BCLME

Benguela Current Large Marine Ecosystem Programme

INCEPTION WORKSHOP REPORT

Project: BEHP/CEA/03/02:

Data Gathering and Gap Analysis for Assessment of Cumulative Effects of Marine Diamond Mining Activities on the BCLME Region

&

Project: BEHP/CEA/03/03:

Assessment of the Cumulative Effects of Sediment Discharges from On-Shore and Near-Shore Diamond Mining Activities on the BCLME

Prepared for

Benguela Current Large Marine Ecosystem Programme

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By

A.J. Penney
Pisces Environmental Services (Pty) Ltd

&

G.G. Smith
CSIR Environmentek

CSIR ENVIRONMENTEK

Contents

Executive Summary 1
List of Acronyms, Symbols and Abbreviations 2
A. PURPOSE OF THE WORKSHOP 3
B. WORKSHOP PARTICIPATION 4
C. WORKSHOP PRESENTATIONS 5
C.1 Project BEHP/CEA/03/02: Data Gathering and Gap Analysis 5
C.2 Project BEHP/CEA/03/03: Sediment Impact Modelling 11
C.3 De Beers Marine Namibia: Marine Mining Activities 14
D. IDENTIFICATION OF MINING IMPACTS AND DATA REQUIREMENTS 16
D.1 Data Levels 16
D.2 Data Resolution 17
D.3 Data Reliability, Uncertainty and Interpretation 18
E. Identification of Mining Impacts, Mechanisms and Data Sources 18
E.2 Specific Data Requirements for Project BEHP/CEA/03/03 25
E.2.1 Model Site Selection 25
E.2.2 Characterization of Impact Mechanisms 26
E.2.3 Distribution of Nearshore Reef Areas 26
E.2.4 Natural Environmental Recovery Rates 26
F. Capacity Building Options 27
G. ACKNOWLEDGEMENTS 28
H. REFERENCES 29
I. APPENDICES 30
Appendix A: Agenda for Joint Project Inception Workshop: Projects BEHP/CEA/03/02 & BEHP/CEA/03/03 30

Executive Summary

The Joint Inception Workshop for projects BEHP/CEA/03/02 (*Data Gathering and Gap Analysis for Assessment of Cumulative Effects of Marine Diamond Mining Activities on the BCLME Region*) and BEHP/CEA/03/02 (*Assessment of the Cumulative Effects of Sediment Discharges from On-Shore and Near-Shore Diamond Mining Activities on the BCLME*) was held at the Namdeb Centre, Windhoek, on 16 – 17 August 2004. It was attended by the project leaders of the two projects, project team members and representatives of De Beers Marine Namibia (DBMN).

Presentations to the workshop described the objectives and scopes of work of the two projects, and the general data requirements of each. Examples were given of marine mining impacts, fishing impacts on the seabed, effects of natural processes and results of past modelling work on sediment transport. DBNM presented a descriptive overview of mining history and impacts in the southern Namibian region, with recently updated information on cumulative sediment discharges since 1968.

Much of the workshop was spent identifying and tabling known or likely impacts of marine mining by the various mining sectors, the fishing industry and natural processes in the BCLME region. For each tabled impact, a brief description of the mechanism and an evaluation of the likely cumulative nature of the impact is given, with descriptions of the types of data required to evaluate each impact and proposed potential sources for each data type. This tabled list of impacts, cumulative mechanisms and data sources will serve as the basis for data collection and summary activities to be conducted under project BEHP/CEA/03/02.

For project BEHP/CEA/03/03, specific consideration was given to additional data inputs required for modelling of sediment transport processes in the region. A number of modelling study sites suitable for evaluating impacts of mining-derived sediments were also proposed. Project 03 also has a capacity building component, and the outcomes of the BCLME Capacity Building Workshop were reviewed to identify potential additional capacity building components or outcomes from these projects.

List of Acronyms, Symbols and Abbreviations

BCLME - Benguela Current Large Marine Ecosystem

DME - Department of Minerals and Energy, South Africa

IIM - Instituto de Investigação Marinha, Ministério de Pescas, Angola

MCM - Marine & Coastal Management: Department of Environmental Affairs and Tourism, South Africa

MDMA - Marine Diamond Mining Association, South Africa

MFMR - Ministry of Fisheries and Marine Resources, Namibia

MME - Ministry of Minerals and Energy, Namibia

A. PURPOSE OF THE WORKSHOP

A Joint Project Inception Workshop was held at the Namdeb Centre, Windhoek, Namibia, on 16 and 17 August 2004.by the two inter-related BCLME projects:

- Project: BEHP/CEA/03/02: *Data Gathering and Gap Analysis for Assessment of Cumulative Effects of Marine Diamond Mining Activities on the BCLME Region.*

- Project: BEHP/CEA/03/03: *Assessment of the Cumulative Effects of Sediment Discharges from On-Shore and Near-Shore Diamond Mining Activities on the BCLME.*

The overall purpose of the workshop was to identify potential cumulative impacts emanating from marine mining and related activities, to select suitable data sources for evaluating such impacts and to finalise work plans for the above projects.

The workshop was intended to produce the following products / outcomes:

- Identification, description and characterization of all known or potential impacts of marine mining operations.
- Identification of the probable mechanisms and potential cumulative nature of these impacts.
- Identification of potential data sources for evaluation of marine mining impacts.
- Identification of data sources for evaluation of natural environmental variability and the impact of other users, particularly fisheries.
- Final selection of data sources to be used in the project, and initial proposals for data formats and broad database content.
- Final planning of the project work plans, capacity building components and schedules.
- Finalisation of Project Team task allocations and schedules for the duration of the projects.

B. WORKSHOP PARTICIPATION

Invitation to participate in the workshop was extended to:

- Angolan and Namibian members of the two project teams.
- A representative from the Namibian Ministry of Minerals and Energy, Windhoek.
- Representatives of Namibian and South African marine mining companies, through the Marine Diamond Mining Association.
- Representatives of the BCLME office, Windhoek.

The workshop was attended by:

Mr A. Penney	- Project Leader: BEHP/CEA/03/02
Mr G. Smith	- Project Leader: BEHP/CEA/03/03
Mr N. Willemse	- University of Namibia and Ministry of the Environment; Project BEHP/CEA/03/03 Namibian team member
Mr A. Goosen	- Environmental Section, De Beers Marine Namibia
Dr L. Maartens	- Environmental Section, De Beers Marine Namibia

Apologies were received from:

Mr J. Boavida	- Universidade Agostinho Neto, Luanda, Angola; Projects 02 and 03 Angolan team member. (Mr Boavida was not available over the dates of the workshop. Arrangements are being made to fly Mr Boavida to Cape Town for direct project planning discussions with G. Smith and A. Penney.)
Ms K. Peard	- Ministry of Fisheries and Marine Resources, Namibia; Project 02 Namibian team member. (Initial project planning discussions were held with Ms Peard during the Lüderitz Upwelling Centre – Orange River Cone (LUCORC) Workshop in Cape Town on 28 – 29 July 2004. Additional direct discussions will be held as the project progresses.)
Dr P. Wickens	- De Beers Consolidated Mines, South Africa.
Ms. L. Roos	- Environmental Section, De Beers Marine, South Africa.

C. WORKSHOP PRESENTATIONS

C.1 Project BEHP/CEA/03/02: Data Gathering and Gap Analysis

Mr Andrew Penney presented an overview of project BEHP/CEA/03/03. The overall objective of Project BEHP/CEA/03/02 is:

- ***To review all available information and gather quantified data that can be used to assess the cumulative effect of marine diamond mining activities on the Benguela Current Large Marine Ecosystem, to identify gaps in these data sources and to make recommendations for additional data gathering and/or monitoring programmes.***

The Terms of Reference to address this objective are contained in the project proposal and the Inception Report for the project. The data sourcing and capture phase of the project is due to run from beginning August to end November 2004, at which time data will be transferred to CSIR: Environmentek for use in the sediment modelling studies under project BEHP/CEA/03/03. Modelling results should be received from the CSIR by the beginning of March 2005, and the Final Report was due at the end of June 2005.

In explanation of the need to include fisheries impact and natural process data in the study, some examples of the relative impacts of each were given from Penney & Pulfrich 2004, looking particularly at impacts and recovery processes in the deeper water offshore areas.

