Skills Audit and Needs Analysis for the Marine Protection Services and Ocean Governance Sectors of Operation Phakisa

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SAIMI

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Foreword

The purpose of this study was to conduct a Skills Audit and Needs Analysis for the Marine Protection and Ocean Governance (MPG) focus area of the oceans economy.

The South African International Maritime Institute (SAIMI), as advised by its Marine Protection and Ocean Governance Working Group, appointed the International Ocean Institute (IOI-SA) to determine the current MPG status, skills needs and proposed interventions to address those needs.

Outcomes set out by the service agreement included:

- Inform the interventions required to grow the skills base of the sector to meet current and future demand;
- Prioritise and guide the development of qualifications that are required for the sector;
- Create a baseline to measure the impact of interventions on the MPG sector; and
- Identify critical and scarce skills required for the MPG sector.

The scope of work entailed gathering data and analysing the data through desk-based research, undertaking comprehensive online surveys and conducting face-to-face interviews of a sample of stakeholders in the MPG sector.

The aim of the study was to determine the educational and skills level of those employed in the MPG sector from entry to management level, what current educational and trainings skills are available and to what extent these meet the needs of the MPG sector. In addition, the study also had to determine whether there was a need and status for Recognition of Prior Learning (RPL) at various levels, including the need for upskilling.

The study also had to determine the level of registration or participation of the MPG sector with the SETAs, as well as capacity building and skills development offered by the public sector, private institutions and independent service providers.

Recommendations required by die service agreement also stipulated a baseline assessment of MPG employment in terms of youth, women and people with disabilities, as well as an assessment of the representation of the various population groups from entry to management level in the sector and perceived constraints in addressing transformation.

A strong outcome of the research was to determine the proposed educational and skills development programmes required for the MPG sector to meet Operation Phakisa aspirations in the future, including recommendations for interventions and mitigating strategies to achieve exponential growth in this subsector of the oceans economy.

SAIMI recognises the broad approach taken by the study, in particular the skills requirements of the MPG sector.

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1. BACKGROUND

1.1 Introduction to Operation Phakisa and the Oceans Economy

Operation Phakisa is a government initiative aimed at fast tracking programmes which have significant potential to contribute to economic growth and job creation in South Africa. One of its focus areas is the oceans economy which was launched in 2014 with a view to unlocking the potential of the country's oceans. Operation Phakisa (oceans economy) has six key areas, namely: Aquaculture; Offshore Oil and Gas; Marine Transport and Manufacturing; Coastal Tourism; Small Harbour Development and Marine Protection and Ocean Governance.
The purpose of this study is to conduct a skills audit for the Marine Protection and Ocean Governance (MPG) focus area to determine the current status, skills needs and to propose interventions to address those needs.

1.2 Marine Protection and Ocean Governance

During 2014, 6-week multi-stakeholder consultations (or Labs) were held to develop implementation plans (or 3-feet plans) for each of these areas. The Lab on Marine Protection and Ocean Governance (MPG) proposed 10 key initiatives as follows:

i. Ministerial Committee and Oceans Secretariat
ii. Enhancement of Legislation (Integrated Oceans and Coastal Management Act/Oceans Act)
iii. Review of Legislation
iv. Accelerated Capacity Building Intervention in Ocean Governance
v. Enhanced and Coordinated Compliance and Enforcement Programme
vi. Ocean and Coastal Information System and Observation Capacity
vii. Ocean and Coastal Water Quality Monitoring Programme
viii. Creation of an MPA Network
ix. MPA/MSP Research and Monitoring Programme
x. Marine Spatial Planning Process.

The Capacity Building Initiative was intended to support the development of the skills required for the successful implementation of all of these initiatives. Following the Lab, the Department of Higher Education and Training (DHET) was tasked with leading the skills development initiative and subsequently appointed the South African International Maritime Institute (SAIM I), to facilitate and coordinate this process. The first step was the establishment, in 2015, of five Skills Working Groups in line with the initial four focus areas including Marine Protection and Ocean Governance. One of the tasks identified as necessary to delivering on the MPG skills initiative was a Skills Audit and Needs Analysis.

1.3 Scope of the work

In the years that have passed since the initial Labs, a lot of progress has been made and a number of the initiatives have completed most, if not all, of the activities identified in the implementation plan. However, most have also led to the establishment of structures, promulgation of legislation and/ or development and implementation of management mechanisms and tools which are intended to be of a permanent - or at least semi-permanent - nature. This Skills Audit and Needs Analysis has therefore attempted to look at the skills requirements not just for the duration of the MPG implementation plan, but also at the skills needs going into the future. In addition, it should be understood that MPG is not limited to the activities covered by the 10 MPG Initiatives. The audit therefore took a much broader approach to the skills requirements. For example, fisheries management is considered to be a crucial element of effective MPG and the oceans economy and was therefore also covered in this work.

2. AIMS AND OBJECTIVES OF THE MPG SKILLS AUDIT

The aim of the MPG Skills Audit is to develop a skills plan to support the MPG Implementation Plan (3-foot plan).

More specific objectives include:

- To identify critical and scarce skills in the MPG sector;
- To inform the formulation of interventions required to grow the skills base of the sector to meet current and future demands;
- To identify, prioritise and guide the development of any additional qualifications required for the sector; and
- To create a baseline against which the impact of interventions can be measured.

The Skills Audit is also intended to contribute to the broader National Skills Development Strategy (NSDS Ill), the aims of which are to ensure increased access to training and skills development opportunities, and to achieve a significant transformation of inequalities linked to class, race, gender, age and disability in South Africa (DHET, 2011). In addition, it aims to address skills shortages and mismatches with a view to improving the effectiveness and efficiency of the skills development system. In general, this is achieved through sector skills plans developed by the Sector Training and Education Authorities (SETAs) in terms of the Skills Development Act (1998).

3. RESEARCH METHODOLOGY

The proposed approach to this work was based on the principles of the 21-Step Process developed by the Department of Higher Education and Training (DHET, 2016a). This Process was, however, originally designed to address skills scarcity related to the Government's Strategic Infrastructure Projects (SIPS) and was primarily focused on infrastructure and constructed on projects. Moreover, some elements thereof are outdated, while some of the sources of information cited in that methodology did not provide the level of detail required for the purposes of this project. The methodology used here therefore took a multi-pronged approach as described below.

3.1 Review of work of the MPG Skills Working Group

The MPG Skills Working Group met in September 2015 and subsequently produced a list of some 240 occupations considered to be important to MPG. This included many existing and/or generic occupations. A subsequent exercise in 2016 produced from this list a sub-set of 19 occupations which were considered to be new. Three of these - Marine Geologist, Biodiversity Planner and Marine Spatial Planner - were then identified as priorities at a meeting between SAIMI and the DEA MPG Delivery Unit in May 2017 (SAIMI, 2017). Most of the 19 new occupations identified were included in the 2017 version of the DHET's Organisational Framework for Occupations (OFO) either as Occupations or as Specialisations or could be considered to be covered under different names. However, in some cases the information in the OFO - such as descriptors and tasks - is missing or inappropriate.

Given the apparent discrepancies and inadequacies of the current (2017) version of the OFO and the findings of the Skills Working Group, it was decided for the purposes of identifying scarce and critical skills, to revert to the 2015 list as a starting point. The list of 240 occupations was subsequently split into 3 categories as follows:

i. Generic occupations which provide support to the MPG sector, but which require no specific training or upskilling in the field (e.g. librarian, restaurant manager, office administrator etc). This category included 152 occupations. These were not considered further.

ii. Generic occupations which are important to the MPG sector, for which the qualifications do not necessarily include any marine focus, and which would therefore likely require some upskilling to enable them to fulfil MPG-related responsibilities (e.g., SAPS and Defence Force officers, water quality analyst). This category included 56 occupations.

iii. Occupations which are critical to the implementation of MPG responsibilities, and which require specific training/qualifications. This list included 32 occupations.

The focus of the subsequent work was on the last category, namely the MPG-specific occupations, although some attention was also given to those more generic occupations which play an important supporting role in the achievement of effective MPG.

3.2 Desk-based research

The main objectives of the desk-based research were to gather existing data to inform the project context, insights, analysis and commentary. Information was gathered from various sources including:

- **Government departments and agencies:** A range of reports, annual reviews, policies, terms of reference for committees, job descriptions and other miscellaneous documents were collated from those government departments who play a role in developing policies for and/or implementing marine protection and ocean governance. Documents from some of the key departments included:

  - Department of Environmental Affairs (DEA): National Environmental Compliance and Enforcement Report: 2016-2017, Briefing on Marine Spatial Planning (2017); various bills and acts e.g., Marine Spatial Planning Bill (2017); and National Oceans and Coasts Water Quality Committee Terms of Reference (2018).
  - Department of Higher Education (DHET): 21 Step Framework; Classification of Education Subject Matter (CEMS) (2009); Statistics on Post-School Education and Training in South Africa (2016); and Organising Framework of Occupations (OFO) (2017).
  - Department of Transport (DoT); Marine Transport Policy (2017).
  - South African Maritime Safety Authority (SAMSA); Five Year Strategic Plan 2015-2010.
  - South African National Biodiversity Institute (SANBI); Human Capital Development Strategy for the Biodiversity Sector 2010-2030 (2010).

Most of the information gathered from the national departments served to provide the context for this work. In addition, some of the documents, such as terms of reference and job descriptions, were used to highlight aspects of the knowledge, skills or capabilities required of individuals who undertake the relevant job functions.

Data quality: The DHET data on student enrolments and graduations (DHET, 2016b) provides information to the 2nd order of CESM codes. This is not sufficient to distinguish between, for example, law courses specific to MPG occupations and other public law courses and is therefore not sufficiently detailed for the purposes of this project. It was therefore necessary to go directly to the training institutions themselves.

Government linked institutions:

Valuable information was also obtained from various other government-linked bodies which play a role in MPG – notably:

- Council for Scientific & Industrial Research (CSIR): Implementation of the Research, Innovation and Knowledge Management Road Map for the South African Maritime Sector (2017).
- South African International Maritime Institute (SAIMI): Provided numerous background documents including the MPG 3ft Plan; minutes of meetings of the MPG Skills Working Group.
- Statistics South Africa (StatsSA): Census data (2016) which provides a high-level indicator of population occupations e.g., manager; employment statistics.

Other entities from which information was obtained included: Transnet National Ports Authority, KwaZulu-Natal Economic Development, Tourism and Environmental Affairs (KZN EDTEA), Human Resource Development Council (HRDC), eThekwini Maritime Cluster; and Wildlife & Environment Society of South Africa (WESSA).

Data quality: Whilst all the documents gathered from this source group were relevant to MPG, information at a granular level on the number of occupations, types of jobs etc. was not forthcoming. This was particularly the case in terms of data from StatsSA (in conjunction with the Department of Labour) which proved to be too high level. As a consequence, a 'bottom-up approach' for gathering more granular data had to be adopted (see discussion in the section on 'Skills Protections' below).

- **Sector Education & Training Authorities (SETAs):** Primary documents accessed from SETAs included scarce and critical skills reports, annual performance reviews, strategic plans and sector skills plans. Documents were gathered from the following SETAs: Chemical Industry SETA (CHIETA); Culture, Arts, Tourism, Hospitality and Sport SETA 9CATHSSETA); Media, Information & Communication Technologies SETA (MICTSETA); Local Government SETA (LGSETA); Manufacturing, Engineering and Related Services SETA (merSETA); Public Services Education & Training SETA (PSETA) and Safety and Security SETA (SASSETA).

Aside from providing an overview of some of the issues associated with scarce and critical skills, an initial pass through the documentation immediately revealed that there is no single – or even lead – SETA that oversees MPG. MPG-related occupations are therefore distributed and accommodated under a myriad of SETAs (see Table 2). In addition, some anomalies were identified: for example, there is no 'natural' home for the natural and life sciences occupations – such as environmental scientists, or marine biologists, which currently fall under CATHSSETA.

The value of this finding is that it aided interview discussions around the role of, and with SETAs, who acknowledge that the dispersion of occupations across SETAs is an issue. Dialogue with interviewees subsequently provided recommendations on how this situation could be overcome.

Data quality: Most skills sector plans (SSPs) and strategic plans are contemporary and provide a useful contextual setting within which the MPG-related occupations would function. However, as no one SETA had a specific focus or chamber directly related to MPG, specific MPG information was not forthcoming, and where occupations associated with MPG were referenced, it was more generic as opposed to a specific reference to MPG skills. For those that had publicly available scarce and critical skills reports, many were published in 2013-2014, as such not providing an up-to-date status on scarce and critical skills and/or occupations.

- **Universities and colleges:** In order to ascertain the supply-side of the MPG spectrum, a data trawl of universities, colleges and private training institutions was undertaken to capture the range of qualifications offered by national, and where appropriate, international institutions. The type of information that was gathered included prospectus', course outlines and where feasible, enrolment and graduation numbers. In the case of the latter – given that DHET data was not detailed enough – this was done by directly approaching the Registrars at the institutions concerned. The intention of this exercise was to try and align the institutions offering qualifications, with demand for critical and scarce MPG related skills and occupations.

3.3 Online surveys

Three separate online surveys were carried out to capture insights and data from a wide network of stakeholders directly and indirectly involved in MPG in South Africa. The three surveys covered:

i. Entities that employ individuals which require marine protection and governance skills (referred to as the demand survey);
ii. Institutions that provide both formal and informal marine protection and governance education and training (supply survey); and
iii. The Sector Education and Training Authorities (SETAs) that are or could be involved in marine protection and governance.

A copy of the set of questions for the demand survey can be found in Appendix 1.

Stakeholders for both the online survey and interviews were identified from a number of pre-existing lists, minutes of meetings, through desktop research or through recommendation by other interviewees. A total of 347 surveys were sent out via Survey Monkey during the first week of April 2018, although it is noted that in some cases, the link was forwarded to colleagues to complete and, in the case of new contacts, the survey was sent at a later date. Up to three reminders were sent out to recipients over the period of 4-6 weeks, with the final date for survey completion being 4th May 2018. Reminders did elicit additional responses.

Of the 347 surveys sent, 75 (22%) were completed. Of these 50 (67%) were adequately completed.

Table 1 below provides a summary of the number of participants in the surveys – per category – while Appendix 2 provides a full list of the organisations sent online surveys, the number of responses received as well as the number of individuals interviewed.

Table 1: Responses to Online survey

Category	#of surveys sent	# of Respondents [% total sent]	# of responses adequately completed
Demand survey			
National government departments	92	20 [22%]	14
Provincial government departments	41	5 [12%]	5
Local government	23	4 [17%]	2
Government research institutions/implementing agents	89	16 [18%]	8
Private businesses, Institutions, Associations and NGOs	40	11 [27%]	9
Supply survey			
Universities and training institutions and department	49	16 [33%]	10
SETA survey			
SETAs	13	2 [15%]	2
TOTAL	**347**	**75 [22%]**	**50**

Low responses are typical of such surveys, but it is likely that in this case the limited response was exacerbated by the fact that:

- Many of the contact details from existing stakeholder lists were out of date. This was addressed by undertaking Google searches for some of the key contacts. This was successful in some cases, but in others – particularly in government positions – many had moved on or Departmental names and e-mail addresses had changed.
- In a couple of cases, individuals complained about the length of the survey. However, it was agreed that a shorter survey would not have provided the required information.

Despite the relatively low response, the surveys provided useful information, with a number of respondents having spent significant time answering the questions and providing considered opinions on current and future skills, scarce skills and numbers holding jobs. In general, a good representation across the core-categories of respondents was received. Moreover, in most cases where there were gaps, these were addressed by scheduling additional, targeted interviews or forwarding hard copies of the survey questionnaire to specific individuals for completion.

Nevertheless, no meaningful contact was made with either the Department of Monitoring & Evaluation (DPME) or the Safety & Security SETA (SASSETA). There was also very limited contact with local government. There was particular concern over the lack of response from SASSETA given that it is a key SETA in the compliance and enforcement sector.

3.4 Stakeholder interviews

From the outset of the research the identification and interviewing of key stakeholders was deemed critical to:

- Understanding different MPG activities and programmes, and their status in delivering MPG under the Operation Phakisa programme, and MPG more general;
- Understanding current MPG employment numbers, gaps and issues, scarce and critical skills and future predictions for MPG skills and occupations.
- Getting an insight into future skills needs and occupations focus, and making recommendations and suggestions on mitigating discrepancies in supply and demand; and
- Gathering data, and/or referrals to data on MPG employment within the relevant organisations.

A total of around 38 interviews were undertaken, predominantly face-to-face, with a few via telephone.

3.5 Skills predictions

One of the key objectives of this audit was to provide an indication of predicted national MPG skills and occupation needs for the next 5, 10 and 20 years. The DHET's 21 Step Process had been identified in a review of skills methodologies for the Green Skills Programme as a useful potential method for calculating such figures and was therefore proposed for this project. Step 4 of the 21-Step Process states that this will be achieved using i) the Linked Macro-Education Model (LM-EM) to forecast estimated national demand for occupations considered scarce, or ii) using detailed research per national occupation where available.

The IOI-SA team therefore engaged with Adrienne Bird of the DHET (who was involved in the development of the process) to assess its viability as a mechanism for generating a list of occupations and determining future demand in the MPG context. During these discussions it emerged that the Process, as it currently stands, is not appropriate for MPG, as it is predominantly set up to cater for construction and infrastructure projects, such as

the building of roads and harbours. Moreover, it also became apparent that the relationship between the developer of the prediction component of the tool (the LM-EM) and the DHET was such that this model was not available.

In this context, the IOI-SA team then assessed potential sources of more detailed numeric data, such as the DHET, Department of Labour (DoL) and StatsSA. However, in all cases, this data was not detailed enough for the purposes of this project. For example, the DHET tables on numbers of graduates only report to the 2nd order of CESM codes which is not sufficient to distinguish between, for example, law courses specific to MPG occupations and other public law courses. Similarly, the DoL statistics only report employment figures to OFO Unit Group level, and not for specific occupations.

As numeric data from online surveys, SAIMI documentation from 2014/2015 and interviews were quite ad hoc, the IOI-SA team decided to adopt a new, multi-pronged approach. This included obtaining detailed data from:

i. The Human Resources personnel of key departments and agencies involved in MPG – with a view to obtaining employment data. To this end, a template containing a list of the MPG occupations of interest was compiled (see Appendix 5) and circulated for completion. In addition, they were also requested to provide Job Descriptions, information on transformation (e.g., number of youth, women and people with disabilities employed) and number of vacancies. Of the 27 entities approached, only 9 provided some form of data.

ii. The Registrars/ Student Records offices of key training institutions – with a view to getting numbers of students enrolling for and graduating in degrees/ diplomas etc. of relevance to MPG occupations (see Appendix 8).

This exercise – together with anecdotal and qualitative evidence gathered from the online surveys, interviews and scarce skills reports – provided enough information to generate a commentary on supply and demand. However, given that not all entities approached provided data (including key departments such as the DEA), the available information was not sufficiently robust to make a credible quantitative prediction for MPG occupation demand and supply. Moreover, since neither the prediction model, nor adequate data were available, predictions were necessarily limited to those based on information provided by individuals in the online survey and in interviews. Those included in the spreadsheet developed by the MPG Skills Working Group in 2015 were considered but on further examination were found to be from only two institutions and were out of date. Instead, more emphasis was put into considering the factors which might be influential in terms of future demand.

3.6 Stakeholder workshop

The draft recommendations were presented to stakeholders at a workshop on 18 June 2018. This was attended by some 22 participants. Comments received at and subsequent to the workshop were then incorporated into this report.

4. FINDINGS OF THE SKILLS AUDIT

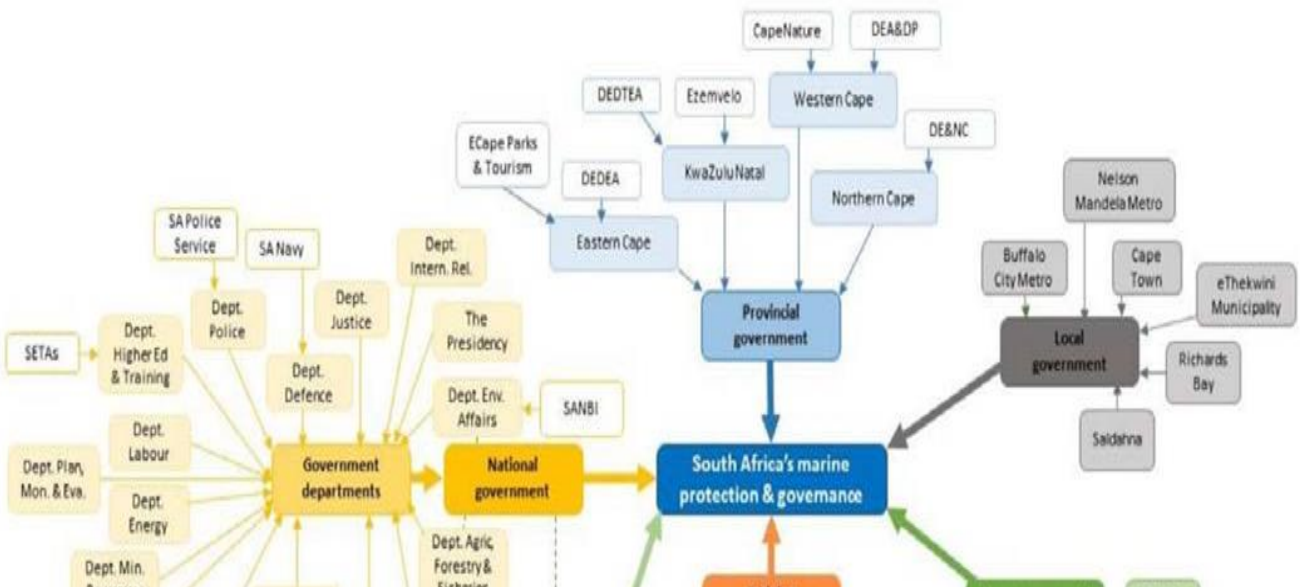
The Operation Phakisa: Oceans Economy Programme is premised on the notion that the use of the ocean and coastal areas – and associated resources – to which South Africa is entitled have the potential to make a significant contribution to economic development, job creation and poverty reduction. Predictions were that the development of the Oceans Economy would result in an increase in the GDP contribution of our oceans from R54 billion by 2030, while the contribution to job creation would grow from 256 000 jobs in 2008 to between

800 000 and 1 million by 2030 (DEA, 2014).

