volker Bird Book Fund, Cape Town.

Ramsay, S. 1989. The therapeutic use of wilderness. Unpublished document presented at the Southern African Wilderness Conference. Technikon Natal, Durban.

Smithers R.H.N. & J.L.P. Tello. 1976. Checklist and Atlas of the Mammals of Mozambique. National Museums and Monuments. Salisbury.

Smithers R.H.N. 1985. The Mammals of the Southern African Subregion. University of Pretoria.

Tinley, K.L. 1991. Stategy for the most beneficial usage of Moçambique's Wilderness Resources. FAO/UN Contract DP 9/7 MOZ/86/003.

Wells, M. & K. Brandon. 1992. People and Parks. The World Bank, World Wildlife Fund, USAID.

Wild,H. & A. Fernandes. 1967. Flora Zambesiaca, M.O. Collins, Salisbury.

Photo [illegible] contiguous to the ENH exploratory [illegible]

Photo [illegible] Mangrove communities in the Save River Delta, contiguous to the ENH exploratory area (refer page 13).

Photo [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible]

Photo : Seasonal lakes (pans) fed by rain water

Photo [illegible] Savanna grassland habita which [illegible]ers most of the ENH area.

Photo 6. Deciduous Miombo woodland

Photo 7: Crater at blown out well No. 4.

Photo 8: Fallow argriculture field showing natural plant succession after 12 years, mainly by broad leaf Combretum spp.

Photo 9: Typical termitera thicket, indicating water-logging soils during the wet season. November to March.

Photo 10: No. 4 well crater - a tourist attraction.

Photo 11: Natural plant succession at the crater after 31 years.

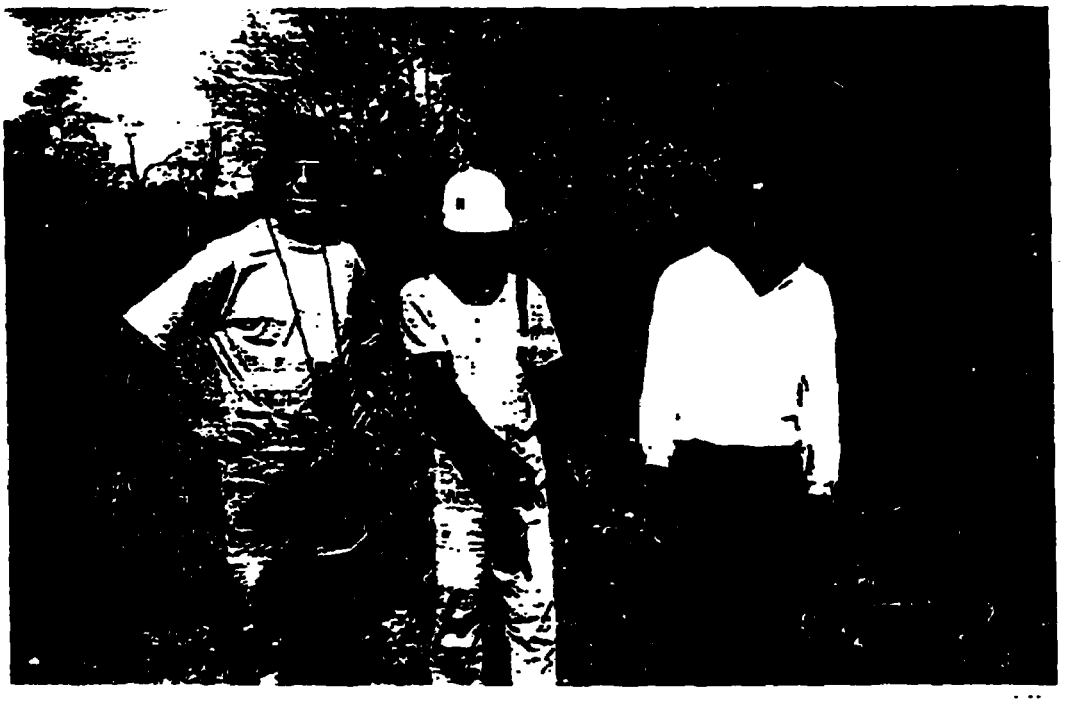


Photo 12: Rangers at Parque Nacional do Zinave indicating the presence of bones from wildlife resulting from the military's occupation.

Photo 13: Local people have a long history as hunter gatherers. A hunter, near Pande No.4, displaying a Helmeted Guineafowl Numida meleagris he had shot with bow & arrow.

Photo 14: Tourists on Bazaruto Island watching Loggerhead turtle Caretta caretta hatchlings emerging from a nest during November 1992.

Photo 15: Mbondeira Adansonia digitata, an important food tree for the local people.

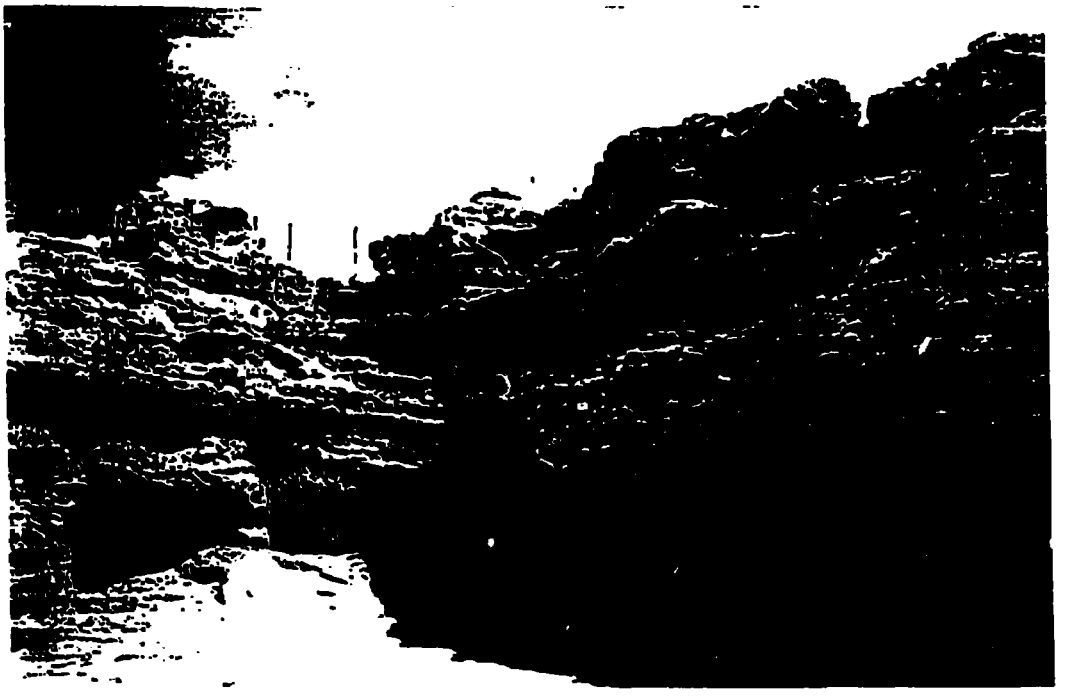


Photo 16: The blown out crater of Pande No. 4 could be regarded as a tourist attraction.

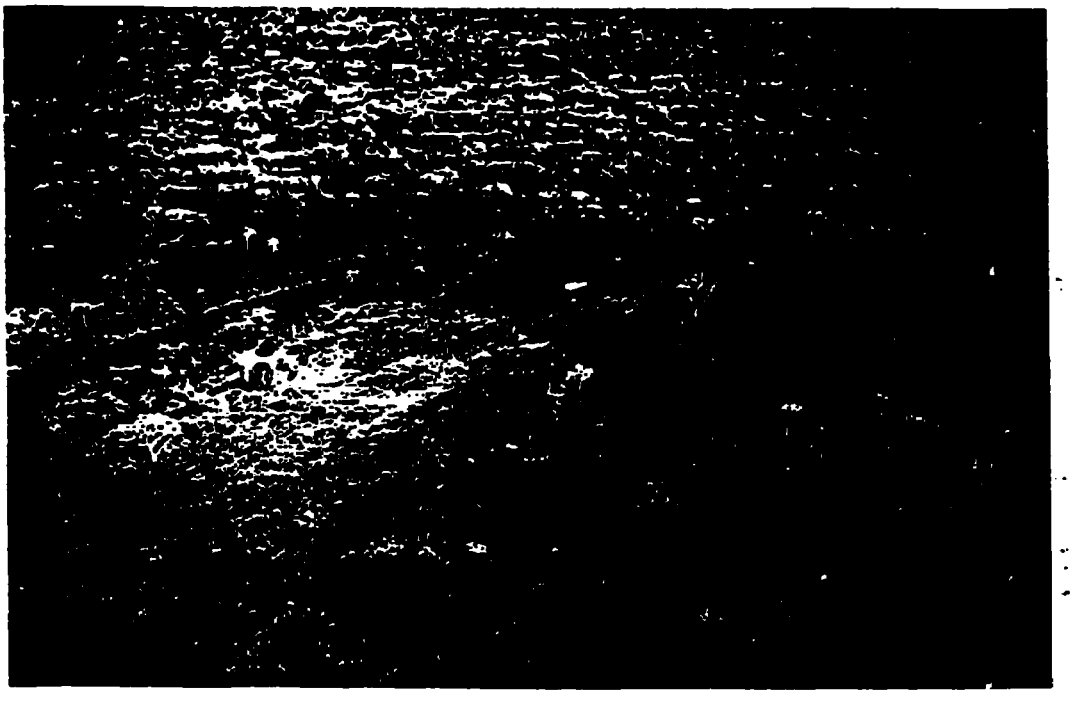


Photo 17: One of the wells supplying gas to Vilankulo. Impacts on the ecology and aesthetic values of the general area are very localized.

PANDE AREA:

A ADMINISTRATIVE BOUNDARIES
area: ± 42Km x 37 Km

B PANDE FIELD

Where Pande wells are located
area: ± 15 Km x 30 Km

C WORKING AREA
including actual seismic programme
area: ± 43Km x 82 Km

POPULATION OF "PANDE AREA"

According to a survey carried out 2 years ago the concentration of people in main areas is the following:

I.	Aldeia de Pande	2484	inhabitants
II.	Pande 1	1171	"
III.	Colongue	721	"
IV.	Machavo	704	"
V.	Maluvane	132	"

Close to the sea side there are few populated areas but the number of inhabitants on each area is always changing. Normally they are families, in the african sense of the word (grandparents, parents, uncles, sons,nephews...)

From these tipe of fishing villages we can mention Mazadeja (Northern side); Mucondo; Mutucue

The big Centres of "Pande Area" (I,II,III, and V)

With exception of Pande 1, and according to the old people of Pande (ENH workers inherited from Gulf Oil) all other concentrations of people are prior to ENH activities.

Most of them inherits the name of the indigenous chief of the area.

The people living around Pande 1 (ENH base at Pande) not only benefits of a small seasonal lake existing there, but also any time they need ENH provides fresh water from the well in the base camp.

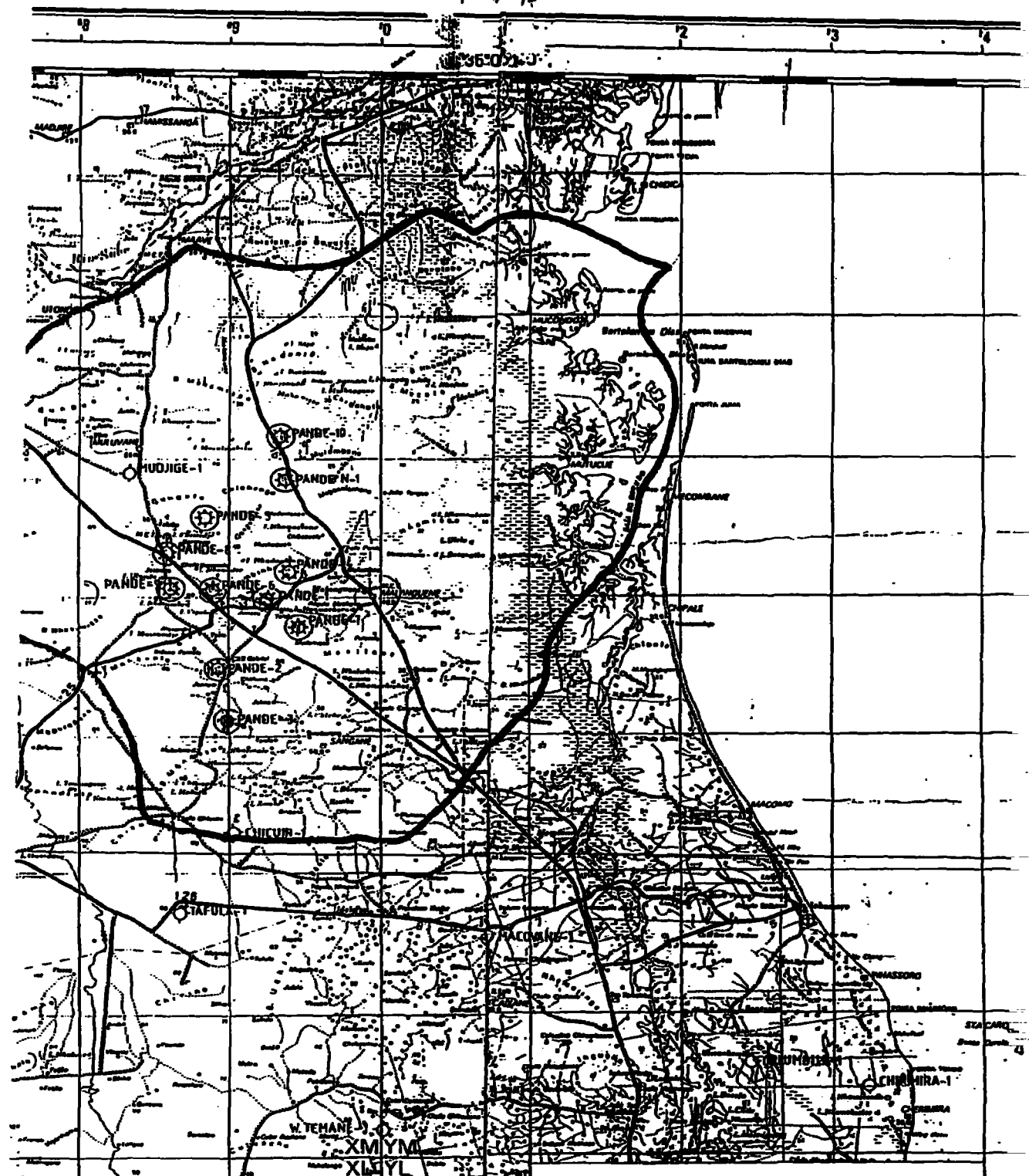
In all the area there a considerable number of people (families) who use to move from place to place.

Normally, when drilling activities take place, around the area at least 3 to 5 families settled down next to the Well.

Also in the area where ENH perform his activities, but outside "Pande Administrative area" (in particular seismic survey being carried out now) there are other important spots with a relative high population densities:

Macovane, 2 Km east of National Road nº1, around 35 Km South of Pande base camp.

Maimelane, next to the National road nº1, 15 Km South from coassing of Inhassoro road.