The main impact of offshore vessel-based remote mining is excavation of the seabed, and associated sediment discarding on adjacent areas (Figure 1 and Plate 1). This causes significant mortality and change in composition of benthic communities in mined areas (Figure 2). In contrast, the fine sediment plumes generated during these offshore mining operations (Plate 2) are of limited extent, with most of the sediment sinking to the seabed within 500m or so from the vessel (Figure 3). These plumes also do not appear to be contaminated with heavy metals or pesticides in this region.

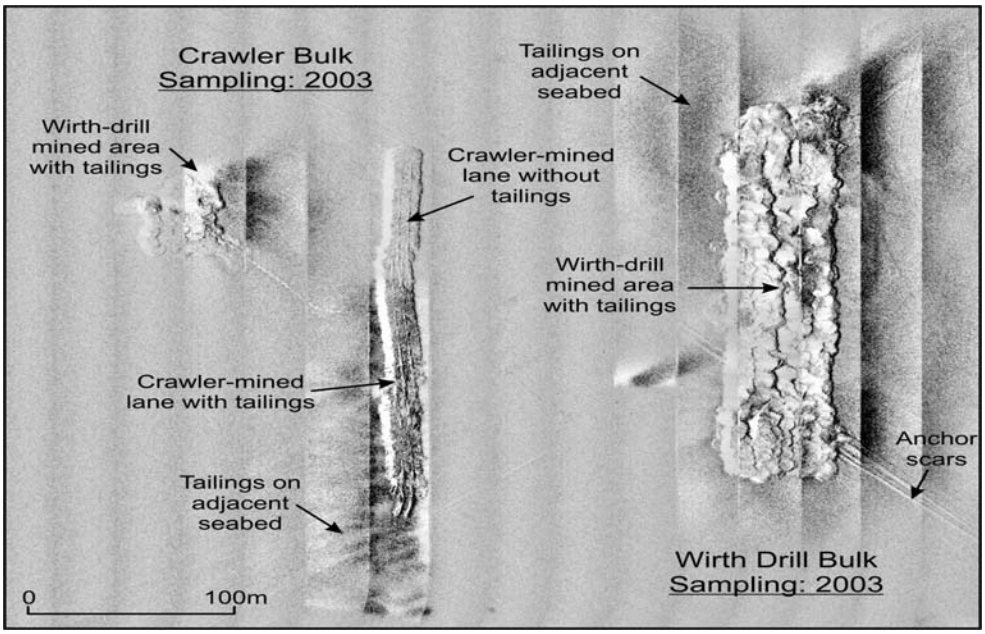

Figure 1. High resolution seabed sidescan sonar images showing Wirth drill and seabed crawler bulk sampling excavations, and resultant adjacent discarded tailings fans and positioning anchor scars.

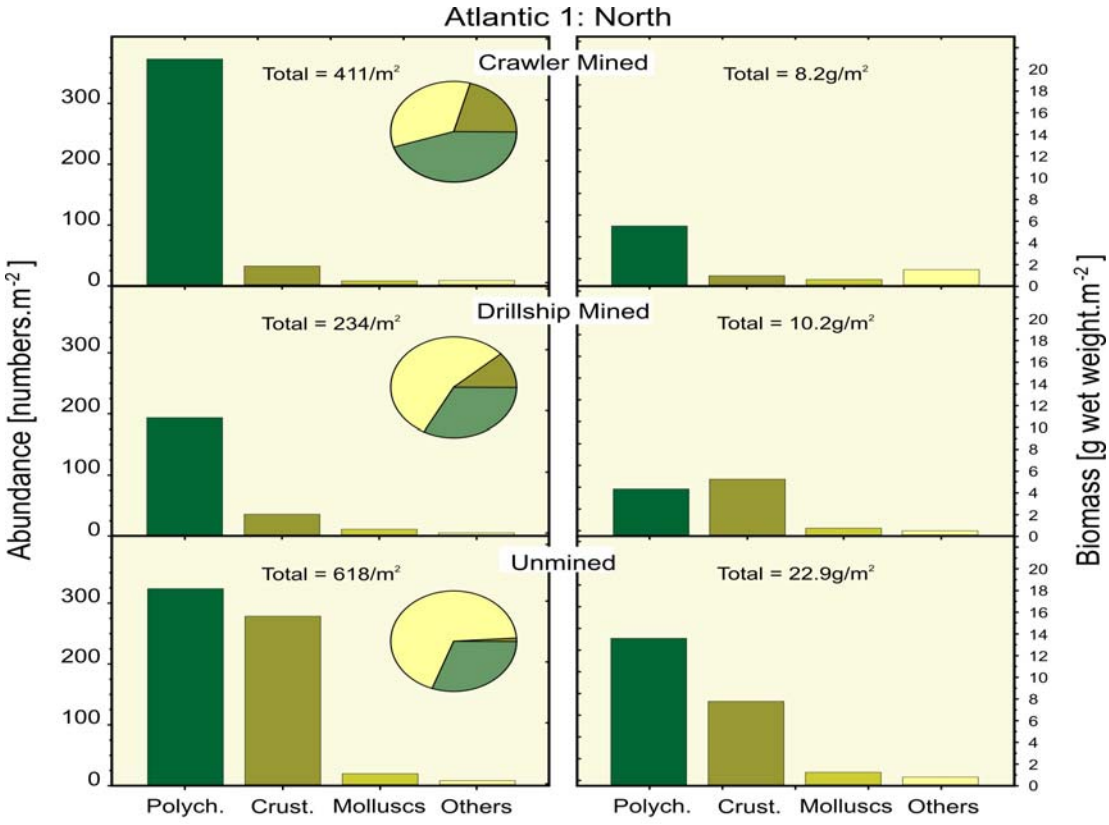

Figure 2. Comparison of sediment composition, abundance and biomass of benthic fauna taxonomic groups in unmined, drill-ship mined and crawler mined sites in the northern research area of the Atlantic 1MLA, Namibia (Pulfrich & Penney 1999).

Plate 1. Seabed video image of a mined area taken using the Jago manned submersible showing the edge of a mining block with a 0.5m thick mud layer covering the 0.2m thick target gravel layer. Some subsequent slumping of the fine surface sediments into the excavation is evident.

Plate 2. Photograph of the De Beers drill-ship Grand Banks operating at sea, showing the typical extent of the fine tailings plume generated by discharge of fine tailings (< 63 µm) during the sediment screening process.

