

# Independent Peer Reviews

## Verification Studies

Sandpiper Project  
Namibian Marine Phosphate (Pty) Ltd

November 2014



Marine Ecosystems  
Management





# FOREWORD

Namibian Marine Phosphate (Pty) Ltd (NMP) commissioned J Midgley and Associates cc to project manage a marine verification work programme based on the NMP Environmental Management Programme (EMP) of the 2012 EIA, as submitted to the Environmental Commissioner on April 11, 2012. The verification programme as detailed in the EMP was expanded to include consideration of the comments on the EIA (2012) by the authorities, independent review parties (appointed by the Environmental Commissioner) and Interested and Affected Parties (I&APs).

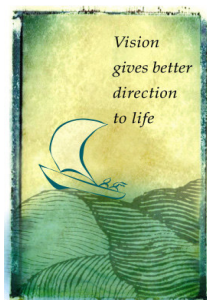
J Midgley and Associates cc in consultation with the CSIR identified a review team with established relevant experience, high integrity and known independence from the NMP phosphate project. Their brief being to provide an independent peer review assessment of the studies that comprise of the verification programme (Appendix 4, terms of reference). In order to ensure that the reviewing parties could evaluate the reports in context of the Verification Programme they has prior access to key reports and correspondence (Appendix 1, list of review documentation), which they were required to assess prior to a two-day workshop in Cape Town (13 -14 August 2014). Their independent reports are provided herein.

The NMP specialist consultants responded to the peer review findings, and their response statements are provided (Chapter 1.2, responses).

Additionally, NMP commissioned the University of Namibia to provide an independent assessment of the processes (field work and analyses) followed during the 2013 – 2014 verification programme. The assessment was undertaken through the university's Central Consultancy Bureau (UCCB). Their report is provided herein. Their terms of reference are found in Appendix 4.

The contributions and findings of these independent reviewers, is significant, as it removes any consideration of bias that has been suggested by parties who are concerned as to the independence of the environmental assessments undertaken in the evaluation of the risks associated with the proposed phosphate project of ML 170.

J Midgley and Associates undertook the project management in collaboration with the CSIR, whose appointed representative, Mr P Morant, provided the services of Independent Programme Reviewer and Process Advisor. J Midgley and Associates compiled the report.



Jeremy Midgley (Pr.Sci.Nat)



November 2014



Patrick Morant (Pr.Sci.Nat)



November 2014

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## **NMP Specialist Consultants responding to the matters raised by the Peer Review Team**

### **To whom it may concern**

#### **Peer Review Assessment of NMP Specialist Reports: Verification Programme**

In the peer review report (August 2014) compiled by myself and the peer review team comprising Dr Barry Clark, Dr Michael J. O'Toole, and Prof. Alakendra N. Roychoudhury we identified a number of matters that we considered required further attention.

These identified concerns have been considered by the NMP Specialist Consultants and an Issues and Response Matrix has been provided which identifies the actions taken to address the concerns raised by the peer review team.

A handwritten signature in black ink, appearing to read 'Payne' followed by three dots.

**Dr Andrew I.L. Payne**

October 2014

### 1.2.3 Issues and Response Matrix

<p><b>1. Peer review comment:</b></p> <p>The whole expert evaluation process has, from a scientific perspective, been followed throughout its existence professionally, credibly and appropriately.</p> <p><b>NMP team response:</b></p> <p>Noted with appreciation</p>
<p><b>2. Peer review comment:</b></p> <p>Comments have been made in writing and verbally about the impacts of the more-extensive Namibian inshore marine diamond-extraction effort relative to that proposed in this application for phosphate mining. In our opinion, one needs to be cautious when comparing the two marine extraction exercises.</p> <p><b>NMP team response:</b></p> <p>The need for caution is duly noted. In 2013 marine diamonds were recovered from an area of approximately 12 km<sup>2</sup> in extent and approximately 14 M tonnes of sediment were mined. The maximum water depth within which diamond mining takes place is approximately 125 m, while the sedimentary depositional environments (flat) and ocean processes are similar to those of ML 170. The comprehensive De Beers Marine plume study, which included both modelling and in situ verification, allows it to be applied realistically to the assessment of the dynamics of the fate of the fines discharged by the dredger. We note the statement of caution and primarily intend to use site-based (ML 170) information.</p>
<p><b>3. Peer review comment:</b></p> <p>It is gratifying to know that the positional accuracy of the dredge head and resolution of the extraction (dredging) process is (technologically) so good; being able to query the technology with the potential dredger operators present at the workshop was valuable.</p> <p><b>NMP team response:</b></p> <p>Noted</p>
<p><b>4. Peer review comment:</b></p> <p>The overarching scientific disciplines covered in the specialist inputs and verification procedures are correct and complete.</p> <p><b>NMP team response:</b></p> <p>Noted</p>
<p><b>5. Peer review comment:</b></p> <p>One will need to be alert to any cumulative (of mining and of mining plus other operational) impacts in future.</p>

***NMP team response:***

Data collected by NMP as a baseline, and as acquired during the monitoring programmes (described in the Environmental Management Plan) will be made available to the authorities (or appropriately authorised commissions or organisations) for their utilisation in conducting cumulative and other environmental assessments. Similarly, NMP's data will be evaluated continuously by the Company in respect of site-specific and cumulative impacts arising from dredging in SP-1 and the possible expansion of operations within ML 170. An additional commentary on environmental effects is provided in the verification programme report (Section A).

**6. Peer review comment:**

Future monitoring of all key aspects including an analysis of the potential impacts on the seabed and surrounding areas of the dredging operation needs to be built into any forward-looking management plan, but it will be crucial in doing so to bear in mind potential seasonal effects and the need for consistency in the methodology, gear deployed and even the vessels used.

***NMP team response:***

These requirements are built into the NMP Environmental Management Plan at a number of levels, e.g. from, regular site geophysical surveying (real time with active dredging, and recovery profile sediment surveys), annual biodiversity surveys (monk trawls, mesopelagic and epifauna assessments), cooperative surveys with MFMR (their cooperation will need to be sought); project based in-plume gathering of data using various platforms for measurements of dredge plume dimensions and effects on water quality, collection and analysis of water column and sediments; macrofauna recovery surveys in dredged areas; periodic collection of meiofaunal samples and their analysis; Also included are on board (dredger) monitoring and observation of ocean conditions, marine mammals and seabirds.

**7. Peer review comment:**

Credible analyses of effect or impact cannot really be developed in opposition to or isolated from government scientists' opinions based on their official data (the latter data include the seemingly inaccessible Norwegian data collected for Namibia and stored in the database of the Nansen project). The relationship with state scientific institutions needs to be continually refreshed.

***NMP team response:***

Relationship building continues to be a priority consideration for NMP in all aspects of the project, with particular emphasis on the authorities, (MFMR – MET and MME) and including I&APs. Effective relationships are based fundamentally on the principle of reciprocity. Efforts by NMP in this regard will be maintained and formal requests for access to the Nansen data will be re-submitted to MFMR. If provided, the received information will be assessed and where recommended by specialists, it will be worked up into the project data sets and used to optimise annual biodiversity and related surveys.

**8. Peer review comment:**

It is recommended strongly that all specialists contributing data and analyses formally publish the outcome of their analyses as soon as feasible; peer-review adds to scientific credibility and cannot be countered professionally.

***NMP team response:***

Noted and it is intended that this recommendation will be implemented. The information of a biogeochemical nature gathered during the verification assessment is new to science. Formal publication in the scientific literature is a priority.

**9. Peer review comment:**

As with all such comprehensive and multi-disciplinary analyses as those presented to the review team here, regular, though infrequent, independent review will add to international scientific credibility.

***NMP team response:***

Noted and the recommendation is accepted. NMP will institute a process of regular independent review of the environmental monitoring plan.

**10. Peer review comment:**

It is recommended that future dredging operations be authorized only within an adaptive management framework (i.e. coupled with intensive monitoring and careful scrutiny of such monitoring data by independent experts and the authorities) and that the authorities retain the right to require that the scale or scope of dredging be adjusted or that additional mitigation measures be implemented to ameliorate any unforeseen impacts that may arise.