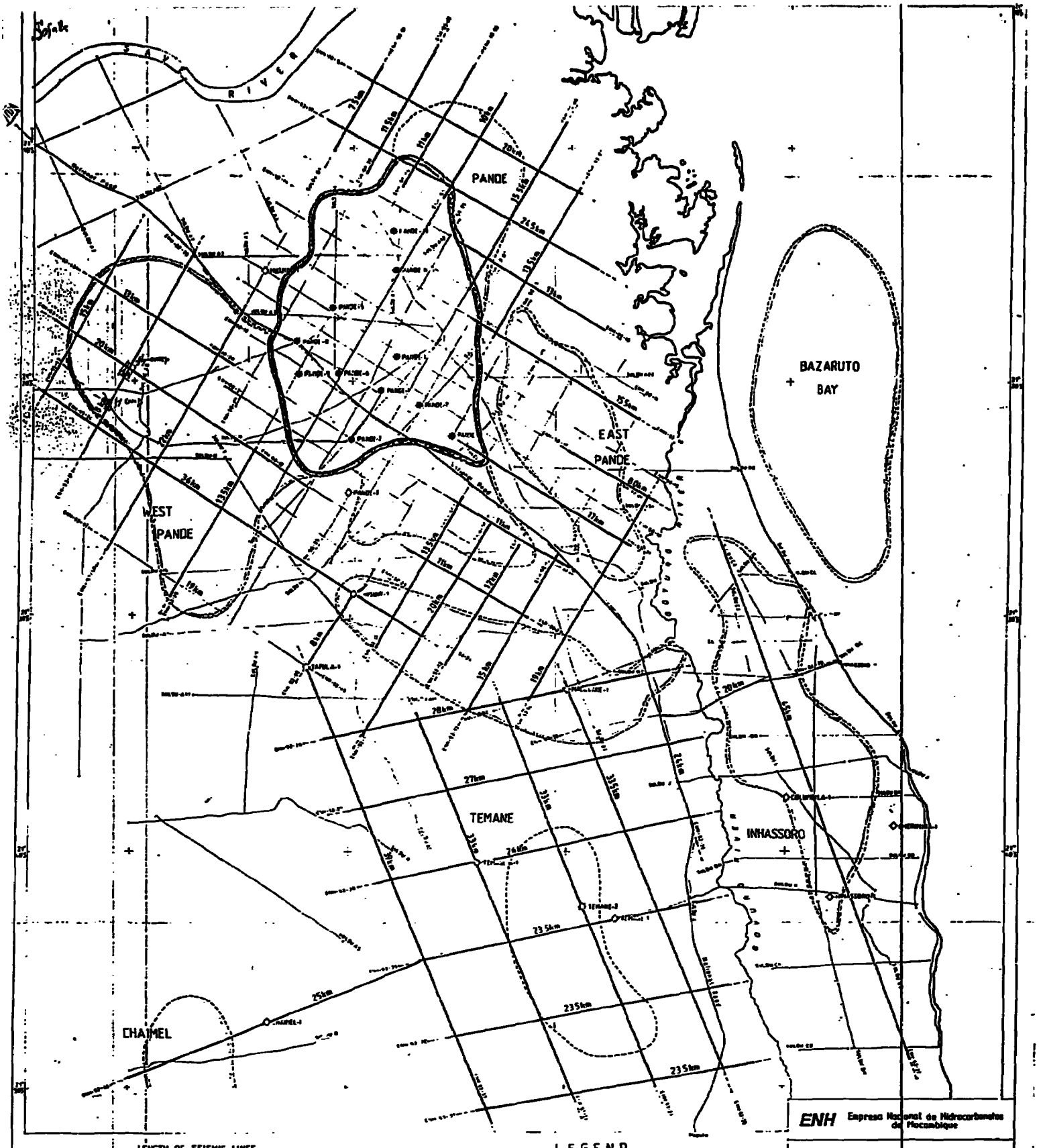
LEGENDA

LÍMITES DE PANDE – ADMIN. BOUNDARY

AGLOMERADO POPULACIONAIS – MAIN CONCENTRATIONS OF PEOPLE

LOCAL	Nº de FAMILIAS	Nº de HABITANTE
ALDEIA	713	2484
PANDE-1	226	1171
COLONGE	238	721
MACHUVO	232	704
MAJUANE	36	132
MAZADEJA	N/A	N/A
MUCONDO	N/A	N/A
MAMBOZA	N/A	N/A

ESCALA 1: 250.000



LENGTH OF SEISMIC LINES WITH 30 FOLD OF COVERAGE

AREA	LINE (km)
PANDE	282.5
WEST PANDE	150.0
TEMANE	339.0
INHASSORO	65.0
TOTAL	836.5

LEGEND

SEISMIC LINES

Gas well

Dry hole

Gas field

Prospect area

ENH Empresa Nacional de Hidrocarbonetos de Moçambique

MOZAMBIQUE BASIN

PANDE-TEMANE-INHASSORO AREA

SEISMIC EXPLORATION PROGRAM

Scale 1:100000

1993

PANDE PROJECT DEVELOPMENT
ENVIRONMENTAL EVALUATIONS

Table of Content

Encl.: - Environmental Report, Pande ENH Exploration Area by Paul Dutton.
- Report on Chemicals stored at Pande Base Camp by SOEKOR (PTY) Ltd.
- Map of Seismic Exploration Programme.

PANDE PROJECT DEVELOPMENT
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- Map of Seismic Exploration Programme.

0. Summary and Conclusions

This report reflects environmental impact observations from a mission to the Pande Gas Development Project in Mozambique. The report includes findings from studies prepared on chemicals left over from past operations and on the flora and fauna in the Pande region.

A pre-investment engineering project includes 1200 km of seismic to verify the size and location of the gas field, three exploration drillings, and a number of studies to verify and support the study.

An environmental overview of the complete development project, as seen today, concludes that no material environmental damage will occur if careful planning is followed.

The mission and the other studies verified that damage caused by past operations in the area is limited to local lack of clean up of old exploration sites and one major, but local, blow out crater caused by the blow out and fire at Pande 4.

The clean up of the old exploration sites can easily be carried out and will result in elimination of the impact from these operations.

The area around Pande 4 will be more difficult to reclaim as the impact from the blow out is serious. The situation has stabilised and vegetation has slowly started to reclaim the area. However, due to salt water contamination of the surface soils the process is very slow. Development of a plan that could speed up the process is therefore included as a proposed component of the engineering project.

The basic causes of environmental damage from previous operations are sloppy engineering and management.

A series of mitigation steps are therefore proposed focusing on institutional strengthening of ENH in combination with setting up standards for preparation of Risk Assessments (RA) and Environmental Impact Assessments (EIA).

Further, improvements to the organisational set up have been proposed with well defined responsibilities for independent safety and environmental monitoring.

No negative social impact has been identified from the ENH operations. ENH's relations with the local residents was found to be good. To avoid later negative socio-ecological impacts from the development project, a scheme for coordinated planning in cooperation with the local population and their representatives is proposed.

Based on the mission and the environmental overview study, it is proposed to let the

1. Introduction

This report presents environmental impact observations made during a mission to the Pande Gas Development Project together with findings of reports prepared by other consultants.

This report does not include a complete Environmental Impact Assessment but defines the present status and defines the necessary assessments and actions to be taken through the development of the project.

The pre-investment engineering project covers 1200 km of seismic to verify the size and location of the gas field, three exploration drillings, and a number of studies to verify and support the study. The environmental impact of the engineering project will therefore be low.

However, recommendations are given to limit the impact. Some of the recommendations are further meant to initiate developments internally in ENH to ensure a proper environmental and safety policy throughout the project development.

The development project to follow, but not covered by this report, includes establishment of production wells, gas treatment facilities and a pipeline to Maputo in the south of Mozambique and Johannesburg and Durban in South Africa.

An environmental overview study has been prepared for the complete development project, as seen today. This report concludes that no material environmental damage will be foreseen if careful planning is followed. The overview study does not include a later expansion of the project with a branch of the gas pipeline to the Natal province in South Africa.

A report focusing on the impact on flora and fauna from the past and present activities was done by Mr. Paul Dutton an consulting ecologist engaged by ENH. His Environmental Report for the area has been compared with my own field observations and this has not led to important corrections. The outcome of the work is given in Chapter 4.

The impact of the project on the culture and development of the population in the area was done by interviews with local residents and selected extracts are given in section 2.2.

A report prepared by SOEKOR (PTY) Ltd on chemicals stored at Pande base camp has been used as background material for comparison with my own field observations to give an evaluation of the impact of the past activities in respect of lack of proper handling- and clean-up procedures.

1.1 Description of my own mission

The mission was carried out as an intensive inspection and interview program in the period 6/10 to 12/10 1993. Most of the time was spent in the area around the Pande Base camp.

The base camp in Vilankulos was only visited at the end of the mission for a short inspection and discussion with ENH officials from Maputo.

The decision for spending the main time in the Pande area was that the base camp in Vilankulos is part of a large urban society and does not have any major influence on the life there and no significant impact outside the town.

The time spent in the Pande area was split between the following activities:

* inspections at old drilling sites to evaluate impact from former activities including the clean-up practice previously used.

* inspection of old seismic lines to evaluate the impact imposed on the flora and fauna.

* inspection of present operational practice in the base camp.

* inspection of preparations for start up of new exploration drillings.

* inspection of present practice for clearing of seismic lines and shooting of same.

* interviewing local city council members and a local family to be able to describe the present and expected future impact of the project on the cultural development in the area.

2. Issues of Environmental Impact

Looking on the overall impact of the exploration program on the flora and fauna and population in the area it can be concluded that the most important need for improvement will be setting up good internal and internationally respected engineering and management standards to avoid repetition of mistakes or pollution problems, as all the negative impact that have been identified from the previous operations appear due to lack of good engineering and management standards. Institutional improvements of ENH are included below in proposals for mitigation steps.

2.1 Impact on Flora and Fauna

The main environmental impact in the past was due to the civil war and not ENH activities.

The soldiers need for red meat protein nearly led to extinction of the bigger mammals, but this population is expected to return to normal.

The impact from the previous Pande gas field exploration activities is limited to poor local clean-up around the exploration drilling sites and the impact around the Pande 4 blow-out site.

Clean-up around the exploration sites has to be carried out, and the local vegetation can thereafter return to normal.

On the Pande 4 site, which has a major crater, it will be more complicated to reclaim the land. A soil balance calculation will have to be carried out before a realistic land reclamation approach can be set up.

The planned and ongoing seismic shooting and the planned three exploration wells will only have marginal and very local impact on the flora and fauna given that proper and prompt standards for clean-up will be followed. Measures to ensure this are included in below given proposals for mitigation steps.

2.2 Impact on Population

The negative impact on local living conditions in the past has been due to the civil war and not the ENH activities.

ENH has been the main employer and protector in the area.

ENH has previously drilled water wells for the local population and is at the moment

cooperating with the Norwegian aid organisation NORAD on upgrading the water well coverage in the area.

The relation between ENH and the local population and their representatives seems to be good. However, full development of the project could later result in conflicts. Proper planning and information programs will therefore have to be prepared in cooperation with the local representatives. Ways to ensure this are included below in proposals for mitigation steps.

2.3 Proposals for Mitigation Steps

* Set up a long term plan for the reclamation of the Pande 4 area,

* Set up plans for proper clean-up of the old exploration sites,

* Set up Good Planning and Engineering Standards (GPES) to be followed in the future planning, engineering and site work. The GPES shall be planned in cooperation with a well respected company with international experience in this field and shall as a minimum include:
  - Definition of engineering standards to be followed. These standards can be chosen in cooperation with e.g. Norwegian Petroleum Directorate (NPD-standards), American Petroleum Institute (API-standards) or other respected organisations,
  - Procedures for prompt cleaning up during field activities,
  - Procedures for handling of chemicals.

* Standards for preparation of Risk Assessments (RA) before physical activities are initiated,

* Standards for preparation of Environmental Impact Assessments (EIA) as part of project preparation,

* Preparation of an organisational set up with well defined responsibilities for an independent safety and environmental monitoring division reporting directly to the top management,

* Set up milestones where a pre-defined standard of clean-up on the last explored site should be achieved before the finances for the next exploration drilling is released.

* Initiate planning work to inform and coordinate with the local population and their representatives to avoid socio-ecological problems from the development project,

* Set up a nature conservation plan, in cooperation with governmental bodies, the local population and NGO's, to minimize conflicts of interest during the investment phase of the project.

3. Population in the Area

The Pande area has a very low population density, with an actual estimated total population of about 5,200 in an area of more than 1200 sq. km, resulting in a low population density of approx. 4 inhabitants/sq. km.

The number of inhabitants was given by ENH after collection of data from the local village leaders who are in charge of controlling the area. See Figure 3.1.

3.1 Historical relocations

Before Mozambique became independent in mid 1970's the population in the Pande area lived in decentralised settlements. After independence, the war with Renamo began in 1980 and the population concentrated around the Pande project area to obtain protection.

Others decided to leave the area and ended up mainly in the major local towns or went to Maputo. This population did not become refugees in the more safe African states.

The dislocation meant that the remaining population in this period lived very concentrated around the base camp in Pande, as the camp was protected by a small number of National Force soldiers.

In 1988 ENH decided to make further seismic investigations and exploration drillings in the area and it became necessary to ensure better propection of the gas field.

ENH therefore paid for the employment of its own army. At its peak, this army consisted of 1000 men, equal to two battalions one located around Vilankulo and one located in the Pande area.

The ENH army protected the whole Pande area including the base camp, the seismic shooting lines and the test drillings, including the new Pande 6 well prepared for production and the Pande 7 well that is producing gas for Vilankulo.

The new protection of the area meant that the fields used for agricultural purposes could be located further out from the Pande base camp. However, the population still stayed overnight in the village near the base camp for protection.

Since the cease fire started in 1992, the total area has become safe, and the ENH army is not in force any more and is awaiting governmental orders for dis-arming.

The former incentives for staying near the base camp are therefore not valid any more and the population has slowly started to move out. There is however still some

reluctance to move out due to a fear that the civil war could come back.

3.2 Local Interviews

A number of people in the Pande area were visited and interviewed for verification of information given by ENH and for obtaining new information about traditional behaviour. The ENH information was confirmed by the interviews.

3.2.1 A Family Interview

The family interviewed is living in the village just outside the Pande base camp.

The family was an old family in the area pointed out for the interview by other members in the village due to the criteria of having lived long in the area.

The interview was carried out with the father, as the family structure among the Matsua people means that only the father can talk on behalf of the family.

History:

The people in the area speak Matsua, which is a dialect of the Tsonga language. Tsonga is spoken from Maputo in the south up to the Save River in the centre of Mozambique and in some parts of South Africa. Matsua is spoken in an area of several hundred kilometres around the Pande area.

Before independence the area was much more populated than today, and families lived spread out in the area.

A family normally consists of all generations alive, typically including grandparents, father and mother, and children.

The traditional way of life of Matsua families is as a completely independent agricultural based unit preferably at a remote and isolated spot.

Hunting was and is used for getting meat. The hunting principle is to burn of a piece of land to make it open and then set up traps for animals like impala, gazelle, birds, monkeys. Hunting by shooting is not normal.

Animal husbandry is unusual, except for goats and chickens, due to the dry conditions in the area, and the connected problems with getting enough water.

There have been some people living in the area with nomadic tendencies.

They are farmers belonging to the same Matsua group, but look for new and better land from time to time.

After independence the war came and the area was heavily influenced by it. Many families fled to the major towns, e.g. Inhambane, in this part of Mozambique or to other major cities like Maputo. The families that fled did not leave for other countries due to the long distances to the border.

Some of the families that fled took all family members with them, other families left some members in the area.

Trade in the area has been very sparse due to the war and the fact that the people had their normal trade substituted by international aid organisations e.g. import of clothes.

Social organisation:

From former times, the families organised in groups of 10 families who selected a leader. The leaders of the different family groups are then called together if a dispute arises.

Conflicts or disputes concerning location of fields are quiet common but also relatively easy to solve due to plenty of land being available and the common understanding of what is needed for individual families.

Expectations for the future:

Due to the peace treaty people have started coming back from the towns, however it is difficult to estimate how many will come back.

It is not expected that there will be any refugees coming back from neighbouring countries. However, the development of the gas field might give work to Mozambican work forces that were formerly employed elsewhere in Mozambique or South Africa.

At the same time people have slowly started moving out to settle down on individual isolated spots, as they like to live that way.

The whole Pande region must therefore be expected to become populated by families living in a dispersed way. The population density is expected to be low.

Concerning socio-political organisation, the system has to be changed according to the peace treaty. New election procedures have to be adopted under UN supervision.

3.2.2 Aldeia Town Council Interview

Aldeia is the name of the nearest town located a few kilometres from the Pande base camp on highway One.

Aldeia town council represented by the Mayor and a number of the leading men in the village was visited.

History:
The mayor explained how the population had lived dispersed over the Pande area until independence and the war. There was no one who knew how big the population where at that point in time.

The village of Pande was founded by the Frelimo forces to create a safe place and at the same time establish a hospital and a school.

At the outbreak of the war a truck was sent out by the government Frelimo forces to bring the people into the city. A high number of people decided to leave due to the heavy fighting going on in the area.

How many people left was not recorded but the mayor expected that around 25% of the population had left during this period.

The present situation was discussed.

The population is slowly leaving the village to move back to their original settlements all over the Pande area. Some of the people who left during the war are coming back to live in their old settlements.

The administration in the village will be according to the new rules to be followed. At the moment the administration is supporting those who want to move back to their original settlements, mostly by favouring them when NGO aid supplies arrive. They get first priority due to the low possibility for obtaining clothes etc. from other channels because they are isolated.

Most families who are leaving the village are leaving their children behind in their old cottages, due to the uncertainty about the stability of the peace treaty. On the positive side, the children can continue in the school for an indefinite time.

The past experience with ENH has been good, as ENH gave protection during the civil war, helped with transportation problems, made the existing drinking water wells, etc. The population is therefore positive towards ENH.

During the Gulf-Amoco period the area had a national police post. They did not remember any problems from this period.

There have been some problems in the area, but they were mostly related to the presence of the army. The local population, which seems very peaceful, is afraid of weapons. The presence of 500 armed mens, and the war, created a general fear.

Social aspects:
The major problem for the authorities in the village seems to be alcohol related disturbances. The mayor clearly expressed the wish to have a local post of the national police. He did not consider nightly disturbances due to drunk people a problem that could be solved by the civil authorities.

The mayor was directly questioned about his view and concerns relating to an expansion of the activities at the Pande gas field with more traffic and more outside staff in the area.

From the past experience it was his opinion that it would only have one significant impact (due to the size of the area) and that would be more employment. Lack of employment possibilities is a problem in the area, as the farm products are mainly used in the area and therefore do not contribute to trade allowing other products to come in.