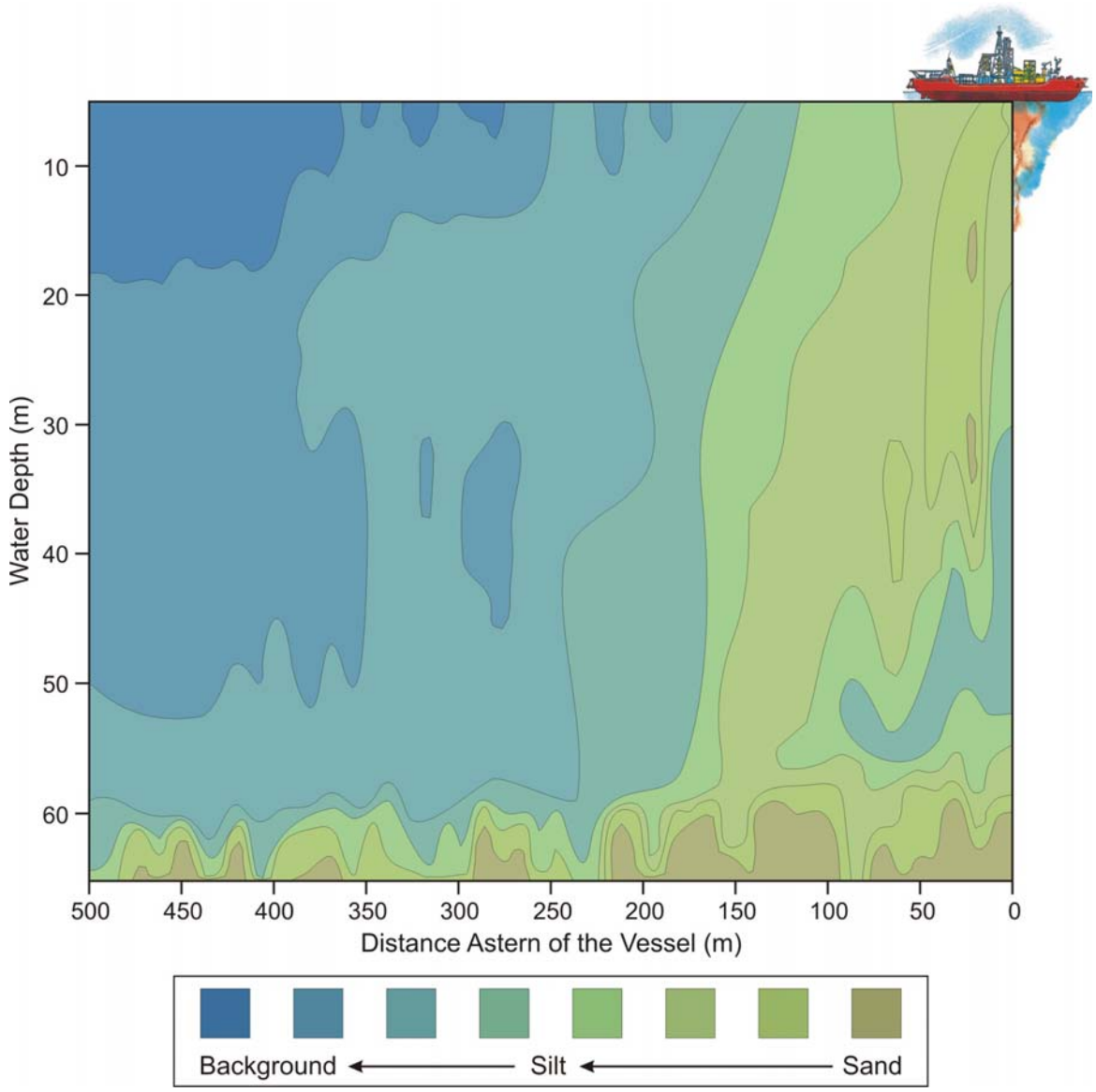

Figure 3. Acoustic Doppler Current Profiler (ADCP) longitudinal section along a tailings plume astern of a marine diamond mining vessel off southern Namibia, showing the depth and distance distribution of sediment particles of various size fractions behind the vessel (adapted from CSIR 1998).

Other user groups, particularly demersal trawl fisheries, typically have a more widespread impact on continental shelf seabed. For example, of the 57% of the seabed impacted in the North Sea, 54% is disturbed by fishing and only 3% by other users (see Table 1). The area of continental shelf impacted by the South African demersal trawl fishery is of a similar proportion (see Figure 4), with more intensely trawled blocks being trawled up to 5 times each year over their entire area.

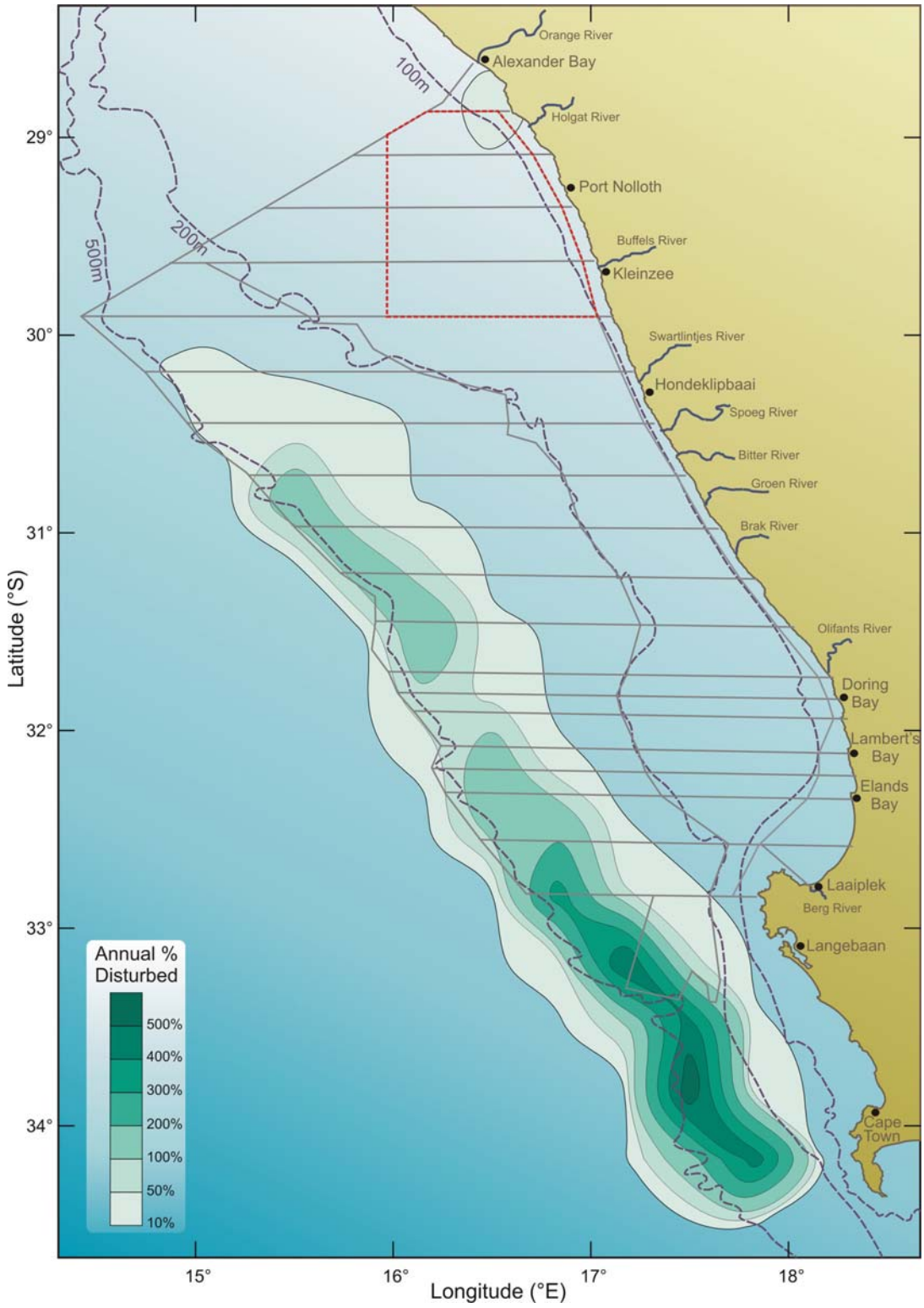

Figure 4. Estimated total annual percentage disturbance of the seabed by the South African demersal trawl fishery per 20' trawl grid block over the period 1997 - 2001 (taking swept area as the area between trawl doors), in relation to the marine diamond mining concession areas.

Table 1. Physical disturbance of the seabed in the North Sea in 1986. (Data supplied by the Institute of Offshore Engineering – IOE, Heriot-Watt University, Edinburgh; OSCOM 13: Report of the Thirteenth Meeting of the Oslo Commission, 1987.) (* indicates annual figures)

% Area	Source	Area	No. or Amount	Reference
54.0 %	Fishing	309 204 km^2*		IOE calculation
0.03 %	Aggregate extraction	180 km^2*	30x106 t	IOE calculation
0.01 %	Dredging disposal	72 km^2*	72x106 t	Calculated from OSCOM 13
0.001 %	Waste disposal	5.5 km^2*	5.5x106 t	Calculated from OSCOM 13
0.001 %	Sludge disposal	5.5 km^2*	5.5x106 t	Calculated from OSCOM 13
0.05 %	Platforms	313 km^2	399	IOE calculation
0.05 %	Well heads	300 km^2	382	IOE calculation
1.5 %	Pipelines	8374 km^2	8374 km	IOE calculation
1.27 %	Cables	7322 km^2	7322 km	IOE estimate
0.05 %	Wrecks	284 km^2	7100	IOE calculation
0.0001 %	Cuttings disposal	0.5 km^2*	593 741 km	IOE calculation
56.95 %	**Total**	**327 000 km^2**		

However, the primary “impacts”, or sources of variability, in factors such as sediment input and movement, organic input and decomposition, low oxygen water generation and sulphur eruptions in the Benguela region result from natural processes. In particular, riverine sediment input dominates sediment processes. The Orange River was estimated to have discharged ~64 million tons of sediment into the region during the 1988 floods (Branch *et al.* 1990, Bremner *et al.* 1990). Wind-borne sediment transport is also substantial. During a single berg-wind event in May 1979, it is estimated that 50 million tons of dust were transported into the sea during by extensive sandstorms along much of the coast from Cape Frio in the north to Kleinsee in the south (Shannon & Anderson 1982).