By including a component on Marine Protection and Ocean Governance (MPG), the Programme also recognises that, in order to not just meet these targets, but to sustain this contribution into the future, these activities need to be done in a sustainable manner. Effective Marine Protection and Ocean Governance as a whole, is therefore critical to the oceans economy. MPG is, however, a complex and multi-disciplinary activity with a wide range of regulators encompassing not only those seeking to protect and conserve marine biodiversity and marine ecosystem services, but those managing the variety of resources and uses of the oceans, from fisheries to petroleum hydrocarbons, and from global shipping and transport to mariculture, tourism and recreation. This complexity is amply demonstrated in the stakeholder map in Figure 1.

The regulators include some who have a primary role – such as developing policy and legislation, setting and enforcing fishing quotas, pollution standards etc – while others play more of a supporting role. For example, the support of SAPS is crucial in compliance and enforcement operations involving poaching and other environmental crimes, while academic and training institutions are essential to providing those employed by the regulators with the knowledge and skills required to do their jobs.

Each of these roles is critical to the effectiveness of MPG in its own way. However, one of the objectives of this project was to identify critical occupations and scarce skills with a view to making recommendations as to how these could be addressed, thereby improving the capacity of the MPG authorities to fulfil their responsibilities. For purposes of this report, critical occupations are therefore considered to be those where there is a shortage of people with the appropriate qualifications and/ or skills – whether due to a lack of training opportunities, or to a lack of sufficient posts. With respect to scarce skills, it needs to be understood that even people with the appropriate qualifications, do not necessarily have all of the required skills. For example, legal drafting is a skill which is important for lawyers working in government but is not a skill which is commonly included in legal qualifications.



4.1 MPG Occupations

As previously mentioned, the MPG Skills Working Group established in 2015 produced a list of some 240 occupations considered to be important to MPG. The clearly generic occupations were excluded from further consideration, although the final list of occupations which were assessed further as part of this study included a number of the supportive occupations (for example, information technology practitioners and SAPS personnel – most of whom do not have marine-specific training) as well as those whose responsibilities are core to MPG. It should be noted that in the final list some occupations have been grouped – particularly in the case of supportive occupations which do not require marine specific qualifications – while in other cases, specialisations have been treated as occupations. For example, in terms of the OFO, a Fisheries Scientist is considered as a specialisation of a Marine Biologist. For the purposes of this work, however, it was considered as a separate occupation as it requires specific skills.

A list of occupations/ skills in relation to the 10 MPG initiatives under Operation Phakisa can be found in Appendix 3.

4.1.1 Assessment of MPG occupations

For purposes of further assessing the list of occupations relevant to MPG, they were broken down into categories based primarily on the OFO codes, but also on the nature of the occupation as follows:

I. Managers (OFO Major Group 1)

II. Physical and Earth Science Professionals (OFO Minor Group 211)

III. Mathematicians, Actuaries and Statisticians (OFO Minor Group 212)

IV. Life Science Professionals & Technicians (OFO Minor Groups 213 and 314)

V. Compliance and Enforcement Officers includes Engineering Professionals (OFO Minor Group 214), Veterinarians (OFO Minor Group 225), Ship and Aircraft Controllers and Technicians (OFO Minor Group 315), Regulatory Government Associate Professionals (OFO Minor Group 335) and some which lack OFO codes.

VI. Planners (OFO Minor Group 216)

VII. Information Technology Practitioners (includes Software and Applications Developers and Analysts (OFO Minor Group 251); Database and Network Professionals (OFO Minor Group 252); ICT and GIS technicians (OFO Minor Group 351) and one with no code.

VIII. Legal Professionals (OFO Minor Group 261)

IX. Social Professionals (OFO Minor Group 263; Unit Group 2631 – Economists; and Unit Group 2632 Sociologists, Anthropologists and Related Professionals).

Information for each of these categories of occupations is summarised in templates which can be found in Appendix 4 (a – i). This information is based primarily on the descriptors and tasks found in the OFO. However, the occupational descriptors and tasks supplied in the OFO are in many cases either too generic – or inappropriate – for MPG occupations. The tasks, in particular, have therefore been adapted for MPG as far as possible, based on job descriptions and/ or advertisements for the relevant posts.

The templates also contain, where possible, information on:

- The required qualifications and skills for each occupation (with more detailed information on qualifications being provided in Section 5 and Appendix 8);
- The availability or scarcity of people with the requisite skills (based on the responses to the On-line survey, interviews and SETA scarce skills lists); and
- The relevant SETA where this is not ambiguous.

Apart from providing a useful summary on the MPG occupations, this exercise was also an opportunity to critically analyse the OFO in relation to these occupations. In addition to the fact that it became clear that a number of the descriptors and tasks were too generic – or inappropriate – it was also evident that a number of MPG occupations were still not explicitly included in the OFO. Moreover, in some cases, it appears that although they had been included in the 2015 version of the code, they were missing in the 2017 version, with no apparent explanation.

The changes to the OFO are discussed in more detail in Section 4.6.

4.1.2 Employment in MPG-related occupations

As indicated in section 3, in the absence of sufficiently detailed employment data from StatsSA, a template listing the MPG-related occupations of interest was circulated to the Human Resources Divisions of key departments and agencies involved in MPG activities with a request for them to provide relevant employment data including, for each occupation, number of posts, number of employees, number of women, youth and disabled, and number of vacancies.

Responses were received from:

- DAFF (FCOs only)
- Nelson Mandela Metro (Marine Law Enforcement Officers only)
- City of Cape Town (Marine Law Enforcement and Coastal Unit)
- eThekwini (Environment Officers – Air Quality only)
- SAMSA
- SAN Parks
- WCape DEA&DP (Environmental Management Inspectors only)
- CapeNature (FCOs and EMIs)
- DEA (limited to personnel involved in OP MPG initiatives).

This information is summarised in Appendix 5 and has been supplemented, where available, by numbers provided by individuals via the Online survey and/ or during interviews. It should be noted that in the case of the latter, the figures are likely to be less accurate. Another important point is that employment figures ONLY include numbers from government departments and agencies whereas people employed in a number of occupations important to MPG are also employed elsewhere – for example, in the private sector and NGOs. In fact, in some cases, the numbers employed in the private sector are likely to far outweigh the numbers employed in government – for example, shipping lawyers.

4.1.3 Critical occupations

Given the limited employment data, the comments below are drawn primarily from responses to the online survey and interviews as well as SETA scarce skills reports where available.

In the first instance, although a number of respondents/ interviewees cited a lack of appropriately qualified individuals as a key challenge to recruitment, many also noted that even where they have appropriate qualifications, they generally lacked experience. At the same time, many of the older experienced individuals had left. There was therefore a situation of a 'missing middle' where not enough individuals in the middle management positions were adequately skilled in MPG and not in a position to mentor new recruits whilst senior managers did not have the time. This issue is regularly cited in skills demand studies and points to the need for improved succession planning.

Other challenges listed in relation to recruitment included:

- Transformation (i.e., while suitably qualified people might be available, they do not always meet the transformation requirements). This is termed relative scarcity;
- In some cases, there was an inability to attract and/ or retain staff. People with legal qualifications, for example, might well prefer to work in the private sector, while seafarers are able to earn in dollars while they are at sea;
- Some people are not willing to go to sea;
- A lack of funding and/ or posts. One example of this which of particular concern was the high number of FCO posts that have been frozen. Another relevant comment was that there are no prospects for fisheries economists in South Africa.

Despite the above challenges – which in most cases probably outweigh the scarcity of suitably qualified individuals – there are some specific occupations where there appear to be real shortages:

- A specific Management Occupation reported to be in short supply is Harbour Manager (132407) although it should be noted that i) this applies to fishing harbours rather than to the commercial ports; and ii) the term which is used as "Harbour Master" rather than Manager, but there is no OFO code for Harbour Master. Information provided indicated that in some cases, Fisheries Control Officers have been appointed as Harbour Masters/ Managers.
- Naval Architects have long been recognised as being in short supply due to the fact that no suitable qualifications are available in South Africa.
- There is also a shortage of Ship Surveyors with adequate training and experience. This is primarily because although training for the relevant SAMSA Certificates of Competency is available, qualification for the job also requires a certain amount of experience at sea and this has proven difficult for seafarers to obtain in the South African context.
- In terms of Physical and Earth Science professionals, Marine Geologists (which are a specialisation of Geologists (211401) rather than an occupation in their own right) were identified as being in short supply. However, at present the only employment opportunities seem to be in the private sector.
- The number of people with a combined qualification in Fisheries Science and Marine Resource Assessment and Modelling (Applied Maths / Statistical Science) is limited.
- The Energy and Water SETA (EW SETA) Sector Skills Plan 2017 – 2022 identifies Water Quality Analysts (213306) as one of the top ten scarce skills for the sector. Although this probably applies to freshwater, it is noted that analysis of sea water is particularly complex and that while there may be laboratories that do this, there is concern regarding the quality of the data generated. This is of particular concern in the context of the National Ocean and Coastal Water Quality Monitoring Programme which is in the process of being established under initiative 7 of MPG.
- The CATHSETA Sector Skills Plan 2017/ 2018 reported that "Conservation: The Park Ranger and environmental Scientist reportedly have the highest vacancies in the current year". The intervention planned by SETA included the provision of bursaries, internships and/ or learnerships for Marine Biologists, Environmental Scientists, Conservation Scientists, Park Rangers and Environmental Managers. Despite the above, the general opinion of people consulted in the course

of this project was that there is not a scarcity of people with the requisite qualifications. However, there may be a relative scarcity if transformation issues are taken into account.

- Marine spatial planning is a relatively new occupation globally and more so in South Africa. It is therefore not surprising that there are few, if any, people with qualifications in this field. A specific challenge is that a person in this occupation needs multi-disciplinary skills which are difficult to find in a single individual.
- There is a shortage of qualified Hydrographers in the country primarily because there are no suitable qualifications available. The appropriate qualifications/ training required is an International Hydrographic Organisations/ International Federation of surveyors (IHO/ FIG) Category A or B from an accredited IHO/ FIG training institution. Depending on the institution, the learner will get an MSC degree or a Diploma in hydrography which is internationally recognised. Most hydrographic surveyors study abroad or through distance learning. However, at present the demand for hydrographic surveyors is limited because of the current slump in the Oil and Gas Industry due to the low oil prices.
- Information Technology Practitioners in general are easily available although those with experience in MPG-related applications are less so. Marine GIS technicians in particular are in short supply, in part at least, because there is not specific training in this specialisation.
- While there is not a shortage of attorneys in general, the number with post-graduate qualifications in environmental, marine, maritime or shipping law is more limited.
- Economists specialising in Nature Resource, Fisheries or Environmental Economics were cited as scarce with one respondent noting that there are no prospects for Fisheries Economists in South Africa.
- Veterinarians with specialisation in aquatic diseases have for some years been identified by the DAFF: Aquaculture Division as being in short supply primarily because no training is available in South Africa.

It is noted that of the three occupations identified as priorities by SAIMI and the DEA MPG Delivery Unit in May 2017, two – Marine Geologists and Marine Spatial Planners – are included in the above. The third – Biodiversity Planner – has not been included as it is considered that a specific qualification is not required for this occupation and that it should rather be considered as a specialisation of Conservation Scientist. A recommendation to this effect has been made in the appropriate section of this report.

4.1.4 Critical occupational cluster: Compliance and enforcement

Compliance and enforcement are both critical to effective governance but may involve different role players depending on the responsible authority/-ies. In general, the role of a compliance officer is to undertake inspections to make sure organisations or individuals conform to permit conditions, contractual obligations, government regulations, and laws. On the other hand, **enforcement** is an action that is taken against an organisation or individual that is not in compliance with the relevant permit, obligation or fine – or may involve a criminal prosecution depending on the nature of the non-compliance.

Compliance and enforcement occupations as a group are critical to MPG. Without effective enforcement of the regulations, other efforts to protect marine ecosystems – such as improved scientific understanding, sophisticated management tools etc. – or regulate economic activities in the marine environment will have limited benefits. It is therefore of particular concern that this was regularly cited not only as an area where there are skills shortages, but one where numerous posts have been frozen.

Compliance and enforcement is also a complex area with different technical issues and approaches in the different sectors and, therefore, potentially different solutions. A further complication is that firstly, they have different job titles in each sector, and secondly, that at least some of their authority is derived from

the legislation which has resulted in officials sometimes having more than one "title". For the purposes of this report, it has been separated into the Maritime Sector and the Environment/ Natural Resources Sector with the latter also being broken down into several sub-sectors.

Maritime Compliance and Enforcement:

Shipping is an international industry and is regulated through a variety of conventions adopted by the International Maritime Organisation (IMO) and brought into force domestically through national legislation. These Conventions are enforced through Flag and Port State Control with the Flag State (i.e., country where a ship is registered) being responsible for ensuring that their vessels are compliant, while Port/ Coastal States are permitted to inspect foreign flag ships calling at their ports to ensure that they comply with the appropriate standards.

In South Africa, shipping is a national competency, and SAMSA is responsible for all compliance in this regard (including international and domestic vessels) – although DEA will be involved if, for example, oil is spilled into the sea following a shipping accident. SAMSA compliance officers include Naval Architects and Ship Surveyors. As noted above, there is a shortage of qualified persons for both of these occupations. Moreover, there are regular amendments to the international Conventions and therefore a need for regular training to ensure these officials are up to date with the regulations.

Compliance and Enforcement: Environment and Natural Resources:

Fisheries

The responsibility for implementation of the Marine Living Resources Act (MLRA) and associated regulations lies with the Department of Agriculture, Forestry and Fisheries (DAFF). Compliance and enforcement falls within the Chief Directorate Monitoring, Control and Surveillance. The job titles of the compliance officers are Marine Conservation Inspectors (Senior, Chief and Control). There are 270 posts to cover the entire coastline, of which 183 are filled, with the balance having been frozen until 2023. They are therefore spread very thin. There is a particular concern in KZN where there is no office, and the duties are undertaken by FCOs from the Eastern Cape.

Despite their job titles, these officials are commonly known as Fisheries Control Officers (FCOs) due to the fact that their authority is derived from Section 9 (1) of the MLRA which states that: "The Minister may, subject to the laws governing the public service, designate posts or ranks in any organ of state of which the incumbents shall be fishery control officers". The Minister has, in fact, appointed numerous FCOs from other government agencies including national (SANParks), provincial and local government. Thus the total number of FCOs is significantly higher – those reported here being over 500. However, the FCOs from other agencies generally have other responsibilities – for example, the SANParks FCOs are actually rangers – so this approach gives the impression that there is far more capacity for fisheries control on the ground than there actually is.

The powers of FCOs are also quite limited in as much as that although they undertake investigations into, e.g., poaching activities, contravention of the MLRA is criminal, so when illegal activities are discovered, they are reported to SAPS who then lead the investigations although they generally liaise with the FCOs.

SAPS have a Specialised Task Force of some 90 officers with a focus on poaching. These specialised units undergo specific training related to working in the marine environment e.g., waterborne course/ swimming and how to scale and skipper small vessels. The SAPS Border Police are also involved in cases of poaching which involve the illegal exportation of goods out of South Africa as they are responsible for securing all

ports of entry. However, there is concern that the size of the Border Police Unit is inadequate.

In terms of qualifications, there does not seem to be a specific requirement for FCOs although they generally have a Diploma in Law Enforcement or Nature Conservation or an Environmental Management or Natural Science-related qualification. In some cases, however, they only have a Matric. There is therefore not a shortage of individuals for these posts, but it is likely that most incumbents will require upskilling of one form or another. For example, those with a qualification in Nature Conservation will require upskilling in Law Enforcement and vice versa. In both cases, there is a need for upskilling in the identification of marine resources. A relatively new initiative aimed at upskilling FCOs is the FishForce Academy which is based at Nelson Mandela University. FishForce runs a variety of short courses related to fisheries compliance and enforcement (see Section 6 for further details).

Environment

A situation similar to FCOs pertains to Environmental Management Inspectors (EMIs) in that they are designated in terms of the National Environmental Management Act, 107 of 1998 (NEMA) which confers on them a wide range of powers to investigate cases of non-compliance with NEMA and/ or the Specific Environmental Management Acts (SEMAs), including NEM:BA, NEM: AQA, and NEM: ICMA.

EMIs are also drawn from national, provincial and local government, although the range of powers and responsibilities may vary depending both on the agency, but also the specific focus of the division within which they are situated – for example, some may deal specifically with pollution issues, others with compliance related to biodiversity regulations. In coastal areas there is an additional focus on compliance with integrated Coastal Management requirements. The actual job titles of these officials may include park rangers and conservation officers, pollution and waste enforcement officials and officials monitoring urban developments. This has nevertheless resulted in the establishment of a network of EMIs which will hopefully result in improved co-operation across the various tiers of government and the protection of different aspects of the environment.

At the national level, DEA has dedicated personnel with a clear split between the compliance and enforcement roles. Compliance officers are responsible for inspections aimed at identifying cases of non-compliance and thus need to have a detailed technical understanding of what constitutes non-compliance. For example, they may specialise in investigations related to biodiversity, or pollution, and, in the case of coastal areas, illegal developments in the coastal zone, illegal coastal discharges, illegal fishing within Marine Protected Areas and coastal access. Once a case of non-compliance has been identified, it is submitted to the Enforcement Division. Enforcement is then done in-house – except in cases which involve a non-environmental crime such as possession of an illegal firearm – and may be administrative or criminal prosecution. Administrative enforcement is done by way of notices or directives, while criminal prosecutions involve the compilation and registering of a docket which is then submitted to the NPA for prosecution. EMIs may then also appear in court to present evidence. There is therefore a lot of work involved and DEA: Oceans and Coasts have only four people in their Compliance and Enforcement Unit.

In terms of prosecutors at the NPA, programmes on the procedures for environmental crimes have been conducted through Justice College (linked to the Department of Justice). Moreover, the NSPP also do *ad hoc* training. However, training in marine and coastal issues is still required.

At provincial and local government level, individual EMIs may be responsible for both compliance and enforcement and/ or may place greater reliance on support from SAPS in the case of criminal cases. The Eastern Cape is the only province where EMIs take the lead on environmental cases. However, most EMIs have responsibilities in relation to the environment as a whole rather than just marine and coastal issues. For example, the Compliance and Enforcement Unit in the Eastern Cape has 32 EMIs, but they are

responsible for all environmental issues.

EMIs clearly need to be multi-skilled to fulfil their responsibilities effectively. Although there are no specific requirements in terms of qualifications – to be accepted to undergo EMI training, an applicant only needs to be employed in a relevant post – EMIs tend to come from either a Law Enforcement or a Nature Conservation/ Science background and then need to be upskilled accordingly.
In general, all compliance and enforcement officials located in coastal areas should undergo specific training in marine and coastal issues.

Mining

The responsibility for implementing NEMA in relation to mining activities has since 2014, been delegated to the Department of Mineral Resources, although the Petroleum Agency of South Africa (PASA) is responsible for implementing regulations for offshore oil and has as part of the Mineral Resources Petroleum Development Act. The main issue along the coast is illegal sand-mining which was a traditional activity but is now becoming a substantial business.

The DMR's Enforcement and Environmental Unit is based in Pretoria where there are 12 staff, including a Deputy Director and Assistant Director and eight inspectors/ compliance officers. Inspectors have the powers to stop illegal mining but, since they are based in Pretoria, with no presence along the coast, they are reliant on reports of illegal activities from elsewhere which they then follow up.

The compliance officers generally have a basic qualification in either law enforcement or environment, and then receive upskilling in the form of a short, certificated course offered by University of Pretoria: Environment in Mining Regulations (EMRI) training. It was suggested that they also be trained in firearm handling for their safety and security.

4.2 Scarce skills and capabilities

As indicated above, even people with the appropriate qualifications for a particular occupation do not necessarily have all of the skills required. The types of skills and capabilities identified as lacking and/ or required by people in MPG occupations can be split into a number of categories: 'Soft' skills, technical and research skills, and practical skills:

'Soft' skills are often neglected, but are critical for managerial job functions, or for those who find themselves in confrontational situations (i.e., those in enforcement). Examples of some of the key skills raised under this category include:

- Motivation, management, supervision and mentoring;
- Liaison, consultation, negotiation and mediation; and
- Stakeholder engagement.

Technical and research skills include:

- Investigation of environmental crimes;
- Identification of marine species;
- Procedures for conducting scientific research and data analysis;
- Legal analysis;
- Policy development; and
- Legal drafting – regulations, legislation, Parliamentary documents etc.

Practical skills: these are skills which are related to the practicalities of working in the marine environment

and include safety at sea, skippering of small boats, diving etc.

Some of these highlighted skills are potentially critical to the effective implementation of MPG. These additional skills can be acquired through upskilling, mentoring and/ or just on-the-job learning and experience. Opportunities to address these skills gaps are discussed further in Section 6.

4.3 Transformation issues

Information of transformation was solicited through the Online survey, during interviews and as part of the request for employment data with the latter addressing employment levels of youth, women and people with disabilities.

Based on the limited employment data received, the following comments can be made:

- Managers: women are reasonably well represented, but there are only a limited number of youth (to be expected) and no people with disabilities;
- Life Science Professionals and technicians: both women and youth are reasonably well represented, but again, no people with disabilities;
- Compliance and enforcement: there is a reasonable representation of youth, but a limited number of women and no people with disabilities;
- Legal professionals: women are well represented.