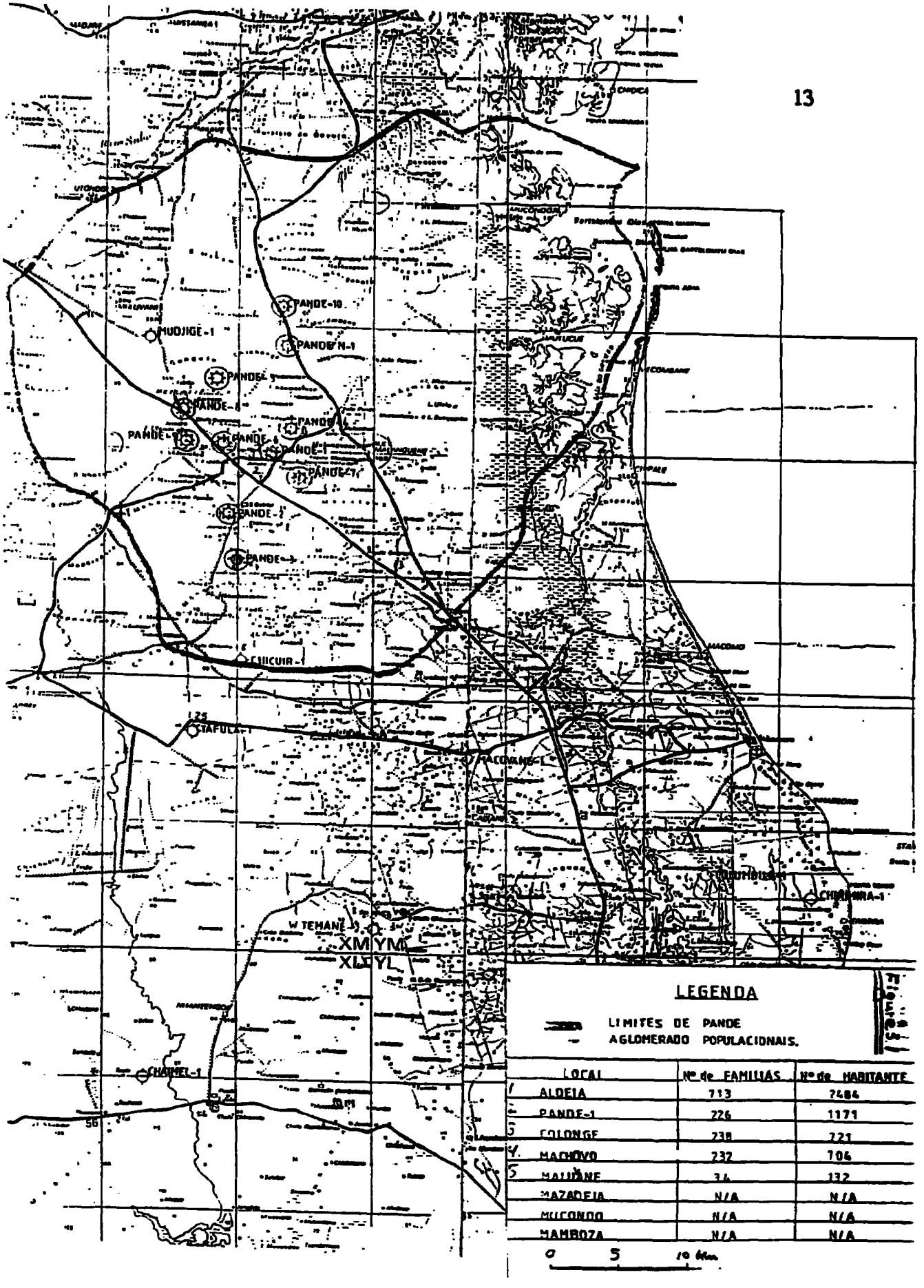
The main problem in the area is lack of water. NORAD is at the moment financing a water well program. The visit to the local authorities was used to discuss differences in priority of new well location possibilities between local and county authorities.

The following comments and questions are raised from the interviews.

The mayor's description of the relation between ENH and the local population as positive seemed to be verified during all stops. Very often the permanent ENH staff knew the local people well.

Concerning the fear of the local army units it must be mentioned that the units were only supported by ENH, but were under the control of the national army and reported to a general in the national army, not to ENH.

It was not clear whether the creation of Pande village was an initiative taken according to the communist ideal of getting the population under control, as done with soviet farmers, with the war being a good excuse to speed up the process. The reason for the doubt is that there was another school, with good buildings, in a nearby part of the area.



LEGENDA

LIMITES DE PANDE

AGLOMERADO POPULACIONAIS.

	LOCAL	Nº de FAMILIAS	Nº de HABITANTE
1	ALDEIA	713	2484
2	PANDE-1	226	1171
3	COLONGE	238	721
4	MACHOVO	232	706
5	MAJIANE	34	132
	MAZADEIA	N/A	N/A
	MUCONDO	N/A	N/A
	MAMBOZA	N/A	N/A

0 5 10 Km

4. Flora and Fauna in the Pande Region

The Pande exploration area is situated in the eastern littoral of the Inhambane Province extending up to the Save River, 200 km south of Beira city and 600 km north of Maputo. See figure 4.1. The climate is transitional between moist and arid tropical environments with an annual rainfall less than 800 mm. The surface geology is mainly sandy soils. Soils with a higher clay fraction support hydromorphic grasslands and seasonal pans which retain rain water.

The inland vegetation ranges from hydromorphic grassland to savanna and closed canopy woodland giving the area a vegetational mosaic character due to the geological and climatical conditions.

4.1 Vegetation or Habitats

Twelve distinct habitats have been identified in the area.

The coastal area contiguous to the exploration area has extensive areas of mangrove swamps, whereas the majority of the exploration area is dominated by savanna repenting a wide variety of robust tree species including baobob. Other habitats include a number of different woodlands. For more details see enclosed Environmental Report prepared by Paul Dutton.

4.2 Wildlife

The wildlife situation in the area is in a critical state having been decimated as the main source of red meat protein for the various military units for the past 15 years.

Elephants, buffalo and hippo, once common in the region, have been hunted to near extinction. Predators such as lion, leopard, hyena and jackal are all severely depleted because of the hunting pressure.

On the positive side, the area, is generally still ecologically viable. With proper management and control of resource use, it can be rehabilitated to its former richness in biodiversity.

4.3 Agriculture

The population density in the area is very low and less than 1% of the land is presently under cultivation.

The crops planted by the farmers are typical crops for this part of the world and do

not have any impact on the surroundings.

The local residents have a long history of deriving food, medicine, and fibres from indigenous species.

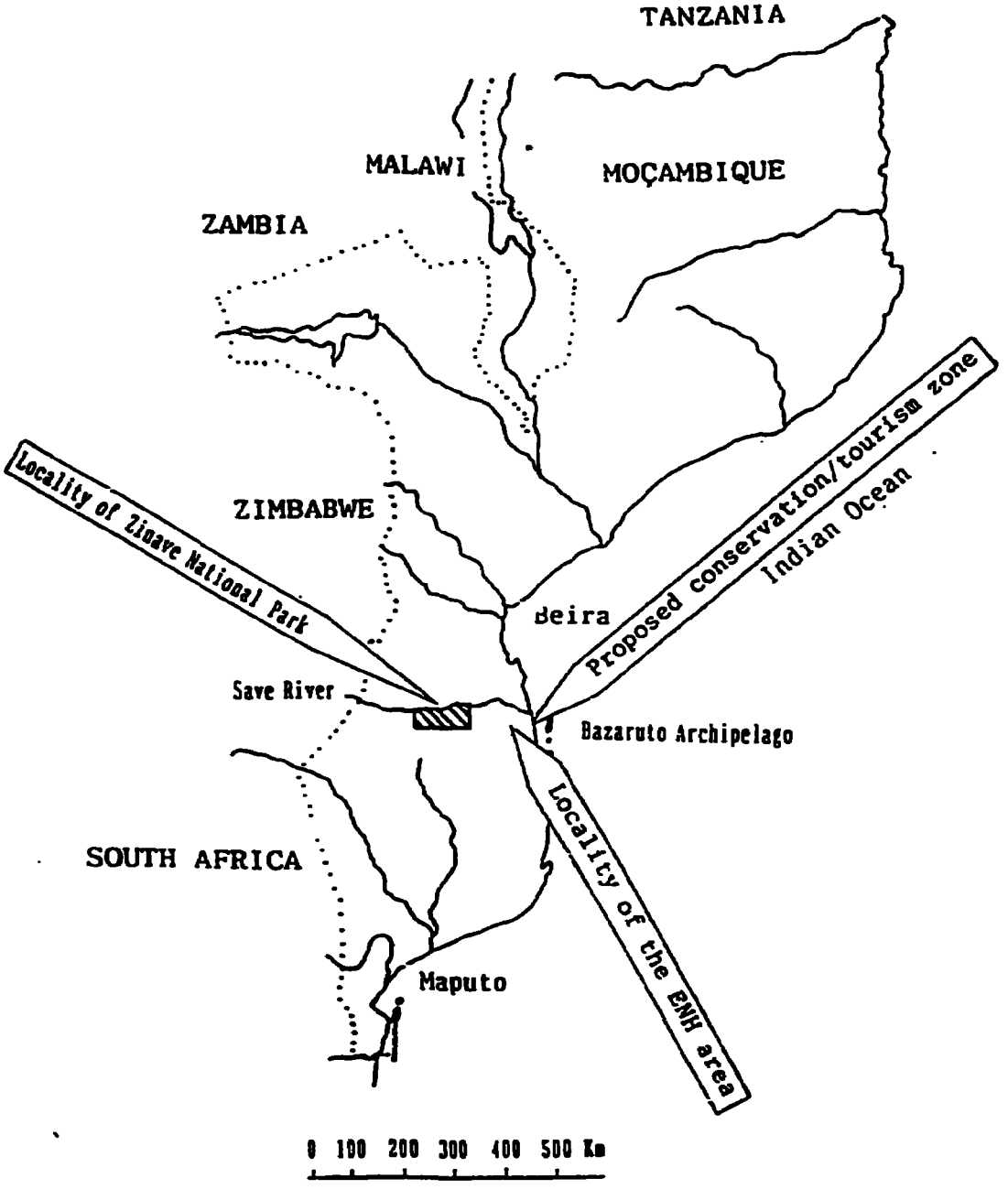


Figure 4.1: Map of Mozambique indicating ENH's exploratory area, Parque Nacional do Zinave and a proposed coastal conservation/tourism zone.

5. Seismic Programme

The seismic programme includes the shooting of approximately 900 km of seismic lines in a network covering the Pande, West Pande, Temane, and Inhassoro area. A map showing the first 850 km of the shootings, as planned, is enclosed.

5.1 Impact on Flora and Fauna

To carry out the seismic shooting, lines have to be cleared for laying out the seismic measuring probes as well as for allowing the vibrators to move in the landscape.

For clearing the approximately 3 metre wide lines, bulldozers are used to remove bushes and minor trees. Damage to major trees is avoided, as the seismic programme can allow for curves in the lines. Special landscape structures are also avoided if found on the lines.

Thus the damage to the flora in the area is significantly limited. Old seismic lines were inspected and lines that were prepared just few years ago were difficult to find.

The fauna in the area did not seem to be influenced by the seismic activities as the long distance between the different working spots avoided build-up of stress factors where animals avoiding one set of activity would be influenced by the next.

Further the wish for easy and smooth shooting of the lines meant, as described above, that any special landscape structure that could shelter special species would be avoided if at all possible.

Several days used for random inspection of the seismic lines verified that the principle of avoiding major landscape structures had been followed.

It was also found that the landscape was of a general flat character allowing for rainfall to be absorbed locally in the ground, so that no erosion problems were found in old or new seismic lines.

As the area covered by the seismic shooting is large, it was not possible, even though several days were used, to inspect more than a fraction of the total lines. The land inspections was carried out during travel in between the different working spots in the Pande area.

At the end of the mission an airborne inspection was carried out following one of the Temane lines and verified that no major difference could be identified between what has been inspected on the land and what could be seen from the air.

5.2 Impact on Population

According to the historical descriptions for the area given both by the ENH staff and verified by local interviews, the presence of ENH influenced the population significantly in the period after the independence in a positive way as ENH was main employer in the area, supplier of fresh water wells and protector during the civil war.

By ENH employing local people, there were higher import possibilities for goods for the local population. The leaders in the nearby village considered this very important, as other local products did not give any major contribution to trade activities.

The water wells drilled by ENH have been important for obtaining fresh water in the area. However several of the wells in the nearby village had problems with the manual pumps. A NORAD program for water well improvement in the area, just started in cooperation with ENH, will be of importance for keeping proper fresh water supplies.

6. Drilling Programme

6.1 Old drilling Programme

All wells, except nos 3 and 5 which are abandoned and are not visible any more, were visited either by myself or by other inspection teams and the area around them inspected.

Several of the wells were completely abandoned with only slight indication of actual positions. No environmental effects could be observed around those wells.

Other wells had a small concrete pit with the christmas-tree, waiting for possible re-opening after drilling out an installed concrete plug. Existing wells were mostly fenced, however, a number were missing both fences and proper clean up of the old drilling site.

The last well drilled still had the old rig stopped on top without any clean up.

It can, therefore, be concluded, that the old exploration program had been stopped without bringing the necessary technical and environmental actions to a complete halt at all locations.

6.1.1 Impact on Flora and Fauna

Some of the previous exploration drilling-sites have not been properly cleaned after end of drilling activities. Those sites contains both spills of chemicals used as well as broken wires, worn out drill bits, and other scrap materials. The SOEKOR report has shown that a lot of unused chemicals have been left over from the operations, most of them at the base camp.

This is unacceptable from an environmental point of view as the left-over materials and spills can cause injuries to humans or especially to animals.

The clean-up of these sites should be rather simple. The chemical spills are easy to collect or deposit due to the low toxicity of the chemicals used, and the scrap materials can be collected by simple manual ways and mostly sent away as scrap metal for recycling.

Clean up of the Pande 4 site is much more complicated due to the blow-out and fire which damaged the area up to 1,000 metre from the initial blow out spot.

The most important for the present project must be to prevent repetition of this disaster.

Complete reclamation of the damaged land will be costly, and a realistic approach

will have to be applied.

The Environmental Report of the Pande ENH Exploration Area recommends that the area be maintained as it is and be promoted as tourist attraction. This cannot be recommended as ENH should focus its limited manpower on project development and operation rather than such dubious fringe activities.

Visual inspection of the crater supports the conclusion that the damage around the crater has stabilised, and the vegetation is slowly coming back.

It is therefore recommended that bulldozers/scrapers be used to fill the salt water contaminated soil and sand layer from the last blow out into the crater. After this transfer of contaminated material a general levelling out of the area could be carried out. It will be necessary to calculate a total soil balance over the crater area before starting moving uncontaminated soil around. The area could eventually end up as a rain season lake due to the lack of filling materials.

6.1.2 Impact on Population

The impact of the old exploration program on the population is very similar to the effect of the seismic program as described in section 4.2.

The protection given by ENH to the local population during the civil war was the basis for the population to stay in the area, otherwise, it is likely that the population would have had to leave the area.

6.2 Planned drilling Programme

A further three exploration wells are planned to be carried out after analyzing the result of the seismic programme. The exact locations for the wells have not been selected yet.

6.2.1 Impact on Flora and Fauna

To carry out the new drilling program it will be necessary to clear new access-roads to the selected drilling sites. The flora and fauna have shown their ability to recover after the previous drilling activities, even though the old equipment demanded very wide roads as the drilling rig could not be taken apart.

The impact from new access roads would be highly dependent on a proper planning of the coming drilling activities to avoid clearing unnecessary roads.

It is therefore recommended that the complete exploration program be planned together with a transportation program for the equipment. It is also recommended to use new modulised rigs that can be transported without excessive clearings of access roads.

An indirect effect of the protection from ENH and the peace agreement has been that the population is moving out of the villages and spreading out in the area. Hunting for monkeys and other small animals has increased and according to local hunters their numbers will decrease. On the other hand large animals like elephants are expected to come back after nearly total extinction during the civil war.

6.2.2 Impact on Population

The impact from the engineering project on the local population is limited to creating a number of new jobs, which will result in a major but short term economical improvement for the population.

It is not likely that the sites to be selected for the three exploration wells will conflict with any local settlement interests. Should a preferred site be occupied by a new settler, it should be relatively easy to define an economical compensation that will make it attractive to re-settle. Alternatively, a minor change of the preferred exploration site should be possible.

7. Conclusion

The environmental impact from the previous operations at the Pande gas field has not been servere. However, some reclaimation work combined with a better standard of operation and clean up will be needed if the situation is to improve instead of getting worse.

Mitigation steps to be followed has therefore been developed, the main ones being:

* Reclamation of the Pande 4 area,
* Proper clean up of the old exploration sites,
* Good Planning and Engineering Standards (GPES) to be followed in the future, including:
  - Definition of engineering standards to be followed e.g. Norwegian Petroleum Directorate (NPD-standards) or American Petroleum Institute (API-standards),
  - Prompt cleaning up during field activities,
  - Chemical handling procedures.
* Risk Assessments (RA) to be prepared before physical activities are initiated,
* Environmental Impact Assessments (EIA) to be part of project preparation,
* Establishing a unit with well defined responsibilities for independent safety and environmental monitoring and reporting directly to the top management,
* Cleaning up the last explored site before the next exploration drilling is authorized.
* Providing information to and coordinating with the local population to avoid socio-ecological problems from the development project,
* Preparing a nature conservation plan to minimize conflicts of interest during the investment phase of the project.