As a result of this high natural variability in the region, marine communities have evolved to be robust to such impacts, and natural “recovery” processes following disturbance are fairly rapid. The workshop noted the importance of understanding and evaluating this recovery potential, and the extent to which it would influence whether impacts would be expected to be cumulative over time, or whether “recovery” would occur. The importance of defining “recovery” was also recognized.

C.2 Project BEHP/CEA/03/03: Sediment Impact Modelling

Mr Geoff Smith presented an overview of project BEHP/CEA/03/03. The overall objective of this project is:

- ***To assess the cumulative effects of sediments input or mobilised as a result of on-shore and near-shore marine diamond mining activities in order to manage more effectively the impacts of these activities on the living marine resources and the ecosystem as a whole.***

This project is scheduled to run for 1 year, and so to end at the end of June 2005. The key questions that will be addressed are:

- What quantities of suspended sediment are transported into the <40m depth zone by rivers, wind and coastal currents ?
- How does this compare with the quantity of sediment re-mobilised/discharged by land-based and near-shore mining activities ?
- What are the relative particle size-distributions of these various sediment inputs ?
- How far, and in which directions, are these sediments transported and by what mechanisms, and where in the near-shore zone are they deposited ?
- What is the extent and duration of the natural deposition of unconsolidated sediments on near-shore reefs ?
- How does this compare with the potential smothering of reefs as a consequence of discharged and mobilized mining-related sediments ?

This will primarily be done by conducted specialist oceanographic and sediment transport modelling studies in selected study areas currently impacted by marine mining, utilising information and data to be gathered by project BEHP/CEA/03/02.

Examples of the types of modelling results that will be generated are shown in Figures 5 – 7 below, from previous studies in the southern Namibian region, in areas proposed by the workshop as study sites for project BEHP/CEA/03/03 (see section E.2.1 below).

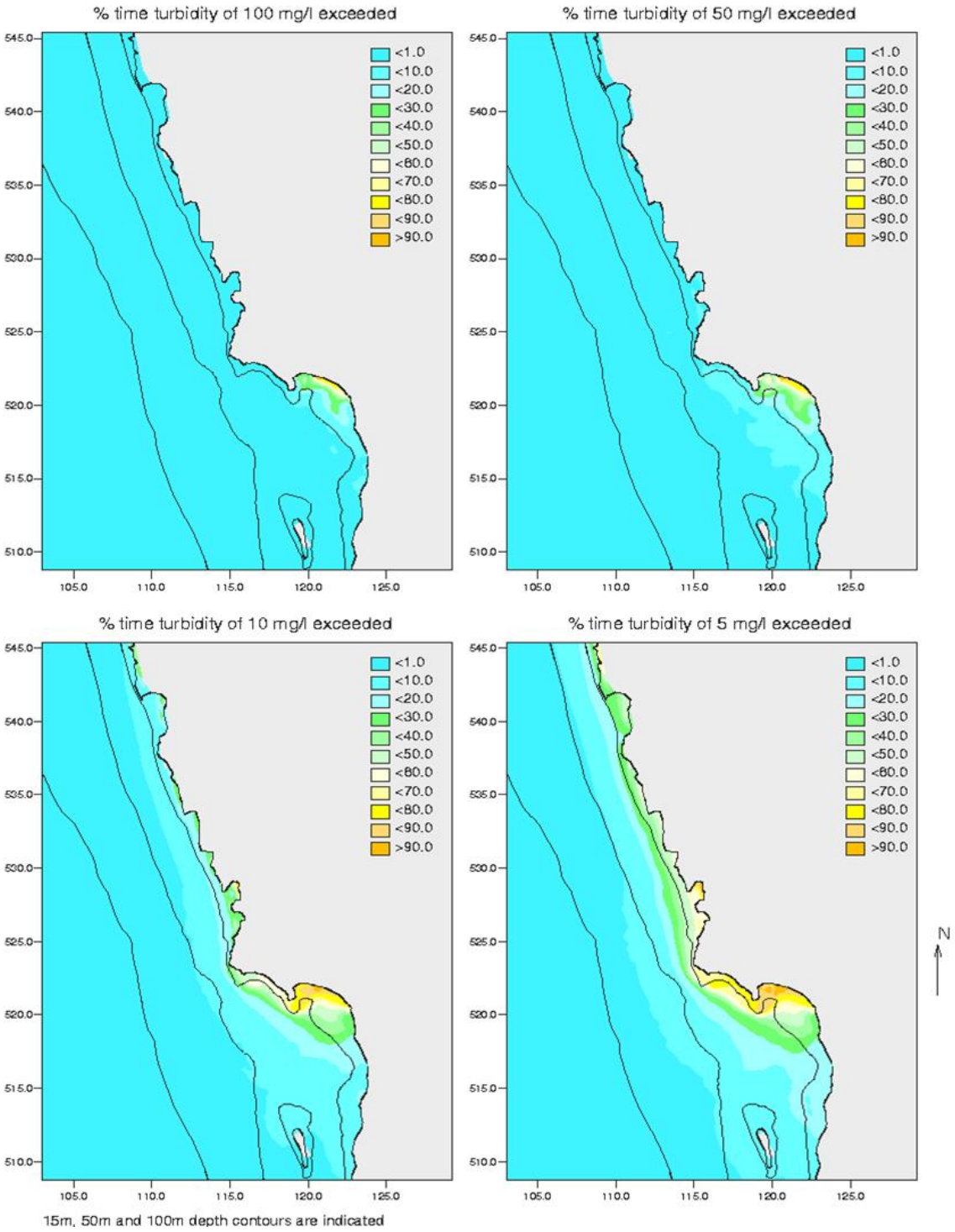

Figure 5. Modelling results showing predicted northwards extension of sediment plumes resulting from planned increased fines discharges from the upgraded Elizabeth Bay processing plant.

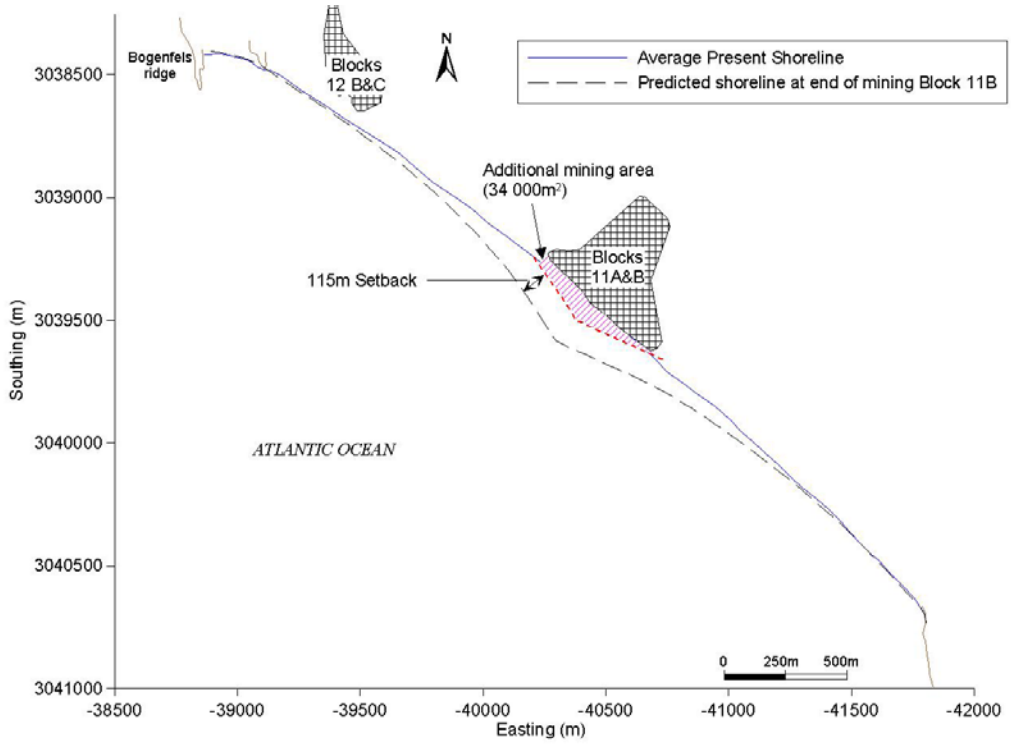

Figure 6. Modelling results showing predicted accretion of the coastline that could result from potential pocket beach mining in the area south of Bogenfels, Namibia.