***NMP team response:***

This is a regulatory matter and is contained in the requirements of the Minerals Act 1992 and the Environmental Act of 2007. Through this regulatory framework, NMP is committed to comply with the legally binding requirements of the Environmental Management Plan and the annual authority reporting requirements. Furthermore the 3-yearly re-application for environmental clearance from MET provides an opportunity for the EMP to be revised / modified in the light of findings from the monitoring programme. The EMP is a dynamic document with changes in the listed requirements being reflected by the (growing) knowledge base and associated re-assessment of the impacts and risk significance. These standards, compliance and management requirements, (as may be amended from time to time) are incorporated into the Environmental Contract issued by MET.

**11. Peer review comment:**

Potential cumulative impacts arising from any future expansion in phosphate mining/dredging in the region will need to be considered by the authorities in their own right, or at the minimum a clear body of evidence will need to be presented that can confirm that the probability of there being a cumulative impact of all current plus extra activities is extremely low.

***NMP team response:***

Noted. This is a matter that has been initiated by the Namibian Government (represented by MFMR): A scoping study, with the intention thereafter of undertaking a strategic environmental Assessment (SEA) on the cumulative effects of marine phosphate mining has been commissioned. Currently the Norwegian group SINTEF is preparing the scoping report. Prior to this the Benguela Current Commission commissioned its own SEA scoping study, formal feed back from this initiative is awaited. All information gathered during the implementation of the Environmental Management Plan will be evaluated in the light of cumulative effects and made available to the authorities for similar local and regional assessments.

**12. Peer review comment:**

Monitoring surveys must be undertaken by NMP after dredging has commenced to confirm that the levels of impact do not exceed those predicted.



***NMP team – Closeout response:***

A detailed environmental monitoring programme has been submitted as part of the regulatory requirements of the Environmental Act (No.7) of 2007. This requirement is addressed in the EMP. Management and compliance indicator reports will be generated on a regular basis, with composite reports being submitted to MET in accordance with the requirements of the Environmental Contract (issued by MET).

**13. Peer review comment:**

It is also crucial that, by way of mitigation of potential impact on the macrobenthos and to minimize the possibility of jellyfish polyps establishing in an area, a residual layer of sediment is left on the clay footwall underlying the mineral deposit. Further and if feasible, “lanes” or areas of sediment be left untouched; these two exercises will together facilitate the re-establishment of benthic macrofaunal assemblages on the substratum.

***NMP team response:***

Noted. This recommendation is in line with the recommendation submitted in the original EIA and has been included in the EMP with the intention being not to dredge to the clay footwall and to leave approximately 10% of the sediment thickness as a residual layer. This will almost completely eliminate the risk of providing a suitable substrate for the establishment of jellyfish polyps. The clay footwall (from a processing perspective) is an unwanted sediment horizon. The vertical positional accuracy and dredging operational techniques are optimised to extract the upper phosphate-rich horizons and to leave residual phosphate sediments so as not to dredge the clay footwall. The resource extraction plan calls for parallel three metre wide dredge cuts (3 m wide cutter suction head) of up to 4 km long to dredge the sediment. The horizontal repositioning from cut lane to cut lane will in instances result in un-dredged sediments being left in areas with the original sediment profile remaining intact. The orientation of these cut lanes is controlled by the dominant swell direction. Hence, depending on swell orientation, there will be occasions where the cuts will not be parallel but at some angle to the usual dredging orientation. This will result in “slivers” of un-dredged ground being left in situ, with the original sediment profile remaining intact. This original material will serve as “seed stock” to enhance benthic faunal recovery. Multibeam geophysical surveys are to be carried out during dredging. Subsequently this will allow for the compilation of composite images of the dredged terrain. These data cross-referenced with independent benthic faunal recovery surveys will optimise the assessment of the post dredging status of the benthic fauna.

**14. Peer review comment:**

Although the current scientific output indicates no such likelihood that it will be a problem, any potential risks arising from ingestion by fish and other fauna of trace heavy metals bound to sediment or organic matter in the water column or on the seafloor should be evaluated by means of laboratory-based sediment toxicity studies.

***NMP team response:***

Through the implementation of the Environmental Management Plan samples of the main commercial fish species will be taken on future biodiversity surveys, analysed for heavy metals and compared with the fishing industry standards to check for any deviations from the norm.

Assessments of trophic transfers of heavy metal contaminants now included in the Verification Survey report (section C of the Verification Programme Report) indicate that, in pelagic food webs, these are generally attenuated at the primary consumer level, dominated by copepods, with low transfer efficiencies to fish. In benthic food webs with carnivorous molluscan whelks as top predators appreciable bio-magnification can occur as whelks sequester and store metals derived from their prey. However the proposed mining operations in the survey area are not expected to increase exposures of benthic fauna to heavy metals such as cadmium over and above that which occurs naturally in the region.

#### **15. Peer review comment:**

The review team is concerned at the absence of any in-depth analysis of the mesopelagic scattering layer in the MLA. Its presence needs to be confirmed either acoustically using a vessel echosounder or from upward-looking ADCP instrument data moored in the area. It is a phenomenon well known in Namibian waters, and some information needs to be provided in the documentary evidence to be provided in support of the application. The potential impacts of sediment plumes (physical and biogeochemical) on this scattering layer (which could comprise zooplankton, myctophids, other bathypelagic fish, bearded gobies and/or jellyfish) need to be evaluated now given the significant biomass of zooplankton that migrates through the water column and its importance in the ecological functioning of the pelagic environment off Namibia.

#### ***NMP team response:***

A specialist review of the upward looking ADCP information from the current meter string (90 day site deployment) has been undertaken and is discussed in the verification programme report (Section C of the Verification Programme Report), in order to address the query on the mesopelagic species.

The ADCP data from the proposed dredge area does indeed show acoustic signals indicative of diurnal vertical migrations of zooplankton and ichthyoplankton. It is apparent from published information that light triggers for such migrations occur at very low light intensity and therefore any alteration of the underwater light field such as may occur under a turbidity plume potentially can disrupt migration patterns. The scale of this, if it occurs, should be limited in terms of space and time (turbidity plume dissipation rates and non-continuous plume generation in the proposed dredging cycle). At least it will be possible to show temporal patterns in vertical migrations from the suite of ADCP measurements (downward and upward looking) planned for the initial phases of the proposed dredging programme.

While the EMP can accommodate for future surveys to be designed (a combination of acoustics and satellite imagery) to incorporate the specific sampling of the mesopelagic species and the scattering layers this is a matter for the competent authority as well. There are few surveys of mesopelagic species on record and they are a difficult group of fish species to sample requiring specialized gear and vessels. If the ML 170 area is indeed deemed to be of importance for the mesopelagic fish and other species there is a clear need for MFMR to include the area in its regular sampling programme using the specialised vessel and gear available to it. NMP will engage with the authorities about partnering to meet this recommendation.

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#### **16. Peer review comment:**

The water column report needs to include a preliminary model applicable to the SP-1 dredging area using data on current measurements and sediment properties that have already been collected in the vicinity, to demonstrate the distribution, dispersal and sinking rate of plume sediments. Such a model can be developed further as additional data are gathered during environmental monitoring and dredging operations.

#### ***NMP team response:***

In response to this recommendation, NMP has commissioned the CSIR to provide an assessment of the value of undertaking the recommended plume modelling to further constrain the environmental risks associated with the sediment plume (beyond that determined in the EIA (2012) specialist study). The CSIR report is included in the Verification Programme Report (Section C) and determines that, while it is likely that the modelled analysis would provide additional characterisation of the extents, and duration (physical parameters) of the plume using the data already collected from site, it is unlikely to provide any further significant information in evaluating the impact risk associated with dredging. In light of this, the advice to NMP is that plume modelling is not material to the assessment of impacts in the area. However, modelling will be undertaken prior to the commencement of dredging as the first step towards building a comprehensive plume model.

**17. Peer review comment:**

The collection in future of site-specific sediment dynamics data would support a better understanding of how MLA 170 will be responding to cumulative anthropogenic and natural effects there.

**NMP team response:**

Post-dredging multibeam surveys coupled with post-dredging interpretation of sediment and water column characteristics will contribute information to the assessment of cumulative anthropogenic and natural effects. These data collection activities are described in the EMP.