The opinions obtained from the Online surveys and during interviews varied widely with some claiming there were no issues, and others that transformation targets were still far from being met. Other points that emerged included:

- Many respondents felt that many of the current employees with experience and skills within government departments, and associated delivery agencies, are still white and/ or older (over 50 years old) and reaching retirement age – and in one case it was stated that there was a reliance on 'pensioners'. Part of the concern in such cases is that many older staff have natural or earth-sciences qualifications, yet MPG these days requires a different set of skills and knowledge: for example, an MPG policy understanding, compliance and enforcement experience, environmental management and ITC training (such as GIS).
- At the same time, it was acknowledged that although youth or new entrants to MPG have the requisite qualifications, they generally lack work-based experience. As a result, there is a 'missing middle' of individuals who have the required qualifications, length of experience and middle-management skills to effectively guide and implement MPG into the future. This was considered of great concern in Departments such as the DEA and DST, both of whom suggested mentorships could be a solution to addressing this gap. However, the DEA did recognise that whilst older employees had the desire to mentor, they did not always have a grasp of the newer qualifications and technological knowledge and adaptability of their younger cohorts. There is therefore an urgent need for those with digitalisation capacity and experience to meet future needs. It was noted on a number of occasions that the serious lack of succession planning for filling the 'missing middle' put the sector at a high risk of losing skills when people retire.
- Whilst it was recognised that youth are entering the sector, the need to introduce and attract many more young people to MPG was stressed. However, there is a disconnection between there being enough entering the sector and the need to employ more, with many respondents noting a lack of experience as a requirement challenge. Whilst not always explicit, this is often directly related to youth who have just entered formal employment and have not gathered adequate on-the-job training and practice. In addition to experience, a number of respondents noted a need for more

young and junior scientists to be encouraged into the sector as they bring 'new ideas'.

- A number of respondents noted that not enough black and coloured female candidates were available with the appropriate qualifications or skills, and therefore it was not always possible to meet transformation targets. Another issue raised with regards to employing more women in MPG was the issue of safety and security, in particular in compliance and enforcement occupations where it might be necessary to confront e.g., abalone gangs or illegal sand miners. It was therefore acknowledged that in some PMG roles women were more at risk than their male colleagues and might not be willing to be involved in these. SAPS, for example, noted that whilst they have a 50% male/ 50% female target, more men are in the Border Police Special Task Force than women. Similar comments were made by DAFF respondents with regards to employing women as FCOs.
- As can be seen from the employment data, no employees with disabilities were reported. However, it should be noted that the data focuses on specific occupations many of which are unsuitable especially for the disabled as work conditions can be extreme and harsh – for example, boat skippers and divers, compliance officers, observers on fishing boats.

4.4 Recognition of Prior Learning

The South African Qualifications Authority defines Recognition of Prior Learning (RPL) as "a process through which formal, non-formal and informal learning are measured, mediated for recognition across different contexts and certified against the requirements for credit, access, inclusion or advancement in the formal education and training system or workplace. (SAQA, 2013). The aim is to make it possible to obtain formal recognition for knowledge gained throughout life, such as in workplaces and own reading or experience. The RPL process also entails providing support to a candidate to ensure that knowledge is discovered and displayed in terms of a relevant qualification registered on the National Qualifications Framework (NQF)."

Although it can be applied in both training institutions and the workplace, the Online survey focused on the latter and drew a mixed response as follows: 1) Highly recognised and absolutely essential; 2) to a degree or when appropriate for a specific job; or 3) low or not at all. In categories (2) and (3) reasons often given were that scientific and technical skills were a requirement that could not easily be achieved through prior-learning/ experience; or training is regulated and competency-based. Some noted that it was recognised, but not formally or defined within policy. For those in category (1), prior-learning was often associated with having local knowledge (key for e.g., EMIs) or experience, which was considered very important for these respondents. In short, the potential for recognition of prior learning depended on the type of occupation.

The feedback from respondents also made it clear that whether it was recognised or not, many felt that their prior-learning and experience was a key factor in their ability to function in their current positions. An interesting example of how a department is drawing on prior learning is the case of the Eastern Cape's Conservation's Compliance and Enforcement Directorate, where many of the EMIs have either environmental degrees or diplomas, or police management diplomas. This mix means they can assist each other when implementing compliance and enforcement. In addition, and within the same Directorate the prosecution team draws on the experience of their current employees, for example one of the team was a Captain of Stock Theft in SAPS before he moved to the Directorate. In both these instances prior-learning is seen as a strength within the team, as diverse backgrounds complement each other. Recognising prior learning also illustrates the importance of diversity of background and how this can enhance a current individual or team's position within an organisation.

Recognition of Prior Learning (RPL) is applied in at least some of the universities in South Africa, although generally in a limited manner. CPUT, for example, practices RPL, but only against qualifications offered by CPUT. As a University of Technology, CPUT has three options for RPL or a combination thereof, namely: "access into first year", "exemptions – RPL" and "advanced standing into post diploma studies". At UCT, there is a special RPL admissions process which requires you to go through the faculty in which you want

to study. Since 2001, UWC has admitted over 600 students on the basis of RPL, many of whom have graduated with certificates, diplomas and degrees.

4.5 Projected future skills needs

It is generally recognised (OECD, 2014; Rosenberg et al., 2017) that it is not easy to determine actual job numbers, let alone estimate how many will be created in the future. Nevertheless, since one of the objectives of this study was to consider future skills demands, an attempt was made to get some insight into the potential growth in demand for MPG-related occupations for the next 5, 10 and 20 years. This was a challenge given that i) the employment data from StatsSA did not provide the level of detail required, and ii) the forecasting model in the DHET 21 Step Methodology process was not available – and the methodology itself proved unsuitable (See Section 3.5). Primary quantitative data on current employment numbers was therefore gathered directly from key departments/ agencies, as well as via interviews and the online survey. The latter also included questions related to future skills demands, while some information was also obtained from reports. Consideration was also given to including the predictions in the spreadsheet produced by the MPG Skills Working Group but on closer scrutiny it was clear that most of the numbers came from the Defence Force and were for 2017/18 (and as such are now out of date). The only other predictions were provided by NMU and were limited to their own needs 4 occupations (3 in Life Sciences and the other for MSP).

In terms of quantitative predictions, the returns were very low – probably a reflection of the difficulty of doing this. The information received is summarised in Appendix 6. In looking at the numbers, it needs to be noted that, in order to make some sense of them, the numbers in the "Current numbers employed" column reflect only those for the organisation/s that has provided the prediction. These numbers are therefore different than those in the same column of Appendix 5, where they reflect the numbers reported by all organisations. Thus, for Marine Biologists, Appendix 5 indicates a total of 11 employed (DEA, SANBI and SANParks combined), whereas Appendix 6 indicates only the 2 from SANBI, because only SANBI provided an estimate of future needs. It should be clear then, that the tables do NOT, provide a reflection of future occupational needs in relation to the whole of the MPG sector.

An additional challenge is that at present there is not a clear vision of where South Africa's ocean economy should be in the next 10, 20 or 50 years. This would require an in-depth assessment not only of the current status and future potential for South Africa, but also of likely developments at regional, continental and global levels and how these might affect South Africa's oceans-related economic potential. Such an assessment is beyond the scope of this project.

Although the quantitative information was limited, a significant amount of qualitative information was obtained through the Online survey, interviews and other documents. Of particular interest were inputs on potential drivers of the future demand for MPG skills. Some of the factors that could drive future demand for MPG skills include:

- Growth in the South African Shipping Register – an objective of Operation Phakisa, DoT and SAMSA. As of March 2017, South Africa had only four commercial ships on the register, but it is anticipated that with changes to the tax legislation and other incentives this will grow further. This will increase the demand for relevant compliance-based occupations.
- Growth in the South African ship-building industry is also an objective of Operation Phakisa and DoT and will similarly increase the demand for relevant compliance-based occupations.
- The development of the oceans economy together with the anticipated growth in ship-based trade globally, has led and will lead to an expansion of port facilities and services. This will drive the demand for port management skills, including those related to managing the environmental impacts of shipping.

- There are 23 existing Marine Protected Areas (MPAs), with plans for a further 22 new MPAs proposed under Operation Phakisa. Many of these are offshore and will increase the % cover of protected areas from 0.4 to 5% of the EEZ; and the % of habitats covered from 60 to 90%. These will increase the demand for MPA Managers and will also present new challenges in terms of technological skills related to compliance monitoring.
- A draft Marine Spatial Planning Bill was gazetted for comment in 2016, and a revised version thereof in 2017. This is undergoing further revisions and was planned to be submitted to the NCOP for consideration in April 2018. In addition, a National MSP Framework was gazetted in May 2017. As MSP is implemented, there will be a need for an increased number of people with MSP skills. Spatial planners will also be required to support coastal resilience initiatives and land-use decision-making (DEA & DP, 2015).
- Related to the initiatives around MPAs and MSP, it is anticipated that there will be an increased demand for GIS practitioners with skills in marine applications.
- The growth of populations in coastal towns and cities is likely to increase the need for coastal zone managers at local government level.
- Climate change: there is an increasing demand for employees having a broader understanding of weather patterns, climate, oceanography, coastal systems, storm water and estuaries and the impacts of climate change on marine ecosystems and the coastal zone. The latter includes the need to understand the impacts of e.g., sea level rise on local and regional development and to plan accordingly.
- The National Ocean and Coastal Water Quality Monitoring Programme under Operation Phakisa and the recent publication of the draft SA Marine Water Quality Monitoring and Reporting Strategy (DEA 2018) both point to the need for increased expertise in this field as the programme is rolled out.
- Sustainable use of living marine resources: It was proposed that there should be an increased role for scientific observers and researchers to monitor fish stocks and human interaction with marine resources.
- Increased exploration and use of mineral resources on the seabed: will lead to an increased demand for marine lawyers and compliance officers with specialist knowledge of seabed exploration and exploitation.
- Expansion of aquaculture: as proposed under Operation Phakisa will result in a greater need for aquatic veterinarians to monitor aquaculture facilities with a view to preventing the spread of exotic aquatic pests and diseases.
- Increased use of technology, new and emerging technologies: the increased use of and reliance on technology for compliance, monitoring and other purposes will increase the need for those skilled in e.g., remote sensing, detection and surveillance; aerial and satellite-based information systems; drone operation etc.
- The Ocean and Coastal Information Management System (OCIMS) which was developed by the CSIR under Operation Phakisa will need to be managed and maintained into the future by the DEA. This will require that they employ staff with the relevant skills.
- Increasing importance of the Oceans Economy might also enhance the need for improved Maritime Security including the use of more advanced technology for monitoring and surveillance.

Comments were also received on skills needs in relation to particular occupations and/or occupational clusters. These are summarised as follows:

i. *Management:* Strategic management (both in terms of individuals and skills) was highlighted as a continued future need. It was also noted that management officials need to be empowered to undertake their job functions, and as such require the necessary education - such as an up-to-date knowledge of changes in various legislation. This requires individuals at this level

who can bridge the gap between environmental management, business and industry in order to facilitate strategic change. The need for increased management capacity was also acknowledged in government's overarching Operation Phakisa strategy as an issue - particularly with regards to carrying out day-to-day operations and implementing the governance framework (SA Government, 2014).

ii. *Legal:* A number of respondents reiterated the continued and increasing need for lawyers specialising in fisheries crime, maritime, marine and environmental law, in particular those drafting new legislation on e.g., sustainable resource use and exploitation of ocean resources. An additional area of required expertise that was identified was for lawyers with an understanding of the regulatory requirements for the use of satellite technology.

iii. *Compliance & Enforcement:* Almost across the board respondents called for more compliance and enforcement officers on the ground. SAPS, for example, highlighted their need for an extra225 border police to effectively respond to incidents and monitor illegal activities. It was also noted that in the Eastern Cape there is a critical and immediate need for officials and inspectors to regulate illegal activities in coastal areas such as sand mining and the destruction of coastal forests. The Operation Phakisa Lab reports (SA Government, 2014) proposed 60 field rangers to monitor South Africa's 3 000km coastline (one field ranger for every 50km).

In addition to officers on the ground, there is a need for a much greater awareness of and commitment to prosecution of environmental offences. Officials in the justice system - including prosecutors, magistrates and judges - should be upskilled in relation to such offences and/or consideration should be given to re-establishing environmental courts.

Whilst not a specific reference to a future skill or demand need, it was noted on a few occasions that compliance and enforcement should progress from being reactive to being proactive. This issue was also highlighted in WWF-SA's State of Management of South Africa's Marine Protected Areas report (Duncan, Chadwick, & Tunley, 2014). Such a shift is likely to require a different focus or set of skills, that may not be held by current compliance and enforcement staff - such as negotiation with stakeholders, community education and research to underpin strategic focus.

Aside from occupational skills, a number of respondents also highlighted an increased future demand for softer skills such as advocacy, stakeholder engagement, people management, translation of scientific findings into policy and operational plans, and conflict resolution. It was also noted that officials representing the country at international and regional meetings which lead to the adoption of formal agreement and treaties need to have strong negotiation skills.

Whilst the focus above is very much from an implementation perspective, the skills of educators and trainers also need to be considered. In order to meet the demand, the universities, colleges and private training institutions need to have appropriate knowledge and educational skills to deliver courses which deliver the required skills to the employers.

4.6 The OFO

In reviewing the work previously undertaken by the MPG skills Working Group, it became evident that the OFO is reviewed every two years - with the most recent version being 2017. As a result, the list of scarce MPG occupations and associated OFO codes compiled by the MPG Skills Working Group is no longer

current. It also became apparent that some of the occupations identified during the project as critical and, in some cases, scarce, are no longer listed in OFO 2017. It was not possible to determine why they had been removed.

An updated list of occupations previously identified as scarce and/or new is attached as Appendix 7 and shows their current status as per the 2017 code. Recommendations on further changes to the OFO can be found in Section 8.7 and Appendix 10.

4.7 The role of SETAs in MPG skills development

The Skills Development Act (1998) states that the role of a Sector Education and Training Authority (SETA) is to: "Develop a sector skills plan to describe the trends in each sector, the skills that are in demand and to identify priorities for skills development." For the purposes of planning and managing the delivery of training, the economy has been divided into some 21 sectors, each of which has its own SETA.

A number of SETAs are of possible relevance to MPG-related occupations as shown in the table below, although it should be noted that lists of occupations per SETA were not available, so these are surmised.

Table 2: SETAs identified as having possible MPG relevance

SETA	Associated MPG Occupations
Agriculture SETA (AgriSETA)	- Conservation Officer - Meteorologist - Climate Change Scientist
Bank SETA (BANKSETA)	- Economist (Natural Marine Resource/ Fisheries) - Economist (Marine Environment)
Chemical Industry SETA (CHIETA)	- Chemist (Analytical/Laboratory Chemist) - Geologist (Petroleum/Mining/Exploration Geologist) - Marine Geologist - Air Pollution Analyst (Air Quality Technician) - Environmental Scientist - Laboratory Manager
Construction SETA (CETA)	- Urban & regional planners (environmental policy/ consent planner in coastal areas)
Culture, Arts, Tourism, Hospitality and Sport SETA (CATHSSETA)	- Park Ranger - Marine Biologist - Life Science/ Biological Technician - Environmental Technician - Physical Oceanographer - Marine Scientist - Oceanographer - Environmental Manager - MPA Manager
Energy and Water SETA (EWSETA)	- Water Quality Analyst (Water Quality Technician)

Media, Information & Communication TechnologiesSETA (MICTSETA)	- ICT Systems Analyst - Software Developer/ Programme Analyst/ Developer Programmer - Applications Programmer (Applications Developer/Integrator) - Database Designer & Administrator - Systems Administrators - ICT Technicians - GIS Technicians - Information Technology Manager - Application Development Manager
Public Services Education & Training SETA (PSETA)	- Managers in the Public Service
Safety and Security SETA(SASSETA)	- Marine Certification & Surveillance Manager - Customs Officer (Coast Watch Officer) - Detective (working in Marine Compliance) - Environmental Practices Inspector (EMI - Marine) - Quarantine Officer (Various Specialisations) - Fisheries Officer (Fisheries Control Officer) - Marine Monitoring Officers (e.g., Water Quality, FisheriesObservers) - Marine Law Enforcement Officers - Defence Force Senior Officer - Senior Police Officer - Military Manager, Commander, Warrant Officer - Attorneys (Marine/Environmental/Maritime Law) - Administrative Lawyer (Advisor/Analyst/Researcher)
Transport SETA (TETA)	- Ship's Surveyor (various specialisations) - Harbour Manager

One SETA plays a lead role or has a core MPG focus, with MPG-related occupations distributed throughout and repeated across those listed. Thus, many occupations may be relevant to, and or recognised, by more than one SETA.

What this Table clearly illustrates is that:

- There is no single SETA that plays a lead role or has an MPG - or even oceans economy - focus, with MPG-related occupations distributed across numerous SETAs. Moreover, some occupations may be relevant to, and or recognised, by more than one SETA. On the other hand, some may not be covered at all.
- As a consequence of the above, any dialogue that occurs on MPG-skills supply and demand needs to be carried out in collaboration with all those listed above, to prevent mixed-messaging or major critical or scarce skills gaps. A number of respondents noted that it would be useful to have a lead SETA or a forum for MPG-related SETAs; and
- There is no natural home for a number of the MPG occupations - for example, Life Science Professionals currently seem to fall under CATHSSETA.

5. ACADEMIC AND TRAINING INSTITUTIONS

A significant number of occupations in MPG - for example, managers, policy makers, scientists - require a high level of skills (i.e., post-graduate education), with the majority of the rest requiring medium level skills (i.e. tertiary education), even for entry-level positions. Only a few of the occupations in Compliance and Enforcement require just matric.

This section therefore provides information on what courses/ qualifications, which are of specific relevance to MPG, are available - predominantly in the country but also, in a few cases, internationally- in relation to the various occupation clusters. It also looks, where possible, at how many graduates are being produced annually (i.e., the capacity of the institutions to supply graduates with the required skills), and, to some extent, the suitability of the content of the courses/ qualifications i.e., are they producing graduates with the required skills.

Information is also provided on the NRF South African Research Chairs Initiative (SARChI) and Centres of Excellence, as well as SETA-funded research chairs.

5.1 SA university qualifications

Fifteen universities were identified as providers of undergraduate and post-graduate courses of potential relevance to MPG.[1] The Registrars of each of these universities were contacted with a view to obtaining enrolment and graduation data for each of these courses from 2016 to 2018. This information is summarised in Appendix 8 although it is noted that not all universities responded. The disciplines included in the Appendix are:

- Law (a)
- Life Sciences (b)
- Natural Resource Economics (c)
- Physical and Earth Sciences (d)
- Maritime Studies (e)
- Applied Mathematics and Statistics (f)
- Information Technology (g)
- Environmental Management (h) and
- Public Administration, Management and Governance (i).

In addition to those listed, the following courses will be starting in 2019:

- Applied Ocean Sciences (AOS) Master of Science hosted by the Marine Research Institute (Ma- Re) at the University of Cape Town.
- Nelson Mandela University recently approved an LLM in Ocean Governance which will start in 2019. The curriculum covers Law of the Sea, Marine Spatial Planning, Maritime Safety, Search and Rescue, and Maritime Security.

One of the points made by respondents to the Online survey was that over time, the most notable development was that there has been an increasing focus on post-graduate studies and specialisation. This means that there was an increasing pool of people with specialised MPG skills available to employers although it is noted that in many areas practical, on-the-job experience is also critical to the upskilling process.

[1] *NOTE: Courses were identified from publicly available material, as such the number of courses may not be a true reflection of total courses offered, as websites and information sources may not reflect all 2018 offerings.

5.2 SARChI and Centres of Excellence

The South African Research Chairs Initiative (SARChI) was established in 2006 by the Department of Science and Technology (DST) and funded through the National Research Foundation (NRF). SARChI is an intervention designed to attract and retain research and innovation excellence at South African universities. Since its inception, 199 research chairs have been awarded (NRF, 2017). Centres of Excellence, on the other hand, are research centres that concentrate existing research excellence, resources and capacity to enable researchers to collaborate across disciplines and institutions on long-term projects (NRF, 2018). They are also funded by the DST and NRF.

Research Chairs funded by other agencies - e.g., SETAs and DEA - seek to complement the work of theSARChI chairs. NSDS III has placed emphasis on the need for SETAs to establish high quality research capability in collaboration with external research partners such as universities and research institutions. SETAs also utilise the services of universities and research specialists, as they themselves are not specialist research institutions, yet require specialist research. As such, many SETAs fund and support research and innovation activities in various universities to increase sector research and innovation outputs and human capacity - such as, through SETA-funded academic chairs (DHET, 2017; Mzabalazo & REAL, 2017).

Table 3 below includes a list of Academic Chairs and Centres of Excellence which are of relevance to MPG.

Table 3: SARChI Chairs, Centres of Excellence and Research Chairs

SARChI Chairs	Institution	Relevant Project
Innovative Small Satellite Technology and Applications for Africa	Cape Peninsula University of Technology	• High Performance Pico-Nano-Micro satellites disaster monitoring, environmental and resources management, space science measurement and experiments.
Law of the Sea and Development in Africa	Nelson Mandela University (Prof.P.Vrancken)	• Legal developments affecting African coasts and maritime environment, incorporation of international law of the sea into domestic legal systems of African states and legal aspects of coastal and marine tourism.
Shallow Water Ecosystems	Nelson Mandela University	• Conservation and management of estuaries • Environmental flow requirements, ecological health & importance indices • Blue carbon ecosystems and responses to climate change • Salt marsh, mangroves, seagrasses • Ecophysiology of estuarine macrophytes • Water quality management and harmful algal blooms

Marine Spatial Planning	Nelson Mandela University (Prof. Mandy Lombard)	• Spatial and seasonal distribution of marinebiodiversity in coastal, benthic and pelagic environments • Evaluation of ecosystem service s and development of accounting techniques for marine environment • Evaluation of marine management strategies • Development of predictive spatial models of outcomes of drivers of change in the marineenvironment • Use of above to inform MSP policy and management
Marine Ecosystems & Resources	Rhodes University	• Understanding how marine ecosystems areinfluenced by modifications to the physical environment
Mathematical and Theoretical Physical Biosciences	Stellenbosch University	• Quantification of emerging ecological patterns.
Water Quality and Wastewater Management	Tshwane University of Technology	• Municipal water and wastewater treatment • Industrial wastewater treatment (bioremediation) and pollution preventionmeasures • Water hygiene and sanitation and water quality management • Water resources management and governance • Capacity building and technology transfer • Social acceptance factors and development of strategies for the adoption of appropriate technologies
Security and Justice	University of Cape Town	• Pioneering work on “environmental security" that responds to South Africa's vulnerability to global environmental change.
Climate Change	University of Cape Town	• Wind atlas for South Africa • Seasonal hydrological forecasting
Marine Ecology & Fisheries	University of Cape Town	• Implementation of the ecosystem approach tofisheries (EAF) in the Benguela large marine ecosystem • Adaptation to, climate change in marine social-ecological systems

International Development Law & African Economic Relations	University of Pretoria	• Reform of international financial governance and promoting socially and environmentally responsible infrastructure and extractive industry projects
Advanced Sensor Networks	University of Pretoria	• Application of advanced sensor networks to: ○ Transportation; ○ air pollution monitoring; ○ wastewater treatment & water quality monitoring; and ○ monitoring of animal migration patterns, detecting behavioural patterns etc.
Centres of Excellence		
Integrated Mineral and Energy Resource Analysis (CIMERA)	University of Johannesburg	
Mathematical and Statistical Sciences (MaSS)	University of the Witwatersrand	
Research Chairs		
Oceans Economy Chair (funded by DEA)	Cape Peninsula University of Technology (Prof. Ken Findlay)	
Arts, Culture & Heritage Conservation	CATHSSETA: University to be confirmed	

Sources: (IOL, 2017; NMMU, 2018; NRF, 2014, 2018; UCT, 2015; Wits, 2017)

An additional Research Chair in Petroleum Geosciences is in the process of being established. It will be funded mainly by SAIMI with support from TETA, CHIETA, and EWSETA.