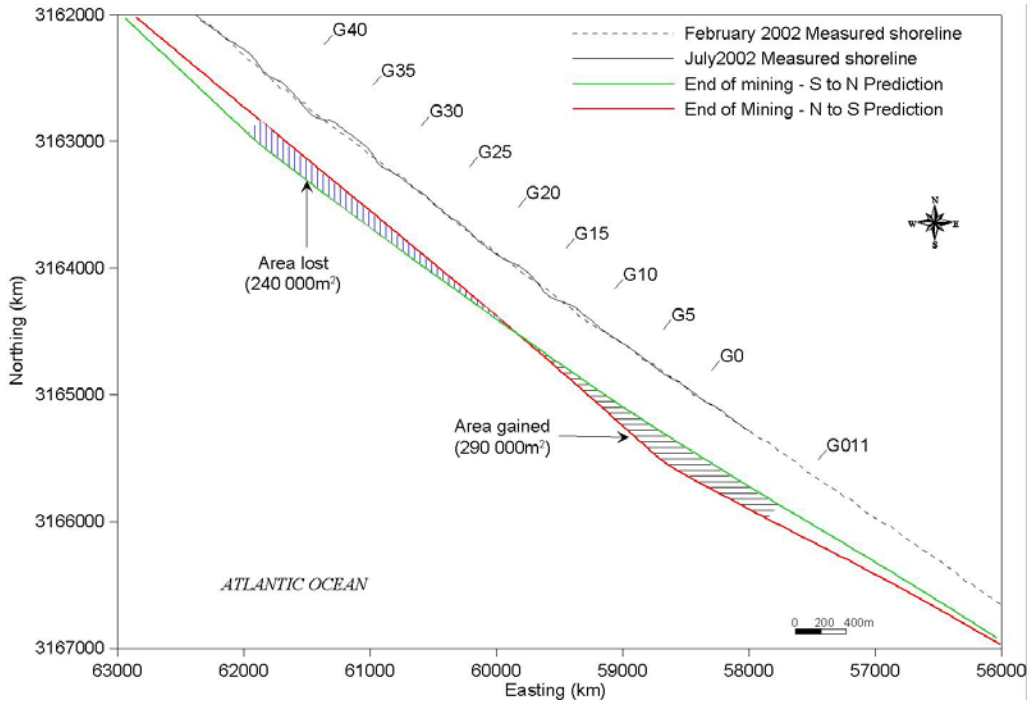

Figure 7. Modelling results showing predicted changes in the coastline that could result from increased wet overburden re-mining of seawalls in the area north of the Orange River, Namibia.

C.3 De Beers Marine Namibia: Marine Mining Activities

Dr Lima Maartens presented an overview on historic and current marine mining activities in the Namibian marine diamond concessions, particularly the midwater and offshore marine diamond concession areas off southern Namibia. Vessel based mining methods were described and their potential impacts reviewed. The area mined since inception of offshore vessel-based mining in the Atlantic 1 MLA is summarised in Table 2, and shown in Figure 8, below. The total area of 26.8 km^2 mined to date amounts to 0.45% of the total Atlantic 1 MLA of 6 000 km^2

Table 2. Area mined per year in the Atlantic 1 Mining Licence Area (southern Namibia) from 1981 to 2004.

Year	Area (m^2)	Year	Area (m^2)
1981	15,000	1996	1,750,000
1987	5,000	1997	1,515,000
1988	22,500	1998	1,900,000
1989	15,000	1999	2,325,000
1990	40,000	2000	2,910,000
1991	270,000	2001	2,932,500
1992	500,000	2002	2,740,000
1993	812,500	2003	3,242,500
1994	1,150,000	2004	3,145,000
1995	1,525,000		
Total			**26,815,000**

Annual total shoreline sediment discharges into the sea off southern Namibia as a result of sea-wall mining, slimes and tailings discharges have been relatively constant over the period 1972 – 2003, averaging about 10.4 million tons per year. The estimated total cumulative sediment discharge into the sea from mining since 1968 has been about 336 million tons (see Figure 9). In comparison, the historic (1930-1969) average annual sediment discharge from the Orange River has been estimated at 60.4 million tons (Midgley & Pitman 1969, Rogers 1977, Bremner *et al.* 1990). A steady downward trend is apparent in Orange River discharge figures quoted in the literature, from 80-90 million tons/year in the 1930's, 30-40 million tons/year in the 1960's and decreasing to <17 million tons/year during the 1980's (Rogers 1977, Bremner *et al.* 1990). Rogers (1979) estimates that current annual sediment discharge varies from 8-26 million tons.

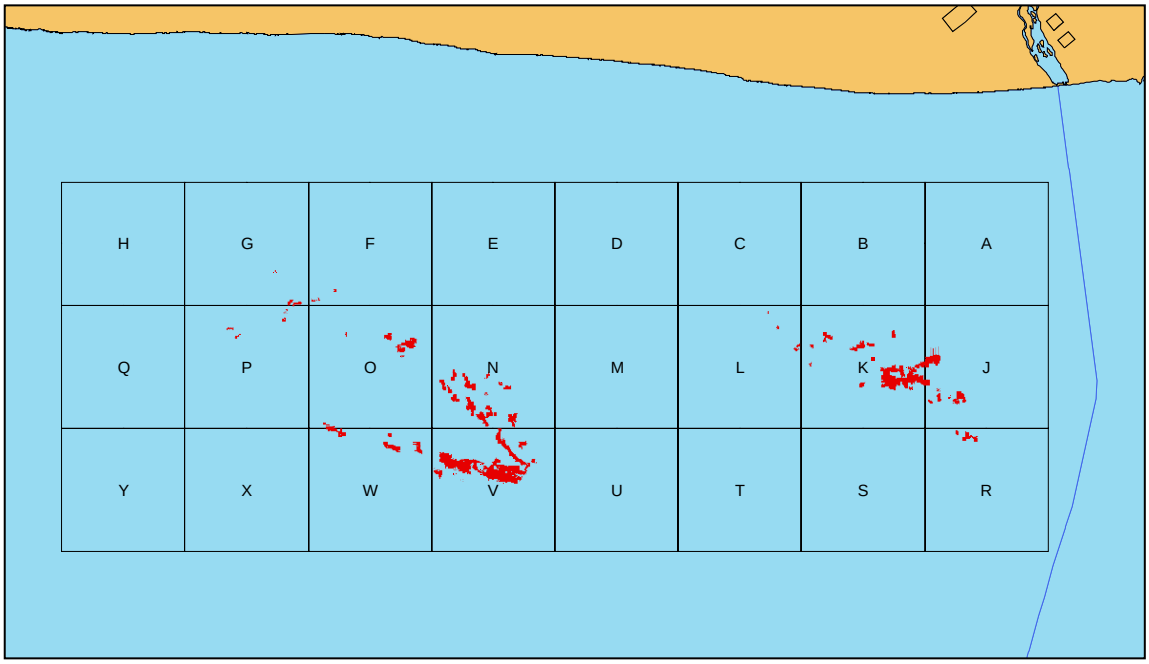

Figure 8. Overview of the seabed areas mined to date using vessel-based remote mining tools (Wirth rills and seabed crawlers) in the Atlantic 1 Mining Licence Area off southern Namibia. (North to the left and the mouth of the Orange River and the preliminary South African / Namibian border shown on the right.)