**18. Peer review comment:**

Sulphide dynamics will be important, so a better understanding needs to be sought during the operational phase of how oxygen consumption will be affected by the reduced (dredged) sediment reservoir.

**NMP team response:**

An assessment of the potential of sulphide derived from iron pyrites dissolution in the water column, i.e. which may be associated with the dredging turbidity plume has been included in the Verification Programme Report. The assessment indicates that a minor proportion of the total iron pyrite pool may contribute reduced sulphide to the water column. This sulphide pool is predicted to be oxidised to sulphur, as opposed to sulphate, therefore no effects on the dissolved oxygen reservoir are predicted to emanate from this. Further details are to be found in Section C of the Verification Programme Report.

**19. Peer review comment:**

Attempts should be made to calculate a geo-accumulation index relative to average marine shale, in order to determine whether there is preferential deposition of trace and heavy metals in the target area.

**NMP team response:**

Data presented in the Verification Survey report show that all of the heavy metals with the exception of cadmium covary with aluminium (an indicator of clay minerals). The elevated cadmium concentration has been explained via published analyses indicating scavenging of this metal by the reduced sulphide pool. This is supported by higher cadmium concentrations in mud belt sediments inshore and north of the proposed dredging site (NatMIRC and CSIR). In view of these features the value of calculating of enrichment factors is moot, especially if global values have to be used for this as local Namibian data on shale composition is not readily available. More information on this topic is presented in Section C of the Verification Programme Report.

**20. Peer review comment:**

In terms of confirming the reproductive dynamics of the commercially important demersal fish species in MLA 170, with focus on the target dredge area SP-1, it will be necessary to monitor on an ongoing basis the reproductive biology of hake and monkfish in the area, collecting appropriate samples as part of a future management plan that includes sample monitoring.

**NMP team response:**

The recommendation is noted. This is a core component of the EMP and the recommendation is addressed through the annual biodiversity survey sampling programme, where refinements can be made to the work programme to improve data gathering regarding the reproductive biology of the main commercial fish species occurring in SP-1 and immediate surrounds.

**21. Peer review comment:**

Consideration should be given to establishing a zooplankton time-series in and adjacent to SP-1; Such additional information is not crucial to the submission of a dredging application and management plan for SP-1, but would aid the evaluation of future applications in the same or adjacent areas.

***NMP team response:***

Cautionary statement: The value of such sampling in a limited area (SP-1) needs to be considered objectively since, if the area is deemed to be too small from a statistical standpoint, then it is questionable and is likely to be of little value to the further understanding of the impacts of dredging. Notwithstanding, the annual surveys provided for in the EMP will incorporate appropriate acoustic surveys for assessment of scattering layers.

**22. Peer review comment:**

Two of the review team are concerned at the high value of 7% (of all Namibian monkfish recruits) calculated for MLA 170. That value needs to be checked carefully, but in any case a sampling strategy needs to be devised to seek any evidence of there being a regular influx of young monkfish into the area (they do not appear to be spawning extensively there) to support such a high value calculated for the recent sampling years.

***NMP team response:***

The modelling undertaken was intended to only provide a first order estimate of the abundance of the main commercial species relative to the population of each species as a whole. The reviewers recognized that the area modelled was extremely small and that extrapolations based on typical fisheries approaches would result in high variance, erring on the conservative side of the estimates provided. The data used and variance can only be strengthened by an increased number of samples from the actual dredge area (SP-1 in ML 170), along with the subsequent re-modelling of the acquired data. This can be improved in two ways:

1) Persisting with the current biodiversity sampling programme until a reasonable time series of data can give greater confidence in the model outputs. The sampling regime would focus on the recruitment, meaning the availability and dynamics of juvenile monk in the area. 2) NatMIRC could significantly strengthen these modelled estimates if they undertook biomass trawls in and around the area during their standard annual hake and monk surveys. NMP will engage with the authorities about partnering to meet this recommendation.

**23. Peer review comment:**

The recent CAPFISH biodiversity verification survey was well designed and fulfilled, but it used a net designed to catch bottom fish and particularly monkfish, so would not have captured many, if any, mesopelagic or bathypelagic fish. The same area in the 1970s was important for mesopelagic fish such as lanternfish, so the biodiversity report needs specifically to state that those fish were not available to the survey because of the selectivity of the monkfish-dedicated trawl sampling gear. Future sampling in the area (to be integrated into the monitoring programmes established for any operational phase) would benefit from at least a few samples being taken of fish scattering layers, deploying if feasible a research midwater trawl (RMT) to prove or disprove their presence in the area. Such information, positive or negative, would supplement the biodiversity baseline dataset compiled from the recent survey.

***NMP team response:***

The recommendation is noted. This is of course specialist surveying, requiring specialist equipment and vessels. Again, NatMIRC has the vessels and gear to do this type of sampling and their support and involvement will be encouraged. NMP will engage with the authorities about partnering to meet this recommendation. Notwithstanding this, for future monitoring purposes, provision to utilize a combination of acoustics and satellite imagery to incorporate some measures for sampling of mesopelagic species and the scattering layers has been made in the EMP

**24. Peer review comment:**

Acoustic monitoring needs to be integrated into future monitoring programmes and undertaken at the proposed extraction site to determine background noise levels and to monitor any local whale or dolphin populations. Ideally, this should be initiated before any dredging takes place, though not necessarily before submission of the revised application. Doing so with passive acoustic monitoring devices (PAMs) is a standard international technique when extraction or abstraction of water on an industrial scale is being considered for the marine environment.

***NMP team response:***

This recommendation has been considered within the Verification Programme Report (Section C) and in response, site based monitoring of pre-dredging acoustic conditions will be undertaken. Acoustic monitoring will be integrated with fisheries monitoring surveys. Similar monitoring will take place during dredging. This is described in the EMP.

**25. Peer review comment:**

Efforts must be redoubled to gain access to the valuable datasets collected off Namibia by the RV “Dr Fridtjof Nansen” programme. Some of those data (especially those collected around MLA 170) could be subjected to rigorous scientific analysis in future to support the current analysis; ideally too, the full Nansen datasets should be made available to the marine science community of the Benguela region and also preferably released into the public domain.

***NMP team response:***

The recommendation is noted. While in broad agreement with the position of the reviewers, the custodianship of the data resides with the countries (and the Benguela Current Commission (BCC)) wherein the surveys are undertaken. The proponent has already requested these data. However, ultimate control over access to the data resides with the competent authority. To address the recommendation, the responsible authorities (MFMR) and the Secretariat of the BCC will again be approached to provide access to this database. The consultants advise, however, that the Nansen data will not necessarily strengthen the EIA as the available data provided by MFMR/NatMIRC is extensive.

**26. Peer review comment:**

In future, effort should be made in the impressively conceived reproductive dynamics work to follow annual cohorts through the samples. This may prove particularly rewarding in terms of pelagic fish, and will certainly enhance confidence in the conclusion currently drawn that marine resources are not being damaged by such industrial-scale activity on part of the Namibian shelf.

***NMP team response:***

The recommendation is noted and is taken to refer to the ongoing monitoring activities encompassed in the EMP. As part of the EMP assessment cohort analysis will be undertaken from the results of the annual (year on year) biodiversity surveys.

**27. Peer review comment:**

Although ecosystem modelling is in its relative infancy and in this context currently not able (for reasons of inherent modelling projection uncertainty given the scale of dredging, scarcity of data and their resolution) to evaluate the potential impact of the proposed dredging, its use should not be written off, especially if there is future expansion of phosphorus-mining. Monitoring data collected from this project should be earmarked for future contributions to input data for ecosystem modelling assessments, with the collection of high-resolution

data.

**NMP team response:**

The recommendation is noted. All data collected and reports generated during the monitoring programmes of the EMP will be made available to competent authorities for input into their ecosystem modelling.

**28. Peer review comment:**

In terms of the biodiversity survey, regularity and consistency of methodology, gear, vessel and season needs to be maintained and the survey established within the management plan proposed.