5.3 TVET and other colleges

The majority of the scarce and critical occupations identified, require degree-level qualifications. The focus of the skills supply data was therefore on universities. However, it was recognised that both private and public colleges - such as Technical and Vocational Education and Training (TVET) colleges - offer some training which is relevant to MPG. Information on this is summarised below.

Courses offered by Technical and Vocational Education and Training Colleges (TVET) are vocational or occupational by nature, which means that students receive education or training for a specific range of jobs, employment or entrepreneurial possibilities. In total there are 56 public TVET colleges in South Africa which operate under the mandate of the DHET (DHET, 2018). Each region has a TVET college, however, for the purposes and focus of this study only colleges based in coastal regions were reviewed - a total of 15 colleges.

Whilst a diverse range of accredited courses are offered by the colleges, the following courses weredeemed of most relevance to MPG-related activities:

- National Certificate in Safety in Society: a three-year programme at NQF Level 2, 3 and 4. It is intended for people wishing to join the police, defence force, private security and National Intelligence Agency. This course could be of relevance to compliance and enforcement officers.
- National Certificate in Public Management: a one-year programme.
- National Diploma in Public Management: 18 months and 18 months practical experience.
- Nated/Report 191 in Public Management: 18 months and 18 months practical experience.
- National Certificate in Public Administration: a 1 or 3-year programme.
- National Certificate in Information Technology and Computer Science: three years full-time.
- National Certificates in Shipping & Logistics.

The colleges providing the above courses are listed in **Table 4** below.

TVET College	**National Certificate in Safety in Society (1)**	**National Nated Certificate in Public Man. (2)**	**National Diploma in Public Man. (2)**	**National (Report 191) In Public Man. (2)**	**National Certificate in Public Admin (3)**	**National Certificate in IT & Computer Science (4)**	**Shipping & Logistics Level 6 (6)**	**Shipping & Logistics Level 6 (7)**
Buffalo City TVET College	X	X				X		
East Cape Midlands TVET College	X							
King Sabata Dalindyebo TVET College	X				X			
Port Elizabeth TVET College	X				X	X		
Mnambithi TVET College	X			X		X		
Thekwini TVET College (FET)	X		X			X	X	X
Boland TVET College	X					X		
False Bay TVET College	X	X				X		
Northlink TVET College	X		X					
South Cape TVET College	X					X		
Lovedale TVET College			X			X		
uMfolozi TVET College			X			X		
Umgungundlovu TVET College			X					
Coastal KZN College				X		X		
Mthashana College				X				

NOTES:

[1) Includes vocational subjects e.g., governance, criminal law and procedure, criminal justice system, policing practice, criminal justice structures and mandates, law procedures and evidence, and criminology

[2) Includes e.g., management communication, public administration

[3) Includes e.g., management communication, public administration, and public law

[4) Includes e.g., systems development, information systems, system analysis and design, computer programming, data communication and networking

[6) Includes e.g., the movement of dangerous goods, overseas trade law

[7) Includes e.g., advanced shipping law, maritime safety and security, international maritime transport system

Given the issue of the 'missing middle' voiced by a number of respondents, and management skills also cited as scarce and critical, the management courses offered by the listed TVET colleges could provide a suitable option and/ or solution for those seeking to enhance their management skills or provide an opportunity for those wanting to move into management positions - something which is much needed.

None of the TVET colleges offer conservation courses. However, these are offered in some private colleges as listed below.

College	Higher Certificate in Nature Conservation: Implementation & Leadership [1]	Advanced Certificate in Nature Conservation: Trans frontier Conservation Management (2)	Field Ranger Course (3)	Security Rangers Law Enforcement(4)
Southern African Wildlife College	X	X		
The Nature College			X	X

NOTES:

[1] 1-year. Includes learning to enforce conservation compliance in own operational area.

[2] 1-year. Includes learning to develop and implement conservation plans.

[3] 6 months.

[4] 1.2 months. Includes conservation guardianship, identify and monitor local wildlife, rifle proficiency.

With respect to articulation between TVET and universities, the DHET recently gazetted an Articulation Policy for the Post School Education and Training system in South Africa (Republic of South Africa [RSA], 2017) which creates an enabling environment to ensure *inter alia* that:

- articulation occurs within and between the three NQF Sub-Frameworks;
- institutions work together to develop learning and work pathways; and
- support is provided for learners as they follow their individual learning and work pathways.

A National Articulation Baseline Study published by SAQA in 2017 found that all of the TVET colleges reported engagement in some articulation activities, while over two thirds of public HEIs did so. However, the situation is quite complex in that there was various forms of articulation, and there was insufficient information available to get an insight into whether current articulation activities are applicable to MPG-related training.

5.4 Seafarer training

There are a variety of career options open to seafarers from Ordinary Seamen to Cadets, to Deck or Engineering Officers, to Chief Navigating Officers and to the Master of a ship. Cadets aspiring to become officers must first complete initially a Certificate in Maritime Studies and later a National Diploma in Maritime Studies and then a Higher Diploma in Maritime Studies. In between each of these steps, they are also required to join a shipping company and complete a 12-month sea service training period.
In addition, seafarers are required to obtain Certificates of Competency through SAMSA. This is coordinated through the Centre for Seafarers which includes the Office of the Chief Examiner as well as the Certification Office. These two offices are responsible for the education, training, assessment and

certification of seafarers to ensure that they are compliant with international and local standards, namely the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW Convention), and the Merchant Shipping (Safe Manning, Training and Certification) Regulations 2013, as amended (the Regulations).

The major stumbling block to seafarer training in South Africa has been the lack of opportunities to complete the required sea-time experience. In an effort to address this, SAMSA purchased the vessel SA Agulhas to use for training purposes and this has been used for preliminary training of cadets on the National Cadet Programme. However, while three months of such training can be recognised, in order to maintain IMO standards, the remainder has to be on board a commercial trading vessel.

5.5 Port Management

The Transnet Maritime School of Excellence is an accredited training institution of the South African Maritime Safety Authority (SAMSA) and the Transport Education and Training Authority (TETA). It provides training in the Port and Maritime sector including Marine and Terminal Operations, Port Management and Port Engineering. The training includes practical activities using advanced training aids and state-of-the-art full mission simulators which teaches students to manoeuvre ships, tugboats and terminal-related equipment and machinery.

While the training is primarily aimed at meeting Transnet's internal skills demands, it does provide training for external customers, as well as research and development services to the broader maritime industry.

5.6 Environmental Management Inspector (EMI) training

Between 2006 and 2011 the basic training courses for Environmental Management Inspectors (EMIs) were developed and presented with the support of tertiary education institutions, namely, UP, UNISA and CPUT. However, since 2012 the EMI training has been presented in-house by DEA. The training comprises basic and specialised training:

- Environmental Management Inspector Basic Training; and
- Environmental Management Inspector Specialised/ Advanced Training.

The EMI Basic Training is a mandatory legislative requirement for the officials to be eligible for designation as EMIs and undertake compliance and enforcement of the NEMA and the SEMAs (including NEM: ICMA). The EMI Advanced/ Specialised Training Courses seek to build on the foundational skills and knowledge delivered through the basic training to develop skills at a more advanced or specialised level. The EMI basic training course includes general principles of compliance and enforcement and only includes limited material that is specific to marine protection and oceans governance - such as references to NEM:ICMA.

The basic training comprises a 3-week contact session as well as a pre-training assignment, while the advanced course is a 3-week contact session. The department is also in the process of piloting E-Learning as a new modality to introduce into both courses.

Recipients of the training include officials from all relevant organs of state including national institutions (DEA, SANParks, SANBI, lsimangaliso WPA), provincial environmental authorities and parks boards and local authorities. To be eligible for the EMI Training a person:

- must be employed within an organ of State;
- must have a minimum % of their job descriptions allocated to compliance and enforcement;
- must have been employed for a minimum number of years.

About 100 officials receive the basic training annually while between 60 and 90 complete the advanced training.

5.7 International qualifications

Whilst the focus of this study is on South African institutions, a number of respondents also referenced international qualifications they or their staff had undertaken. Those of particular interest include:

i) World Maritime University (WMU)

The World Maritime University in Malmo, Sweden, is a postgraduate maritime university founded in 1983 by the International Maritime Organisation, a specialised agency of the United Nations. The primary objective of WMU is to build the capacity of member states to meet their obligations under the IMO conventions, laws and policies. They offer a number of MSc.-level qualifications which focus on marine protection and ocean governance.[2] The most recent of these (2017) is Ocean Sustainability, Governance & Management. Other specialisations include:

- Maritime Safety
- Environmental Administration
- Maritime law & policy

DoT/ SAMSA and TETA have an institutional agreement with WMU, and over the past few years have regularly sponsored students to attend their courses.

ii) Fisheries Management

There are various universities internationally which offer courses in Fisheries Management, including:

- The School of Aquatic and Fishery Sciences (SAFS) at the University of Washington, Seattle, USA, offers a number of post-graduate courses in the field of fisheries management;
- There is a Masters level course in Fisheries Management at Hull University in the UK;
- The International Fisheries Management (IFM) programme in Tromso, Norway, is a unique, interdisciplinary Masters programme which opens careers in the private and public sector, as well as further academic studies; and
- Masters in Fisheries Biology and Management in Bergen, Norway.

iii) Postgraduate courses in Marine Spatial Planning

There are a number of universities international which offer Masters level courses in MSP. Examples include:

- A Masters-level degree in Marine Studies (Marine Spatial Planning and Management) which is offered at the Fisheries and Marine Institute of Memorial University of Newfoundland in Canada; and

[2] https://www.wmu.se/docs/academic-handbook

- A Masters-level degree in Marine Planning and Management which is offered at Liverpool

University in the UK.

iv) Postgraduate course in Aquatic Veterinary Studies

A Masters in Aquatic Veterinary Studies is available at Stirling University in Scotland. It provides trainingfor the investigation, prevention and control of aquatic animal diseases.

5.8 Suitability of existing qualifications/training

While there are a few examples of MPG-related skills for which there is a lack of appropriate training in South Africa, in general, there is a wide range of qualifications/courses available. However, a few respondents have raised concerns regarding the suitability of at least some of these qualifications and/or training in relation to the requirements of the employers.

An obvious example of this is that qualified attorneys do not necessarily have any training in legal drafting. Other concerns were that marine/environmental law qualifications do not necessarily provide sufficient knowledge about the relevant international law and do not adequately cover the law on Integrated Coastal Management.

With regard to course content, over 55% of respondents to the Online survey noted they kept up to date via academic publications to inform curricular, with academic conferences contributing 14% to respondent's knowledge acquisition. The survey also suggested that many of the qualifications offered have been running for 10 years or more (36% of respondents). A further 27% have been running for only 2-5 years (27%) and 18% less than 2 years. Despite the fact that the reasons given for running the courses were split equally between government incentives and industry demand, it is suggested that perhaps there is a need for training institutions to update especially the older courses in collaborationwith government and other employers to ensure that graduates have the required skills.

Some respondents also noted the need to move away from outdated disciplines and academically-orientated approaches and for courses to be more orientated towards problem-solving. Recommendations to resolve this situation include a more targeted funding approach by government, andincreased investment from the private sector.

Another key issue cited by academics was the compartmentalised nature of academia, which doesn't adequately allow for departments to collaborate effectively. This is a particular concern in the MPG sector where there is an increasing need for people to be multi-skilled and it was interesting to note that some institutions have introduced qualifications in marine science which cover a range of disciplines. In addition, Nelson Mandela University established an Ocean Sciences Campus which, amongst others, will pioneer transdisciplinary, postgraduate ocean sciences research, teaching, innovation and engagement.

6. TRAINING AND UPSKILLING OPPORTUNITIES

While 33% of respondents to the Online survey noted that formal education was the predominant form of education for those working within their organisations, it was also apparent that in-house private training (14%) and on-the-job training (19%) was also important as a means for upskilling current employees. In addition, upskilling can be accomplished through a variety of short courses provided by universities, research institutions, and NGOs.

6.1 Short courses

A variety of short courses are available at universities and colleges, with others being presented by NGO's such as IOI-SA, WWF and WIOMSA. They offer upskilling opportunities in the following areas:

- Information technology;
- Compliance and enforcement;
- Legal skills;
- Environmental management; and
- Policy development and management.

Relevant short courses available are listed in Appendix 9.

In addition, the nine residential centres and a distance training option of the Law Society of South Africa provide vocational training for candidate attorneys to acquire the practical skills to become effective practitioners:
http://www.lssalead.org.za/

A more extensive list of training opportunities can be found via the following link: https://meam.openchannels.org/trainings

6.2 Workplace based learning

Workplace-based learning (also often referred to as work-based learning, on-the-job training or work-integrated learning) covers opportunities within the place of work when employees are provided with upskilling that directly relates to their current post. In some instances, the training is provided off-site (a theoretical component) with applied (practical *in situ* elements) components undertaken in the place of work, or internal or external training providers present training on-site. It excludes full-time or part-time formal academic qualifications funded by the employee or through bursaries as these do not have a workplace-based learning element.

Workplace-based learning comes in many forms such as:

- Part-time or one-off training or short-courses offered in-house or externally (but with a workplace-base component). Training providers can be private or in-house trainers employed by the place of work;
- Mentorships - this can be provided by current employees, retirees or mentors external to the organisations; and
- Internships (which can be components of learnerships) - internships provide an opportunity for workplace-based experience and is often taken up by those entering the world of work. Often internships will have a mentoring component. SETAs do and could play a particularly strong role as they are funded through the Skills Development Levy to fund mostly workplace-based learning programmes - as the levy is received from their sectoral members who include industry and business within their specific sectors (DHET, 2017).

The time allocated to workplace-based learning is recognised by the employer, with costs (financial and/ or time) often covered by the employer. In many instances the courses or mentorship programme will be predetermined and requested for approval through HR. Since the course is approved by the employer, the employee is also given approved time to undertake the course. Examples of workplace-based learning provided by respondents and identified via the research are summarised in Table 5.

Table 5: Examples of work-placed based learning

Part-time/ one-off Training or Short Courses *It should be noted that it is likely that many of the short courses identified previously will have a workplace-based component.*	
Occupational cluster	**Example**
Compliance & Enforcement Officers	- In-house FCO and Skipper training - In-house EMI training provided by DEA - In-house Crime Scene Management provided by DEA - In-house SAPS Special Task Force training e.g., waterborne/ swimming,how to scale vessels and Skippers Licence Training - accredited by SAMSA - Pre-sea training provided by SAMSA under Initiative 5
	- How to run Joint Operations - provided under Initiative 5 - FCO Taxonomic training
Life science professionals	- Marine Science SCUBA field course - provided by CAPE Research & Diver Development (RADD) - Marine Ecology & Research - provided by Wildlife & Ecological Investments, with certification provided by Project AWARE Coral ReefConservation
Managers (those dealing with marine protection & governance only)	- In-house IMO refresher courses - [How to ...] Mentors for the Environment - provided by WWF-SA
Mentorships	
Occupational cluster	**Example**
Compliance & Enforcement Officers	- Mentoring of new EMIs by retired employees in the Eastern Cape funded by TRAFFIC
Life science professionals	- Senior scientists supervise and mentor young scientists - DAFF Fisheries Research & Development
Internships	
Occupational cluster	**Example**
Information technology (marine applications)	- DSIDE internships - offered by DST
Life science professionals	- Research internships - provided by Sea Search
Various	- DEA internship programme - DAFF post-matric and 'Technikon' internships - WWF-SA graduate internships - CSIR internships (linked to OCIMS development).

The value highlighted by a number of respondents for undertaking workplace-based learning, which requires an element of learning by doing, is that this is often recognised as a good method for upskilling and gaining experience. Workplace-based learning also aligns to public and private organisations' work-skills plans (WSPs) or individual personal development plans. Whilst requests may be made through HR for training, financial constraints were cited as a common reason for not all training requests being approved e.g., for every 10 courses requested, only one may be approved.

Given the issue of the 'missing middle', a number of respondents recommended mentoring as a suitable mechanism for bridging this gap. However, this can be difficult when there is a small workforce. In addition, given that in-house capability and capacity was regularly cited by respondents as an issue, more relevant workplace-based learning could be a suitable mechanism for upskilling employees,

particularly in instances, for example, where requirements and laws change regularly.

7. GAPS IN TERMS OF SKILLS/QUALIFICATIONS/TRAINING

In this section, the critical occupations identified earlier in this report have been assessed against the available demand and supply data with a view to providing a basis for the interventions around qualifications which are described in Section 8. It should be noted that: i) there are significant gaps in the demand data and to a lesser extent, in the supply data; ii) the demand data has only been sourced from government departments/ agencies, whereas for a number of occupations there is also a significant demand from the private sector. The numbers therefore need to be treated with considerable circumspection although gaps which have been identified are, for the most part, supported by expert opinion.

7.1 Legal occupations and skills

The basic qualification for everyone in the legal profession is an LLB, with specialisation only taking place at post-graduate level. The fields of specialisation which are of relevance to MPG include:

- Maritime/Shipping Law
- Marine And Environmental Law
- Fisheries Law
- Space Law
- Criminal Law

7.1.1 Maritime/Shipping Law

In the public sector, attorneys with post-graduate qualifications in Maritime and/ or Shipping Law are likely to be employed by SAMSA and DoT. It is noted that, although the shipping law qualifications are in commercial law rather than public law, they do cover public law aspects such as pollution from ships (MARPOL Convention and domestic legislation)[3]. This is particularly important given that the domestic maritime legislation needs updating on a regular basis to ensure it is in line with international obligations under IMO Conventions.

Occupation	**Current demand**		**Predicted demand**	**Supply**	
	Dept/ agency	# of posts		Institution/Course	Average # of graduates
Attorney (Maritime/ Shipping law)	SAMSA	5	Likely to increase with growth in shipping register	UCT: Postgrad Dip in Shipping Law	
				Masters in Shipping Law	10 -15
	DoT	2[4]		UKZN: LLM in Maritime Law	3
	TOTAL	Min=7		TOTAL	Min= 13

[3] Bradfield, UCT. *Pers.comm.*

[4] Unconfirmed.

Based on the numbers available (see previous Table), it seems that the training institutions are producing sufficient graduates in maritime/ shipping law to meet the demand by government entities. However,

i) it was reported that a number of these graduates are from other parts of Africa; and ii) the private sector demand for attorneys with these specialisations is likely to be higher than that of government. There may well, therefore, be a shortage of qualified individuals available to work in government.

7.1.2 Marine and Environmental Law

Most environmental law is applicable to the marine environment. However, in addition to environmental laws, there are a number which are specific to marine areas - for example, the Integrated Coastal Management Act and the Marine Spatial Planning Bill/ Act. DEA (Oceans and Coasts) would most likely be the only public sector employer of environmental attorneys with specific marine law skills as those employed at DEA Head Office, or at provincial and local government level would not necessarily need those specialisations. Specific tasks under the MPG initiatives relate to the enhancement/ amendment of the Integrated Coastal Management Act, development of the Marine Spatial Planning Bill/ Act and gazetting of new Marine Protected Areas.

Occupation	**Current demand**		**Predicted demand**	**Supply**	
	Dept/agency	**# of posts**		**Institution/Course**	**Ave # of graduates**
Attorney (Marine/ Environmental)	DEA (O&C)	3[5]	6	UCT: Postgrad Dip in Marine & Environmental Law	1
	DEA	10[6]		UCT: Masters in Marine & Environmental Law	8
				UKZN LLM in Environmental Law	4
	TOTAL	**Min= 13**			**Min= 13**

Again, based on the limited numbers available, it seems likely that the training institutions are currently producing sufficient graduates in these specialisations to meet the demand by government entities. It is noted, however, that i) the UCT courses were not available in 2017 due to lack of staff capacity (but are available again from 2018); and ii) neither the UCT nor UKZN courses adequately cover Integrated Coastal Zone Management Law or Marine Spatial Planning. The UCT courses available include Principles of Environmental Law, International Environmental Law, Land Use Planning, Pollution Law, Natural Resources Law and International Law of the Sea. The UKZN LLM includes modules on Research Methodology, Land Use and Planning Law, Natural Resources Law and Pollution Control Law and may offer modules on Ocean and Coastal Law, Wildlife Law and International Environmental Law depending on circumstances and demand. Although Nelson Mandela University will be introducing a new qualification in Ocean Governance from 2019, it is not designed to fill this gap and although it will cover Marine Spatial Planning, it does not cover ICZM. In addition to MSP, it will cover Law of the Sea, Maritime Safety, Search and Rescue and Maritime Security. There is thus a significant gap with respect to ICZM Law. Moreover, in terms of numbers, in addition to government, environmental attorneys are also commonly employed in law firms which provide consulting services as well as environmental NGO's.

[5] Directorate: Law Reform and Appeals. In addition, Oceans and Coasts have another 3 lawyers who provide corporate support (contracts, legal opinions and review/advice on decisions when DEA is sued.)