If these mitigation steps are followed properly it is my oppinion that the project can be developed without any unacceptable issues of environmental impact.

MKT NO:R83/PROJECT NO: 124

ENH MOCAMBIQUE

REPORT ON CHEMICALS STORED AT PANDE BASE CAMP

October 1993

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SOEKOR

CONSULTANTS REPORT

This report has been prepared as a consulting service by Soekor (Pty) Ltd to Empresa Nacional de Hidrocarbonetos de Mocambique (ENH). While every effort has been made to ensure that the interpretations presented are the best that can be derived from the information available, Soekor makes no warranty as to the value or validity of the interpretations presented and accepts no liability for interpretations or inferences drawn therefrom or for actions taken by the client ont he basis of any such inferences or interpretations.

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SOEKOR

ENH MOCAMBIQUE

Project No: 124

REPORT ON CHEMICALS STORED AT PANDE BASE CAMP

OBJECTIVES

1. To provide an inventory of drilling fluid and cement chemicals and their location at the Pande base camp.
2. To advise on the disposal or the retention of these chemicals for future drilling operations.
3. To suggest possible alternative uses for selected chemicals
4. To carry out analyses to identify chemicals of uncertain composition.

SOEKOR

REPORT ON CHEMICALS STORED AT PANDE BASE CAMP

CONTENTS

SOEKOR

1.0 INTRODUCTION

A chemical stock count was conducted at the Pande base camp from 23-24 September 1993.

The objectives of this exercise were to:

1. Supply ENH with a chemical inventory;
2. To advise ENH on the disposal or retention of these chemicals;
3. To suggest possible alternative uses for selected chemicals.

Five chemicals were unidentifiable and samples were taken and analysed in Cape Town. The results of this analysis are attached in Annexure 4.

2.0 FUTURE DRILLING PROJECTS

It is strongly recommended that prior to any further drilling activities, an experienced drilling fluid consultant be mobilised to inspect the available chemicals and to assess the possibility of designing an effective drilling fluid programme utilising the chemicals presently available at the Pande base camp. He should also be capable of advising on disposal and/or alternative markets for possible sales.

3.0 CHEMICAL USES AND RECOMMENDATIONS

3.1 CMC - Carboxy Methyl Cellucose

C.M.C is a water soluble polymer which is used in drilling fluids as a viscofier and filtrate controller.

It is non-toxic.

It is recommended that the CMC be sorted and the undamaged material stockpiled for possible future drilling operations, or for sale or alternative use.

Alternative uses:

Detergents, soaps, food products (eg, ice cream), textile industry, paper, paint, cosmetics.

3.2 Baryte (Barium Sulphate)

Baryte is a non-toxic, inert substance used for weighing up drilling fluids. There is a necessary requirement for baryte in future drilling programmes, and the stock at Pande should be kept until no longer required. Formation over-pressures are difficult to predict and it is advisable to be well prepared.

The baryte stored at the Pande-11 wellsite, should be returned to the base camp.

Market prices of baryte vary from $120/ton to $185/ton.

Alternative uses:

Paints, textile industry, rubber, plastics.

3.3 Sodium bicarbonate

Used to treat out cement contamination from drilling fluids.

Recommended to retain for future drilling operations.

Alternative uses:

Manufacture of effervescent beverages, baking powder, treating wool, fire extinguishers, pharmaceuticals.

3.4 Calcium chloride

Used in drilling fluids to stabilise clays
Recommended to retain for future drilling operations.

Alternative uses:

Concrete conditioning, paper industry, pharmaceuticals.

3.5 Graphite

Occasionally used in drilling fluids to reduce friction (pump) pressures and to improve hole slickness.
Recommend to await advice from drilling fluid consultant.

Alternative uses:

Lubricants, paints, seal rings, pencils, self lubricating bearings.

3.6 Salt (Sodium chloride)

Used in drilling fluid to stabilise clays.

Recommended to retain for future drilling operations

Alternative uses

Table salt, metallurgy, food preservative, soap manufacture, herbicide, fire extinguishing.

3.7 Bentonite

Used in drilling fluid as a viscofier and filtrate controller.

Recommended to retain for future drilling operations.

Alternative uses:

Cement extender (in oil well cementing), cosmetics, polishes, ceramics, food additive.

3.8 Cement and Bentonite (mixed)

Recommended to be analysed for possible use for an extended cement slurry in future drilling operations. Soekor has the necessary resources to conduct this investigation.

3.9 Baroid - Cellex

This is an organic polymer (sodium CMC)

This chemical should be stock piled with the other usable CMC, for possible future use. Lab test should be performed on the substance to substantiate its properties. Soekor would be able to assist with this.

Recommended to await advice from drilling fluid consultant.

3.10 Baroid - Q Broxin

This is a ferrochrome lignosulphonate, used in drilling fluids as a thinner and fitrate controller.

It is recommended that this substance is retained to await for advice from drilling fluid consultant.

3.11 Lignosulphonate (Russian supplied)

This is a lignosulphonate, used in drilling fluids as a thinner and filtrate controller.

It is recommended that this substance is retained to await for advice from drilling fluid consultant.

3.12 Caustic (Sodium Hydroxide)

Used in drilling fluids as ph controller.

To be retained for future drilling operations

3.13 Chemicals - Ex Pande - 11

These chemicals include:

Polymers (HIPAC)
Polymers (Antisol)
Borewell - C (Lignosulphonate)
Bugbuster (Bactericide)
Microbiocide (used in completion fluids)

To be retained for future drilling operations:

3.14 Cement Additives

These include CFR - 2, CFR - 3 and Hallad - 22. They should be retained for future drilling operations.

3.15 Gypsum

Used in drilling fluids to stabilise clays. To be retained for future drilling operations.

4.0 CHEMICAL ANALYSES

The chemical stored outside at the Pande base camp have been analysed. The white powder (approx 357 drums) has been identified as Calcium Chloride - Annexure 4, Sample 4.

The liquid in the other containers, (approx. 71 drums) appears to be a pre-prepared drilling mud - Annexure 4, Sample 5. This should be kept pending the advise of a drilling fluid consultant.

Sample #1, - Location store #2 Area A, was analysed as Sodium Bicarbonate.
Sample #2, - Location store #4 Area E, was similar to Sample #1 (Sodium Bicarbonate).
Sample #3, - Location store #4 Area C, was analysed as lignosulphonate.

REPORT ON CHEMICALS STORED AT PANDE BASE CAMP

ANNEXURE 1

CHEMICAL INVENTORY

STORE LOCATION

DESCRIPTION	1	2	3	4	5	6	Outside	Pande - II	Total
CMC	33T	2T	-	-	6,6T	-	-	-	41,6T
Barite	-	90T	-	-	245T	6,25T	-	29	370T
Bentonite and cement (loose	-	-	-	15T	-	0,5 T	-		15,5T
Bentonite	-	-	-	-	16T	-	-	-	16T
Caustic	-	-	-	600kg	2200kg	-	-	-	2,8T
Gypsum	-	-	-	-	7,5T	-	-	-	7,5T
Sodium Bicarbonate	-	-	-	2T	3T				5,0T
Salt (NaCL)	-	-	-	-	-	10T	-	-	10,0T
Graphite	-	-	-	-	1,5T	3T	-	-	4,5T
Nut plug (Loss circ. mat.)	-	-	-	18T	-	-	-	-	18T
Lignosulphonate	-	-	-	0,5 T	-	-	-	-	0,5T
Hipac polymer	-	-	-	1000kg	-	-	-	-	1T
Lopac polymer (Antisol)	-	-	-	5450kg	-	-	-	-	5,45T
Bug Buster	-	-	-	250l	-	-	-	-	250l
Borewell C	-	-	-	1000kg	-	-	-	-	1T
Microbiocide	-	-	-	25l	-	-	-	-	25l
Calcium chloride	-	-	-	-	-	-	9 T	-	9T
Q-Boxin (Lignosulphonate)	-	-	-	-	4,4T	-	-	-	4,4T
Cellex (Polymer)	-	-	-	-	4,4T	-	-	-	4,4T
Cement Class A	-	-	-	-	-	10 T	-	-	10 T
CFR 3 (Cement Dispersant)	-	-	-	100kg	-	-	-	-	100kg
Hallad - 22 (fluid loss add)	-	-	-	600lbs	-	-	-	-	600lbs
CFR 2 (Cement Dispersant)	-	-	600lb	-	-	-	-	-	600lbs

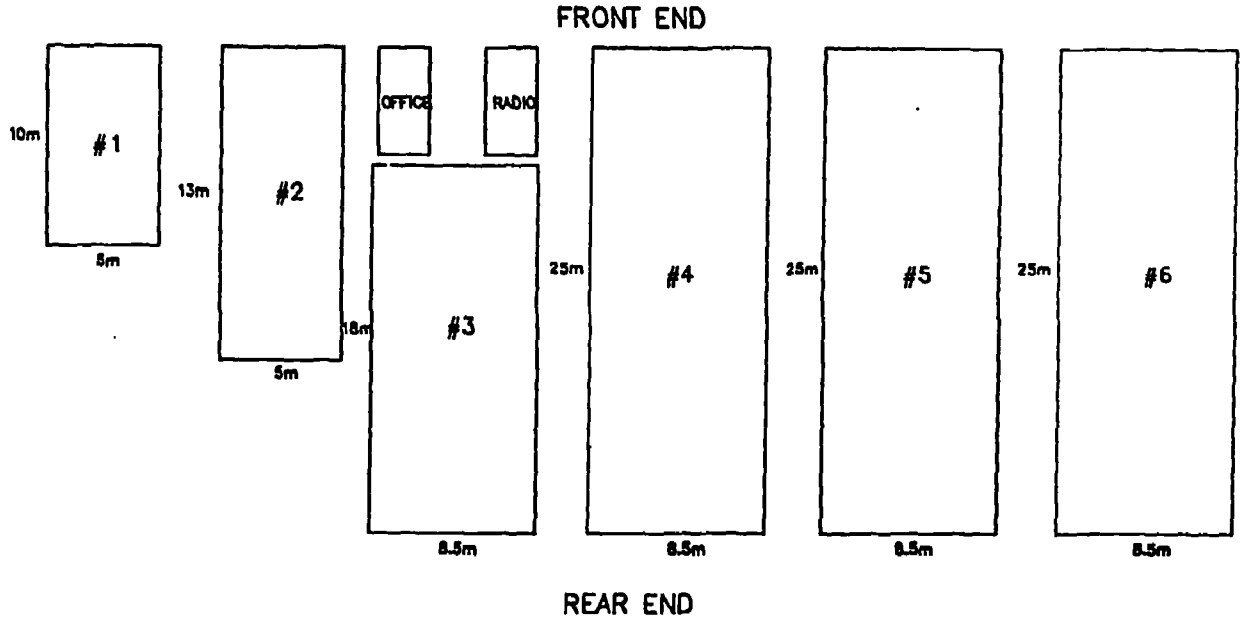
T = Tonnes

ANNEXURE 1

SOEKOR

ANNEXURE 2

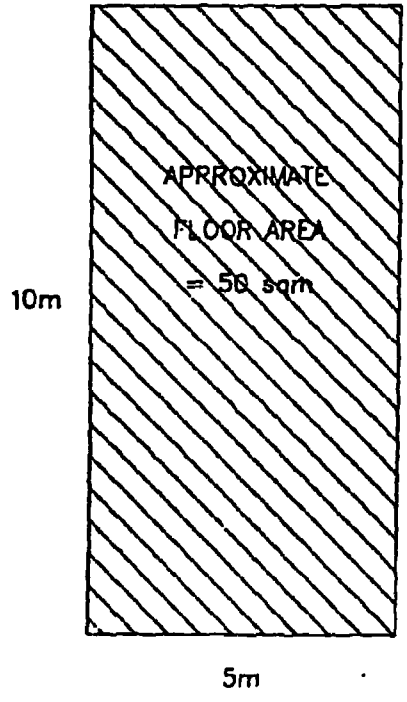
STORE LAYOUT @ PANDE BASE CAMP



SOEKOE

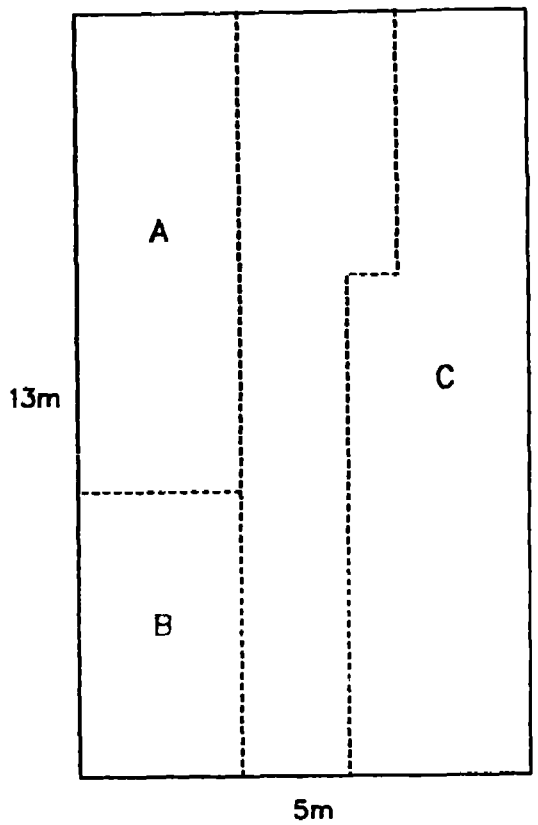
SUEKOR

STORE #1



Store #1 is filled with approx. 33 tons CMC
Sacks are broken and the chemical is damaged
This CMC was supplied by the Russians as a viscofier for drilling muds

STORE #2



A

Approx. 1.1 Tons CMC mixed with
approx. 1.5 tons sodium bicarbonate *

B

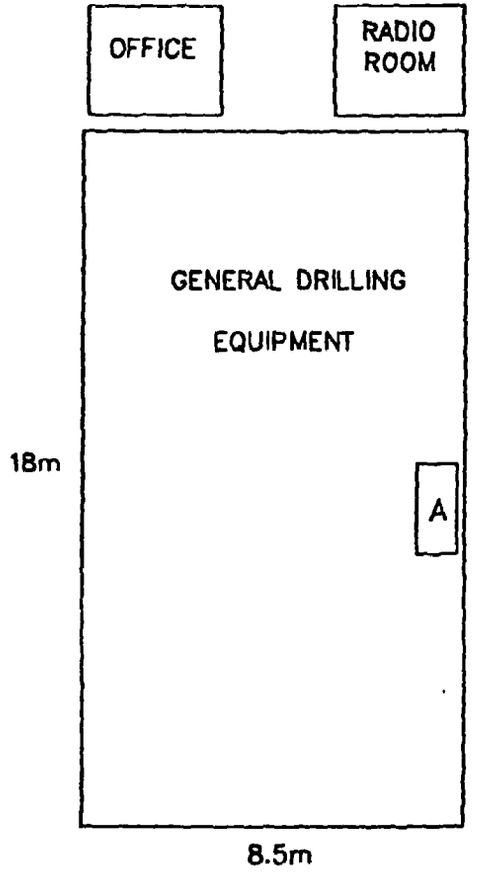
Approx. 1 ton of CMC (in broken bags)