**NMP team response:**

The recommendation is accepted and addressed in that all planned surveys described in the EMP will be standardised. Modifications to any such surveys will be managed in consultation with the Company's appointed consultants as well as the competent authorities through the terms of the Environmental Contract.

**29. Peer review comment:**

Effort should be redoubled to coordinate NMP-supported and official Namibian survey effort in future, if the licence to operate is granted.

**NMP team response:**

NMP will continue to engage with the authorities to establish a reciprocal relationship and to secure their partnering to conduct relevant research and data gathering in the ML 170 area in line with this recommendation.

**30. Peer review comment:**

For now, no further meiofaunal surveying is considered necessary, but baseline data have been established, so occasional sampling and comparison with these baseline data during a future operational phase could be revealing.

**NMP team response:**

This recommendation is addressed under the current EMP provisions. Additional samples will be collected and analysed on an infrequent basis. This will be managed through the EMP. Samples will be collected from both the dredged and un-dredged (reference) areas.

**31. Peer review comment:**

Perhaps in future, given the availability of these new data, the Namibian authorities will be able to commission an exercise to evaluate whether there are any specific lessons that can be learned about the ecosystem effects, including recolonization, plume dispersal and sedimentation rates, of marine industrial mining/dredging as an additional anthropogenic effect on the Namibian shelf.

**NMP team response:**

The recommendation is noted and the sentiment is shared. NMP will collaborate with the authorities in this regard and provide annual reports and relevant data to the authorities, or managing commission.

**32. Peer review comment:**

Effort should be escalated in future to try to integrate any impact models from the current extraction proposal exercise with similar assessments undertaken on the fishing industry and the fishery, using industry, government and Nansen data. MFMR and/or the Benguela Current Commission could coordinate such an exercise, to the benefit of understanding water dynamics throughout Namibia.

***NMP team response:***

The recommendation is noted and the proponent agrees with the sentiments presented.

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## **PART 2: Independent review of the NMP Verification Programme Process**

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# **INDEPENDENT REVIEW OF THE NMP VERIFICATION PROGRAMME PROCESS**

**2013 to 2014**

**Prepared for:**

Namibian Marine Phosphate (Pty) Ltd.

**Report collated and compiled by:**

Dr Sam Mafwila  
Department of Fisheries and Aquatic Sciences;  
and  
University Central Consultancy Bureau.



University of Namibia

Independent Observers Report

September 2014

## UNIVERSITY OF NAMIBIA

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# EXECUTIVE SUMMARY

## **Independent Review of the NMP Verification Programme Process 2013 – 2014**

**Collated and compiled by Dr Sam Mafwila**

Namibian Marine Phosphate (Pty) Ltd. (NMP) is proposing to extract marine pelletal phosphate ore from deposits off the Namibian central coast. The phosphate will be extracted by dredging and the assessment of the environmental impacts associated with the project was conducted during the environmental impact assessment (EIA) stage of the project. However, some stakeholders had raised a number of concerns and issues regarding the then prepared EIA, and recommended some follow up specialist studies to verify the significance of the findings previously presented in the NMP EIA (2012) which was based on both historical and limited recently collected data. NMP in their quest to address the issues and concerns raised by stakeholders, commissioned the verification survey. The purpose of the verification survey was to confirm the sediment properties, water quality, local oceanographic processes of the seafloor and water column, benthic macrofauna and meiofauna within the proposed dredge area. In addition a biodiversity survey was also conducted mainly to address aspects of the demersal fish species, and epifaunal species diversity. All the information was then used, in conjunction with previous scientific investigations of the region, to further inform the assessment of impacts on the marine environment as a result of the proposed dredging operations. Finally the information is synthesized in the Verification Programme Report and Environmental Management Plan for the Mining Licence Area (MLA).

Apart from the various specialist consultants appointed to conduct specific tasks of the verification survey, NMP also entered into three-tier agreement with the University Central Consultancy Bureau (UCCB) of the University of Namibia (UNAM). Part of the agreement was that UNAM provides Specialist Marine Scientists to be independent observers of the field operations of the verification programme, verify and comment on the suitability of equipment and sampling techniques, on-board sample processing and handling of samples (on board processing, storage, marking, transportation, record keeping), completion of the sampling operation and general comments on the overall operation. Furthermore, assess and comment on the laboratory facilities and sample processing in the laboratories, analytical processes, data analysis and interpretation results, biodiversity survey methods, and results, and finally, the peer-review process and workshop.

This independent observer report documents the verification survey and comments on the abovementioned terms of reference. The first verification survey, which dealt with the water column, sediment characteristics, and local oceanographic conditions as well as the benthic macrofauna and meiofauna, was well planned and coordinated. Detailed sampling methods and sample processing were carefully chosen to appropriately address and fulfill the comments and concerns that were raised by the Ministry of Fisheries and Marine Resources (MFMR) and other stakeholders. Although not all the concerns were dealt with, NMP has striven to address the most critical ones to the best of their ability in a more transparent and practically feasible way. Among the issues, notably the mooring on the seafloor deployed for 90 days, has thus far generated good data for the local oceanographic conditions of the MLA. The use of the Day Grab and the Box-Corer instead of the Van Veen Grab was one of the recommendations, and was implemented during the first verification survey. Reliable data were generated for both benthic macrofauna and meiofauna within the primary dredge target area of SP-1. Verification was done on the sediment characteristics, which have confirmed the area is

not within a mudbelt, with very little, or no hydrogen sulphide and organic-rich sediments. In situ measurements of the water column parameters such as oxygen, temperature, pH and salinity were captured using suitable instruments. Issues regarding benthic macrofauna and meiofauna were fully addressed. The sample handling onboard and processing was adequately conducted with care and good workmanship. However, field operations are faced with challenges, the oxidation-reduction potential (ORP) measurements in situ was challenging as the sediment gets exposure to open air. Generally, the whole operation for the first verification survey was successful.

The second verification survey dealt with the demersal fish biomass distribution and diversity, as well as the epibenthic fauna within the MLA and the surrounding nearby areas. Although a hake trawl was not available for use in this survey, a similar but slightly heavier monk directed trawl net was deployed during this survey. This survey generated a wealth of information, the level of which is unique to the area. The sample processing was handled by qualified personnel and data reliability is high. Upon interpretation, the results confirmed and improved our understanding of the potential impacts that dredging may have on the local fish resources and epifauna, as well as mammals and seabirds. Other specialist studies looked at the recruitment dynamics of the fish stocks off Namibia, with emphasis on the MLA; the fish stock dynamics in terms of biomass; and a review of ecosystem models in the northern and southern Benguela. Specialist consultants performed these tasks, and the results have convincingly supported and enhanced the earlier studies in the area.

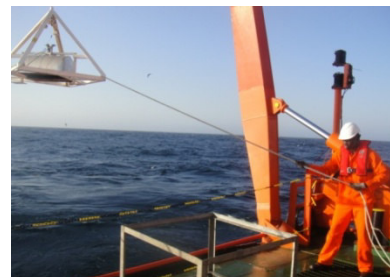
It is a custom in natural science that scientific work should undergo thorough peer-review in order to have a high quality output. NMP has gone the mile extra to subject all the scientific studies conducted on their behalf by specialist consultants to a peer-review process. A carefully selected panel of internationally profiled experts in biogeochemistry, fisheries, marine ecology, and benthic ecology was appointed to review the specialist work conducted during the verification surveys in conjunction with the earlier EIA and comments there in. The peer-review panel had a chance to review the work at their convenience, and eventually attended a two-day peer-review workshop in Cape Town, where all the work were presented. The whole process was appropriate and efficient. The peer-review workshop was the best thing to do, as it provided a good platform for information sharing and review in a short period of time. A fair and transparent peer-review was the order of the day. Critiques and comments were dealt with immediately, and if not, then the specialist consultants were given the opportunity to re-analyze their data or re-run their analytical process where possible. The final results were incorporated into the final reports.

As a UNAM representative in this whole verification programme, I am of the conviction that NMP has thus far conducted the most comprehensive scientific studies in their MLA. These studies have addressed uncertainties that were raised by the MFMR and beyond. New data sets were generated and new insights about the area have been brought forth, and improved our understanding of the physical, chemical and biological nature and dynamics of the area, and what would be the potential impacts of dredging. It is imperative to continue with monitoring surveys in the MLA, (detailed in the EMP) in order to support the current assumptions and statements. However, in the Regional context, the monitoring of the state of the environment should be a concerted combined effort by government and mining companies.