[6] There are around 10 lawyers in Compliance and Enforcement in DEA (some in Cape Town, the majority in Pretoria) many of whom have qualifications in environmental law but undertake a range of legal tasks. Jacques du Toit, *pers.comm.*

7.1.3 Fisheries Law

The only department that employs - or is likely to employ - someone specialised in Fisheries Law is DAFF, and they are unlikely to employ more than one or two people in such an occupation. On the other hand, fisheries lawyers may also be employed in the private sector - for example by fishing companies and as consultants - and by NGO's with an interest in fisheries.

Fisheries lawyers should be familiar with:

- Fisheries management approaches for both industry and small-scale, artisanal fisheries (quotas, TURFS etc.);
- International regulatory framework;
- Regulation of aquaculture/ mariculture;
- Seafood safety standards; and
- Compliance and enforcement options.

At present there are no specific qualifications available in Fisheries Law in South Africa, although it is covered to some extent in undergraduate courses (as Marine Living Resources Law), and in the post-graduate Diploma and LLM (under Natural Resources Law) at UCT. Given the small number of potential employment opportunities for this occupation, this is probably sufficient although it may be useful to review the specific content of the existing courses to ensure they cover all the required information.

7.1.4 Space Law

Initiative 6 of the Operation Phakisa: MPG component involves the use of satellites, remote sensing etc. for earth observations and other monitoring with DST and the South African National Space Agency (SANSA) being responsible for the provision of satellite imagery. Since the use of space is regulated through international conventions and domestic law, there is a need for legal specialists in this field. There are currently two such specialists in the country[7] but should the programme expand, there may be a need for more.

The only available training in this field appears to be a 10-day course offered by Enterprises University of Pretoria. The course planned for 2018 will focus on the legal framework pertaining to air, space and telecommunications, including the relevant international treaties and their application within the South African context.

7.1.5 Criminal Law, compliance and enforcement

Although an understanding of Criminal Law is important, there is not necessarily a need for Criminal Law specialists to be employed in the main MPG departments. In any event, the prosecution of environmental and other MPG-related crimes requires a technical understanding of the crime itself - something which criminal lawyers are unlikely to have. Moreover, criminal law and procedure is covered in all LLB qualifications while more advanced skills can be obtained through upskilling and on-the-job experience. The enforcement of these laws may only require administrative actions - such as the issuing of notices or directives - and at national level, even where environmental crimes have been committed, this is handled in-house by DEA lawyers, many of whom are specialists in environmental Law rather than Criminal Law. DAFF, in contrast, does not deal directly with offences in terms of the MLRA, but submits them to SAPS for further investigation.

[7] Interview with Lerato Dube, DST.

There are a number of universities which offer post-graduate courses in Criminal Law, including LLMs in Criminal Justice (Nelson Mandela University); Criminal Law (UoFS); Criminal Law and Criminal Procedure

(NWU, UNISA); and Advanced Criminal Justice (UKZN). However, Criminal Law is wide-ranging, and what is more important is the application of Criminal Law and procedure to environmental and fisheries-related crimes. The EMI training provides the required skills in relation to NEMA and the SEMA's, with the result that some of the provinces are also in a position to investigate and submit cases of environmental offences for prosecution. However, the EMI training only covers marine and coastal issues to a limited extent.

Moreover:

- Although the EMI basic and specialised training courses provide practical knowledge and skills, the courses, presenters and evaluators are not SAQA-accredited; and
- The capacity of the EMI training unit at DEA is limited and it may not be able to meet the demand.

It is noted, however, that DEA are in the process of undertaking a feasibility study into the creation of an EMI Training Academy that may be able to address these issues.

Programmes on the prosecution of environmental crimes are provided for prosecutors at the National Prosecuting Authority (NPA) through Justice College, which is linked to the Department of Justice. However, it is likely that these also do not adequately cover marine and coastal issues.

In relation to fisheries crime, the FishForce Academy at Nelson Mandela University is promoting Fisheries Crime Law Enforcement as a viable career path with the development of short courses and formal qualifications. For example, the Nelson Mandela University Diploma in Law Enforcement specialises in Fisheries Crime. In addition, the Higher Certificate in Criminal Justice was originally developed to serve a variety of needs, mostly within local government, but it has been extended to include fisheries crime. FishForce short courses include:

- Law for Fishery Control Officers
- Detection & Monitoring of Fisheries Transgressions
- Crime Scene Management & Investigative Support in Fisheries Crime
- Species Identification & Fisheries Technology
- Conducting Advanced Investigation s in Fisheries Crime
- Advanced Forensic Investigations in Fisheries Crime
- Fisheries Trade Monitoring & Compliance

FishForce also runs a helpdesk, the aim of which is to provide advice to people who formed part of the training and who require further assistance while at a crime scene or while doing an investigation. It will also provide advice on how to improve prosecutions. The helpdesk therefore provides an opportunity to obtain expert guidance and advice in "real-time".

FishForce is a relatively new initiative, and the adequacy thereof will need to be assessed in a few years. However, it has been widely welcomed by most of the relevant government agencies.

7.1.6 Soft skills

In addition to the need to upskill attorneys employed in government agencies in specific technical skills, concerns have been raised regarding the adequacy of their "softer" skills for government posts - in particular, the need to undertake legal analysis and to draft legislation and other formal documents. What this study has revealed is that there are short courses in legal drafting available in the country. There are, therefore, opportunities for upskilling of new recruits into the legal services divisions of the relevant

departments.

7.2 Marine Spatial Planners

Marine Spatial Planning (MSP) is a new field in South Africa, and it is unlikely that anyone in the country can be considered as fully trained in this occupation. Nevertheless, there are a number of employees at DEA who are responsible for Initiative 10 which is tasked with developing MSP in the country. To date, this has included the publishing of an MSP Bill as well as an MSP Framework.

There are, at this stage, no registered university courses in MSP. However, at least some of the DEA staff- and others - have attended some short, project-funded courses in the region (e.g., GEF projects such as BCLME and SAPPHIRE). In addition, the IOI-SA Ocean Governance course includes a section on MSP and IOI-SA is considering running a separate MSP course in future in collaboration with a German-based initiative called Blue Solutions. Nelson Mandela University has a SARChI Chair in MSP (Prof. Lombard) and was going to develop a Masters course, but there was no agreement on the approach and funding has fallen away. Prof. Lombard does, however, have a number of students doing research on MSP primarily in relation to conservation planning. They are also doing a case study in Algoa Bay. In addition, Prof Vrancken (also from Nelson Mandela University) has a student working on the legal aspects of MSP.

7.3 Marine Geologists

There are many qualifications available in geology as a whole, but opportunities for specialisation in Marine Geology are seemingly limited to those at UKZN as shown in the table below. In this case, modules in Marine Geology are also included at undergraduate level. It is noted though, that Marine Geology is just one specialisation of a Geologist (as per OFO). Others include Petroleum Geologist, Exploration Geologist, Geological Oceanographer and Environmental Geologist, all of which are relevant to MPG although most are more important in the context of offshore mining. Marine Geology is important in terms of environmental protection where natural coastal processes are disrupted as a consequence of the development of coastal settlements and related infrastructure.

It is understood that there are only 3 marine geologists in the country - one at UKZN, one at the Council for Geoscience and one retired - although it is likely that others are employed in consulting firms or the offshore mining sector. However, this occupation is regarded as important for marine spatial planning purposes, amongst others, and demand is therefore predicted to grow in the future.

Occupation	**Current demand**		**Predicted demand**	**Supply**	
	Dept / agency	**# of posts**		**Institution / Course**	**Ave # of graduates**
Marine Geologist	Council for GeoScience	1	10 (5 yrs), 50 (10 yrs), 100 (20 yrs)[8]	UKZN: BSc Hons in Marine Geology	4
				MSc & PhD - research degrees	3
	TOTAL	**Min=I**		**TOTAL**	**4 Hons level**

[8] Predictions provided by Prof. Andrew Green, UKZN.

7.4 Water Quality Analysts

The EW SETA Sector Skills Plan 2017 - 2022 identified occupation 213306 Water Quality Analyst as one of the top 10 scarce skills for the sector. The planned Intervention was to provide some 100 bursaries for studies in engineering and water sciences: NQF Level: 7. Although this intervention was likely directed at fresh water, it should be noted that the analysis of seawater is far more complex than that of fresh water. Laboratories undertaking seawater analysis need to understand the procedures which involve the use of reference materials and duplicate samples in order to ensure that their analyses are accurate. They should also be accredited.

There are relatively few labs in the country that meet these criteria. Those that do, include the CSIR and some of the larger municipalities - such as City of Cape Town - which undertake water quality monitoring at various coastal sites such as estuaries and beaches which are used for recreational purposes.

In addition, it should be noted that even when pollutants in coastal waters are quite low, they tend to accumulate both in sediments and in biota - particularly the tissues of filter-feeding species (e.g., mussels and oysters) and those at the top of the food chain. It is therefore important that coastal monitoring programmes also sample and analyse sediments and some indicator species.

A National Pollution Laboratory to service the National Coastal Water Quality Monitoring Programme being established under Initiative 7: MPG has been established at Walter Sisulu University in Mthatha. Given the central role of this laboratory in ensuring coastal water quality is maintained, it is critical to ensure that there are sufficient, properly trained Water Quality Analysts. At present, there is a Laboratory Manager and three technicians, but the National Pollution Laboratory is eventually expected to have the following staff complement:

- **For chemical analyses**: 2x Senior Technicians, 1x Technician, 1x Junior Technician & x1 intern;
- **For microbiological analyses**: 2x Senior Technicians, 1x Technician, 1x Junior Technician & 1x intern;
- **Field (sampling):** 1x Senior Technician, 3x Technicians (1x micro, 1x chem & 1x biol).

In terms of qualifications, courses in Chemistry, Microbiology and Environmental Management are widely available so there are many candidates who could potentially be upskilled to become Water Quality Analysts. There are some short courses in water quality analysis and monitoring (University of Pretoria) but these likely focus on freshwater. In addition, the CPUT National Diploma in Marine Science has a component on marine pollution which includes practical sampling and analysis of seawater. However, there are currently no training courses specifically aimed at seawater analysis and the CPUT course is unlikely to provide the level of skill required. There is therefore a need for a new course focused on the analysis of seawater (and associated pollutants) and/or internships or mentoring.

7.5 Fisheries-related occupations

In the OFO, Fisheries Scientists are not listed as a separate occupation but as a specialisation of a Marine Biologist. However, it is proposed that this be considered as an occupation in its own right because Fisheries Scientists are not just biologists with an interest in fish (and other living marine resources) but should also have statistical/modelling skills in order to provide living marine resource assessments and management advice aimed at ensuring sustainable use thereof. In addition, there is a need for Fisheries Economists (Natural Resource Economists), Social Scientists with knowledge of fishing communities, and Fisheries Managers, who should have a broad understanding of the social, economic and legal aspects of fisheries management i.e., a multi-disciplinary occupation.

Fisheries Scientists are mainly employed at DAFF as well as various academic and research institutions such as the South African Institute of Aquatic Biodiversity. In addition, they are likely to be employed in the

private sector by fishing and/ or mariculture companies.

Training in Fisheries Biology/Science is available at Rhodes and UCT, with research at UCT including the Ecosystem Approach to Fisheries (EAF) Management and Ecological Modelling. WWF-SA also runs a short course in Responsible Fisheries Management which promotes the Ecosystem Approach. However, it was reported that there are few individuals that have both the fisheries biology and mathematical skills to provide accurate resource assessments and management advice. This could potentially be addressed by introducing a Masters-level course covering both of these aspects as well as the EcosystemApproach.

It appears that DAFF does not employ a Fisheries/ Natural Resource Economist and it was noted that "there are no real prospects for fisheries economists in South Africa". This is a situation which should be addressed, as such an occupation could make a valuable contribution to improving fisheries management and is also important in the context of Marine Spatial Planning. Masters-level courses in Natural Resource Economics are available at UCT, UKZN, with UCT having a particular focus on fisheries.

Occupation	Current demand		Predicted demand	Supply	
	Dept / agency	# of posts[9]		Institution / Course	Ave # of graduates
Fisheries Scientist	DAFF	10		Rhodes: BSc (Hons) in Ichthyology & Fisheries	12
	SAIAB	5		UCT: BSc in Marine Biology[10]	26
	UCT (MARAM)	5			
	TOTAL	**20**		**TOTAL**	**38**

The social aspects of fisheries are increasingly important with greater emphasis being placed on the concept of sustainable livelihoods and small-scale fisheries. There does not seem to be any specifictraining in this field although broader social-science applications and research methods would be covered in courses such as Environmental Education, Anthropology and Sociology. There are also no courses available locally for Fisheries Managers who should have a broad, cross-disciplinary understanding of fisheries issues.

7.6 Aquatic Veterinarians

Veterinarians with an understanding of aquatic diseases and pests are becoming increasingly important in the regulation of the aquaculture industry. DAFF currently employs at least 2 people with training in this field. However, at present there is no training available in SA and DAFF have been sending people abroad.

7.7 Shipping-related compliance officers

Naval Architects are employed by SAMSA to ensure that new and existing vessels in South Africa comply with regulations on design and construction.

[9] With the exception of MARAM at UCT, these are estimates as no data was provided.

[10] Third year includes module on Marine Resources and includes some coverage of the human aspect s as well as anintroduction to modelling.

Ideally, SAMSA requires one in each port although at present there are only two Naval Architects in the country. Should the shipbuilding industry and the South African ships registerexpand in line with Operation Phakisa's targets, it is likely that additional posts will be required. There are currently no qualifications available for Naval Architects in South Africa, although some courses are offered as part of undergraduate

degrees in Mechanical Engineering (B. Mech Eng or B.Sc. Mech Eng) at Stellenbosch and Marine Engineering at Nelson Mandela University. Many of the current South African Naval Architects in fact completed their B. Mech/Marine Eng at the University of Stellenbosch, and then did either an MSc. Nav Arch, or M.Sc. Marine Eng at University College London (http://www.triton.co.za/). This has long beenrecognised as a significant gap.

Ship Surveyors are also employed by SAMSA to undertake Port State control which includes inspecting foreign vessels visiting South African ports to assess their compliance with IMO Conventions related to ship safety and environmental protection. SAMSA has 54 such posts, the majority of which are filled. However, it is understood that some incumbents do not have the preferred level of qualification due to a shortage of suitably qualified individuals. This could be exacerbated in future if the anticipated growth in ship-borne trade materialises.

Ship Surveyors would normally be qualified seafarers - with qualifications in Maritime Studies which are available at DUT and CPUT as well as Certificates of Competency which are issued by SAMSA and whichalso require that they have had a minimum of 3 years of maritime working experience. The shortage is primarily due to the fact that opportunities to get experience at sea are limited in South Africa. This is being addressed through a number of other initiatives, including the use of the SA Agulhas as a training vessel.

7.8 Information Technology and GIS Practitioners

Information Technology practitioners are important for all government departments/ agencies, but they have a specific and critical role to play in some of the MPG Initiatives - in particular Initiative 6: National Ocean and Coastal Information and Earth Observation Capabilities - as well as Initiatives 8, 9 and 10 which address the establishment of new MPAs and Marine Spatial Planning.

Information Technology qualifications are widely available and, in most applications, do not need specific marine training. However, one area which has been identified as requiring specific marine training is Geographical Information Systems (GIS). The table below suggests that adequate numbers of people are being trained in GIS in general, but it is notable that NONE of the courses currently address marine applications and the few people in the country that have these skills have been self-taught on-the-job. The demand for Marine GIS technicians will depend to some extent on the manner in which MSP is implemented. If plans are developed only at national level, the demand might be limited whereas if it is extended to the local level, the demand might be more substantial. Moreover, there is also likely to be a demand in those sectors affected by MSP e.g., oil and gas, offshore mining and fisheries.

Occupation	Current demand		Predicted demand	Supply	
	Dept/ agency	# of posts		Institution/ Course	Ave # of graduates
GIS technician (Marine)	DEA	1	3	NMU: BSc Hons in GIS	9
	Ezemvelo KZN Wildlife	1		Stellenbosch: BSc Hons in Geoinformatics	8
	SANBI	0	1	UCT: BSc in Geoinformatics	3
				BSc Hons in GIS	6
	Other?		10 - 20?	U Pretoria: BSc Hons in Geoinformatics	17
				UP: MSc Geoinformatics	4
				UP: PhD Geoinformatics	3
				UKZN: BSc GIS and Earth Observation	?

				U Fort Hare: BSc Hons in Applied Remote Sensing & GIS	?
				Fort Hare: MSc in Applied Remote Sensing & GIS	?
	TOTAL	**2**	**15 - 20**	**TOTAL**	**Min. 40 graduates at Hons level**

NOTE: None of the courses specifically address marine applications

7.9 Upskilling for managers

Historically many scientists who entered government to do research ultimately ended up in management positions and although the concept of Specialist Scientists was introduced to address career path concerns, even today many MPG Managers started off as Biologists and need upskilling to enable them to be effective managers. Additional skills that should be required of someone to move from a technical post to management level include:

- Basic management (staff, budget, etc.);
- Understanding of the legislation and policy making - managers need to be able to brief lawyers on what should go into the legislation; and
- Soft skills such as mentoring, liaison, consultation, negotiation, mediation and stakeholder engagement.

It is understood that since 2012 there has been a compulsory induction course for all public sector employees which covers many of the soft skills requirements, while those wanting to transition to management are strongly urged to attend relevant management courses of which there are many available. However, this requirement does not seem to be enforced - perhaps for practical reasons.

Nonetheless, there is a wide range of relevant qualifications and short courses as listed in Appendices 8 and 9 of this report.

CONCLUSIONS AND RECOMMENDATIONS

The primary objectives of this Skills Audit were to identify critical and scarce skills in the MPG sector and to formulate interventions aimed at growing the skills base to meet current and future demands. This proved to be a significant challenge given i) the lack of availability of adequate quantitative data on the demand for and supply of specific MPG skills; ii) the fact that many of the skills concerned are not limited to the MPG sector but are also in demand in other components of the oceans economy - including the private sector (an assessment of which was beyond the scope of this project); and iii) thefact that many individuals - particularly at provincial and local government level, but in some cases also at national level - have responsibilities which are broader than MPG alone. For example, those providing legal skills generally do so for the environmental sector as a whole rather than just MPG. Nevertheless, based primarily on the experience of those working in the sector, a number of gaps have been identified and interventions aimed at addressing these are outlined in Section 8.2 below.

In addition, the research undertaken unearthed a number of other issues which are of relevance to skills development in the sector. These related to the Organisational Framework for Occupations (OFO) itself, the structure of the SETA's in relation to MPG occupations, the lack of availability of sufficiently detailed

data at national level, the lack of a formal mechanism to convey government training needs to the academic and training institutions, and the apparent lack of succession planning in either government departments or training and research institutions. Recommendations have therefore also been made on these issues with a view of creating a framework which is more conducive to supporting skills analysis and development in MPG in the future.

8.1 Scarce skills, critical occupations and availability of posts

In general, it can be said that there is an **absolute scarcity** of skills in only a few MPG occupations and, in most cases interventions to address these gaps should be relatively straight forward. Proposals in this regard are made in Section 8.2.

On the other hand, for a number of the occupations, the conclusion is that while qualified individuals with the required skills are available, there are no posts - or insufficient posts - available to employ them. In some cases, this may be due to the fact that government does not recognise the value of such skills - for example, there appear to be no government posts at all for Marine Geologists or Natural Resource Economists, both of which could make valuable contributions to, for example, Marine Spatial Planning. In other cases, the lack of posts may be linked to the question of responsibility in terms of the Constitution - marine resources being a competence of national government. Thus, in some of the provinces coastal/oceans governance is not seen as a priority and is merged with other environmental responsibilities (i.e., terrestrial) rather than there being a specific Marine Directorate or Coastal Unit. This is problematic in that DEA, DAFF and DMR have limited capacity on the ground and need the support of the provinces and municipalities to be effective, particularly in compliance and enforcement.

Another key conclusion is that the entire cluster of **compliance and enforcement** occupations and skills should be regarded as being **critical** because scientific understanding of marine ecosystems and rules and regulations themselves are not sufficient to protect marine and coastal ecosystems. It is therefore of particular concern that on top of the lack of sufficient posts in compliance and enforcement, a number of posts have been frozen due to budget cuts. For example, in DAFF, 87 of the 270 FisheriesControl Officer posts have been frozen until 2023 despite the fact that illegal fishing is already a serious problem and is growing. Similar situations were also reported at provincial and local government level. This is short-sighted and fails to recognise the importance of compliance and enforcement to sustaining the use of marine resources and the oceans economy in general.

Recommendations:

- Government should revisit its complement of posts in relation to the skills required for MPG ingeneral, and especially in light of the imminent implementation of Marine Spatial Planning;
- Given the lack of adequate capacity of key national departments involved in MPG, the relationship between the various tiers of government in relation to MPG responsibilities should be revisited with a view to delegating additional implementation responsibilities to provinces and municipalities; and
- While OP:MPG Initiative 5 is improving co-operative governance in the compliance and enforcement area, there is also an urgent need to also facilitate access to additional funding to create and/ or fill the required permanent posts at all levels of government.

8.2 Occupation-related interventions

There are a variety of reasons why skilled and adequately trained personnel might be scarce in a particular field. These include:

- Although there may be many graduates with the required qualifications, they might not be

available to government because the private sector offers higher salaries;
- There may be a lack of awareness of career prospects in certain sectors of society with the result that there is a relative shortage in as much as those available do not meet equity criteria. This is known as Relative Scarcity;
- The qualifications that are available may not provide all the necessary skills (for example, there are many law graduates, but legal drafting is not a skill which is incorporated into basic qualifications). These are known as Top-up Skills;
- There may be new fields of work - for example, Marine Spatial Planning;
- The capacity of the institutions in the country may be insufficient to produce the required number of graduates; and
- The required qualifications are not available in the country (Absolute Scarcity).

Understanding these reasons is crucial to being able to formulate appropriate interventions.

8.2.1 Legal skills/occupations

Although there is not a shortage of attorneys in general - or even those with MPG-related post-graduate qualifications - there may be a Relative Scarcity and it is therefore recommended that in those cases where this is not already the case, elective or compulsory modules in maritime/ marine/ environmental law/ ocean governance be included in the final year of LLB to raise awareness of the sea career options.