C

Approx. 90 tons barite

* This was Sample #1 identified as sodium bicarbonate

STORE #3

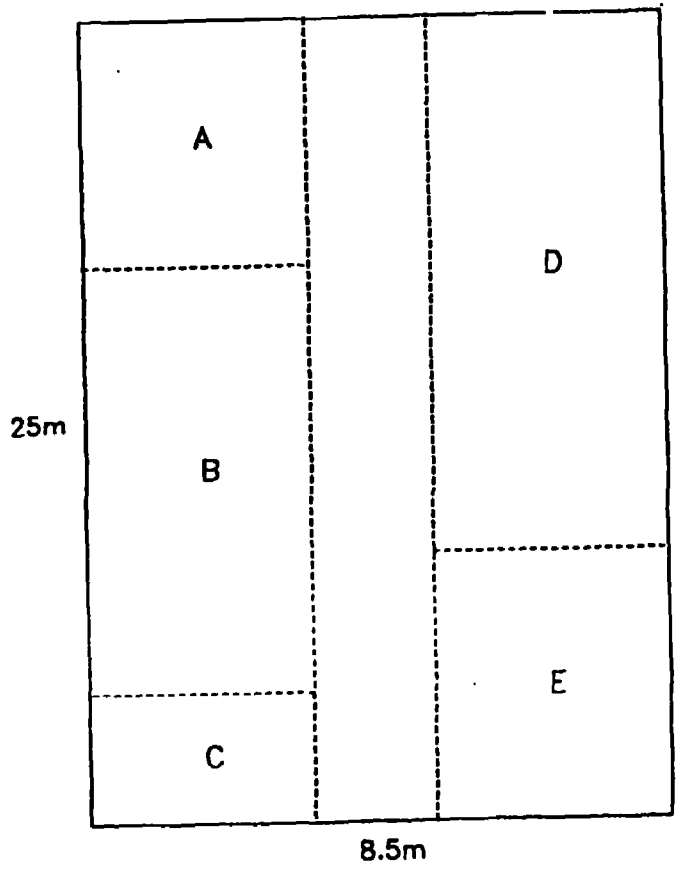


A

6 * 100 lbs CFR-2 (Drums)
Haliburton cement dispersant

Infinite shelf life if powder is in sealed bags

STORE #4



A Approx. 15 tons loose bentonite mixed with cement

B Approx. 18 tons nut plug – broken bags

C Approx. 0.5 tons lignosulphonate (Sample #3) *

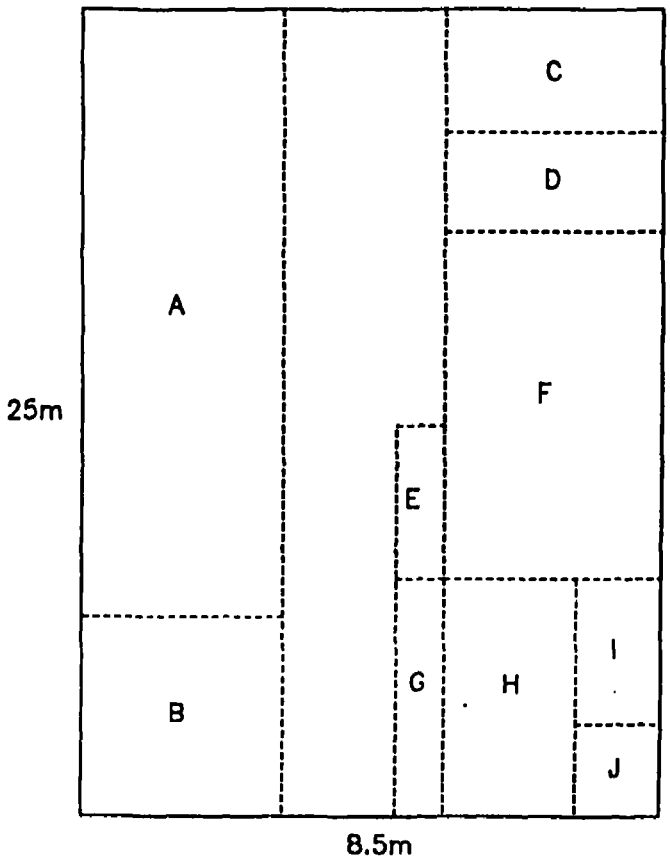
D Chemicals from Pande–11 drilling project
- BUG BUSTER 10 X 25l
- MICROBIOCIDE ANIKEM 7AN218 1 X 25l
- ANTISOL LO–PAC POLYMER 218 X 25kg
- HI–PAC POLYMER 40 x 25kg
- CAUSTIC 24 x 25kg
- BOREWELL–C (LIGNOSULPHONATE) 40 x 25kg
- CMT ADD HALLAD–22 6 x 100lbs
- CMT ADD CFR–3 4 x 25kg

E Approx. 2 tons sodium bicarbonate (Sample #2)m **

** Sample #2 identified as NaHCO3

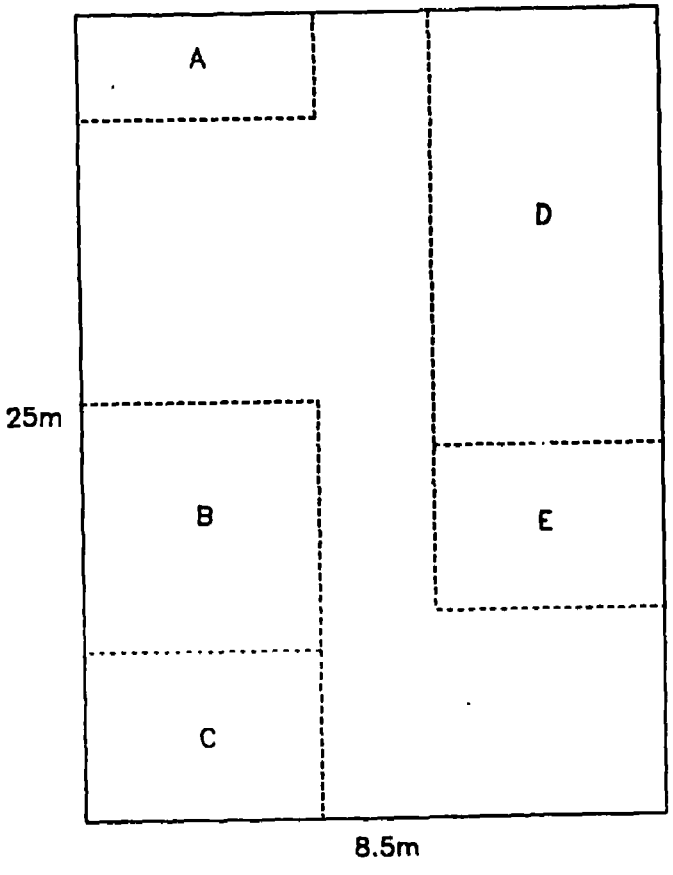
* Sample #3 identified as a lignosulphonate used as a drilling fluid dispersant and filtration control agent

STORE #5



A Approx. 155 tons Baryte (Macobar)
B Approx. 2.2 tons CMC
C Baroid "Celex" (polymer) 200 x 22kg
& Baroid G-Broxin (lignosulphonate) 200 x 22kg
D Bentonite 400 x 40kg
E Caustic Soda 22 x 100kg drums
F Approx 90 tons Baryte
G Approx 4.4 tons CMC
H Approx 7.5 tons Gypsum
I Approx 3 tons sodium bicarbonate
J Approx 1.5 tons graphite

STORE #6



A Approx 0.5 tons of loose cement & bentonite

B Approx 10 tons salt (NaCl)

C Approx 3 tons graphite (loose)

D Approx 10 tons cement (loose)

E Approx 6.25 tons Baryte

ANNEXURE 3

NL Baroid
Drilling Fluids Products

CELLEX®
Organic Polymer

CELLEX® organic polymer is sodium carboxymethylcellulose in the form of a white granular powder produced in Regular and High Viscosity grades.

Recommended Uses

Rapidly decreasing filtration rate and cake thickness in fresh or brackish water-based drilling fluids (Regular grade).

Increasing hole-cleaning capabilities of low-solids water-based fluids (High Viscosity grade).

Promoting hole stability in water-sensitive formations.

Major Advantages

Efficiency. CELLEX® is a fully active material. In small amounts it mixes quickly to improve drilling fluid properties.

Versatility. CELLEX is effective in hard and salty waters.

Environmental acceptability. In water solution CELLEX organic polymer is colorless, odorless, tasteless and nontoxic. It does not ferment.

Recommended Treatment

See table.

Approximate Amounts of CELLEX® Organic Polymer* Added to Fresh or Brackish Water-based Fluids

	lb/100 gal	lb/bbl	kg/m³
To improve performance (better hole cleaning, thinner filter cake, increased hole stability)	0.7-3.5	0.3-1.5	0.8-4

Method of addition: Sift slowly into a jet mixer or into the vortex of a high-speed stirrer.

*For maximum viscosity, use High Viscosity grade CELLEX® organic polymer.

Packaging

CELLEX® is packaged in asphalt-laminated paper bags containing 50 pounds (22.7 kg).

Availability

CELLEX® organic polymer may be purchased from any NL Baroid Service Center or from the Houston plant.

D40D09
Printed in U.S.A.

NL Baroid/NL Industries, Inc., P.O. Box 1675, Houston, Texas 77251

NL Baroid
Drilling Fluids Products

Q-BROXIN®

Thinner and Filtration Control Agent

Q-BROXIN® thinner and filtrate controller is ferrochrome lignosulfonate prepared by an exclusive process. It is a dark brown, nonhygroscopic, cold-water soluble, free-flowing powder which does not cake. Q-BROXIN itself is stable at temperatures encountered in most drilling, although lignosulfonates as a class begin to degrade at temperatures approaching 375°F (190°C).

Q-BROXIN thinner and filtration control agent is the most universal mud-treating agent presently in use. It has been used successfully and economically to treat a wide variety of muds everywhere rotary wells are drilled in the free world.

Recommended Uses:

Freshwater Drilling Fluids

Highly efficient thinning of freshwater muds.

Effective control of filtration from freshwater muds.

Effective thinning and filtration control even in the presence of water-soluble contaminants such as salt, gypsum, anhydrite, and cement

Compatibility with other thinners and filtration control agents.

Seawater Muds

Preparation, maintenance, and treatment of seawater muds.

Efficient thinning in seawater muds having a pH range of 7 to 12.

Thinning efficiency which is not adversely affected by soluble calcium and magnesium salts. In fact, above pH 10, the soluble magnesium salts in the seawater are precipitated. However, precipitation of the divalent magnesium cations reduces the shale inhibition property of the mud. Where maximum shale inhibition is desirable, a pH of less than 10 should be maintained.

Control of filtration rates in these drilling fluids.

Gyp Muds

Effective thinning of gyp muds or muds contaminated with anhydrite.

Superior filtration control in gyp muds or muds contaminated with anhydrite.

Control of gels in muds containing gypsum.

Salt, Brackish, and Contaminated Water Muds

Thinning of freshwater muds, saltwater and seawater muds, muds containing lime or calcium chloride, and muds affected by various contaminants.

See **Recommended Treatments.**

Major Advantages:

Versatility

Q-BROXIN thinner reduces the gels and viscosity of many types of mud.

Freshwater Mud:

Q-BROXIN thinner and filtrate controller performs better than other thinners, especially in the presence of contaminants.

Salt and Seawater Mud:

Thinning with Q-BROXIN thinner is effective at lower pH than other thinners.

Gyp Mud:

The performance of Q-BROXIN thinner is outstanding in this type of mud.

Lime-treated Mud:

Q-BROXIN thinner is superior to quebracho in performance in the presence of salt and sulfate contamination and equivalent to quebracho in uncontaminated mud.

Lime-treated-mud Breakovers:

The viscosity and gel peak of breakovers can be controlled by using Q-BROXIN thinner, especially in muds contaminated with salt.

No Problems with Overtreatment

Q-BROXIN® thinner does not cause mud to thicken

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NL Baroid
P.O. Box 1675, Houston, Texas 77251

drastically due to overtreatment. The mud can be pretreated for anticipated contaminants, resulting in saving rig time that would otherwise be used for mud-conditioning when the contaminants are encountered. Because of this, accidental overtreatment does not waste materials.

Quick Release at the Surface

Because of the effectiveness of Q BROXIN® thinner in maintaining low gels, gas and cuttings are released from the weighted muds used for deep drilling where high pressures and sloughing shale are problems.

Savings on Emulsifiers

Q-BROXIN thinner is an effective emulsifier. No other emulsifiers are needed when oil is added to a drilling fluid treated with Q-BROXIN thinner and filtration control agent.

Easy Rheological Control

Because drilling fluids treated with Q BROXIN thinner will tolerate large increases in dissolved salts, mud properties are easier to control during and after saltwater flows or the drilling of salt or anhydrite. Savings in mud materials and rig time result, and there is less hole trouble.

Compatibility with Calcium Inhibition

Q-BROXIN thinner does not reduce the calcium ion concentration in the mud filtrate as do most other chemical thinners; therefore, Q-BROXIN is a more suitable thinner where calcium is carried in the mud to inhibit swelling or hydration of shales.

Wide General Application

Q-BROXIN thinner is convenient because of its wide application as a general utility thinner and filtration control agent.

Recommended Treatments:

Initial Treatments

The quantities of materials recommended are wide in range because of the variation in field muds. For any given mud the quantity to be used may be determined by pilot testing.

Freshwater Q-BROXIN Fluids:

To prepare a Q-BROXIN thinner freshwater mud simply add the Q-BROXIN thinner in the concentration necessary to attain the desired thinning and filtration control. Caustic soda is usually added with the thinner in the ratio of one part caustic to 10 parts Q-BROXIN thinner and filtrate controller. Additions may be made through the chemical barrel or mixing hopper.

Gyp Muds:

To make a gypsum mud from a freshwater mud, begin by determining the amount of dilution required by pilot-testing. Add water first or along with other materials. Then add 3 to 6 pounds of gypsum, 2 to 8 pounds of Q-BROXIN thinner, and 0.25 to 1 pound of caustic soda per barrel of mud (8.6 to 17.1 kg of gypsum, 5.7 to 22.8 kg of Q-BROXIN, and 0.71 to 2.85 kg of caustic soda per cubic meter of mud).

Add the thinner and the gypsum through the mixing hopper and the caustic soda through the chemical barrel in one or two circulations of the drilling fluid.

Salt or Brackish Fluids:

To make a saltwater or brackish-water mud using Q-MIX™ viscosifier and filtration controller, begin by adding to fresh water, in order of addition:

25 to 35 lb/bbl (71 to 100 kg/m^3) of AQUAGEL® gellant

3 to 5 lb/bbl (8.6 to 14.3 kg/m^3) of Q-BROXIN thinner

½ to 1 lb/bbl (1.4 to 2.9 kg/m^3) of caustic soda

Add enough of this mixture to achieve the desired properties.

Pilot-test. You should find that between 5% and 40% by volume of Q-MIX viscosifier and filtrate controller will be needed. For saturated saltwater mud, add the Q-MIX mixture first; then add the salt.

Seawater Mud:

To treat seawater mud, add from 3 to 8 pounds of Q-BROXIN thinner and 1 to 3 pounds of caustic soda per barrel of mud (8.6 to 22.8 kg of Q-BROXIN and 2.85 to 8.6 kg of caustic soda per cubic meter of mud). Add through the hopper or chemical barrel.

Making Lime Mud:

To prepare lime mud, add 1 to 4 lb/bbl (2.85 to 11.42 kg/m^3) of Q-BROXIN thinner and 1 to 3 lb/bbl (2.85 to 8.55 kg/m^3) of caustic soda. Add through the mixing hopper. Add 2 to 5 lb/bbl (5.7 to 14.26 kg/m^3) of lime. Add through the mixing hopper.

Controlling Saltwater Contamination:

To treat mud contaminated by a saltwater flow, if the pH of the mud is not high, raise it to about pH 10 (alkalinity of filtrate, Pf, to about 0.5 ml). If the drilling fluid has been treated with Q-BROXIN thinner, increase the amount of thinner.

If the drilling fluid has not been treated with thinner, pilot-test with 1 to 6 lb/bbl (2.85 to 17.12 kg/m^3) of Q-BROXIN thinner. If the pH of this drilling fluid is high, maintain it at 12 to 12.5 with caustic soda, and pilot-test with Q-BROXIN thinner in additions of up to 6 lb/bbl (17.2 kg/m^3) of drilling fluid.

NOTE: Depending on the percentage of clay solids in the drilling fluid, dilutions of up to 30% with water may be required to effectively overcome the thickening caused by the saltwater flow. Using a mud centrifuge will reduce the clay content and the amount of dilution required.

Controlling Filtration:

For filtration control, pilot-test concentrations of 2 to 15 lb/bbl (5.7 to 42.8 kg/m^3) while using caustic soda to maintain the pH at about 9.5 (Pf of about 0.3 ml).

Maintenance Treatments

Freshwater Fluids:

To maintain a freshwater mud, add Q-BROXIN thinner as needed to control the yield point and gels. For control of filtration, use more if needed.

Maintain pH at about 9.5 (Pf of about 0.3) by adding caustic soda. Add water as required to maintain suitable solids concentration.

Conventional Gyp Muds:

For a gypsum mud made from a conventional freshwater mud, red mud, or lime mud, keep calcium ion concentration in the filtrate above 500 ppm or 25 epm (500 mg/l or 25 mol/m^3 ½Ca + +) Keep excess gypsum in the mud—at least 2 lb/bbl (5 7 kg/m^3) Keep pH between 8.5 and 10 (Pf of 0 1 to 0 5 ml) by addition of caustic soda or lime.

Add Q-BROXIN® thinner as needed for control of gels (50 to 150 lb or 22 to 68 kg per tour) To control filtration, use more thinner if needed. Add water to maintain optimum solids concentration

Saltwater Fluids:

To maintain a saltwater mud, add caustic soda and Q-BROXIN thinner in a weight ratio of 1 part caustic soda to 4 parts Q-BROXIN thinner as required to control yield point and gels. Best results are obtained by dissolving the Q-BROXIN thinner and caustic soda in fresh water before adding them to the salt mud. Good solids control will, of course, require adding water.

Lime Muds:

To maintain a lime mud, add Q-BROXIN thinner to control the gels and the yield point. Add caustic soda to maintain a Pf of 1 ml or greater. Add lime to maintain desired lime content. Add water as required to maintain optimum solids concentration.