Overall, the NMP verification programme was a great effort, and has augmented the original EIA, and responded to the queries put forward by the MFMR. The sampling design, sampling methods, sample handling and processing, analytical procedures, data generated and results thereof are reliable, high quality and trustworthy, and were validated by the peer-review process.

**Dr Sam Mafwila**

September 2014



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## 2.1 VERIFICATION SURVEY

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### 1) Background

Namibian Marine Phosphate (Pty) Ltd (NMP) is proposing to extract marine pelletal phosphate ore from deposits on the Namibian continental shelf (Figure 1). The phosphate will be extracted by dredging and the assessment of the environmental impacts associated with the project is therefore strongly reliant on a sound understanding of the sediment properties of the dredge area. The purpose of this verification survey is to confirm the sediment properties, water quality and local oceanographic processes of the seafloor and water column within the proposed dredge area. This information will then be used, in conjunction with previous scientific investigations of the region, to further inform the assessment of impacts on the marine environment as a result of the proposed dredging operations. This will aid in the final assessment of the impacts as detailed in the EIA / EMPR.

The verification survey was conducted to collect the seafloor sediments, macrobenthos and meiofauna using sediment-sampling devices such as a box corer or a Day grab (where seabed properties prevented or limited efficient use of the box corer). Water column features were measured via profiling using a CTD, with additional sensors, and water sampling at various intervals down the water column to provide samples for chemical analyses.

A mooring, which was deployed, previously, during phase 1 of the surveys, to provide time series (90 days) data of current speeds and water column dynamics, was successfully serviced during phase 2 of the verification survey.

#### i. Rationale

To have an independent observation of the verification sampling within the ML 170 belonging to Namibia Marine Phosphate (NMP).

#### ii. Terms of Reference (ToR)

The Terms of Reference (ToRs) for engagement of SANUMARC/UNAM in the verification were as follows:

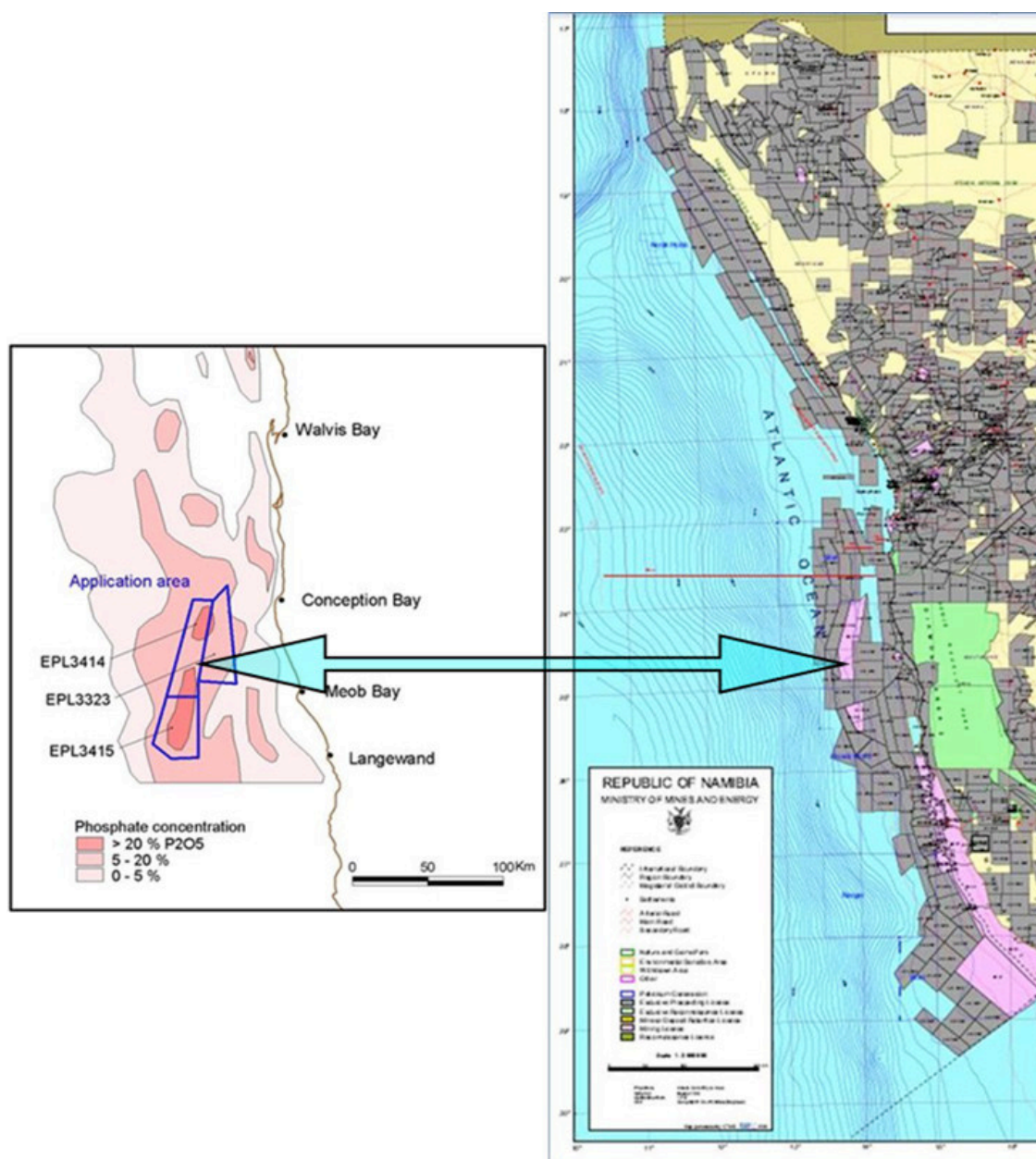
1. Provision of an Independent Observer of Field Operations (MV *DP Star*)
  - a) 1 x Scientist to be on-board vessel MV *DP Star* as "Observer"
  - b) Verify and comment on suitability of equipment and sampling techniques (gathering, handling, storage) used for specific scientific objectives as outlined in the Verification Programme
  - c) Verify and comment on the suitability of on board sample processing and handling of samples (on board processing, storage, marking, transportation, record keeping) for specific scientific objectives as outlined in the Verification Programme
  - d) Verify and comment on the completion of the sampling operation in accordance with the detail and coverage as outlined in the Verification Programme
  - e) General comments on the overall operations
2. Additionally, a request from UNAM to include students (luckily NMP availed space for two students) to gain practical experience during the verification survey phase 2.

### 2) Methodology

The Verification Survey was conducted onboard MV *DP Star* (see specification in Section D, Appendix 1.2), from the 24<sup>th</sup> of July to 04<sup>th</sup> of August 2013. The survey was conducted in mining licence area (ML 170) in

SP1 belonging to Namibia Marine Phosphate Ltd., as indicated in more details on map in Figure 2. The sampling points representing different samples collected for specific purposes are shown on the map (Figure 2). Lwandle Technologies Ltd. developed the project execution plan, and all the details pertaining to the sampling methods and equipment are fully described therein (Section D, Appendix 1.1).

A participatory approach was used during the verification survey, where the Independent Observer participated in the day-to-day activities of the survey. Photographic materials were also captured, annotated with daily notes. Different instruments used during the survey were checked for suitability of use for specific purposes, as outline in the NMP Verification Survey project execution plan (Lwandle Technologies, 2013). Instrumentation checks were done at random as spot-checks, on all water profiling, and equipment used for sediment characteristics and their biota.



**Figure 1. Location of Mining Licence Area (MLA) 170 offshore central Namibia.**  
MLA 170 is a consolidation of EPLs 3414 and portions of EPLs 3323 & 3415.