A further recommendation is that appropriate post-graduate qualifications should be seen as compulsory for individuals employed in these occupations in government, especially those in senior positions. If necessary, conditional bursaries should be offered to new recruits - especially BEE candidates - to ensure that they receive the required upskilling and remain in government for a reasonable period of time following graduation. The possibility of internships in private law firms should also be investigated to assist young graduates in gaining experience.

With respect to qualifications, the content of some of the existing courses should be reviewed with a view to achieving a suitable balance between theoretical/ academic and practical content and to ensure they provide the knowledge and skills requirements of those implementing MPG. For example, marine and environmental LLM qualifications could be enhanced by including:
- material on the prosecution of environmental and natural resource crimes (i.e., a criminal law element);
- integrated coastal management law and marine spatial planning;
- compulsory modules on the relevant international regulatory framework; and
- additional material on fisheries law (see 7.1.3).

It is recommended that a workshop be held with relevant stakeholders to address these gaps.

In addition, legislative drafting courses should be reviewed in consultation with experienced practitioners to ensure that they cover both the design and how to write legislation. In terms of upskilling, there is a need to upskill a wide variety of people in the compliance and enforcement and justice system - from SAPS to DEA lawyers and NPA officials - in the marine and coastal aspects of Environmental Law. This can be achieved by including additional material into e.g., the EMI training and the programmes on the prosecution of environmental crimes provided through Justice College. It should be accompanied by information which increases the awareness of these officials of the value of marine and coastal resources to the country.

In addition, new recruits should be provided with opportunities for upskilling in related technical skills -

for example:

- Legal drafting
- Legal analysis
- Negotiation
- Conflict resolution

Upskilling in legal skills should also not be limited to those in the legal divisions of any department. Technical employees at more senior levels in government also need to be familiar with the policy-making process as well as the regulatory framework which they are expected to implement as they will be expected to draft policy and to advise the lawyers what technical issues need to be addressed in the legislation. This can be done through short courses (see Appendix 9) or in the form of qualifications such as the Post-Graduate Diploma in Marine and Environmental Law offered at UCT provided that the content of this is amended to include courses on ICZM and MSP.

8.2.2 Marine Spatial Planning

Given that an MSP Bill and MSP National Framework have already been gazetted, there is a critical need for individuals trained in this field. However, it is unlikely that the demand for specialist Marine Spatial Planners will be significant, at least in the short-term. Moreover, MSP is a process, following which the plans need to be implemented as part of overall coastal/ marine environmental management. It would therefore be better to provide MSP skills to people with qualifications in broader environmental/ marine/ coastal management.

Recommendations: on this basis, it is recommended that a multi-pronged approach be taken to addressing this gap. This should include:

i. the early incorporation of modules on MSP in Environmental Management and other relevant qualifications - including the "soft" skills required for MSP such as stakeholder consultation, negotiation and conflict resolution;
ii. in the longer term, to have a specific Masters-level qualification in MSP;
iii. in the interim, relevant DEA personnel could be supported to attend one of the international courses available (see Section 5.5); and
iv. the development of short courses in MSP for delivery within the country by NGO's and/or other training institutions.

It should be noted that MSP is a multi-disciplinary occupation and that the development of a qualification in MSP is likely to require cross-disciplinary co-operation in the training institutions. This is a challenge at present and it is therefore also recommended that a study be undertaken to investigate international approaches such as that used in Norway where they have set up a Generic Degree - i.e., one that is not specifically linked to any particular faculty/department. The study should also look at the content and structure of such qualifications.

8.2.3 Coastal water quality monitoring and analysis

It is recommended that a comprehensive short course be developed on coastal and marine environmental quality monitoring and analysis. It should cover both the procedural aspects as well as the actual analysis of seawater, sediments and animal tissues. In addition, the establishment of internships at existing accredited laboratories should be considered.

8.2.4 Fisheries Scientists/Managers

In the OFO, the occupation Fisheries Scientist is currently considered as a specialisation of Marine

Biologist. This is seen as inappropriate, and it is recommended that it be added as a new occupation specialising in Fisheries Biology and Stock Assessment (see Section 8.7 below for further details). However, the management of fisheries is a multi-disciplinary activity and, in addition to Fisheries Science, there is also a need for specialists in Fisheries Economics, Fisheries Social Science and Fisheries Law. It is therefore also recommended that consideration be given to adding these to the OFO as specialisations (in Economics, Social Science and Law) in addition to a second new fisheries-related occupation, namely a Fisheries Manager (with a management level OFO code). The latter would need to have a broad understanding of all the dimensions of fisheries.

Training for Fisheries Scientists is available at undergraduate level at both UCT and Rhodes, while Rhodes also offers a BSc Hons in Ichthyology and Fisheries Science. These include some material on the human aspects and stock assessment. Nevertheless, it is recommended that Masters-level qualifications in both Fisheries Science and Fisheries Management be introduced. The latter should include not only fisheries biology, stock assessment and modelling, but also fisheries economics, social aspects of fisheries, and the regulatory framework. As for the proposed MSP qualification, this would require cross-disciplinary co-operation in the relevant training institution/s.

8.2.5 Aquatic veterinary skills

It is recommended that additional content on aquatic veterinary problems and practices be included in the South African veterinary curriculum.

8.2.6 Compliance and Enforcement: Maritime Sector

In the Maritime sub-component of MPG there is currently a shortage of Naval Architects, Ship Surveyors/Principal Officers and Harbour Masters for small/fishing harbours. Moreover, the demand for people in these occupations is likely to grow in light of the initiatives under Operation Phakisa to grow the SA Shipping Register and the ship-building industry. The National Programme: "The Small Harbours and State Coastal Property Development project" which includes plans around 50 potential and unproclaimed harbours (in addition to the existing 12 proclaimed fishing harbours) will also contribute to future demand.

The shortage of Naval Architects is related to the lack of training opportunities in South Africa. It is understood that this is being addressed through other channels[11]. The shortage of Ship Surveyors is primarily due to the fact that, in addition to having the required Seafarer Certificates, they are required to have a minimum of 3 years of maritime work experience. However, there are limited opportunities for South African seafarers, many of whom remain unemployed after completing training. This is being addressed by SAMSA and SAIMI - for example, at SAMIC 2017 a Memorandum of Understanding (MoU) between the South African International Maritime Institute (SAIMI) and the Global On-Board Training Centre (GOBTC) was signed committing the two organisations to work together to secure berths on vessels for maritime cadets. The Department of International Relations and Cooperation has also been working with SAIMI in this regard. Efforts to increase the number of SA registered vessels will also have a positive impact on this, and it is recommended that these initiatives be supported.

[11] E. Dzinic *pers.comm.*

Harbour Masters for commercial ports, which fall under the TNPA, are appointed in terms of the National Ports Act (2005). However, Harbour Masters for fishing and other small harbours do not seem to be covered by any legislation. In November 2017 a Small Harbours Pollution, Safety and Security (PSS) Task Team under Initiative 5 of MPG found that there were significant problems and gaps in relation to the management of small harbours. The Task Team recommended, amongst others, that:

- Relevant legislation and regulations need to be amended to ensure proper management of proclaimed fishing harbours;
- The appointed Harbour Masters should be appropriately mandated, trained and equipped in order to be the final authority of small harbours; and
- The requirements for the appointment of Harbour Masters should be reviewed.

These recommendations should be supported. Consideration should also be given to changing the title of Harbour Master to distinguish between Harbour Masters for commercial ports and those for small harbours, as the level of responsibility - and training requirements - are likely to be significantly different. Both occupations should then be included in the OFO.

8.2.7 Environmental compliance and enforcement

There are numerous governmental agencies that are involved in environmental compliance of one form or another, with different agencies having different job titles for what are effectively their compliance officers. This is further complicated by the fact that in some cases, compliance officers are mandated by legislation to undertake specific tasks and are commonly referred to in relation to these tasks. For example, DAFF Marine Conservation Officers are usually referred to as Fisheries Control Officers as they are designated as such in terms of the Marine Living Resources Act (MLRA), Section 9 (1) which states that: "The Minister may, subject to the laws governing the public service, designate posts or ranks in any organ of state of which the incumbents shall be fishery control officers."

A similar situation applies in the case of Environmental Management Inspectors (EMIs) where, in terms of NEMA's Section 31B and C, the Minister and MECs are empowered to designate EMIs (and they have the discretion to decide which officials to designate). The Minister and MECs can further delegate this power to designate EMIs, as has already happened in the case of SANParks and in the Western Cape (to the Head of the Department of Environmental Affairs and Development Planning).

The legislation does, however, not specify what qualifications are required for such delegations - except that to be eligible for EMI designation, an official must complete "any relevant training course approved by the Director-General" (see EMI regulations), which at present is the EMI Basic Training Course run by DEA. Since the different government agencies have differing requirements in terms of qualifications for "compliance officers" - with some requiring at least an undergraduate degree or diploma and others only requiring a NSC certificate - this has given rise to a situation where there are significant differences in the qualifications and skills of not only EMIs and FCOs, but for compliance and enforcement officers in general. This is likely to complicate efforts to enhance cooperation amongst the various agencies.

This system, where one official can have multiple designations in addition to their job title, has also given rise to an overestimation of the capacity on the ground. Thus CapeNature, for example, may have five designated FCOs but, in fact, the primary responsibilities of these officers are related to the terrestrial environment, and they spend a very limited amount of their time working on fisheries-related offences.

A general recommendation is that this system is revisited with a view to putting in place one that:

- has a single job title for all Environmental/ Natural Resources Compliance Officers;
- merges the roles of Compliance Officers to include not only NEMA and the SEMAs, but also the LMRA and possibly other relevant legislation. It should also include those NEMA responsibilities currently delegated to DMR;
- enables all EMI's (Environmental Compliance Officers) to compile and carry dockets for environmental/ natural resource-related crimes;
- introduces some level of standardisation in terms of the level of required qualifications and

skills for Compliance Officers in all organisations. For example, there could be a common basic diploma as a minimum requirement - including both law enforcement and environmental management components - following which individuals could specialise into specific areas, such as fisheries, CITES, pollution, etc.;
- standardised remuneration across all tiers of government to avoid high turnover rates at provincial and local government levels; and
- aims to enhance the image of compliance and enforcement officers.

Such an approach might be easier to achieve if all compliance officers - at least for the Environment/ Natural Resources sector - were absorbed into a single agency with officers housed within the various departments with relevant responsibilities.

With respect to training, it is recommended that the proposed expansion of the capacity of DEA to provide EMI training be supported and that the content of the training be enhanced to cover this expanded mandate, with greater emphasis on marine and coastal aspects.

8.2.8 Information Technology

As has been noted, while there is not a scarcity of people with Information Technology qualifications - or even GIS training - there is an absolute shortage of individuals with training in GIS for marine applications. This is linked to the fact that there is no such training in the country. It is therefore recommended that steps be taken to develop and implement such training - either as a short course for upskilling, or as a module/s in existing GIS qualifications - or both.

8.3 Integration of multi-disciplinary skills

Governance of the coasts and oceans requires not only a broad perspective across various sectors and disciplines, but also a multi-disciplinary set of skills. This is especially true for an occupation such as Marine Spatial Planning, but most occupations these days require some IT skills and there has been growing emphasis on public consultation prior to decision-making on a range of MPG-related activities.

The difficulty, though, lies in how to achieve this in the context of universities which are as much separated into "silos" as government departments are.

A number of quite detailed comments were received on this topic and are quoted here – although the names of the individuals have been withheld.

- Respondent 1: The required skills are rarely provided by universities at present, which tend to focus on outdated disciplinary and academically-oriented approaches, rather than providing the skills to deal with complex, multi-disciplinary and sectoral issues that governance entails. Disciplinary specialists are required and will still be required in the future, but they should be trained to be more open to working in multi-disciplinary teams and their courses should be more problem-oriented, rather than descriptive and theoretical. In addition, it is and will be necessary to train individuals in multi- and inter-disciplinary approaches to science and governance, again ensuring that problem-solving is an integral part of courses and that integrative, innovative, open-minded and creative attitudes are fostered.
- Respondent 2: In South Africa it is difficult to study a multi-disciplinary Ph.D./ degree whereas in Brazil, for example, to be employed in their Space Programme - and government in general - you must have a BSc and Political Science. New recruits to government service should be given a Political Science crash course so they know how to write policy.

- Respondent 3: One of the challenges of a qualification in Marine Spatial Planning would be to make it transdisciplinary. University structures would need to be specifically set up in a way that enables this - something which they are not at present. A possible approach is one which has been adopted in Norwegian universities, namely, to offer a "Generic Masters" - i.e. one which is not specifically linked to any one Department or Faculty.
- Respondent 4: South Africa still thinks in compartments and not holistically.
- The CATHSETA Sector Skills Plan 2017/2018 states that: "The dominance of information and communication technologies has placed new skills demands on traditional occupations. In the conservation sub-sector, curators and conservation biologists require information management skills. There is a growing demand for crosscutting trans-disciplinary skills. This calls for tailored professional development programmes to support the traditional higher education curricula, which should also offer programmes of specialisation at post-graduate level."

There are a number of possible options for achieving a cross-disciplinary approach:

- The approach that has been adopted in Norwegian universities, namely to offer "Generic Masters" - i.e. degrees which are not specifically linked to any one department or faculty.
- Another option to achieving a transdisciplinary qualification within a training institution is to bring all the required skills in under a single umbrella. The CPUT Diploma: Marine Science is at present the only undergraduate qualification to offer a diverse scope of content relating to various fields of Ocean Governance from Marine Biology to Marine Law and Coastal Management, etc. However, there are some concerns that since this is at undergraduate level, the resulting graduates - although they would have a broad overview - would have only limited understanding of the details and intricacies of specific programmes or approaches. A better approach, therefore, might be to have a Marine Science qualification at post-graduate level where students already have a thorough understanding of at least one of the disciplines.
- Transdisciplinary courses can be run outside of the formal structures of training institutions - for example, by NGO's. In such cases, academics and experts from specific disciplines can be brought in to present different parts of the course. The primary challenge here is in getting accreditation for the course.
- It is also noted that a group of universities in South Africa (UWC, UCT, Nelson Mandela University and UFH) recently developed a concept for a South African School of Ocean Sciences and Technology which is in the process of being submitted to the NRF for funding. However, it seems that this is primarily science-based rather than multi-disciplinary.

Recommendation: a more detailed study of international examples of multi-disciplinary qualifications should be undertaken to establish best practice prior to implementation in South Africa.

8.4 Regular stakeholder interaction

In addition to the need for more multi-disciplinary qualifications, concerns were raised that in some cases the available qualifications do not adequately cover the skills needs of employers. In some cases, the gaps can best be met by the introduction of short courses, but in others the content of qualifications should be reviewed. Either way, there was a general consensus amongst stakeholders that communication between the institutions providing the training/ qualifications and the employers is inadequate and that it would be useful to both sides to address this.

Recommendation: a mechanism to improve communication between the stakeholders on an ongoing basis should be put in place. Options include:

i. *Establishment of an MPG Skills Development Forum:* consideration should be given to establishing a forum where training institutions, the relevant SETAs, relevant sectors, professional

associations and employers of MPG personnel could meet on a regular basis to better tailor the qualifications/ training to meet the needs of employers. The initial step could be a conference/ workshop to debate and set out the terms of reference for such a concept. The initiative could be led by SAIMI and/ or the relevant SETA for MPG (see section 8.8).

ii. *Advisory Committees at individual Institutions:* CPUT has established an Advisory Committee which includes industry representatives. It actively engages with both staff and 3rd year students: with staff at meetings at least twice a year, and the students at an orientation week programme. Similar concepts could be applied at other training institutions.

8.5 Filling the training gaps

One approach which was recommended as a mechanism to address the qualification/training gaps would be to have the relevant SETA develop tenders - in consultation with employers - calling for proposals by training institutions to develop modules/ courses to address these gaps.

Another proposal to encourage training institutions to contribute to society - by delivering qualifications or research which is beneficial to society - is to recommend that the NRF include societal impact as one of the criteria when evaluating scientists and/ or their research. This would, in any event, be in line with the mandate of the NRF.

8.6 Science vs Management

Historically many scientists who entered government to do research ultimately ended up in management positions - effectively without any appropriate training - because it was the only way to move up the career path. At some point, the concept of Specialist Scientists was introduced so that scientists could then choose to remain in research rather than move into management without compromising too significantly, their pay packages. However, even today many MPG managers started off as biologists and need upskilling to enable them to be effective managers.

It is understood that since 2012 there has been a compulsory induction course for all public sector employees which covers many of the soft skills requirements while those wanting to transition to management are strongly urged to attend relevant management courses of which there are many available. It is recommended that these should become requirements which are enforced. In addition, consideration should be given to having managers have some legal/ policy development training as a minimum through short courses, or through obtaining a qualification such as a Graduate Diploma in Marine and Environmental Law.

8.7 Recommendations regarding the OFO

Skills development at a national level takes place within the framework of the OFO. During the course of this project, it became clear that, not only are some of the MPG occupations not clearly covered, but in some cases, the descriptors and task lists listed within OFO 2017 are too generic or even inappropriate. Moreover, some of the occupations previously proposed by SAIMI/ Operation Phakisa do not appear in the 2017 version of the OFO. A further concern is that the OFO codes do not seem to be aligned with job titles or PSA codes. A number of recommendations regarding improvement of the OFO in the context of MPG have therefore been developed.

8.7.1 Proposed changes to specific codes

Changes to some specific codes/ occupations are highlighted below, while further, more detailed

proposals can be found in Appendix 10:

- Marine Protected Area Manager (previously proposed as OFO 213312). The OFO description for this occupation suggests that this manager addresses internal operations of an organisation to ensure they comply with environmental legislation. However, the specialisations include occupations related to the management of wildlife, protected areas etc. It is suggested that there be three separate occupations:

  8.7.1.1 Environmental Compliance Manager (for organisations);

  8.7.1.2 Protected Areas Managers - of which MPA Managers could be a specialisation;

  8.7.1.3 Coastal Zone Managers.

  The descriptions and tasks would then need to be amended to be consistent. In fact, perhaps the whole Unit Group 1349 needs to be revisited and a specific Unit Group for Environmental Managers should be created.
- Marine Monitoring Officer (previously OFO 335917) seems to have been removed and should be re-instated although it is proposed that the occupation name be changed to Coastal and Marine Monitors.
- The occupation Fisheries Scientist is at present listed as a specialisation of Marine Biologist. It is recommended that this be established as an occupation in its own right as it requires specific skills related to resource assessment and management. In addition, it is recommended that a new occupation of Fisheries Manager be established.
- The occupation Marine Scientist is currently listed as a specialisation under Geophysicist (211402). Marine Science is, however, normally seen as a cross-disciplinary degree i.e., the graduate would have completed courses in Physical, Chemical, Biological and Geological Oceanography. This is therefore considered inappropriate, and consideration should be given to adding it as a new occupation.
- Physical Oceanographer is listed as a specialisation under Geophysicist (211402). This should rather be a specialisation under Oceanographer (211407).
- Environmental Impact Assessor was previously listed as a specific occupation (214303) under the Minor Group 214 which is Engineering Professionals. This is not appropriate given that most EIA specialists are biologists. However, it seems to have been removed and the only location where environmental impact assessment seems to appear is as a task under the occupation Marine Biologist. Undertaking an EIA is a specific skill, and there are training courses available in this field, and although government personnel do not generally themselves undertake EIAs, they are required to assess the results and make decisions based thereon. They therefore need to have an understanding thereof. It is therefore recommended that Environmental Impact Assessor be identified as a specialisation.
- It is proposed that Aquatic Veterinarian be added as a specialisation of occupation 225102: Veterinary Public Health Professional/ Practitioner.
- Harbour Manager (132407) should be split into two occupations - or possibly two specialisations - so as to distinguish between the managers of commercial ports and those responsible for fishing and/ or small harbours. It is proposed that the managers of commercial ports be called Port Managers, while those for fishing and small harbours are called Harbour Masters.
- Fishing Boat Skipper and Master Port Operations should be added as specialisations under code 315201.
- Electro Technical Rating should be added as a specialisation under code 315101.

Other occupations for which there are no codes include Marine Law Enforcement Officers, Biodiversity Information Managers, Dry-dock Master, VTS Operator and VTS Supervisor[12]. These should be added.

8.7.2 Review of OFO and alignment of codes

While a number of recommendations regarding the OFO have been made above and in Appendix 10, reviewing the OFO was not a primary objective of this project. Given the problems identified during this project, it is recommended that a comprehensive review of the OFO in relation to MPG occupations - and perhaps in relation to oceans economy occupations as a whole - be undertaken to ensure that appropriate descriptors, specialisations and tasks are incorporated.

In addition, consideration should be given to aligning the OFO codes with Job Titles - at least in the Public Service - and with PSA codes. Without such alignment, it is difficult to see how accurate figures for employment against specific occupations can be obtained - which, in turn, makes it very difficult for forward planning.

8.8 SETAs

As noted previously, MPG-related skills and occupations are currently spread across a wide range of SETAs. Therefore, there is no coordinated approach to skills development for MPG. This could result in misalignment or duplication of SETA Skills Sector Plans and Strategic Plans, or more seriously, some MPG occupations being neglected entirely. There is, for example, no natural home for the Life Science occupations which are currently mainly housed under CATHSSETA.

It is therefore recommended that SAIMI/ DHET convenes a meeting of SETAs to address this issue.

Options which could be considered include:

- A SETA for Life Science and Environmental Management occupations;
- A consortium of SETAs relevant to MPG occupations with the new - or an existing relevant SETA - acting as the lead for the consortium;
- A new SETA to encompass and link all MPG-related occupations; or
- A new SETA for the Oceans Economy as a whole.

8.9 Succession planning

Succession planning is a process for identifying and developing junior staff members who can replace senior managers - or other key staff members - when they leave or retire. This generally entails developing internal people with the potential to fill these positions. While it is more common in business, it can be done in the public sector and academic/ training institutions although it can be difficult when the number of people employed in a particular discipline is small. In the South African context, it could be used to address transformation needs.