Saltwater-contaminated Fluids:

To maintain a mud contaminated by a saltwater flow, add Q-BROXIN thinner as required to control gels. Additional Q-BROXIN thinner will help control filtrate loss. Add caustic soda as required to maintain the proper pH. Add water as required to maintain the proper solids concentration.

Precautions

Foaming may occur in low-solids or salty muds. A defoamer should be added if necessary

If oil is added, the mud may foam SURFLO® W-300 defoamer or aluminum stearate (0 05 to 0.5 lb/bbl or 143 to 1.43 kg/m^3 of mud) dissolved in diesel fuel is an effective treatment.

If the mud foams excessively, add an appropriate defoamer and eliminate mechanical causes of air entrapment such as cascades in the surface system and mud guns which are not submerged.

Packaging:

Q-BROXIN thinner and filtration control agent is packaged in multiwall paper bags containing 50 pounds (22.7 kg).

Availability:

Q-BROXIN thinner and filtration control agent may be purchased through any NL Baroid Service Center or from the Houston plant.

BW Mud Limited

DATA SHEET

SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

NUT PLUG

COMPOSITION	OLIVE GRANULES
PHYSICAL FORM & APPEARANCE	LIGHT AND DARK GRANULES NO CHARACTERISTIC ODOUR
PHYSICAL PROPERTIES	DENSITY: 700 - 800 KG/M3 PH SAT SOLN: 4.5 - 6.0 PARTICLE SIZE: 500 µM - 4 MM EXPLOSION LIMITS: LEL - 40 G/M3 (FOR DUST)
REGISTRATION	DOE CNS CATEGORY O
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	25 KG SACKS, 25 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	
a) **STABILITY**	NEPA GRADE NO.1
b) **EXTINGUISHING AGENTS**	WATERSPRAY/CARBON DIOXIDE
c) **SPECIAL PRECAUTIONS**	
SPILLAGE - EMERGENCY RESPONSE	SWEEP OR VACUUM FACE MASK FOR DUSTY SITUATION
DISPOSAL - REGULATION REQUIREMENTS	INCINERATION OR LANDFILL NOT TO BE DISPOSED OF IN SEWER

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS TLV - TWA 10 MG/M3 TOTAL RESPIRABLE DUST

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN			
EYES	SLIGHTLY IRRITANT	IRRIGATE WITH WARM WATER	USE FACE AND NOSE MASK IF REQUIRED
INHALATION	DUST - IRRITANT	MOVE TO DUST FREE ENVIRONMENT	
INGESTION			
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP DRY

SPECIAL REQUIREMENTS

APPLICATION LOST CIRCULATION MATERIAL. NORMAL TREATMENT DEPENDS ON SEVERITY OF LOSSES. IF LOSSES ARE ANTICIPATED 3- 6 PPB FINE PLUG CAN BE ADDED AS A PREVENTATIVE MEASURE. IF LOSSES OCCUR PILLS OF 10 - 20 PPB SHOULD BE USED. FOR SEVERE LOSSES MEDIUM AND COARSE GRADES CAN BE USED, ALONE OR IN CONJUNCTION WITH OTHER LCM. NUT PLUG WILL DAMAGE MWD TOOLS IF CIRCULATED THROUGH THEM.

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BW Mud Limited

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

SALT

COMPOSITION	PURE DRIED VACUUM (PDV) SALT SODIUM CHLORIDE CAS NO:- 7647-14-5
PHYSICAL FORM & APPEARANCE	WHITE CRYSTALLINE SOLID
PHYSICAL PROPERTIES	MP: 802°C SG: 2.17 SOLUBILITY: 36 - 39 G/100 CC
REGISTRATION	DOE CNS CATEGORY 0
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	50 KG SACKS, 20 PER PALLET 25 KG SACKS, 42 PER PALLET 1000 KG BAGS
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	STABLE - NON INFLAMMABLE
b) EXTINGUISHING AGENTS	N/A
c) SPECIAL PRECAUTIONS	
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE TO TIP
DISPOSAL - REGULATION REQUIREMENTS	

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	IRRITATION ON PROLONGED CONTACT	WASH WITH WATER	AVOID CONTACT WITH THE SKIN AND AVOID HIGH CONCENTRATIONS OF DUST
EYES	STINGING	IRRIGATE WITH WATER	
INHALATION	INFLAMMATION DUE TO DUST	REMOVE TO FRESH AIR	
INGESTION	SEVERE INFLAMM-ATORY REACTION	INDUCE VOMITING AND GIVE LARGE AMOUNT OF WATER. OBTAIN IMMEDIATE MEDICAL ATTENTION	
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP COOL AND DRY

SPECIAL REQUIREMENTS

APPLICATION PREPARATION OF SALT SATURATED MUDS FOR DRILLING HALITE FORMATIONS FRESHWATER WILL REQUIRE APPROX 125 PPB TO REACH SATURATION SOLUBILITY OF SALT IS HIGHLY TEMPERATURE DEPENDENT. ALSO USED FOR COMPLETION BRINES UP TO 10 PPG.

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

BW Mud Limited

CALCIUM CHLORIDE

COMPOSITION	CALCIUM CHLORIDE - CACL2 CAS NO:- 10043-52-4
PHYSICAL FORM & APPEARANCE	OFF WHITE - ODOURLESS - POWDER
PHYSICAL PROPERTIES	MP: 176°C BULK DENSITY: 58 - 60 LBS/FT VERY SOLUBLE IN WATER - HYGROSCOPIC
REGISTRATION	DOE CNS CATEGORY 0
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	R 36 IRRITANT S 22, 24
PACKAGING	50 KG SACKS 25 KG SACKS
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	STABLE
b) EXTINGUISHING AGENTS	-
c) SPECIAL PRECAUTIONS	-
SPILLAGE - EMERGENCY RESPONSE	BRUSH UP AND DISPOSE TO CHEMICAL TIP - HOSE DOWN AREA.
DISPOSAL - REGULATION REQUIREMENTS	CHEMICALLY APPROVED TIP

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS 8 HR TWA TOTAL DUST = 10 MG/M3
RESPIRABLE DUST = 5 MG/M3

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	SLIGHT DEHYDRATION	WASH WITH WATER	VENTILATE & AVOID DUST. WEAR DUST RESPIRATOR IF REQUIRED
EYES	IRRITANT	IRRIGATE FOR 10 MINUTES	GLOVES AND RUBBER BOOTS SHOULD BE WORN WHEN REQ'JIRED
INHALATION	DUST - IRRITATING TO UPPER RESP. TRACT	REMOVE TO FRESH AIR	
INGESTION	PRACTICALLY NON-HARMFUL. MAY CAUSE NAUSEA	RINSE MOUTH - GIVE 200 - 300 ML WARM WATER TO DRINK	
TOXIC EFFECTS	NOT KNOWN		
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS COOL DRY CONDITIONS - AVOID EXCESSIVE VENTILATION - PRODUCT ABSORBS MOISTURE FROM AIR

SPECIAL REQUIREMENTS

APPLICATION INCREASING DENSITY OF SOLIDS FREE WORKOVER FLUIDS

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

SODIUM BICARBONATE

COMPOSITION	SODIUM BICARBONATE NA HCO2 CAS NO:- 144-55-8
PHYSICAL FORM & APPEARANCE	WHITE ODOURLESS POWDER
PHYSICAL PROPERTIES	S.G.: 0.98 SOLUBILITY (H2O): 9% W/W
REGISTRATION	DOE CNS CATEGORY O
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	50 KG SACKS, 40 & 20 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	STABLE - NON FLAMMABLE
b) EXTINGUISHING AGENTS	N/A
c) SPECIAL PRECAUTIONS	DO NOT ALLOW TO MIX WITH ACIDS CO2 PRODUCTION HAZARDOUS IN ENCLOSED SPACE
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE
DISPOSAL - REGULATION REQUIREMENTS	NO SPECIAL REQUIREMENT

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS TWA 8 HR - 10 MG/M3 TOTAL DUST

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	NONE KNOWN	WASH WITH WATER	DUST LEVELS MUST REMAIN LOW. USE VENTILATION IF REQUIRED. USE DUST MASK, GLOVES AND GOGGLES IF DUST PREVAILS
EYES	DISCOMFORT		
INHALATION	NONE KNOWN		
INGESTION	NONE KNOWN		
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA LD50 - 4220 MG/KG (RAT)

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA NON TOXIC

STORAGE - RECOMMENDED CONDITIONS DRY CONDITIONS

SPECIAL REQUIREMENTS

APPLICATION USED TO PRECIPITATE CALCIUM IN WATER BASED MUDS. NORMALLY USED TO TREAT CONTAMINATION FROM CEMENT OR ANYHYDRITE. FOR SUCCESSFUL TREATMENT MUD PH MUST BE ABOVE 8.3. NORMAL TREATMENT LEVELS DEPEND ON THE LEVEL OF CALCIUM AND NORMAL TREATMENT WILL BE IN THE REGION OF 0.5 TO 1 PPB.

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

GYPSUM

COMPOSITION	CALCIUM SULPHATE DIHYDRATE. CASO4 2H2O CAS NO:- 10101-41-4 95% MIN PURITY
PHYSICAL FORM & APPEARANCE	WHITE POWDER
PHYSICAL PROPERTIES	S.G: 2.32 P.H: 6.8 - 7.5
REGISTRATION	
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	25 KG SACKS/42 PER PALLET 50 KG SACKS/20 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	NON FLAMMABLE
a) STABILITY	STABLE - INERT MINERAL
b) EXTINGUISHING AGENTS	
c) SPECIAL PRECAUTIONS	
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE
DISPOSAL - REGULATION REQUIREMENTS	DISPOSE IN ACCORDANCE WITH LOCAL REGULATIONS

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN		WASH WITH WATER	VENTILATE TO REDUCE DUST NUISANCE. WEAR GOGGLES AND DUST MASK IF REQUIRED
EYES	NUISANCE DUST ONLY	FLUSH WITH WATER	
INHALATION			
INGESTION			
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP DRY

SPECIAL REQUIREMENTS

APPLICATION GYPSUM IS A SOURCE OF CALCIUM IN INHIBITIVE CALCIUM BASED MUD SYSTEMS. A VISCOSITY HUMP IS OBSERVED WHEN ADDING GYPSUM TO BENTONIC MUD SYSTEMS. FOR THIS REASON SOLIDS AND MBT SHOULD BE KEPT AS LOW AS POSSIBLE. TREATMENT LEVELS RANGE 4 - 8 PPB TO MAINTAIN 600 - 1200 PPM CA IN FILTRATE

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

CAUSTIC SODA

COMPOSITION	SODIUM HYDROXIDE N. ..; CAS NO:- 1310-73-2
PHYSICAL FORM & APPEARANCE	WHITE PEARL/SOLID
PHYSICAL PROPERTIES	DENSITY: 1200 KG/M3 M PT: 318°C PH: 13.5
REGISTRATION	DOE CNS CATEGORY 1
TRANSPORT CLASSIFICATION	UN NO: 1823 CLASS 8 IMO CODE: 8215
LABELLING	R PHRASES: 35 CORROSIVE S PHRASES: 2, 26, 37/39
PACKAGING	50 KG DRUMS, 18 PER PALLET 25 KG DRUMS, 36 PER PALLET

FIRE & HAZARDOUS REACTIONS :- NON FLAMMABLE

1 ADDITION OF CAUSTIC TO WATER IS ACCOMPANIED BY CONSIDERABLE EVOLUTION OF HEAT AGITATION IS REQUIRED TO AVOID LOCAL BOILING AND VIOLENT SPURTING OF THE LIQUOR.

2 SOLIDS FORM. IN CONTACT WITH MOISTURE OR WATER MAY GENERATE SUFFICIENT HEAT TO IGNITE COMBUSTIBLE MATERIALS.

3 CONTACT WITH THE FOLLOWING METALS CAN GENERATE HYDROGEN GAS WITH ITS ASSOCIATED HAZARDS:- ALUMINIUM, BRASS, TIN, ZINC.

4 CAN REACT VIOLENTLY OR EXPOSIVELY WITH MANY ORGANIC CHEMICALS. PARTICULARLY CHLORINATED HYDROCARBONS.

SPILLAGE - EMERGENCY RESPONSE SPILLAGES MUST BE DEALT WITH IMMEDIATELY. THE CAUSTIC MUST BE SHOVELLED UP AND PUT IN TO STEEL DRUMS FOR SUBSEQUENT DISPOSAL, WASHING THE AREA AFTERWARDS WITH COPIOUS AMOUNTS OF WATER. SPILT MATERIAL MAY BE "NEUTRALISED" BY APPLYING EXCESS SODIUM BICARBONATE.

DISPOSAL - REGULATION REQUIREMENTS EMPLOY SPECIALIST WASTE DISPOSAL FIRM

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS TWA 8 HR = 10 MINS - 2 MG/M3

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
"KIN	BOTH SOLID & STRONG SOLUTIONS ARE PRIMARY IRRITANTS, WILL RAPIDLY DESTROY THE TISSUE CAUSING CAUSTIC BURNS WHICH ARE SLOW TO HEAL AND LEAVE A SCAR	DRENCH THE AFFECTED AREA WITH COPIOUS QUANTITIES OF BORIC SOLUTIONS OR WATER. CONTINUE TREATMENT FOR NOT LESS THAN 15 MINUTES	MUST BE KEPT FROM CONTACT WITH SKIN AND EYES. ATMOS-PHERE LEVELS OF DUST MUST BE MINIMISED. DUST MASKS SHOULD BE USED CHEMICAL GOGGLES, PVC GLOVES, BOOTS & APRON SHOULD BE WORN
YES	CAN CAUSE SEVERE DAMAGE WITH PERMANENT IMPAIRMENT OR EVEN LOSS OF VISION	IRRIGATE WITH BORIC SOLUTION OR WATER FOR AT LEAST 10 MIN CONTINUE IRRIGATION UNTIL MEDICAL ATTENTION IS CAN BE OBTAINED	
INHALATION	DUST OR CONCENTRATED MIST MAY CAUSE DAMAGE OF THE UPPER RESPIRATORY TRACT AND LUNG TISSUE	REMOVE TO FRESH AIR. KEEP PATIENT WARM AND AT REST. ADMINISTER OXYGEN IF NECESSARY	
NGESTION	CAUSES SEVERE DAMAGE TO THE MUCOUS MEMBRANES OR DEEPER TISSUE OF THE MOUTH, THROAT OESOPHAGUS AND STOMACH AND DEATH MAY RESULTS FROM SUBSEQUENT PENETRATION INTO VITAL AREAS	DO NOT INDUCE VOMITING. WASH OUT MOUTH WITH WATER AND MILK TO DRINK, FOLLOWED BY 1% ACETIC ACID (DILUTE VINE-GAR) OR FRUIT JUICE	

SUPPLEMENTARY ADVICE TO PHYSICIAN ALL EXCEPT CASES OF VERY MINOR EXPOSURE SHOULD OBTAIN MEDICAL ATTENTION FOLLOWING FIRST AID TREAT-MENT ON SITE

TORAGE - RECOMMENDED CONDITIONS MATERIAL SHOULD BE STORED UNDER DRY CONDITIONS AND CONTAINERS RESEALED AFTER USE

PPLICATION FOR THE CONTROL OF PH IN ALL WATER BASED MUD SYSTEMS. IT ALSO INCREASES THE RATE OF HYDRATION OF CLAYS AND IS AN AID TO CORROSION CONTROL.
"AUSTIC SODA IS A STRONG ALKALI AND SHOULD BE USED WITH EXTREME CAUTION AS IT CAUSES · EVERE BURNS. NORMAL TREATMENT DEPENDS ON THE MUD SYSTEM AND THE REQUIRED PH

ONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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DATA SHEET

SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

BW CHROME FREE

COMPOSITION	IRON LIGNOSULPHONATE SERLA-SOL FE - P60
PHYSICAL FORM & APPEARANCE	BROWN POWDER
PHYSICAL PROPERTIES	IRON: 6% PH: 3
REGISTRATION	DOE CNS CATEGORY 0
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	IRRITANT
PACKAGING	25 KG SACKS/25 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	THE PRODUCT WILL SUPPORT COMBUSTION
b) EXTINGUISHING AGENTS	FOAM AND SAND
c) SPECIAL PRECAUTIONS	TREAT AS EXPLOSION HAZARD IF DUST IS PRESENT
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE
DISPOSAL - REGULATION REQUIREMENTS	DUMP IN ACCORDANCE WITH LOCAL REGULATIONS FOR FLAMMABLE AND HAZARDOUS WASTE

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS TLV 8 HR 25 MG/M3

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	IRRITANT - SKIN RASH	WASH WITH SOAP AND WATER APPLY SKIN LOTION	USE LOCAL VENTILATION. WEAR GLOVES, GOGGLES & DUST MASK
EYES	IRRITANT	IRRIGATE WITH WATER	
INHALATION	IRRITANT	REMOVE TO FRESH AIR	
INGESTION	IRRITANT	INDUCE VOMITING AND CONSULT PHYSICIAN	
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP AWAY FROM SOURCES OF IGNITION AND EXCESSIVE HEAT