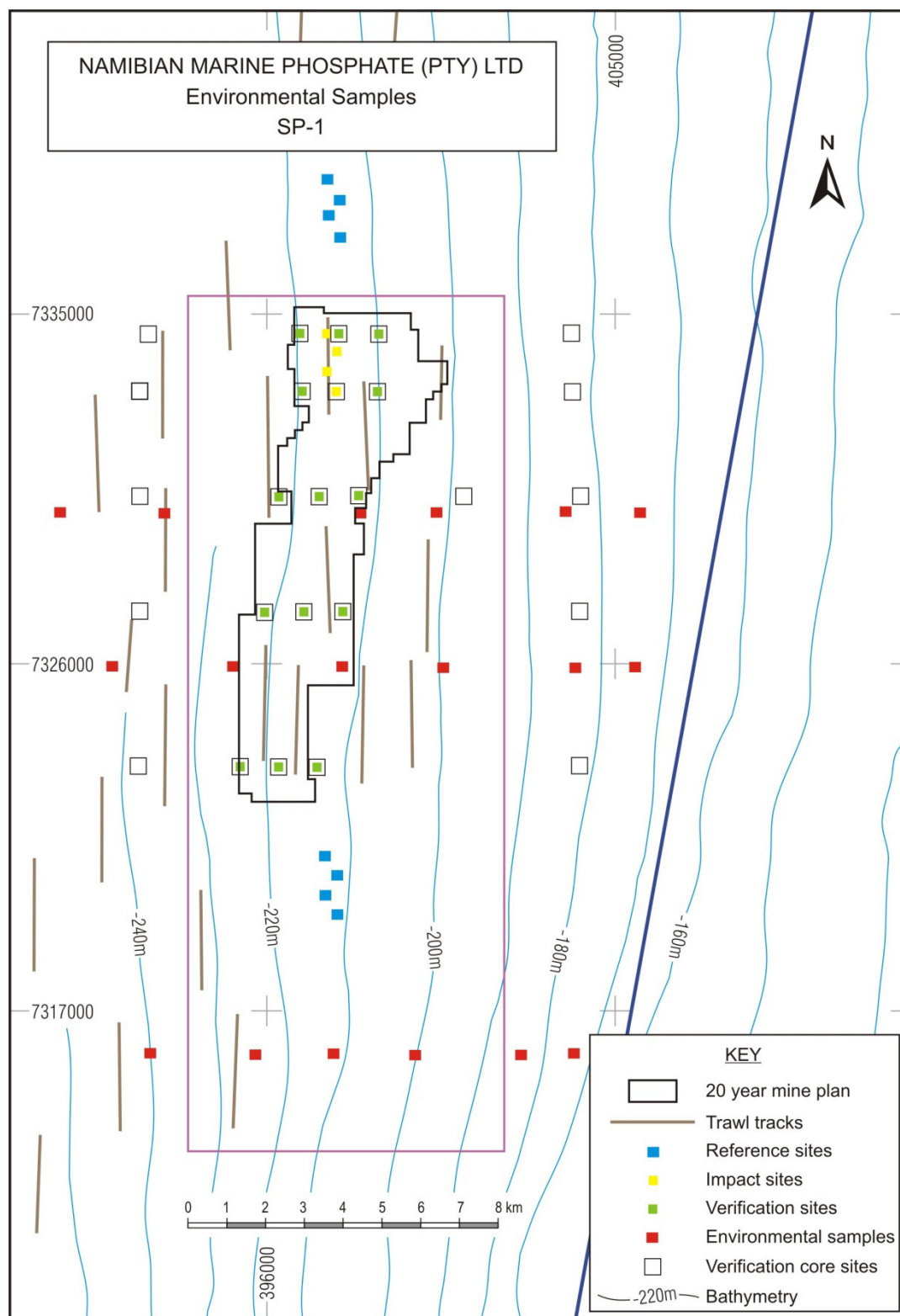


Figure 2. Verification sampling sites in Mine Area SP-1.





Note that the verification survey sites are represented by black open squares. Green squares represent sites identified for benthos verification sampling; additional sampling sites for the macro benthos, meiofauna and sediment properties monitoring programme are shown in yellow (impact) and blue (reference). The blue square shows the provisional moored instrumentation site.


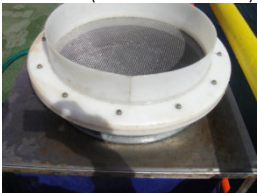


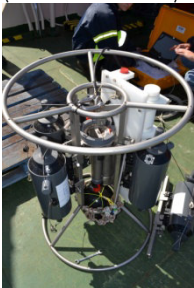

### 3) Findings and Discussion






#### i. Suitability of equipment and sampling techniques

The summary of all equipment is provided in Table 1.

Table 1. Equipment used during the verification survey and their suitability for use in different measurements and sampling purposes.

Equipment Name	Manufacturer	Purpose	Comment	Mitigations
1. pH/ORP Meter 	Hanna Instruments	Handheld unit for in situ measurement of pH and Oxygen Redox Potential in water	Suitable field measurements of pH and ORP. However, if used in open-air environments the measurements can be affected by fast dissolution of atmospheric gases into the water.	Closed door laboratory use recommended.
2. Dissolved Oxygen Meter 	HACH Instrument	Hand-held Instrument for measuring in-situ dissolved oxygen concentration in water.	Reliable and suitable instrument should be used in closed areas void of influence of atmospheric oxygen.	Closed environment such as laboratory. Alternatively, oxygen titrations using Winkler test.
3. Box-corer: surface area (0.25 m x 0.25 m = 0.0625 m <sup>2</sup> ) 	Ocean Instrument Inc. San Diego, California	Winch operated from the side of a vessel for retrieving benthic sediments (geochemical and benthic macrofauna)	Suitable for sediment collection from the seafloor	Alternative: Van Veen Grab, standard sediment collection tool. Used in the previous work in the same area (highly recommended for consistency).
4. Day Grab 	Unspecified	Winch deployment: Sediment collection from sea-floor	Larger surface area, heavier and works better in all sediment conditions. Suitable for benthic macrofaunal studies, but not suitable for core subsampling due to its D-shaped design.	Alternatively the multicorer can do much better for core sampling than the Day grab. Multicorer highly recommended.

<p>5. Core-tubes</p> 	<p>PVC pipes, home-made (Customized): 75 mm, 55 mm</p>	<p>Used for sub-sampling of sediments from a box-corer</p>	<p>Suitable for use with the box-corer</p>	<p>Use of box-corer recommended with this sub-core tubes.</p>
<p>6. Sieve (3mm mesh size)</p> 	<p>Benthic Solutions</p>	<p>Sieving sediments to retain macrofauna</p>	<p>Suitable for separation of macrofauna from microfauna, especially if sediment is too shelly.</p>	<p>The standard 1 mm sieve can be used.</p>
<p>7. Sieve (0.3mm mesh size)</p> 	<p>Benthic Solutions (Universal Test Sieve) SABS approved</p> 	<p>Sieving sediments to retain benthic invertebrates more than 0.3 mm in size.</p>	<p>Suitable for meiofauna</p>	<p>The standard 0.5 mm sieve can be used</p>
<p>8. Rosette Sampler (six Niskin bottles)</p> 	<p>RBR Instruments</p>	<p>For water sampling at preferred depth in the water column. Deployed using a winch from the side of the vessel.</p>	<p>Highly Suitable for sampling the water column</p>	
<p>9. CTD with Conductivity, Temperature, Turbidity and depth profiler</p> 	<p>RBR Instruments</p>	<p>Used for water quality characteristics, can have more sensors depending on the desired measurements</p>	<p>Highly suitable for water column profiling</p>	<p>Data for salinity and dissolved oxygen should be corrected for by salinometric analysis and DO by titration using basic Winkler test.</p>

<p>10. Moored buoy (ADCP, 2 current meters, 2 Aquadops, 1 CTD with fluorescence sensor)</p>  	<p>Nortek AS <a href="http://www.nortek.no">www.nortek.no</a> and RD Instruments</p>	<p>Time series data collection for currents speed and direction, and CTD for water column characteristics</p>	<p>Highly suitable</p>	<p>More days even better</p>
<p>11. Sieving table with a washer system</p> 	<p>Benthic Solutions</p>	<p>Customized for washing benthic sediments to retain macrofauna over the sieves.</p>	<p>Suitable</p>	<p>Works better with bigger mesh-size sieves (&gt; 0.5 mm), as small sizes clogs quickly making washing taking longer.</p>
<p>12. Echo-sounder (Receiving Unit and transducer)</p> 	<p>FURUNO</p>	<p>For water depth determination, and location of the CTD under water.</p>	<p>Suitable</p>	<p>Can be misleading in terms of tracing the CTD under water</p>
<p>13. Hydrophone</p> 		<p>For setting the Aquadops, communication with the mooring.</p>	<p>Highly Suitable</p>	

## ii. Sampling Techniques

Sampling technique/strategy followed a transect design with predetermined sampling stations on the transects covering a representative area of SP-1 (Figure 2). Sediments for geochemical, benthic macrofauna and meiofauna analyses were retrieved using the Day grab after the box-corer had failed several times.