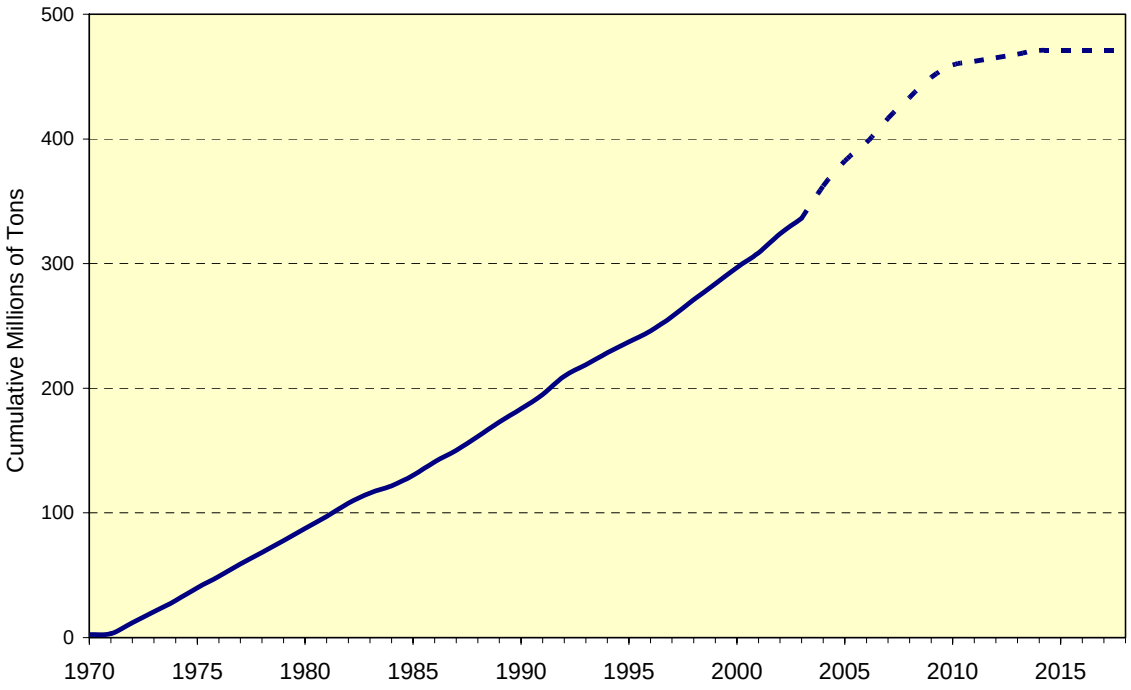

Figure 9. Estimated historical and predicted future cumulative sediment discharges into the sea from shore based mining and processing operations in southern Namibia.

D. IDENTIFICATION OF MINING IMPACTS AND DATA REQUIREMENTS

D.1 Data Levels

The workshop recognized that available data on marine mining, fisheries and natural environmental impacts would range from general descriptive information to geo-referenced time series of quantitative data, and could be classified into the following data levels:

1. Descriptive Information: This will generally already have been published in local and international papers, reports, EIAs and EMPRs. All relevant information will be sourced, summarised and used to identify, describe and evaluate potential cumulative impacts of marine mining. Additional descriptive information will be extracted from information summaries, analyses and modelling results generated from data collected during the projects.

2. Single Value Quantitative Estimates: The descriptive information above will contain certain single value quantitative estimates from previous local or international studies. Examples of such estimates would include conversion ratios (e.g. from sediment weights to sediment volumes), averages (e.g. average mining rates, average sediment discharge rates, average trawl speeds, average fish processing raising factors) or estimates (e.g. current directions and speeds in an area, estimates of sediment transport at certain river flow rates). A number of these values will be useful in raising, quantifying or estimating values generated during the projects, or as inputs to the modelling procedures to be used to evaluate sediment transport dynamics in the region. These quantitative values will be specifically extracted from available sources and, wherever possible, some evaluation made of the accuracy and uncertainty of these estimates. Useful quantitative estimates will then be used, where appropriate, to derive data required to evaluate impacts.

3. Overview Maps of Information: Where actual geo-referenced time series data are not available for environmental impacts or characteristics of interest, overview maps of

certain parameters may still be available from previous studies. Examples could include maps of typical seabed oxygen concentrations, maps of average current directions and velocities, maps of seabed sediments from past surveys or maps of fisheries information for which raw data no longer exist. As with the single quantitative estimates, these maps can be useful as inputs to other analyses or modelling trials, or as a basis for estimating other values of interest over the mapped areas. Appropriate maps will be sourced from past publications, their reliability and uncertainty evaluated, and the information used to estimate geographic distribution of parameters of interest to the projects.

4. Geo-Referenced Time series of Quantitative Data: The highest resolution, and most valuable data sets, will consist of quantitative estimates of important parameters by time and area. Examples include areas mined at particular times, sediment volumes excavated or dumped by time and area, distribution of fishing catch and effort by time and area and estimates of time series of sediment discharge by various rivers per year. These geo-referenced data time series will be incorporated into the database to be developed by the projects, and will be used as the basis for most of the analyses and modelling exercises to be conducted. It is therefore these data series that will be the primary focus of the Inception Workshop.

D.2 Data Resolution

The workshop proposed the following standards for resolution of the quantitative (geo-referenced time series) data to be incorporated in the project database:

- **Time Period**: Ideal - Monthly
  Option - Annual

- **Geographic Position**:
  Mining Data: Point sources:
  Required - Lat/Lon

Mining Data: Areas:

Ideal - Lat/Lon polygon
Option - 1x1 km
Worst - 10 x 10 km

Fisheries Data:

Ideal - 20' x 20' block
Option - 1° x 1° block

D.3 Data Reliability, Uncertainty and Interpretation

The workshop noted the importance of including meta-data in the database, to provide detailed explanations of what is known about the uncertainty and variance of each data type, as well as to provide information on limitations in reliability or interpretation of the various data sets.

E. Identification of Mining Impacts, Mechanisms and Data Sources

Much of the workshop was spent identifying the known or likely impacts or issue of concern related to the various components of marine mining (shore mining, shore-based diver mining, ship-based mining, offshore platforms and future dredging operations), as well as impacts by fisheries and natural processes in the BCLME region.

The impacts, mechanisms, cumulative nature data requirements and data sources identified during the workshop are summarised in Table 3 below. This table will serve as the basis for work to be conducted under project BEHP/CEA/03/02.

Table 3. Identification of potential impacts or issues of concern, perceived mechanisms of impact, likely cumulative nature of impact (**C** – Definitely cumulative, c – possibly cumulative, o – not likely to be cumulative), data required to evaluate impacts and potential data sources for various mining sectors, fisheries sectors and natural processes in the BCLME region.

Potential Impact or Issue of Concern	Mechanism & Cumulative Index		Data	Data Source
A. Mining Impacts				
1. Onshore Mining / Processing Activities				
Discharge of tailings (fines) into the sea or beach	Degradation of coastal habitat (vegetation, seabirds, coastal fauna, archaeology). Change in coastline and nearshore currents. Reef scour and smothering: damage to reef communities, reduction in lobster recruitment. Increased turbidity, impacts on filter feeders. Reduction of light impacts on algae.	**C**	Point sources - Tons (or m3) by month by Lat/Lon. Average sediment particle size distribution by point by month, quarter or year. Conversion ratios from sediment volumes to weights. Aerial photographs of e.g. discharge points, mine dumps, sediment plumes.	Mining companies with shore processing facilities that incorporate pipeline discharges to sea.
Creation of seawalls	Degradation of coastal habitat (vegetation, seabirds, coastal fauna, archaeology). Change in coastline and nearshore currents. Habitat destruction and reduction of biodiversity (scarce species concern). Loss of cultural heritage.	**C**	Position of coastline - Lat/Lon digital coastlines (GIS / aerial photos / ALS / high water mark surveys). Volumes of sediment in initial seawall construction - m3 (tons) by month by Lat/Lon start and end (GIS / aerial photos). Background information on how equipment changes have contributed to increased volumes of sediment in sea-walls.	Mining companies involved, either currently or in the past, in coffer-dam and seawall beach mining operations.
Erosion of sea walls: sediment input into nearshore area.	Degradation of coastal habitat (vegetation, seabirds, coastal fauna, archaeology).Reef scour and smothering: damage to reef communities, reduction on lobster recruitment. Increased turbidity, impacts on filter feeders. Reduction of light - impacts on algae.	**C**	Rates of sediment replenishment - tons (m3) by month by Lat/Lon start and end (GIS / aerial photos).	