[12] List includes some new occupations and specialisations requested by SAMSA.

At present the focus is on personal development plans. While this is important, it is recommended that each department and/ or unit has a succession plan for strategic and critical posts where incumbents are required to have scarce skills. It should include the use of internships and/ or mentoring programmes where necessary and should have a long-term perspective rather than just fulfilling short-term needs.

8.10 Combined audit

Finally, it is recommended that the results of all the skills audits done for the various components of the oceans economy be combined once they are available. This might give a better overall picture of scarce and critical skills.

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10. APPENDICES

10.1 Questionnaire for the demand survey

SAIMI/DEA Project: Marine Protection and Ocean Governance Sector (Operation Phakisa): Skills Audit & Needs Analysis

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Respondent details (will remain confidential)

1. Name
2. Position and role
3. Department and/or unit etc
4. Organisation
5. E-mail address

MPG activities

6. What MPG activities are undertaken by your organisation and/or function?
7. What are the main reasons for undertaking MPG e.g. government policy and mandate?
8. In which geographical region do you operate?

Occupations and skills

9. Who is responsible in your organisation or unit for undertaking marine protection and ocean governance activities? Provide job titles, and number of staff occupying this role.
10. For each of the occupations listed, for which is marine protection and ocean governance the main focus of the function, or is it just a smaller component? Comment.
11. Of the occupations listed, which do you regard as critical for effective marine protection and ocean governance in your organisation?
12. For each of the occupations listed, please indicate the skill level required for the job (e.g. low = matric or less; middle = tertiary education; high = post-graduate education)
13. Are the current skills associated with those undertaking marine protection and ocean governance in your organisation adequate? Comment.
14. What are your current challenges when recruiting for marine protection and ocean governance positions? (e.g. scarcity of people with the appropriate skills; lack of experience; poor training)
15. Do you have any specific needs to address transformation in marine protection and ocean governance? (e.g. youth, women or people with disabilities).

Knowledge acquisition

16. How are those undertaking MPG activities in your organisation obtaining their skills, knowledge and experience? Drop down list:
    In-house work-based learning (private training provider)
    On the job training through undertaking work with other colleagues Attending conferences

Private training provider theme/specialism-focused courses
Formal education e.g. through a college or university (diploma, degree, post-grad) Other

17. To what extent does your organisation recognise prior learning?
18. Which forms of learning, in your opinion, are the most effective? Explain.
19. Can you list any examples of good education or training received by your marine protection and ocean governance employees? (e.g. a specific university course or international conference)
20. What role does your Human Resources department play in recruiting or training marine protection and ocean governance employees? (e.g. providing a training budget; helping with job descriptions; development of a work skills plan)

Collaboration

21. Who are the other main organisations or institutions you collaborate with for marine protection and ocean governance? Where possible, name the job functions you mainly work with.

Future predictions

22. What do you think the marine protection and ocean governance sector skills needs will be over next 5, 10 and 20 years, and how will these change? Comment
23. Where feasible, indicate the type of marine protection and ocean governance jobs and numbers that your organisation will need over the next 5, 10 and 20 years.
24. Do you foresee any new marine protection and ocean governance skills or occupations in the future? (e.g. to meet new technology innovations)
25. Do you think South Africa has the capability to meet your organisation's marine protection and ocean governance future needs? Comment on any barriers or opportunities.

Should you have any <u>further comments</u>, please insert here.

10.2 Summary of responses to Online surveys and interviews conducted

National government	# of interviews	# of responses to On-line survey
Department of Environmental Affairs (DEA): Oceans & Coasts	9	5
Department of Environmental Affairs (DEA) – other than O & C	2	4
Department of Agriculture, Forestry & Fisheries (DAFF)	1	3
Department of Defence (DoD)	0	2
Department of Energy (DoE)	0	0
Department of Higher Education & Training (DHET)	1	0
Department of International Relations & Cooperation (DIRCO)	0	1
Department of Labour (DoL)	0	1
Department of Mineral Resources (DMR)	1	0
Department of Monitoring & Evaluation (DM&E)	0	0
Department of Public Service & Administration (DPSA)	0	0
Department of Public Works (DPW)	0	0
Department of Science & Technology (DST)	1	0
Department of Tourism (DoT)	0	0
Department of Trade & Industry (DTI)	0	0
Department of Transport (DoT)	2	1
Department of Water & Sanitation (DWS)	0	0
Presidency	0	1
Provincial government	**# of interviews**	**# of responses to On-line survey**
CapeNature	1	0
Western Cape: DEAD & P	1	0
Eastern Cape: Dept Eco Dev, Env Affairs & Tourism	1	0
Eastern Cape: Parks & Tourism Agency	0	1
KwaZulu-Natal: EDTEA	1	0
Ezemvelo KZN Wildlife	1	2
Northern Cape: Dept of Environment & Nature Conservation	0	2
Local government		
Buffalo City Metropolitan	0	0
City of Cape Town	1	1
eThekweni Municipality	0	2
Nelson Mandela Bay Metro	0	0
Government research institutions/implementing agents		
Council for Scientific and Industrial Research (CSIR)	1	2
Council for Geoscience	0	0
Transnet National Ports Authority	0	2
National Prosecuting Authority (NPA)	1	1
National Research Foundation (NRF)	0	0
SA Local Government Association (SALGA)	0	0
SA Marine Safety Authority (SAMSA)	1	4

SA National Biodiversity Institute (SANBI)	1	1
SA National Defence Force (SANDF) (excl. Navy)	0	0
SA Navy	0	2
SA Police Force (SAPS)	1	0
SA Revenue Service (SARS)	0	1
SA Weather Service	0	0
South African Environmental Observation Network (SAEON)	0	0
South African Institute for Aquatic Biodiversity (SAIAB)	0	0
SANPARKS	1	2
SA National Space Agency (SANSA)	0	1
SSA	0	0
SETAs & Training bodies		
Chemical Industry SETA (CHIETA)	0	1
Culture, Arts, Tourism, Hospitality and Sport SETA (CATHSSETA)	0	0
Health & Welfare SETA (HWSETA)	0	0
Media, Information & Communication Technologies SETA (MICTSETA)	0	0
Insurance SETA (InSETA)	0	0
Local Government SETA (LGSETA)	0	1
Manufacturing, Engineering and Related Services SETA (merSETA)	0	1
Public Services Education & Training SETA (PSETA)	0	0
Safety and Security SETA (SASSETA)	0	0
Services SETA (SSETA)	0	0
Transport Education & Training SETA (TETA)	1	0
Universities and training institutions		
Cape Peninsular University of Technology (CPUT)	1	1
Durban University of Technology (DUT)	0	2
Imbewu Maritime Schools	0	0
King Cole Maritime	0	1
Lawhill Maritime Centre	0	0
SAIMI: National Cadet Programme	0	0
Nelson Mandela University (NMU)	3	6
Rhodes University	1	1
SA Graduates Development Association (SAGDA)	0	0
SA Maritime Training Academy (SAMTRA)	0	0
University of Stellenbosch	0	0
Transnet Maritime School of Excellence	0	0
UKZN	0	1
Umfolozi College	0	0
UNISA	0	1
University of Cape Town	2	3
University of Fort Hare	0	0
University of Western Cape	0	2
Walter Sisulu University	0	0

Private businesses, Institutions, Associations and NGOs		
African Earth Observation Network	0	0
Access	0	0
Bayworld	0	1
Burport Marine Consultancy	0	0
CapFish cc/Capricorn FM	0	1
Coastwatch	0	1
DeBeers Marine	0	0
Development Bank of South Africa (DBSA)	0	0
Durban Chamber of Security & Justice Committee	0	0
Earthlife Africa	0	0
EnAct International	1	0
eThekwini Maritime Cluster (EMC)	0	0
Institute for Global Dialogue	0	0
Institute for Maritime Technology	0	0
Institute of Natural Resources	0	0
Institute of Security Studies	0	0
Law Society	0	0
Mandela Bay Composites Cluster	0	1
Maritime Law Association	0	0
Metocean Services International	0	0
Oceanographic Research Institute	0	1
SA Petroleum Industry Association (SAPIA)	0	1
SA Shipyards Association	0	0
SADSTIA	0	0
Safeguard our Seabed	0	0
Society of Master Mariners SA	0	0
South Durban Community Environmental Alliance (SDCEA)	0	0
TRAFFIC	0	1
WESSA/Coastwatch	0	1
Wild Oceans	0	0
WWF-SA	0	1
INTERNATIONAL		
World Maritime University	0	1

10.3 MPG Initiatives, Occupations and Skills Requirements

MPG Initiative	Summary of proposed interventions (from Lab Reports)	Skills/knowledge	Occupations
1. Ministerial Committee & Oceans Secretariat	• Establishment of an Oceans Inter-Ministerial Committee (OIMC) chaired by a Minister in the office of the Presidency	• Need to have an understanding of the value and benefits of the marine environment and the need to maintain its integrity.	• Legislators/Ministers
	• Establishment of a DG Oceans Forum (FOSAD) to facilitate joint planning and decision-making with Technical Working Groups to support it.	• Need to have an understanding of the value and benefits of the marine environment and the need for a holistic and integrated approach to its use and management.	• Senior government managers and officials (DGs, CDs, HODs etc)
	• Establishment of an Oceans Secretariat in DEA to support the technical committees and provide oversight and monitoring of ocean activities	• Specialist knowledge of the marine environment, technical aspects and relevant legislation.	• Specialist Advisors and project managers.
	• Legislation to be amended to formalise the ocean governance institutional framework	• Legal drafting	• Attorney (marine/environmental)
2. Enhancement of legislation	• Amendment of Integrated Oceans and Coastal Management Act and/or promulgation of Oceans Act (process includes White Paper, draft Bill/s, stakeholder comments, review by state law advisors, passage through Parliament).	• Legal drafting skills/experience • Understanding of marine/maritime regulatory framework and of Parliamentary processes	• Attorney (marine/environmental) • State law advisor • Senior departmental officials

3. Review of ocean-related legislation	• Establishment of an inter-departmental task team to review existing international and domestic legal instruments; identify overlaps, conflicts and gaps between those instruments; develop recommendations.	• Understanding of marine/ maritime regulatory framework (international and domestic) including policies on marine/maritime issues	• Attorney (marine, maritime, environmental) • Senior departmental officials
4. Capacity Building	• Registration of relevant occupations; qualifications; work/learning opportunities. • Skills audit & needs analysis; • Training plan developed & implemented.	• Understanding of the skills required for MPG as well as the skills development field.	• Specialist advisor in training/skills assessment and development
5. Enhanced and Coordinated Enforcement	• Establishment of Interim Committee on enforcement (pilot phase) • Pilot project • Establishment of NWG on Compliance & Enforcement (ongoing monitoring) • Collaborative study to identify gaps in compliance and enforcement capability • Workplan/s to coordinate & optimise inter-departmental compliance & enforcement functions	• Understanding of compliance and enforcement.	• Environmental Management Inspectors Fisheries Officers SAPS personnel Defence Force personnel Operations Planner Data analysts Customs Officer Taxation Inspector Prosecutors ICT Technician Criminologist Sociologist Social Scientist

	• Develop National Oceans & Coasts Information Management System (OCIMS) • Establish infrastructure for OCIMS		Oceans & Coastal Domains Experts Research Scientists (various) Modeller (mathematical) Systems developers (senior/junior) Systems Architect Systems Engineer Software tester Communications Manager User support coordinator Call centre agent Training agent Integrated System Support Coordinator Administrators (system, database, network, security) GIS Technician (marine) Data Base Designer and Manager Data curator Biodiversity Information Management Specialist Legal Advisor (OCIMS entity)
	• Establish management structure for OCIMS and Earth Observation		Executive Manager/Director Operational Manager Scientific and Technical Research Development Manager Project Manager

6. National Ocean and Coastal Information and Earth Observation Capabilities	• Establish earth observation capacity (EEZ, extended continental shelf)	Policy development (most are scientists but need to be able to formulate policy)	
7. Oceans & coasts pollution monitoring programme	• Develop ocean and coastal monitoring programme • Establish a national pollution laboratory • Establish methodology for setting limits/standards for coastal effluent discharges • Promulgate standards		Data Collection Technicians Data Analysts (Chemical, Physical, Biological) Data Interpreter and Reporter Marine Environmental Officer ICT Technician Toxicologist Marine Pollution Analyst Environmental Impact Assessors Data Base Designer and Manager Coastal Officers
8. MPA Representative Network	• Develop a technical proposal for an MPA network • Gazette intention to declare an MPA network • Stakeholder consultations • Declaration of the MPA network • Draw up management and implementation plans for the new MPAs • Develop an MPA expansion plan		Marine Scientist Marine Geologist Biodiversity Planner Marine Spatial Planner MPA Operations Manager Environmental Law Advisor Environmental Inspectors Social Scientists Community Liaison Data Base Designer GIS Technician

9. MPA/MSPG Discovery Research and Monitoring Programme	• ACEP and Phakisa Ocean Cruises (including MPA/MSP research) • Establishment of MPA/MSP Research, Monitoring and Capacity-building Committee • Design & implement MPA/MSP DRuM Programme • MPA/MSP Scoping Exercise 2018-2030 • Capacity Building & Transformation Programme		Marine Scientist (Chemical, Physical, Biological) Marine Spatial Planner Marine Atmospheric Scientist Statistical Ecologist Biodiversity Planner Marine Geologist Data Base Designer and Manager MPA Manager
10. Marine Spatial Planning	• Establishment of National MSP Working Group • Integrate WG into Information Systems Initiative • Capacity building for MSP • Agreement on suitable model/ process for development of National MSP Framework • Identification of existing information as well as gaps • Development of National MSP Framework • Development of Regional & Sub-regional MSP frameworks • Development of implementation plan for MSP Framework/s • Monitoring & evaluation of MSP frameworks and plans Conflict resolution and trade-offs	Marine Spatial Planning Marine GIS Analysis	Marine Spatial Planner Marine Geologist Marine scientists Marine GIS Analyst Social Scientists GIS Technician Surveyor Data Base Designer Marine Lawyers

10.4 MPG Occupation templates

(a) MPG – related Managers			
MPG Initiative(s)	**1 - 10**		
OFO major group	**OFO sub-major group**	**OFO Minor Group**	**Unit Group**
1 - Managers	11 – Chief Executors, Senior Officials and Legislators 13 – Production and Specialised Services Managers	111 – Legislators & senior officials 132 – Manufacturing, Mining, Construction & Distribution Managers 133 – Information and Communications Technology Service Managers 134 – Professional Services Managers	1111 – Legislators 1112 – Senior officials 1324 – Supply, distribution & related Managers 1331 - Information and Communications Technology Service Managers 1347 – Armed Forces Managers 1349 – Professional Services Managers not elsewhere classified

Relevant OFO Occupations	**Relevant specialisations**
111101 – Local or provincial government legislator 111102 – Parliamentarian	MECs and Ministers (of relevant departments)
111201 – Defence Force Senior Officer 111202 –General Manager Public Service 111203 – Local Authority Manager 111204 – Senior Government Official 111205 – Senior Police Officer 111207 – Senior Government Manager	Numerous but none specifically marine. However, 111207 includes DGs of relevant departments.
132407 – Harbour Manager 132410 – Maritime Search & Rescue Mission Coordinator	
133102 – ICT Project Manager 133103 – Data Management Manager 133104 – Application Development Manager 133105 – Information Technology Manager 133106 – Information Systems Director	Numerous but none specifically marine
134701 – 03 – Military Manager, Commander, Warrant Officer	Numerous including some naval specialisations
134901 – Environmental Manager	Wildlife Management/Species Protection/Pollution and Waste/ Conservation Science Manager
134902 – Laboratory Manager	

Occupation description and purpose	**111101/02 – Legislators:** Represents the interests of people in a constituency as their elected member to local/provincial/national government.
	111201 – 07 – Senior officials: Senior government officials advise governments on policy matters, oversee the interpretation and implementation of government policies and legislation by government departments and agencies, represent their country abroad and act on its behalf, or carry out similar tasks in intergovernmental organizations. They plan, organize, direct, control and evaluate the overall activities of municipal or local, regional and national government departments, boards, agencies or commissions in accordance with legislation and policies established by government and legislative bodies.
	132407 – Harbour Manager Plans, organises, directs, controls and coordinates the operations of a harbour.
	132410 – Maritime Search & Rescue Mission Coordinator The Maritime Search and Rescue Mission Coordinator directs, organises and manages maritime search and rescue operations within the South African search and rescue region.
	133102 – 06: Information and Communications Technology Service Managers Information and communications technology service managers plan, direct, and coordinate the acquisition, development, maintenance and use of computer and telecommunication systems.
	134701 - 03 – Armed Forces Managers: Armed forces managers provide high level management to support the running of organisational, geographical and operational units and sections within the South African National Defence Force.
	134901 – Environmental Manager Plans, organises, directs, controls and coordinates the development and implementation of an environmental management system within an organisation by identifying, solving and alleviating environmental issues such as pollution and waste treatment in compliance with environmental legislation and ensures corporate sustainable development.
	134902 – Laboratory Manager Plans, organises, directs, controls and coordinates the operations of a research or production laboratory.
Tasks relevant to MPG[1]	**111101/02 – Legislators:** • Presiding over or participating in proceedings of legislative bodies and administrative councils of national, state, regional or local governments or legislative assemblies • Making, ratifying, amending or repealing laws, public rules and regulations within a statutory or constitutional framework • Negotiating with other legislators and representatives of interest groups in order to reconcile differing interests, and to create policies and agreements • Determining, formulating, and directing policies of national, state, regional or local governments.
	111201 – 07 – Senior officials • Recommending, reviewing, evaluating and approving documents, briefs and

[1] Based on tasks as described in OFO, but adapted where possible to include MPG specific responsibilities. NOTE: Tasks are described per OFO Unit Group and not for individual occupations.

	reports on MPG matters submitted by middle managers and senior staff members • Advising national, state, regional or local governments and legislators on MPG policy matters • Establishing MPG-related objectives for government departments or agencies in accordance with government legislation and policy • Advising on the preparation and amendment of MPG-related laws and regulations
	132407 – Harbour Manager • Planning and directing daily operations • Liaising with other departments and customers concerning requirements for outward goods and associated forwarding transportation
	132410 – Maritime Search & Rescue Mission Coordinator • Planning and directing daily operations
	133102 – 06: Information and Communications Technology Service Managers • Directing ICT operations, analysing workflow, establishing priorities, developing standards and setting deadlines – nothing specifically marine
	134701 - 03 – Armed Forces Managers: • Making policy decisions and accepting responsibility for operations, performance of staff, achievement of targets and adherence to budgets, standards and procedures – nothing specifically marine
	134901 – Environmental Manager • Providing overall direction and management for a service, facility, organization or centre – nothing specifically marine or even wildlife/species/ecosystem management.
	134902 – Laboratory Manager • Providing overall direction and management for a service, facility, organization or centre – nothing specifically marine.
Required/available qualifications	In general, Managers should have at least an understanding of the technical issues related to MPG – and preferably a relevant qualification – and/or training in public service administration and management. There are a wide variety of potential technical qualifications which are discussed in more detail elsewhere.
Additional skills required	Soft skills such as staff motivation, management, supervision and mentoring; liaison, consultation, negotiation and mediation; Stakeholder engagement etc..
Availability/scarcity	Harbour Managers are currently reported to be in short supply, especially for the Fishing Harbours. In addition, there is a general lack of individuals with the skills appropriate for middle management positions.
Associated SETA	No specific SETA

<table>
<tr><th colspan="4">(b) Physical and Earth Science Professionals</th></tr>
<tr><td>MPG initiative(s)</td><td colspan="3">6, 8, 9, 10</td></tr>
<tr><td>OFO major group</td><td>OFO sub-major group</td><td>OFO Minor group</td><td>Unit group</td></tr>
<tr><td rowspan="10">2 – Professionals</td><td>2017 - 21 - Physical, Mathematical and Engineering Science Professionals</td><td>211 – Physical and earth science professionals</td><td>2111 – Physicists
2112 – Meteorologists
2113 – Chemists
2114 - Geologists</td></tr>
<tr><td>OFO occupations</td><td colspan="2">Relevant specialisations</td></tr>
<tr><td>211101 – Physicist</td><td colspan="2">Nanotechnology Engineering Technologists</td></tr>
<tr><td>211201 – Meteorologist</td><td colspan="2">Atmospheric Scientist
Weather Forecaster
Climate Scientist
Hydro-meteorologist
Climatologist</td></tr>
<tr><td>211205/06 – Climate change scientist</td><td colspan="2"></td></tr>
<tr><td>211301 - Chemist</td><td colspan="2">Analytical Chemist
Laboratory Chemist</td></tr>
<tr><td>211401 - Geologist</td><td colspan="2">Petrologist (petroleum geologist)
Geological Oceanographer
Environmental Geologist
Marine Geologist
Exploration Geologist</td></tr>
<tr><td>211402 - Geophysicist</td><td colspan="2">Geophysical Scientist
Hydrologist
Physical Oceanographer
Seismologist
Marine Scientist</td></tr>
<tr><td>211407 - Oceanographer</td><td colspan="2"></td></tr>
<tr><td>Occupation description and purpose</td><td colspan="3">Physicist: Studies matter, space, time, energy, forces and fields and the interrelationship between these physical phenomena to further understanding of the laws governing the behaviour of the universe, and seeks to apply these laws to solve practical problems and discover new information about the earth and the universe.</td></tr>
<tr><td></td><td colspan="3">Meteorologist: Studies the physics and dynamics of the atmosphere to increase understanding of weather and climate, and to forecast changes in the weather and long-term climatic trends.</td></tr>
<tr><td></td><td colspan="3">Climate change scientist: Evaluates scientific data carries out research on the climate to create predictive models of likely changes in the earth's climate, and concomitant impacts on natural ecosystems and civilisation.</td></tr>
<tr><td></td><td colspan="3">Chemist: Studies the chemical and physical properties of substances and develops and monitors chemical processes and production.</td></tr>
<tr><td></td><td colspan="3">Geologist: Studies the composition, structure and other physical attributes of the earth to increase scientific knowledge and to develop practical applications in fields such as mineral exploration, civil engineering, environmental protection and</td></tr>
</table>

	rehabilitation of land after mining.
	Geophysicist: Studies the composition, structure and other physical attributes of the earth, locates minerals, petroleum or ground water, and detects, monitors and forecasts seismic, magnetic, electrical, thermal and oceanographic activity.
	Oceanographer: Studies the physical, chemical and biological properties of the ocean water masses.
Tasks relevant to MPG	**Physicist:** • developing methods, numerical models and techniques to extend knowledge of fields such as navigation, satellite communication and earth observation systems; • use of nanotechnologies in satellite applications
	Meteorologist: • Studying data collected from meteorological stations, radar and satellite imagery and computer model output to plot and forecast weather conditions • Participating in studies of the effect of weather on the environment
	Climate change scientist: • Analysing the impact of industrial projects and human activity on the climate and quality of the air and work with the social science, engineering and economic communities to develop appropriate mitigation strategies
	Chemist: • Conducting programs of sample and data collection and analysis to identify and quantify environmental toxicants
	Geologist: • Interpreting research data and preparing geological reports, maps, charts and diagrams, reports and papers • Locating and determining the nature and extent of oil, gas and mineral deposits using seismological, gravimetric, magnetic, electrical or radiometric methods
	Geophysicist/Oceanographer: • Studying and measuring physical properties of seas and the atmosphere and their inter-relationship, such as the exchange of thermal energy
Required/available qualifications	All of these occupations require at least an undergraduate degree in the relevant discipline. Courses/qualifications are available in all of them at universities in South Africa – details available in Appendix 7.
Additional skills required	In some cases, specialist skills are required for MPG purposes – for example, the analysis of seawater requires particular analytical techniques.
Availability/scarcity	Marine geologists are reported to be scarce. Analytical chemists specialised in analysis of seawater quality are limited.
Associated SETA	**The EW SETA Sector Skills Plan 2017 – 2022:** identifies Water Quality Analyst (213306) as one of the top ten scarce skills for the EW sector.