The use of the Daygrab or box-corer was inconsistent with the earlier survey conducted during the EIA stage of the Sandpiper project. The use of different gear compromises the comparability and consistency of the data. The Van Veen grab was used in the previous study and is a commonly used tool in benthic studies therefore it may be a good idea to maintain consistency in this case. The criticism by some scientists suggest that the Van Veen grab tends to create a current ahead of it when under deployment which disturbs the benthic fauna and sediment just before it hits the seafloor. Both the Van Veen and Day grab would cause

such a current, however this problem was long resolved by some Van Veen grabs being designed with rubber flaps/covers on top of the two jaws of the grab to allow subsampling of water and sediments. These flaps or windows open during the down deployment of the grab and close when the grab is brought up. This allows the water to flow inside the grab and out through these windows thus solving the issue of a current wave.

Mimicking the multi-corer by sub-sampling of the sediments retrieved by the day-grab was yet another daunting task, introducing errors due to variations in the amounts of sediment and the coherence of sediments disturbed. Some samples were too loose to be sub-sampled using core tubes thus causing some inconsistencies in sampling. For geochemical analysis, the multi-corer system is highly recommended, although its penetration in the sediments depends on the type of bottom substrate. With any field sampling there are some technical hurdles, thus this survey was no exception. Therefore, results from these samples would be of acceptable standard.

### ***iii. On board sample processing and handling of samples***

#### ***Verification and comments on the suitability of on board sample processing and handling of samples (on board processing, storage, marking, transportation, record keeping) for specific scientific objectives as outlined in the Verification Programme***

Lwandle Technologies (Pty) Ltd. and their partner Metocean Services International (Pty) Ltd. are two competent companies, with a good track record of similar works. Implementation of the processing, storage, marking, transportation, and record keeping were well coordinated. The suitability of the whole process to specific scientific objectives are outlined in table 2.

Table 2. Showing the suitability of onboard sample processing and handling.

	Suitability	Comment
Onboard Processing	Suitable	<b>Benthic macro-faunal samples:</b> <ul style="list-style-type: none"> <li>properly washed and sieved (seawater not filtered though) over 1 mm and 0.3 mm mesh size</li> <li>formalin fixed.</li> </ul> <b>Sediments</b> <ul style="list-style-type: none"> <li>Dissolved oxygen (could suffer from atmospheric oxygen influence)</li> <li>Redox potential measurement (not recommended in open air)</li> </ul> <b>Water column parameters:</b> <ul style="list-style-type: none"> <li>Mooring carefully retrieved and data downloaded</li> <li>Water samples from niskin bottles were carefully collected in sample bottles according to the different needs.</li> </ul>
Storage	Suitable	Samples were stored safely as per protocol. Non-formalin fixed samples were kept in frozen in a deep freezer
Marking	Suitable	Samples were clearly marked and label tags were inserted in all benthic macro-fauna samples bearing the date, station number/ID etc for easy identification.
Transportation	Suitable	All samples (benthos and sediment) transported safely from sampling area to the Port of Walvis Bay and further transported by road to Cape Town.
Record keeping	Suitable	All records were saved and backed up (sent to the land-based Project Coordinator every day). Label tags of each grab were photographed

#### iv. Comments on the completion of the sampling operation

##### **Verification and comments on the completion of the sampling operation in accordance with the detail and coverage as outlined in the Verification Programme**

The sampling operation covered SP-1 only due to time constraints owing to fact that there were some down times due to bad weather. Therefore SP-2 and SP-3 were not sampled during this campaign.

#### v. General comments on the overall operations

One of the key factors to a successful survey is good planning and implementation. This survey was well organized both on onshore and offshore. Very high levels of safety measures onboard the vessel were maintained throughout the survey. The Captain and the crew of the MV *DP Star* have shown high dedication to their duties onboard the vessel, which was great. The sampling plan was executed accordingly. The limitations to the sampling were those of a physical nature (e.g. bad weather, where no sampling took place) of oceans. Overall operation and equipment used for sampling was satisfactory.

## 4) Concluding Remarks

The samples collected in this survey are worth yielding meaningful scientific insights on the physical and chemical characteristics of the water column, community structure of benthic macrofauna within SP-1. NMP should incorporate epibenthic fauna in their surveys to understand their interactions with demersal species, infauna, pelagic and phosphate mining, and if any negative effect occurs then devise ways to mitigate those effects. Capacity building through this initiative and other planned activities by NMP is highly commendable and should continue. Two UNAM students have gained hands-on experience during the verification survey.

## 5) Suggested Reading materials

- a. Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. and Death, R.G. (2011) Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand.
- b. U.S. EPA. 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA 823-B-01-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- c. Ranasinghe, J.A., K.C. Schiff, C.A. Brantley, L.L. Lovell, D.B. Cadien, T.K. Mikel, R.G. Velarde, S. Holt, and S.C. Johnson. 2012. Southern California Bight 2008 Regional Monitoring Program: VI. Benthic Macrofauna. Southern California Coastal Water Research Project. Costa Mesa, CA. Technical Report 665.
- d. IAE. 2003. Collection and preparation of bottom sediment samples for analysis of radionuclides and trace elements. IAEA-TECDOC-1360, Austria.

## 2.2 FACILITIES AND LABORATORY PROCESSING

---

### 1) Introduction

This part of the brief report deals with the processing of samples after the survey in part I. All the samples were loaded on the truck to laboratories in South Africa, viz the CSIR in Stellenbosch for sediment chemistry and the Department of Biodiversity and Conservation Biology Laboratory at the University of Western Cape (UWC) for sorting benthic macrofaunal samples, which were eventually shipped to a contracted consultant in Tanzania for identification and enumeration. This brief report concentrates on the sediment chemistry and the sorting of benthic macrofauna.

### 2) Approaches to the Assessment of Process

Laboratory visits were conducted on the 20<sup>th</sup> of September 2013 at CSIR Laboratories and lastly at UWC. A couple informal meetings and presentations by the Laboratory Manager that was followed by a tour of the laboratories complemented the visit to CSIR laboratories. Furthermore, a detailed description of methods used for the geochemical analysis was provided for review. At UWC, a quick tour of the facilities was led by Prof. Mark Gibbons and had a chance to look at the envisaged processing of benthic macro and micro faunal samples. No further details were supplied on sorting procedures and handling for further review.

### 3) Council for Scientific and Industrial Research (CSIR), Stellenbosch

The following assumptions were made *a priori*:

- a) The CSIR is a competent institution and laboratories accredited for this type of work.
- b) Personnel are well-trained in biogeochemical analyses
- c) Methods prescribed used were meticulously adhered to
- d) No sample contamination took place
- e) Data generated is true reflection of what was found.

*Comments:*

Firstly, the laboratory facilities were found to be highly suitable for the kind of analyses performed on the sediment (sub-core and surficial grab sediment) samples, which included the following:

- Oxidation Reduction Potential measurements
- Acid Volatile Sulphides and Extracted Metals
- Interstitial water-soluble nutrients for sub-surface cores
- %Moisture and Organic Matter determination
- %Organic Carbon and Nitrogen determination
- Particle size analysis by laser diffraction and wet sieving
- Seawater elutriation testing

The labs were well equipped with the right machines to run the abovementioned tests. The methods and procedure used are internationally accepted, which should not cast any doubts on the credibility of the results. However, something of a concern would be the oxidation-reduction potential (ORP) and acid volatile sulphides (AVS), which are very sensitive to contamination when exposed to open air especially at the point of collection. As pointed out in Part I of this report, these tests are best done in situ, with very limited exposure to open air, as these reactions in the sediment are continuous, thus due to the volatility of the sulphide (if present) may not be detectable at the later stage of testing. Redox potential measurements also seem to have suffered from the same inconsistencies. Other than that, all other measurements are basic and reliable.