Increased windblown sediment from tailings dumps.	Reef scour and smothering: damage to reef communities, reduction on lobster recruitment. Increased turbidity, impacts on filter feeders. Reduction of light: impacts on algal production.	**C**	Wind data - by wind station (weather bureau, harbours, specialist sites) by hour or day. Position, size, height and particle size distribution of dumps by Lat/Lon polygon (aerial photos). Past modelling results on sand movement by wind.	Mining companies that have established large mine-dumps in, or adjacent to, the coastal zone. Past publications - modelling results.
2. Shore-Based Divers				
Damage by vehicles, equipment storage, hydrocarbons, waste	Coastal habitat degradation, reduction in biodiversity (but note that kelp harvesting has similar impacts). Hydrocarbon pollution of ground / groundwater.	c	Number of contractors - by sub-contract area (Lat/Lon start and end) by year. Change in equipment by year (hose size, pump capacities, numbers of divers). Number of days worked - by site (Lat/Lon) by Month. Volumes of gravel delivered - by Lat/Lon (or concession area) and month. (Field survey would be required to map damaged areas).	Mining companies that have deployed, either currently or in the past, shore based diver units ('walpompe').
Physical damage moving of boulders / pipes	Direct destruction of reef communities.	c	Use above information.	
Disposal of tailings on reef areas habitat alteration (boulder beds)	Destruction of reef communities. Habitat alteration: creation of tailings piles.	c	Use above information. (Field survey will be required to map historical tailings heaps).	
Cutting of kelp	Change in reef communities. Reduction in lobster habitat / recruitment.	o/c	No data available (being addressed experimentally by Project BEHP/CEA/03/04). Review past publications.	Past publications.
3. Boat-Based Divers				
Disposal of tailings on reef areas	Destruction of reef communities. Habitat alteration: creation of boulder beds.	c	Number of contractors - by contract area (Lat/Lon start and end) by year. Change in equipment by year (vessel size / hold, hose size, pump capacities, numbers of divers). Number of days worked - by site (Lat/Lon) by Month. Volumes of gravel delivered - by Lat/Lon (or concession area) by month.	Mining companies that have deployed, either currently or in the past, boat-based diver operations.
Discharge of waste & hydrocarbons	Pollution.	o	No data available.	Nil

Mortality of benthic organisms in mined gullies	Change in communities: reduced food availability. Decomposition contributes to anoxic sediments.	o	Review past publications (effects of natural seasonal movement of low O2 water).	Past publications.
4. Nearshore Mining Platforms				
General Descriptive Information			Description of recent developments in walking / self-elevating mining platforms for nearshore use.	Mining companies involved in development of platform technology.
Formation of sediment plumes in nearshore area	Reef scouring and smothering: damage to reef communities. Effects on communities (reduced light penetration, clogging of filter feeders).	c?	No data, no existing operation - Future monitoring requirements only. Description of platform mining technology potentially to be used. Comment on potential future mining rates and volumes.	Nil
Disposal of tailings on reef (larger scale than shore- or boat-based divers.)	Destruction of reef communities. Habitat alteration creation of boulder beds.	c?		
Physical damage by platform legs	Damage to reef communities.	o		
Spillage of hydraulic fluids and other wastes	Pollution.	o		
5. Offshore Ship-Based Remote Mining Tools				
General Descriptive Information			How has mining methodology changed over time, particularly affecting accessible areas (mudbelts), mining rates / depths, etc.	Mining companies involved, either currently or in the past, in ship-based deepwater remote mining operations. Past publications (offshore mining technology).
Excavation of the seabed, and deposition of tailings on adjacent areas	Mortality of benthic organisms, alteration of benthic communities, reduction in biodiversity. Reduction in food for benthic predators H2S release and O2 reduction.	c	Areas of seabed mined - m2 by month by 1x1 km block (or 5x5 km block). Mined sediment depths - by month by 1x1 bock (or 5x5 block) (used to estimate volumes of sediment). Average mining rates for various mining tools.	Mining companies involved, either currently or in the past, in ship-based deepwater remote mining operations.

Creation of fine sediment plumes	Reduction in light penetration and phytoplankton productivity. Release of stored contaminants from seabed sediments.	o/c	(Volumes of sediment mined - by month by 1x1 km block (or 5x5 km block) calculated from above). Sediment particle size distribution - by month by 1x1 km block (or 5x5 km block). Past studies, aerial observations and observations. Example modelling scenario/s using existing current information for a representative area. Existing chemical analysis results of sediment discharge point (heavy metals and pesticides). Past publications and results of seabed H2S distribution.	Mining companies involved, either currently or in the past, in ship-based deepwater remote mining operations. Past publications (sediment plumes). CSIR: Past modelling results.
Loss of equipment (anchors and drill strings)	Seabed hazard: interference with demersal trawling.	c	List and positions of lost equipment - by item by Lat/Lon.	Mining companies involved, either currently or in the past, in ship-based deepwater remote mining operations.
Loss of FeSi into the sea	Heavy metal pollution ?	o?	Estimates of FeSi loss - by month by 1x1 km block (or 5x5 km block). Alternately, average FeSi use / loss rates per area mined or day.	
Direct morality of rock lobsters	Actual capture of rock lobster by the mining tool.	o	Existing data on rock lobster recorded on sorting screens.	
Effects of noise ??	Interference with marine mammals.	c	Marine mammal sightings results - by species by month by 20' block. Survey results of rock lobsters on CT harbour wall.	Past publications (impact of noise on marine mammals; Cape Town harbour lobster studies).
6. Offshore & Nearshore Dredging				
General Descriptive Information			Description of recent developments in deeper water trailing suction hopper dredges suitable for seabed mining.	Mining companies involved in evaluating use of dredgers for mining.
Excavation of the seabed, and deposition of tailings on adjacent areas	Larger scale than existing offshore mining. Mortality of benthic organisms, alteration of benthic communities, reduction in biodiversity. Reduction in food for benthic predators. H2S release and O2 reduction.	**C**	No data yet, no existing operation - Future monitoring requirements only. Description of dredging technology potentially to be used. Comment on potential future mining rates and volumes	Nil
Excavation of H2S rich mudbelt	H2S eruptions: personal safety risk (toxic). Localised O2 reduction.	o		
Excavation of nearshore pits	Wave focussing and resultant changes in erosion / accretion in shore areas.	**C**		

Dumping of dredge overburden spoils in separate area	Smothering of additional seabed area other than the mined area. Mortality of benthic organisms.	**C**		
Creation of fine sediment plumes		c/**C**		
Marine mammal collisions	Interception of marine mammal migration routes.	O		
Construction and maintenance of pipeline to shore	Exclusion zone restriction on lobster fishing.			
Threat of shipwreck from nearshore discharge operations.	Potential major oil pollution threat in an isolated area.			
Effects of vessel noise ??	Interference with marine mammals. Disturbance of lobsters dredger across migration route??	**C**		
B. Environmental Data				
River Sediment Inputs	Historically the main source of sediment into the Benguela nearshore region, particularly near river mouths. Also the source of marine diamond gravel deposits.	**C**	River flow rates and volumes - by river by month (or year). Sediment load of rivers - by river by month / year.	Depts of Water Affairs. Past publications (river flow rates and sediment transport).
Wind-Borne Sediment Inputs	Also a major natural seasonal source of sediment input into the Benguela nearshore area.	**C**	Wind data - by wind station by hour. Past modelling results on sand movement by wind. Remote sensing of sediment transport to sea ??	Weather Bureaus, Harbour Offices, Lighthouses, Specialist monitoring sites (CSIR)
Plankton Production	Primary source of organic production in the region, as well as of organic deposition on the seabed.	**C**	Estimates of phytoplankton and zooplankton production and sedimentation - by month by 1° block (or by region). Maps of distribution of plankton production in various areas times.	MCM and MFMR. Past publications (plankton production).
Oxygen Depletion & Sulphur Eruptions	Decay of organic material deposited on the seabed creates areas of O2 depleted water.	**C**	Maps of distribution of low O2 water, H2S and sulphur eruptions.	Past publications (O2 and H2S distributions).