SPECIAL REQUIREMENTS

APPLICATION BW CHROME FREE IS A DISPERSANT GRADE MODIFIED LIGNOSULPHONATE FOR USE IN WATER BASED DRILLING FLUIDS. THE PRODUCT CONTAINS NO HEAVY METAL IONS, REDUCING TOXICOLOGICAL EFFECTS NOTED WITH ALTERNATIVE PRODUCTS. IT IS USED PRIMARILY AS A DISPERSANT IN MOST WATER BASED MUD SYSTEMS UP TO TEMPERTURES OF 300°F. IT ALSO ACTS AS A SECONDARY FLUID LOSS CONTROL ADDITIVE. BW CHROME FREE IS BEST ADDED THROUGH THE MIXING HOPPER AT 5 - 10 MINS/SK. TREATMENT IS NORMALLY IN THE RANGE FROM 2 - 8 PPB.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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WEST TULLOS
ABERDEEN
AB1 4AD
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GREAT YARMOUTH
NORFOLK
TELE:- 0493 601743

BW MUD LIMITED
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DATA SHEET

SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

CALCIUM LIGNOSULPHONATE

COMPOSITION	SERLA-SOL PC MODIFIED CALCIUM LIGNOSULPHONATE
PHYSICAL FORM & APPEARANCE	MEDIUM BROWN POWDER
PHYSICAL PROPERTIES	DENSITY: 600 KG/M3 P.H: 4.5 DECOMPOSITION: > 125°C VERY SOLUBLE IN WATER
REGISTRATION	
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	IRRITANT
PACKAGING	25 KG SACKS, 25 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	NON FLAMMABLE
b) EXTINGUISHING AGENTS	ALL SUITABLE
c) SPECIAL PRECAUTIONS	INCOMPATIBLE WITH OXIDANTS
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE TO TIP
DISPOSAL - REGULATION REQUIREMENTS	DO NOT ALLOW TO PASS INTO WATER COURSES

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	SLIGHT IRRITANT	WASH WITH SOAP AND WATER	AVOID INHALATION OF DUST. GLOVES AND GOGGLES SHOULD BE WORN
EYES	SLIGHT IRRITANT	IRRIGATE WITH WATER	
INHALATION	SLIGHT IRRITANT		
INGESTION	SLIGHT IRRITANT		
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA LD50 > 16 G/KG (RATS)

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP DRY

SPECIAL REQUIREMENTS

APPLICATION CALCIUM LIGNOSULPHONATE IS A DISPERSENT GRADE MODIFIED LIGNOSULPHONATE FOR USE IN WATER BASED DRILLING FLUIDS. THE PRODUCT CONTAINS NO HEAVY METAL IONS, REDUCING TOXICOLOGICAL EFFECTS NOTED WITH ALTERNATIVE PRODUCTS. IT IS USED PRIMARILY AS A DISPERSANT IN MOST WATER BASED MUD SYSTEMS UP TO TEMPERATURES OF 300°F. IT ALSO ACTS AS A SECONDARY FLUID LOSS CONTROL ADDITIVE. CALCIUM LIGNOSULPHONATE IS BEST ADDED THROUGH THE MIXING HOPPER AT 5 - 10 MINS/SK. TREATMENT IS NORMALLY IN THE RANGE FROM 2 - 8 PPB.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

BW GEL

COMPOSITION	SODIUM MONTMORILLONITE - WYOMING BENTONITE
PHYSICAL FORM & APPEARANCE	LIGHT GREY POWDER
PHYSICAL PROPERTIES	S.G: 2.5 P.H: 8 - 8.5 FUSION TEMP: 1400°C
REGISTRATION	DOE CNS CATEGORY O
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	25 KG, 50 KG SACKS
FIRE & HAZARDOUS REACTIONS :-	INERT CLAY
a) STABILITY	NON FLAMMABLE
b) EXTINGUISHING AGENTS	
c) SPECIAL PRECAUTIONS	CAUSES SLIPPERY SURFACE WHEN WET
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE TO TIP
DISPOSAL - REGULATION REQUIREMENTS	

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	NONE NOTED	WASH OFF WITH WATER	USE IN WELL VENTILATED AREA. USE GOGGLES AND DUST MASK TO MINIMISE THE EFFECTS OF DUST
EYES	MECHANICAL IRRITATION BY DUST	IRRIGATE WITH WATER	
INHALATION	PROLONGED INHALATION OF DUST MAY CAUSE LUNG INJURY	REMOVE TO FRESH AIR	
INGESTION			
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP DRY

SPECIAL REQUIREMENTS

APPLICATION BW GEL IS A NATURALLY OCCURING SODIUM MONTMORILLONITE CLAY WHICH WILL YIELD A MINIMUM OF 90 BBLS OF 15 CPS MUD PER 2000 LBS OF MATERIAL. IT IS USED FOR VISCOSITY AND FLUID LOSS CONTROL IN ALL FRESH WATER MUDS. BW GEL WILL NOT YIELD IN THE PRESENCE OF SALT AND IF CHLORIDE CONCENTRATION IS IN EXCESS OF 7000 MG/L, IT MUST BE PRE-HYDRATED IN FRESH WATER PRIOR TO BEING ADDED TO THE SALT WATER. BW GEL HAS A HIGHER GELLING CAPACITY THAN PREMIUM GRADES OF BENTONITE AND FORMS A GOOD COMPRESSIBLE FILTER CAKE. TREATMENT IS AS REQUIRED TO GIVE THE DESIRED PROPERTIES. IN FRESH WATER 20 PPB WILL GIVE A FUNNEL VISCOSITY OF APPROXIMATELY 36 SEC/QT.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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DATA SHEET

SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

BW EXHICELL

COMPOSITION	SODIUM CARBOXYMETHYLCELLULOSE (CMC)
PHYSICAL FORM & APPEARANCE	CREAM COLOURED POWDER
PHYSICAL PROPERTIES	DENSITY: 1.55 G/CM3
REGISTRATION	
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	25 KG SACKS, 25 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	STABLE - FLAMMABLE
b) EXTINGUISHING AGENTS	ALL SUITABLE
c) SPECIAL PRECAUTIONS	AVOID DISPERSION OF DUST IN AIR TO REDUCE POTENTIAL FOR DUST IGNITION/EXPLOSIONS. AVOID IGNITION SOURCES
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP IMMEDIATELY
DISPOSAL - REGULATION REQUIREMENTS	REMOVE TO TIP - DISPOSE AS NON HAZARDOUS WASTE

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	NONE KNOWN	WASH WITH SOAP AND WATER	AVOID DISPERSION OF DUST. USE LOCAL VENTILATION. WEAR GOGGLES, PLASTIC GLOVES AND DUST RESPIRATOR IF DUST PERSISTS
EYES	DISCOMFORT AND REDDENING	FLUSH WITH WATER	
INHALATION	NONE KNOWN	REMOVE FROM EXPOSURE TO DUST	
INGESTION	NONE KNOWN		
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA — VERY LOW TOXICITY

STORAGE - RECOMMENDED CONDITIONS — KEEP DRY AND IN CLOSED CONTAINERS

SPECIAL REQUIREMENTS

APPLICATION BW EX HI-CELL IS A SODIUM CARBOXYMETHYLCELLOSE HAVING A HIGH DEGREE OF SUBSTITUTION AND AN EXTREMELY HIGH MOLECULAR WEIGHT. IT IS AN EXTREMELY EFFECTIVE VISCOSIFIER AND FLUID LOSS ADDITIVE FOR WATER BASED MUDS AND IS PARTICULARLY RECOMMENDED FOR USE IN SATURATED SALT AND SEAWATER SYSTEMS. THE PRODUCT HAS A HIGHER MOLECULAR WEIGHT THAN OTHER GRADES OF CMC AND IS THEREFORE GENERALLY USED AT LOWER DOSAGE. TREATMENT LEVELS DEPEND ON THE REQUIRED PROPERTIES, BUT AS A GUIDE 1 PPB OF EX HI-CELL WILL GIVE AN INCREASE IN APPARENT VISCOSITY OF 10 CPS IN A SATURATED SALT WATER SLURRY.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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DATA SHEET

SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

DRISCOSE POLYMER

COMPOSITION	CARBOXY METHYL CELLULOSE GRADES LV, REG, HV
PHYSICAL FORM & APPEARANCE	OFF WHITE POWDER
PHYSICAL PROPERTIES	
REGISTRATION	
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	50 LB SACKS, 44 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	
b) EXTINGUISHING AGENTS	WATERSPRAY, CARBON DIOXIDE
c) SPECIAL PRECAUTIONS	IF FINELY DIVIDED, TREAT AS A FLAMMABLE DUST
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP
DISPOSAL - REGULATION REQUIREMENTS	PLACE IN DISPOSAL CONTAINER

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS NUISANCE DUST - OEL = 10 MG/M3 TOTAL DUST

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN		WASH WITH WATER	USE LOCAL VENTILATION OR DUST MASK AND GOGGLES
EYES	IRRITANT	FLUSH WITH WATER	
INHALATION	IRRITANT DUE TO HYGROSCOPIC QUALITIES	REMOVE TO FRESH AIR	
INGESTION			
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA LD50 > 5 G/KG

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA	NON TOXIC
STORAGE - RECOMMENDED CONDITIONS	STORE IN COOL, DRY CONDITIONS
SPECIAL REQUIREMENTS	AVOID DUST FORMATION IN HANDLING. THE PRODUCT IS INCOMPATIBLE WITH STRONG OXIDISING AGENTS

APPLICATION BIOZAN A POLYSACHARIDE GUM WHICH PROVIDES HIGH VISCOSITIES AT LOW CONCENTRATIONS, AND PRODUCES AN EFFECTIVE SHEAR THINNING FLUID LEADING TO OPTIMUM DRILLING RATES AND HOLE CLEANING PARAMETERS. IT HAS GREATER TEMPERATURE STABILITY THAN XC AND XCD POLYMER AND IS STABLE UP TO TEMPERATURES OF 350°F. TREATMENT LEVELS 0.5 - 1.5 PPB MIXED THROUGH THE HOPPER AT NOT LESS THAN 20 - 30 MINUTES PER SACK ARE NORMAL.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

BW BENTONITE QS

COMPOSITION	BENTONITE - GRANULAR
PHYSICAL FORM & APPEARANCE	GREY - BROWN GRANULES
PHYSICAL PROPERTIES	Q.S. BENTONITE - GRADE 2 (2 - 4 MM DIAM) Q.S. BENTONITE - GRADE 5 (5 - 10 MM DIAM) Q.S. BENTONITE - MIX (2 - 10 MM DIAM)
REGISTRATION	
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	25 KG SACKS/40 PER PALLET
FIRE & HAZARDOUS REACTIONS :-	INERT CLAY
a) STABILITY	NON FLAMMABLE
b) EXTINGUISHING AGENTS	
c) SPECIAL PRECAUTIONS	CAUSES SLIPPERY SURFACE WHEN WET
SPILLAGE - EMERGENCY RESPONSE	SWEEP UP AND REMOVE TO TIP
DISPOSAL - REGULATION REQUIREMENTS	

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN	SLIGHTLY IRRITANT	WASH WITH SOAP AND WATER	USE LOCAL VENTILATION, GLOVES AND GOGGLES
EYES	MECHANICAL IRRITATION	FLUSH WITH WATER	
INHALATION	DUST NUISANCE	REMOVE TO FRESH AIR	
INGESTION	NON-TOXIC		
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS KEEP DRY

SPECIAL REQUIREMENTS

APPLICATION IT IS UNIQUE IN THAT IT EXTENDS THE YIELD OF BENTONITE CLAYS WHILE SELECTIVELY FLOCCULATING LOW YIELDING DRILLED SOLIDS. IT HAS A WIDE APPLICATION IN LOW SOLIDS MUD SYSTEMS, IS ADDED THROUGH THE MIXING HOPPER OR DISSOLVED IN WATER AND ADDED THROUGH A CHEMICAL BARREL. TYPICAL TREATMENT 0.05 PPB. NOTE: DO NOT USE IN A CALCIUM ENVIRONMENT.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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SAFE HANDLING OF CHEMICALS (S.H.O.C.)

E & P OPERATING COMPANIES

BW BARITE

COMPOSITION	BARIUM SULPHATE APPROX 95% CAS NO:- 7727-43-7
PHYSICAL FORM & APPEARANCE	ODOURLESS PINK OR GRAY POWDER
PHYSICAL PROPERTIES	SG: 4.2 - 4.4
REGISTRATION	DOE CNS CATEGORY 0
TRANSPORT CLASSIFICATION	UN NO: N/A
LABELLING	
PACKAGING	50 KG SACKS, 30 PER PALLET OR BULK

FIRE & HAZARDOUS REACTIONS :-	
a) STABILITY	STABLE - INERT MINERAL
b) EXTINGUISHING AGENTS	N/A
c) SPECIAL PRECAUTIONS	

SPILLAGE - EMERGENCY RESPONSE	SWEEP UP
DISPOSAL - REGULATION REQUIREMENTS	REMOVE TO TIP

HEALTH & SAFETY INFORMATION AND FIRST AID

OCCUPATIONAL EXPOSURE LIMITS

	IRRITANT EFFECTS	TREATMENT	RECOMMENDED PERSONAL PROTECTION
SKIN			WEAR DUST MASK AND GOGGLES WHILST DUST PERSISTS
EYES	IRRITANT DUST	FLUSH WITH WATER	
INHALATION	IRRITANT DUST	REMOVE TO FRESH AIR	
INGESTION			
TOXIC EFFECTS			
ANY OTHER			

SUPPLEMENTARY ADVICE TO PHYSICIAN

EXPERIMENTAL ANIMAL DATA

ENVIRONMENTAL DATA

REGULATORY REQUIREMENTS

ENVIRONMENTAL DATA

STORAGE - RECOMMENDED CONDITIONS DRY CONDITIONS

SPECIAL REQUIREMENTS

APPLICATION BW BAR IS THE CHEMICALLY INERT, FINELY GROUND, LOW ABRASION POWDER BARIUM SULPHATE, WITH A MINIMUM SPECIFIC GRAVITY OF 4.2. BW BAR IS USED IN ALL DRILLING FLUIDS TO INCREASE DENSITY. FLUIDS WITH WEIGHTS UP TO 2.0 PPG MAY BE OBTAINED WITH BW BAR AND STILL REMAIN PUMPABLE. BW BAR IS EASILY SUSPENDED AND HAS LITTLE EFFECT ON VISCOSITY AND GEL STRENGTHS. THE QUANTITY OF BW BAR REQUIRED DEPENDS ON THE DESIRED MUD WEIGHT AND CAN BE CALCULATED USING STANDARD WEIGHT UP EQUATIONS.

CONTACT PERSON ....BILLY.COCHRANE..... POSITION ...TECHNICAL.MANAGER.....