#### **4) Department of Biodiversity and Conservation Biology Laboratory at the University of Western Cape**

*Assumptions:*

- a) Lab Personnel are well-trained benthic in macro-faunal sorting
- b) Internationally accepted sorting and handling procedures were used
- c) No loss of samples during handling and sorting
- d) Whole sample was sorted

The facilities have a great potential and visually appeared neat and well equipped. Sufficient laboratory space to conduct the sorting and identification of benthic macrofauna but lacked human capacity to do it. This may have hampered the task to be completed on time. Further identification and enumeration of both benthic macro-and-micro-fauna were conducted somewhere else though, thus no further comments can be made.

## 2.3 MODELLING REVIEW

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### 1) Ecosystem Modelling by Dr Kevern Cochrane

#### Background

This review looked at the Ecosystem Impacts related to mining of phosphates offshore of Namibia. At least two models were considered for the Northern Benguela (viz Ecopath with Ecosim (EwE) and Ecospace (spatial EwE model), and three papers were also considered for Southern Benguela and these applied EwE, OSMOSE (individually-based, multispecies, spatial) + EwE, and OSMOSE + EWE.

The author concluded the following after the review of the ecosystem models:

- Ecosystem modelling, including spatial models, can be valuable tool for the investigation of ecosystem impacts;
- However, ecosystem models have high uncertainty and the small area being impacted and small direct impacts means that it is very unlikely that models would produce reliable information on indirect impacts;
- Available information suggests ecosystem impacts are likely to be small, in proportion to direct impacts. However, if direct impacts are scaled-up ecosystem impacts will be too, with possibility of crossing critical thresholds and disproportionately severe (unknown) consequences.
- Available results suggest disproportionate 'surprises' will be unlikely but that could change if the mined area is of particular ecological importance;
- Direct impacts of mining in mined area will be substantially greater than equivalent fishing impacts, but much less than fishing impacts across the northern Benguela ecosystem as a whole.

#### Comments:

1. These are good tools to assess ecosystem impacts, however the assumptions which lie behind these models maybe too critical at times, thus unreliable.
2. Results should be used with caution
3. Benguela Current large marine ecosystem is a dynamic ecosystem, thus models need to be fine tuned every time.
4. The current work or report is well crafted, with indication of what could happen under different model settings.
5. Inclusion of benthic macro and meiofauna in the models could yield more insights.

### 2) Assessment of Fisheries Biomass in the Mining Licence Area by J. Gaylard

#### Background

This study was aimed at estimating the contribution of the MLA, especially SP-1, to the biomass of three commercially important demersal species (*Merluccius capensis*, *Merluccius paradoxus*, and *Lophius vomerinus*) in space and time. Furthermore, the contribution of the MLA to recruitment and the spawner biomass stock.

The study made the following conclusions:

- Less than 0.2 % of each species considered lies directly within the proposed primary SP-1 target dredge site.
- The SP-1 site also makes no significant contribution to recruitment or spawner stock for any of these species.
- Within the larger MLA, there is an estimated 7% of monk recruits which should be taken into account when considering wider impacts.

Comments:

1. The study was conducted well, given the limitations of the data.
2. New insights have emerged out the study and they consolidate the findings of the earlier assessment in the EIA.
3. The MLA's contribution to the total stock biomass for the species assessed is negligible.
4. This is a dynamic system, thus continued assessments with latest data should be conducted timeously.

### **3) Recruitment Study by H. Ndjaula**

Recruitment studies are usually pose some difficulties in undertaking them, let alone the various definitions that exist and the inherent issues pertaining to paucity of data. Therefore, it is only appropriate that this study assessed the reproductive dynamics of the major commercial species namely hakes (*Merluccius capensis* and *Merluccius paradoxus*), monk (*Lophius vomerinus* and *Lophius vaillanti*), horse mackerel (*Trachurus capensis*) and the sardine (*Sardinops sagax*). Further more, the study assessed the significance of the MLA to fish spawning and recruitment. Data are based on gonad data and maturity stages of the fish collected during survey by NatMIRC.

The study has shown that Cape hake, horse mackerel and sardine spawn outside the proposed MLA a bit further north on the shelf. Thus, the MLA is not a significant spawning area for demersal species such as Cape hake and monk. Similarly, with recruitment, the study suggests the MLA is not a significant recruitment area for the abovementioned species. Most of the fish at a mature gonad level were found outside the MLA.

Comments:

1. This report was well crafted, and provided some good insights
2. The current data suggest the MLA is not a significant spawning and recruitment area, however, this could change over time and space, due to the dynamics of the system, thus it warrants continued monitoring and evaluation.
3. To complement the existing data, eggs and larvae could be included during the surveys in the MLA and nearby areas. It may strengthen our understanding of spawning and recruitment for both pelagic and demersal fish species.
4. The report has a potential to be published as a journal paper.

### **4) Biodiversity Study**

This was yet another survey that was devoted to demersal fish and epifaunal species in the MLA. In addition this study included mammals and seabirds counts in the MLA. The study was the first of its kind in the proposed mining area.

*Comments:*

1. Study was well conducted
2. New biodiversity insights emerged
3. Consider inclusion of pelagic species in future surveys

## **5) Macro-benthic Fauna and Meiofauna**

Benthic macrofauna and meiofauna have a potential to respond to disturbance, thus can be used as good indicators for monitoring of seafloor activities. These studies were aimed at creating baseline information and assess the importance of meiofauna, and validate the impacts identified in an earlier EIA.

*Comments:*

1. Well written and structured reports
2. MLA is not a special area of concern
3. Benthic faunal species found there are also found everywhere along the coast
4. The 0.5-micrometre sieve mesh did not yield any important or unique information, thus 1 mm sieve is still good enough.
5. Consistence with sampling equipment is highly recommended

## **6) Jellyfish Study**

The jellyfish study was aimed assessing risks of blockage of the seawater intakes of the dredger, as well as the distribution, abundance and likely impacts to jellyfish.

*Comments:*

1. Well documented
2. In as much as jellyfish play an important role in the ecosystem they may become a nuisance due to prolific population.
3. Not really of a great concern, however their potential impacts should be noted.

## 2.4 PEER REVIEW WORKSHOP - CAPE TOWN

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### 1) Background

NMP has made it a commitment that all the work conducted during the EIA and the verification programme were put under scrutiny by the peer-review process. Thus, at the end of the verification programme all the scientific work conducted had to go through a peer-review process, which culminated in a peer-review workshop. The workshop brought together all the specialists who conducted the work based on their specific terms of references (ToR). Invited to the workshop was a panel of experts to review the verification work. The peer-review process is an ingredient of the good scientific information output.

### 2) Comments

- a) NMP have gone the extra mile ahead of all other phosphate companies by investing in good science
- b) The workshop was well organized, with a small group of scientists, and efficient in information sharing and review.
- c) Lot of good science emerged out of the verification work on water column characteristics, biodiversity study, benthic work, and geochemistry of the sediments.
- d) Couple of confirmations of the earlier EIA work and the earlier work enhanced.
- e) The panel consisted of four experts in Marine Ecology, Fisheries and Geochemistry, they all gave very useful comments which need to be considered in the final specialist reports.
- f) Specialist studies were all validated, with recommendations to include the mesopelagic species, plankton, eggs and larvae in future monitoring work.
- g) Biodiversity studies should continue in the future.
- h) Workshop organizers well done, it was worth your efforts.

#### ***2.4.1 Letter from Dr S. Mafwila***

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## UNIVERSITY OF NAMIBIA

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### **To whom it may concern**

During 2013 and 2014 I undertook on behalf of the University of Namibia and independent review assessment of the processes followed by Namibian Marine Phosphate (Pty) Ltd verification programme.

The report is titled "Independent Review of the NMP Verification Programme Process 2013 – 2014".



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