Additional Oceanographic Modelling Inputs			Detailed ocean currents at selected modelling sites - by hour by Lat/Lon by depth. Maps of typical ocean currents at various times. Wave height, period and direction - by hour by Lat/Lon. Suspended sediment concentration measurements at various sites (natural or anthropogenic). Typical or specific single value snapshot sediment particle size distributions in various areas / at various sites. Water temperature and salinity depth profiles - by Lat/Lon at time of sampling.	CSIR: Past publications (currents, waves, sediments, temperatures and salinities).
C. Fisheries Data				
Rock Lobster Fishery	Main anthropogenic cause of mortality in rock lobsters. Interaction / conflict with nearshore marine mining activities.	**C**	Distribution of fishing effort (no. of traps) - by 20' block (or 1° block), by year. Distribution of lobster catch - by 20' block (or 1° block) by year.	MCM and MFMR. IIM ?
Trawl Fishery	Economically most important fisheries in the region, although little interaction with marine mining, due greater depth / distance offshore. Main source of anthropogenic disturbance to the continental shelf seabed in the region. Potentially significant source of input of organic material (discarded offal and unwanted by-catch species) to the seabed.	**C**	Distribution of fishing effort (no. of trawls, hours trawled) - by 20' block (or 1° block), by year. Distribution of catch - by species, by 20' block (or 1° block) by year. Fish processed weight conversion factors (offal discard ratios) - by species / by process category. Estimates of unwanted by-catch discards - by species, by 20' block.	MCM and MFMR. IIM ?
Purse-Seine Fishery	Potential interaction / conflict with nearshore mining operations, although none reported to date.	c	Distribution of fishing effort (no. of sets) - by 20' block (or 1° block) by year. Distribution of catch - by species, by 20' block (or 1° block), by year.	MCM and MFMR. IIM ?
Demersal Longline / Set-Net Fisheries	Demersal fishery nearer shore than trawl, for species such as hake and monkfish. Potential interaction / conflict with nearshore marine mining operations, although none reported yet.	**C**	Distribution of fishing effort (no. of sets / no. of hooks / net length) - by 20' block (or 1° block) by year. Distribution of catch - by species, by 20' block (or 1° block) by year.	MCM and MFMR. IIM ?

The most important post-workshop data collection activities were identified as being:

- To identify, and obtain contact persons' names and contact details, for all mining companies involved in past and present shore-based or marine mining in the BCLME region.
- To make contact with these companies and ascertain the availability, whereabouts, quantity, quality and formats of the data requirements listed in Table 3 above.
- To contact the various departments of Minerals & Energy, Fisheries and the Environment in the region to ascertain the availability, whereabouts, quantity, quality and formats of the departmental data sources listed in Table 3 above

E.2 Specific Data Requirements for Project BEHP/CEA/03/03

In addition to the general data requirements for evaluation of the cumulative nature of impacts identified and listed in Table 1 above, a number of additional specific data were identified as being necessary or useful for the modelling work to be conducted under project BEHP/CEA/03/03.

E.2.1 Model Site Selection

For the purpose of the sediment modelling studies, it is hoped to select 4 or 5 sites for evaluation. Certain sites will be obvious as a result of past / existing modelling work, and the consequent availability of substantial amounts of data. Initial possibilities include:

- Elizabeth Bay: Massive scale shore-based discharges into the marine environment.
- Orange River / LUCORC / Alexander Bay area: Trans-boundary sediment movements.
- Bogenfels Arch to Chameis Bay area: Impacts of marine mining generated sediments on nearshore reefs and the lobster fishery.

For these sites, every effort will then be made to gather as much complementary or ancillary data (e.g. fisheries data, environmental data). Additional sites may be chosen

after initial data collection, once it is known what quantity / quality of data have been obtained. Options include:

- Marshall Fork / Marshall Reef area ??: Main rock-lobster fishing area north of Lüderitz. Characterized by fine sediments, and susceptible to H_2S accumulation.

E.2.2 Characterization of Impact Mechanisms

Once available data have been collected and initially overviewed, there will have to be a specific process to identify and describe impact mechanisms that can effectively be predicted and modelled. For example, while actual sedimentation rates can easily be predicted, information is needed on the thresholds at which sedimentation rates become detrimental to various ecosystem components. For the purposes of these projects, such information will have to come from existing published studies. However, there may be a need for future work to clarify these impact thresholds for ecosystem components of concern in the BCLME region. These needs will be addressed at the Gap Analysis Workshop.

E.2.3 Distribution of Nearshore Reef Areas

Modelling and predicting reef areas to be impacted by sediment transport will require information on the distribution of reefs in the nearshore area. As far as possible, available sidescan information on reef distribution, particularly in the chosen modelling study site areas, will be required. Options will need to be investigated for obtaining such data, without jeopardising the confidentiality requirements of the mining companies concerned.

E.2.4 Natural Environmental Recovery Rates

Evaluation of the cumulative nature and magnitude of any impact will require information on rates of recovery. Without rates of recovery it becomes almost impossible to conclude whether impacts are cumulative (i.e. accumulating over time or space before recovery can occur). However, this will also require careful consideration

of the definition of recovery, and information on the likely future frequency / magnitude of impacts in the area.

F. Capacity Building Options

Projects, BEHP/CEA/03/02 and BEHP/CEA/03/03 specifically incorporate the BCLME emphasis on capacity building in the region. However, due to the short duration of these projects (03/02 due in 6 months and 03/03 due in 12 months) both teams are aware that capacity during the duration of the projects will be limited. However, substantial opportunities exist to use the results of these projects for additional future capacity building initiatives. The conclusions and recommendations of the BCLME Strategic Planning Workshop on Training and Capacity Building held in Johannesburg during 8 and 9 July 2004 will be specifically reviewed to determine how the outcomes of these projects could address some of the identified short-term capacity needs in the region. Furthermore, in their gap analysis process, these two projects will identify and recommend further training / research projects with a strong focus on training and capacity building, designed to meet the needs identified at the Johannesburg workshop.

The top five training & capacity needs, as prioritised by the participants in the BCLME Strategic Planning Workshop on Training and Capacity Building, have been identified as:

1. Trans-boundary fisheries and environmental monitoring.
2. Management and reporting of scientific data and products, including IT and database management.
3. Quantitative survey techniques and modelling, including fish stock assessment.
4. Training in project management philosophy and tools.
5. Training in awareness of policy formulation.

The principal conclusion of the Johannesburg workshop was that the above training needs, for scientists, middle and top management, are urgent and need to be met in the next 3-5 years through rapid informal and formal tertiary training. The workshop

recommended that staff exchanges between the three countries be initiated for "in-house" training and skills transfer.

BCLME projects BEHP/CEA/03/02 and BEHP/CEA/03/03 are fully expected to contribute to meeting these training needs, particularly related to trans-boundary natural and mining-related sediment and organic impacts, database development and management and project management. In addition to the regionally available database and comprehensive background report, these projects will specifically generate a number of proposals for further skills development initiatives, ranging from training in field monitoring, Technikon projects, University projects and regional cooperative research programmes. These will be designed to be compact, achievable, locally relevant, cost-effective and geared towards generation of long-term capacity in the region.

G. ACKNOWLEDGEMENTS

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I. APPENDICES

Appendix A: Agenda for Joint Project Inception Workshop: Projects BEHP/CEA/03/02 & BEHP/CEA/03/03

Workshop Day 1	
09h00 – 10h30	Introduction of Projects and Project Teams
	Presentations on Projects 02 and 03
	Presentations on Marine Mining Operations
10h30 – 11h30	Tea
11h30 – 13h00	Review of Mining Operations and Impacts
13h00 – 14h00	Lunch
14h00 – 15h30	Identification of Mining Impacts
15h30 – 16h00	Tea
16h00 – 17h30	Identification of Mining Impact Data Sources
Workshop Day 2	
09h00 - 09h30	Review of Outcomes of Day 1: Mining Impacts, Mechanisms and Data Sources
09h30 – 10h30	Identification of Natural Environmental and Fisheries Impacts
10h30 – 11h30	Tea
11h30 – 13h00	Environmental and Fisheries Data Sources
13h00 – 14h00	Lunch
14h00 – 15h30	Additional Data Requirements for Sediment Modelling (Project 03)
15h30 – 16h00	Tea
16h00 – 17h30	Capacity Building Requirements and Options