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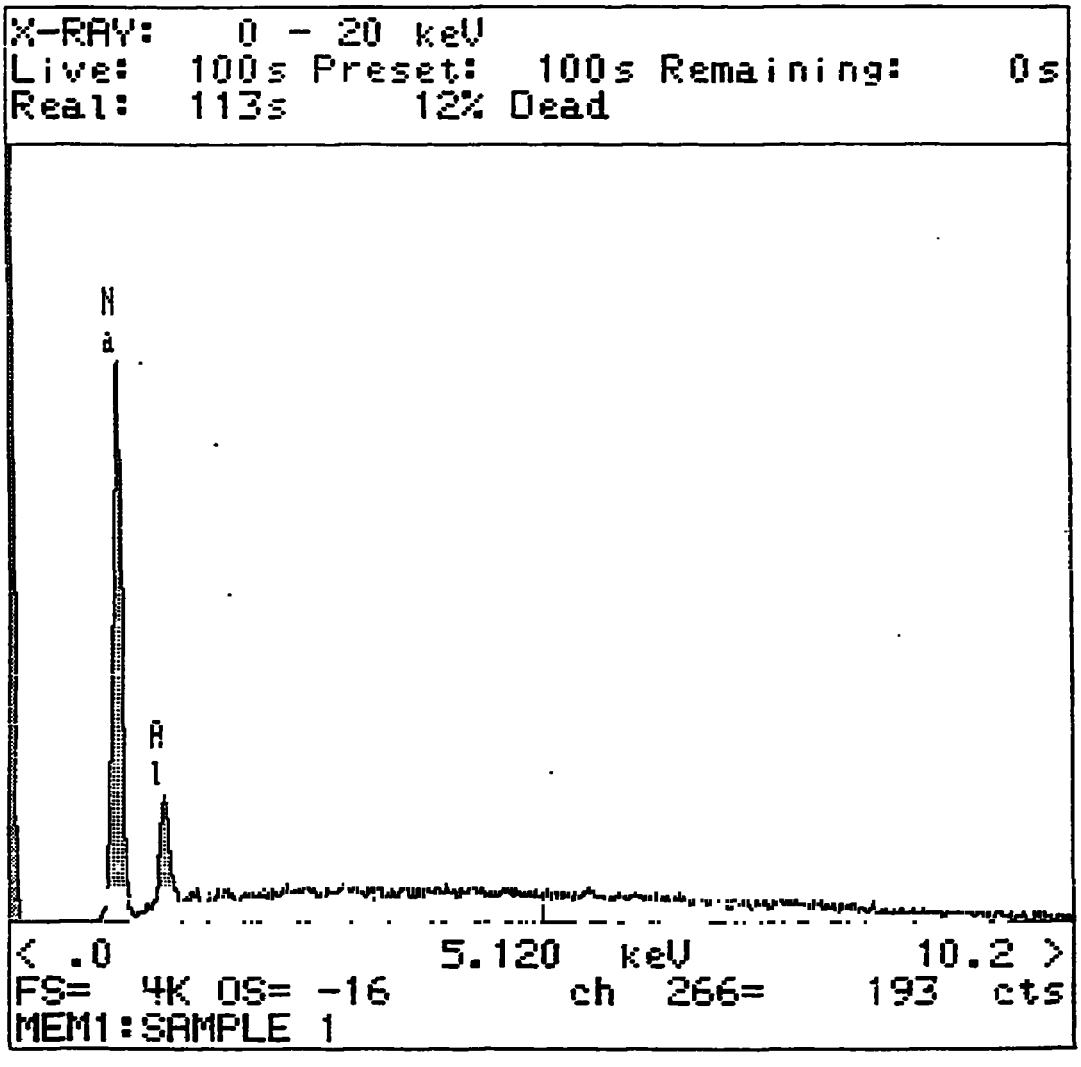
ANNEXURE 4

SOEKOR

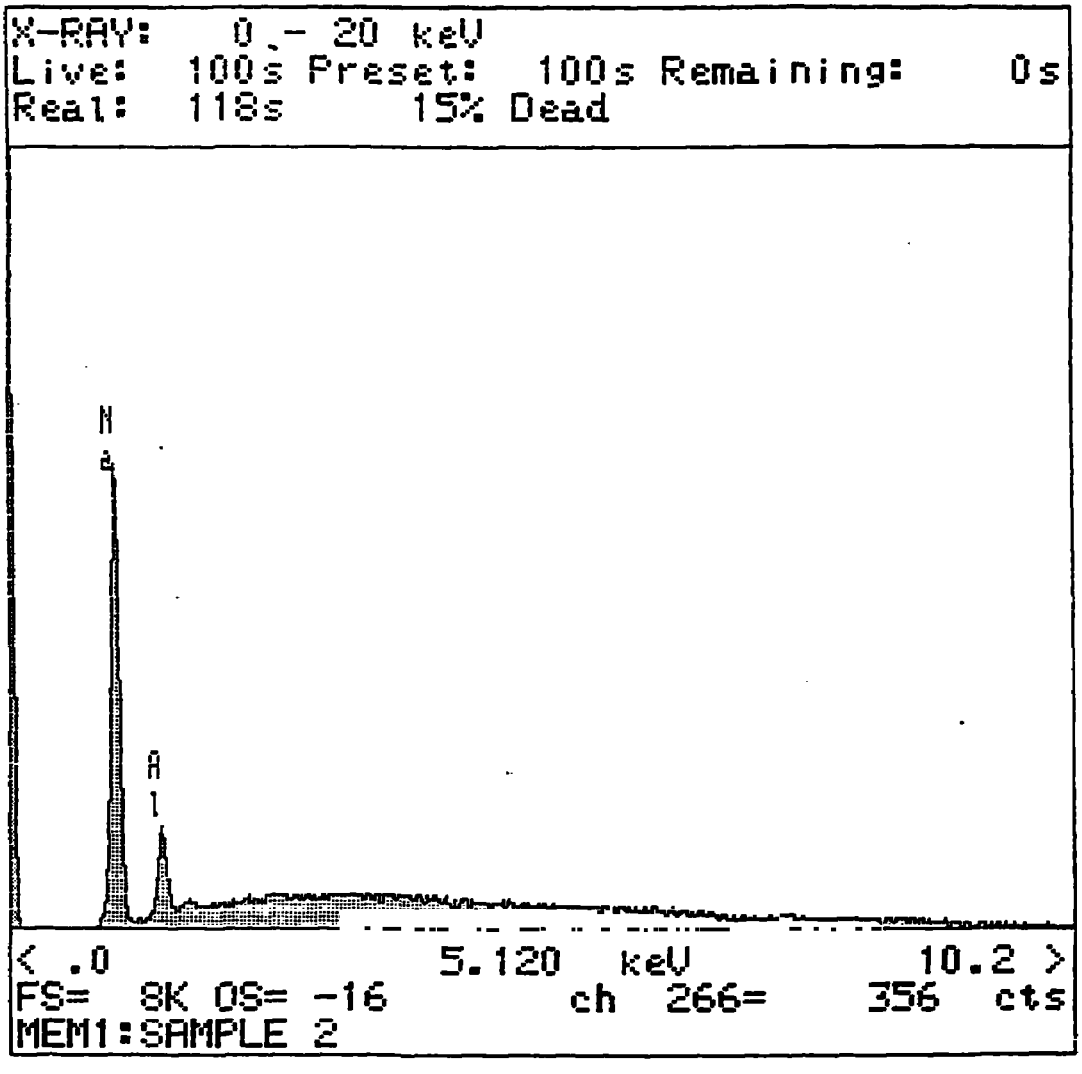
ENERGY DISPERSIVE SPECTROMETER (EDS)

ANALYSED AS SODUIM (BICARBONATE)



ENERGY DISPERSIVE SPECTROMETER (EDS)

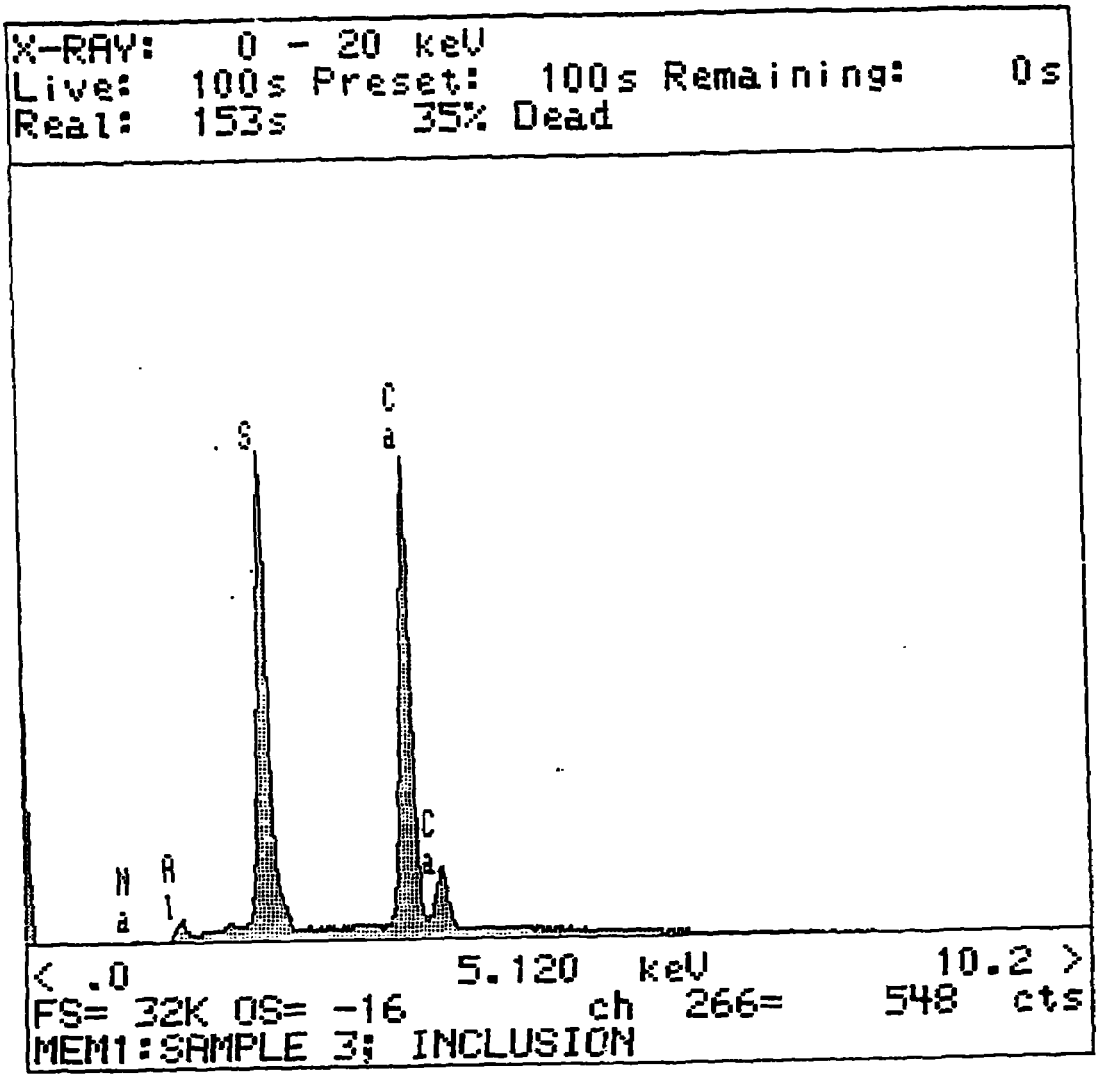
ANALYSED AS SODUIM (BICARBONATE)



SOEKOR

ENERGY DISPERSIVE SPECTROMETER (EDS)

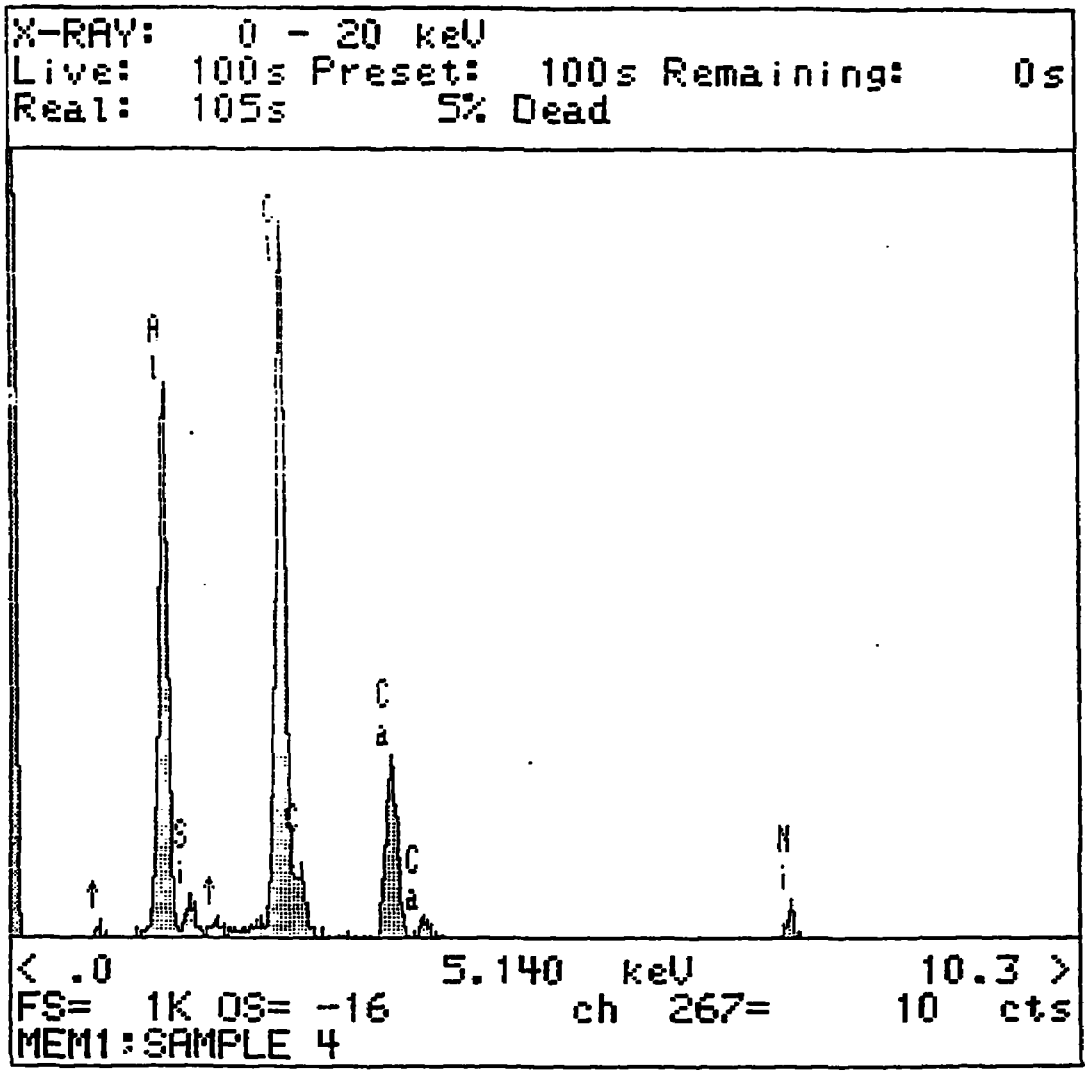
ANALYSED AS LIGNOSULPHONATE



SOEKO

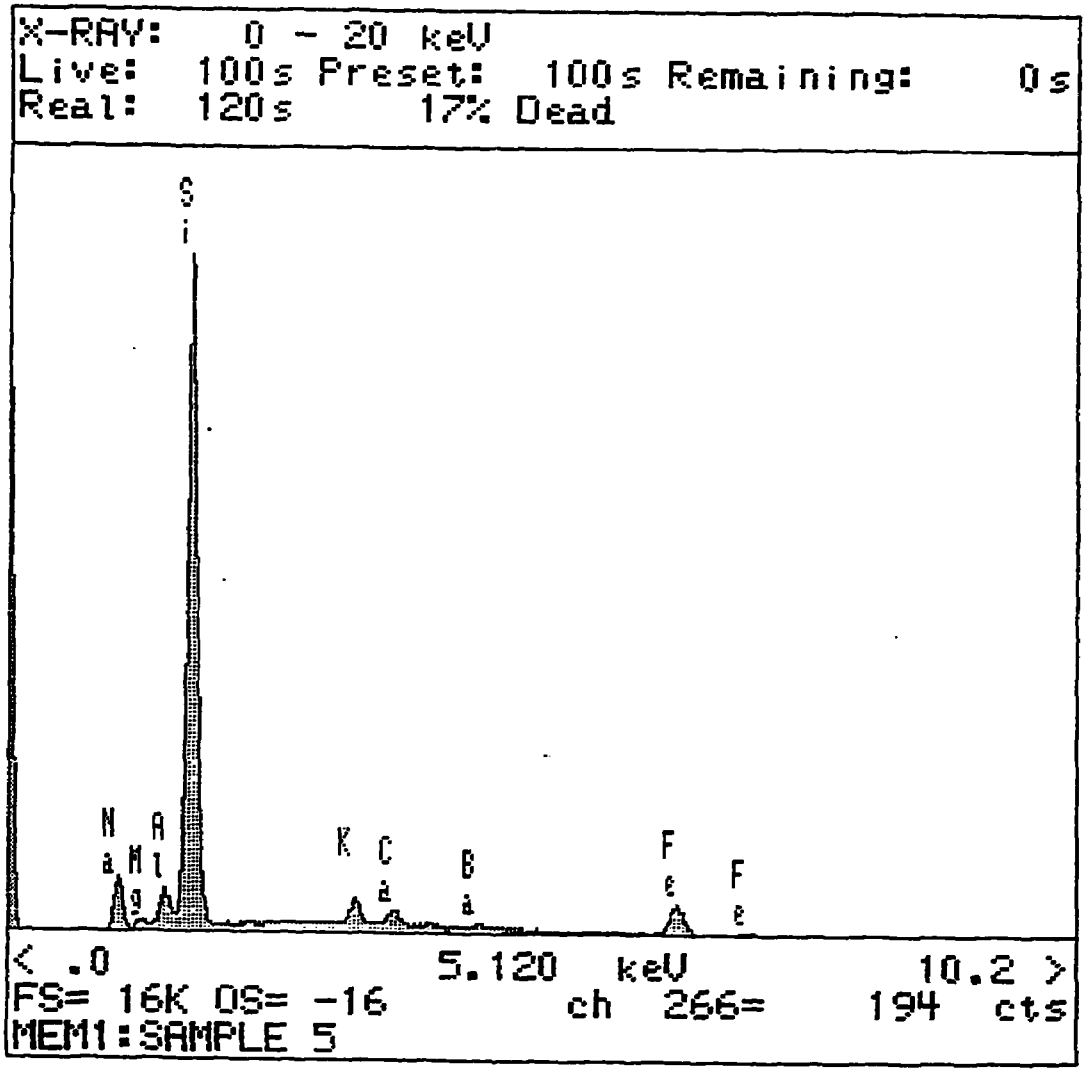
ENERGY DISPERSIVE SPECTROMETER (EDS)

ANALYSED AS CALCUIM CHLORIDE



ENERGY DISPERSIVE SPECTROMETER (EDS)

ANALYSED AS POSSIBLY PRE-PREPARED MUD



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