<table>
<tr><th colspan="4">(c) Mathematicians and Statisticians</th></tr>
<tr><td>MPG initiative(s)</td><td colspan="3">6, 8, 9, 10</td></tr>
<tr><td>OFO major group</td><td>OFO sub-major group</td><td>OFO Minor group</td><td>Unit group</td></tr>
<tr><td rowspan="3">2 - Professionals</td><td>2017 - 21 - Physical, Mathematical and Engineering Science Professionals</td><td>212 – Mathematicians, Actuaries and Statisticians</td><td>2121 – Mathematicians, Actuaries and Statisticians</td></tr>
<tr><td>OFO occupations</td><td colspan="2">Relevant specialisations</td></tr>
<tr><td>212103 – Statistician</td><td colspan="2">Population Analyst
Statistical GIS Specialist
Statistical Modeller</td></tr>
<tr><td>Occupation description and purpose</td><td colspan="3">Statistician:
Designs and applies statistical principles and techniques for collecting, organising and interpreting quantifiable data, and uses statistical methodologies to produce statistical reports and analyses for government, commercial and other purposes.</td></tr>
<tr><td>Tasks relevant to MPG</td><td colspan="3">• Advising on or applying mathematical principles, models and techniques to a wide range of tasks in the fields of engineering, natural, social or life sciences – for example, fisheries.
• Provision of scientific advice on marine resource assessment and sustainable management</td></tr>
<tr><td>Required/available qualifications</td><td colspan="3">This is a highly specialised field and individuals require post-graduate qualifications. These are not available in South Africa. A recommended institution is the University of Washington in Seattle, USA.</td></tr>
<tr><td>Additional skills required</td><td colspan="3">Post-graduate training in fisheries statistics required.</td></tr>
<tr><td>Availability/scarcity</td><td colspan="3">Given the lack of suitable training in SA, there is a shortage of these skills in the country.</td></tr>
<tr><td>Associated SETA</td><td colspan="3">No information</td></tr>
</table>

(d) Life Science Professionals and Technicians			
MPG initative(s)	**6, 7, 8, 9, 10**		
OFO major group	**OFO sub-major group**	**OFO Minor group**	**Unit group**
2 – Professionals 3 – Technicians and Associate Professionals	21 - Physical, Mathematical and Engineering Science Professionals 31 – Science and Engineering Associate Professionals	213 – Life science professionals 314 – Life science technicians and related Associate professionals	2131 – Biologists 2133 – Environmental Protection Professionals 3141 – Life science technicians (excluding medical)
	OFO occupations	**Relevant specialisations**	
	213107 – Marine biologist	Fisheries Analyst Fisheries Biologist Aquatic Biologist Fisheries Researcher Fisheries Scientist	
	213301 – Conservation scientist	Marine Ecologist Conservancy Advisory Scientist Fisheries Advisor Conservation Officer Ecological Researcher Species Protection Officer	
	213302 – Environmental scientist	Environmental Consultant Environmentalist Environmental Research Scientist Environmental Advisor Environmental Officer Environmental Auditor Climate Change Analyst Environmental Waste Officer	
	213305 – Air pollution analyst	Air quality technician	
	213306 – Water quality analyst	Waste Water Treatment Officer / Technician Hydrographical Technical Officer Water Quality Technician Hydrological Technical Officer	
	213309 - Toxicologist		
	213310 – Biodiversity Planner		
	314101 – Life Science Technician	Numerous specialisations including Microbiology Technician, Marine Biology Technician and Fisheries Technical Officer	
	314102 – Environmental Science Technician	Numerous specialisations – none specifically marine.	
Occupation description and purpose	**Marine biologist:** Studies the anatomy, physiology, functions, characteristics, behaviour and environments of all forms of life living in the sea and connected water bodies.		
	Conservation scientist: Develops and implements programs and regulations for the protection of fish, wildlife and other natural resources.		
	Environmental scientist: Studies and develops policies and plans for the control of		

	factors which may produce pollution, imbalance or degradation of the environment.
	Air pollution analyst: Analyses and develops policies and plans for the control of factors which may produce air pollution.
	Water quality analyst: Analyses and develops policies and plans for the control of factors which may produce water pollution.
	Toxicologist: Investigates the possible harmful effects on living things of chemical agents (for example, drugs, pesticides, food additives, industrial chemicals), biological agents (for example, plant and animal toxins) and physical agents (for example, ionizing and electro-magnetic radiation).
	Biodiversity Planner: Identifies geographic area of biodiversity importance and develops strategies and tools that support management of these areas to promote persistence of biodiversity patterns and processes.
	Life Science Technician: Identifies and collects living organisms and conducts field and laboratory studies in support of life scientists and technologists.
	Environmental Science Technician: Performs tests and experiments, and provide technical support functions to assist environmental scientists and technologists in research and teaching.
Tasks relevant to MPG[2]	**Marine Biologists**: • Evaluating environmental impact assessments to support decision-making in respect of coastal and other developments. • Gathering specimens and data on marine species, and studying their biology. • Providing advice to government in areas such as conservation, management of natural resources, the effects of climate change and pollution. • Identifying, classifying, recording and monitoring living organisms and maintaining databases.
	Conservation scientist/Environmental scientist/Air pollution analyst/Water quality analyst/Toxicologist/Biodiversity Planner (all in the same unit group): • Assessing an organization's compliance with government and internal environmental regulations and guidelines, identifying violations and determining appropriate remedial action • Conducting audits to evaluate environmental impact of existing activities, processes, wastes, noises and substances. • Developing conservation plans for marine species/ecosystems. • Assessing the likely impact that potential or proposed activities, projects and developments may have on the environment and recommending whether such developments should proceed.
Required/available qualifications	All these occupations require a formal qualification. Such qualifications are available at many SA universities, including National diploma, BTech, MTech or DTech in conservation, BSc, MSC, PhD in Zoology, Botany, Marine Biology, Marine Ecology etc. Details available in Appendix 7.
Additional skills required	Individuals working in the field in marine occupations should be able to swim, while skills such as SCUBA diving and boat handling are an added advantage. In addition, people in such posts are increasingly required to have information
	management skills (CATHSETA Sector Skills Plan 2017/2018).

[2] Based on tasks as described in OFO, but adapted where possible to include MPG specific responsibilities. NOTE: Tasks are described per OFO Unit Group and not for individual occupations. Occupations in the same Unit Group are therefore listed together.

Availability/scarcity	CATHSETA Sector Skills Plan 2017/2018: "Conservation: The Park Ranger and Environmental Scientist reportedly have the highest vacancies in the current year". The intervention planned by SETA included: Marine Biologists (213107): BSc Oceanography and Maritime Studies. (bursaries and internships); Environmental Scientists (bursaries), Conservation Scientists and Park Rangers (learnerships) and Environmental Managers (internships). Despite the above, the general opinion of people consulted in the course of this project suggests that there is not a scarcity of people with the requisite qualifications. However, there may be a relative scarcity if transformation issues are taken into account. The EW SETA Sector Skills Plan 2017 – 2022: identifies Water Quality Analyst (213306) as one of the top ten scarce skills for the EW sector.
Associated SETA	CATHSeta EW SETA
Additional notes	As can be seen above, the OFO Unit Group 2133 includes quite a diverse range of occupations from Marine Biologist to Water Quality Analyst to Biodiversity Planner with an equally diverse set of tasks/responsibilities. The current list of tasks does not begin to cover these. This grouping should therefore be revised.

(e) Compliance and Enforcement Officers			
MPG Initiatives	**5**		
OFO major group	**OFO sub-major group**	**OFO Minor group**	**OFO Unit Group**
2 – Professionals 3 - Technicians and Associate Professionals	21 – Physical, Mathematical & Engineering Science Professionals 22 – Health Professionals	213 Life Science professionals 214 - Engineering professionals 225 Veterinarians	2133 Environmental Protection Professionals 2144 – Mechanical Engineers 2145 – Chemical Engineers 2251 - Veterinarians
	31 – Science & Engineering Associate Professionals 33 - Business and Administration Associate Professionals	315 - Ship and aircraft controllers and technicians 335 – Regulatory Government Associate Professionals	3152 – Ship's Deck Officers and Pilots 3351 – Customs and border inspectors 3355 – Police Inspectors and Detectives 3359 - Government Regulatory Associate Professionals not Elsewhere Classified

OFO Occupations	**Relevant specialisations**
213307 – Park Ranger	Park Warden Fish Warden Beach and Estuary Warden
214405 – Naval Architect	Naval architect Marine designer Marine architect
214503 – Explosives & dangerous goods inspector/Maritime Safety Officer	
225102 - Veterinary Public Health Professional / Practitioner	
315203 – Ship's Surveyor	Marine Engineer Surveyor Nautical Information Advisor Nautical Surveyor
315204 – Marine Certification and Surveillance Manager (Principal Officer)	
335101 – Customs Officer	Coast watch Officer
335501 - Detective	Numerous specialisations – none specifically marine
335906 – Environmental Practices Inspector (EMI's)	
335911 – Quarantine Officer	Exotic Disease Investigator Border Protection Office Microbiological Security Officer Quarantine Inspector Quarantine and Agricultural Ports Officer
335912 – Fisheries Officer	Fisheries Investigator Fisheries Inspector

OFO Occupation description and purpose	**Park Ranger:** Controls state or national parks, scenic areas, historic sites, nature reserves, recreation areas and conservation reserves in accordance with authorised policies and priorities.
	Naval Architect: Designs, constructs and repairs ships, boats, other marine vessels and offshore structures, both civil and military.
	Explosives & dangerous goods inspector: Inspects and examines premises, vehicle, vessel or aircraft where suspect explosives or dangerous goods may be found.
	Veterinary Public Health Professional: Conducts and oversees the provision of advanced Veterinary Services in any of the following fields: diseases control, import and export policy & control, epidemiology, quarantine, veterinary public health, animal welfare, animal health, laboratory diagnostics and related remedies.
	Ship's Surveyor: Surveys machines and hulls of ships to ensure they are constructed, equipped and maintained according to safety standards, rules and regulations laid down by marine authorities.
	Marine Certification and Surveillance Manager: Surveys marine vessels in accordance with international safety standards determine seaworthiness.
	Customs Officer: Administers and enforces customs and related legislation, and assists with customs control of overseas passengers, crew, aircraft, ships, cargo, mail and bond stores.
	Detective: Investigates serious crimes such as terrorism, homicide, armed robbery, vice and arson, and gathers evidence to arrest and prosecute criminals.
	Environmental Practices Inspector: Examines places of business to ensure compliance to environmental practice requirements. May issue certificates.
	Quarantine Officer: Inspects incoming animals, plants, and animal and plant products to ensure compliance with laws and regulations to prevent the spread of exotic pests and diseases.
	Fisheries Officer: Inspects fishing vessels, gear, licenses and catches to ensure that fisheries laws and regulations are obeyed
Tasks relevant to MPG[3]	**Park Ranger:** • Developing and implementing conservation plans • Ensuring compliance with the regulations pertaining to the relevant coastal/marine protected area.
	Naval Architect: • Ensuring that vessels (old and new) are constructed in compliance with relevant legislation, design specifications and safety standards • Checking ship's stability information, tonnage, load line etc • To provide surveyors with training and guidance for plan approval, stability book approval, load line and tonnage computations. • To provide training for surveyors on vessel construction and stability • To formulate policies through marine notices, circulars and provide guidance to surveyors/industry. • To oversee the process of Vessel Registration and licensing of existing / new vessels • To assist Surveyors with investigations into casualties of a specific technical nature where Naval Architectural expertise is required.

[3] Based on tasks or description/purpose as described in OFO, but adapted where possible to include MPG specific responsibilities. NOTE: Tasks are described per OFO Unit Group and not for individual occupations.

	Explosives & dangerous goods inspector: • Ensuring safety procedures for hazardous cargoes are effectively implemented
	Veterinary Public Health Professional: • disease control in aquaculture facilities • quarantine • laboratory diagnostics and related remedies.
	Ship Surveyors: • Surveys vessels and their fittings and equipment to ensure they are constructed, equipped and maintained according to safety standards, rules and regulations laid down by maritime authorities • Ensures proper and safe manning of vessels • Carry out and submit reports on casualty Investigations • Setting and assessment of relevant examinations • Accreditation of training courses, Institutions/providers and seafarer recruitment agencies • Inputs to relevant legislation/regulations and drafting of Marine Notices & Circulars
	Marine Certification and Surveillance Manager: = Principal Officer??? • Surveys marine vessels in accordance with international safety standards determine seaworthiness. (look at job descriptions)
	Customs Officer: • Coordinating and cooperating with other agencies involved in law enforcement, deportation and prosecution • Performing related administrative tasks to record findings, transactions, violations and determinations; when necessary, testifying in a court of law about the circumstances and results of investigations carried out • Patrolling national borders and coastal waters to stop persons from illegally entering or leaving the country and from illegally importing or exporting currency or goods • Detaining persons and seizing prohibited and undeclared goods found to be in violation of immigration and customs laws
	Detective: • Establishing contacts and sources of information not readily available or apparent concerning establishments or the circumstances and behaviour of persons, usually with the aim of preventing a crime; making arrests • Obtaining and verifying evidence by examining crime and accident scenes for clues and physical evidence, interviewing witnesses and suspects and analysing documents and computer files • Testifying in courts of law or reporting to superiors about circumstances and results of investigations • Establishing contacts and sources of information about crimes planned or committed, in order to prevent crimes or identify suspected offenders • Analysing evidence in order to solve crimes, identify criminal activity and gather information for court cases
	Environmental Practices Inspector: None of the tasks described in the OFO are that relevant and even the description seems inappropriate - need to add from Job descriptions etc. NOTE: Seems that this is where an Environmental Management Inspector (as trained by DEA) would fit in.
	Quarantine Officer: Inspects incoming animals, plants, and animal and plant

	products to ensure compliance with laws and regulations to prevent the spread of exotic pests and diseases
	Fisheries Officer: Inspects fishing vessels, gear, licenses and catches to ensure that fisheries laws and regulations are obeyed.
Required/available qualifications	**Park Rangers:** This occupation requires a formal qualification at least at senior levels. Such qualifications are available at many SA universities, including National diploma, BTech, MTech or DTech in conservation, BSc, MSC, PhD in Zoology, Botany, Marine Biology, Marine Ecology etc. Details available in Appendix 7.
	Naval Architect: Requirements: B.Eng. (Mech.) with MSc. in Naval Architecture or B.Eng. (Naval Architecture) with at least 2 years' experience; B. Eng. (Marine Engineering) with at least 1 year sea time and two years Naval Architecture training/ experience. Availability: not available in South Africa
	Explosives & dangerous goods inspector: Chemical engineering (need job description)
	Veterinary Public Health Professional / Practitioner: Requirements: veterinary degree plus specialised training in aquatic veterinary practice. Availability: not available in South Africa.
	Ship's Surveyor: Requirements: Grade 12 + one or more of the following depending on grade and specialisation (small vessel, fishing vessel, engine, deck, radio etc): • Certificate of Competency or Diploma in Small Vessel Surveying • Certificate of Competency as Fisherman Grade 2/Skipper Fishing • Second Engineer >3000 kW STCW Certificate of Competency (COC), having completed the required sea service for a chief engineering COC and all the required academics • STCW ancillary courses and any other equivalent training • Chief Engineer >3000 kW Certificate of Competency or • Equivalent Marine Engineering Degree • National Diploma in Electrical/Electronic Engineering and GMDSS General Operator's Certificate • GMDSS First or Second-Class Radio Electronic Certificate Availability: COCs issued by SAMSA, Diplomas, degrees offered at various institutions (see relevant templates). Port State Control courses are run by SAMSA and/or in collaboration with regional bodies (e.g. Indian Ocean Rim) and through PSC MoU's.
	Marine Certification and Surveillance Manager/Principal Officer: same as Ship Surveyor but with managerial skills as well.
	Environmental Practices Inspector: EMI training provided by DEA
	Fisheries Officer: Requirements: Diploma in Law Enforcement (NQ5) or Diploma in Nature Conservation or Degree in Life Sciences. Available qualifications: Diploma in Law Enforcement (NQ5) – SAPS Academies Short courses & Diploma in Fisheries Compliance (NMU – FishForce)

Additional skills/knowledge required	**Surveyors:** • Knowledge of relevant legislation as well as maritime safety and pollution prevention practices and standards (Port State Control) • Seagoing experience at relevant level • Experience as a Radio Surveyor/Radio Technician employed at a professional marine radio installation inspection service company approved and monitored by a Recognised Organization • IMO SOLAS/STCW and the ITU/RSA Radio Regulations
	General: all compliance officers that operate in the marine space need to have the following additional training/skills: • Pre-Sea Training (basic training on boat/ship safety for those who have never been to sea before) • Knowledge of relevant legislation (with regular updates) • Communications skills.
	Fisheries Officers: • Taxonomy of marine species
Availability/scarcity	There is a scarcity of people with the following qualifications/skills: • Surveyors (especially Engineering Surveyors are scarce) • Naval Architect
Associated SETA	SASSETA (Safety and Security SETA) (Policing and Defence Chambers
Additional Notes	Surveyors: a new specialisation could be a fishing vessel surveyor + others

<table>
<tr><th colspan="4">(f) Planners & surveyors</th></tr>
<tr><td>MPG Initiative(s)</td><td colspan="3">10</td></tr>
<tr><td>OFO major group</td><td>OFO sub-major group</td><td>OFO Minor Group</td><td>Unit Group</td></tr>
<tr><td rowspan="7">2 - Professionals</td><td rowspan="2">21 - Physical, Mathematical and Engineering Science Professionals</td><td rowspan="2">216 – Architects, Planners, Surveyors & Designers</td><td>2164 – Town and Traffic Planners</td></tr>
<tr><td>2165 – Cartographers and Surveyors</td></tr>
<tr><td>OFO Occupations</td><td colspan="2">Relevant specialisations</td></tr>
<tr><td>216401 – Urban and regional planners</td><td colspan="2">Environmental Consent Planner
Natural Resource Management Consultant/Officer/Planner
Environmental Policy Planner</td></tr>
<tr><td>216403 – Marine Spatial Planners</td><td colspan="2"></td></tr>
<tr><td>216501 - Cartographer</td><td colspan="2"></td></tr>
<tr><td>216502 - Surveyor</td><td colspan="2">Hydrographer</td></tr>
<tr><td>Occupation description and purpose</td><td colspan="3">Urban and regional planner: Develops and implements plans and policies for the controlled use of urban and rural land including that in the coastal zone.</td></tr>
<tr><td></td><td colspan="3">Marine Spatial Planner: Analyses and allocates the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process.</td></tr>
<tr><td></td><td colspan="3">Cartographer: Applies scientific and mathematical principles to design, prepare and revise maps and charts.</td></tr>
<tr><td></td><td colspan="3">Hydrographer: Plans, directs and conducts survey work to determine, delineate, plan and precisely position tracts of land, natural and constructed features, coastlines, marine floors and underground works, and manages related information systems.</td></tr>
<tr><td>Tasks relevant to MPG[4]</td><td colspan="3">Urban and Regional Planner:
• Planning layout and coordinating development of coastal areas
• Conferring with government authorities, communities and specialists in fields such as architecture, planning, social science the environment and the law
• Advising governments, companies and communities on urban and regional planning issues and proposals</td></tr>
<tr><td></td><td colspan="3">Marine Spatial Planner:
• Compiling and analysing data on economic, legal, political, cultural, demographic, sociological, physical and environmental factors affecting use of coastal and marine areas
• Conferring with government authorities, communities and specialists in fields such as marine science, natural resources, shipping, the environment and the law
• Developing and presenting marine spatial plans to stakeholders</td></tr>
<tr><td></td><td colspan="3">Cartographer (Marine):
• Making charts and maps to be used in determining navigable waters and channels and in planning construction of marine structures</td></tr>
</table>

[4] Based on tasks or description/purpose as described in OFO but adapted where possible to include MPG specific responsibilities. NOTE: Tasks are described per OFO Unit Group and not for individual occupations.

	Hydrographer: • Designing, compiling and revising maps and nautical charts using aerial and other photographs, satellite imagery, survey documents and data, existing maps and records, reports and statistics • Making charts and maps to be used in determining navigable waters and channels and in planning construction of marine structures
Required/available qualifications	Qualifications not currently available in South Africa.
Additional skills required	Stakeholder consultation Negotiating skills Hydrographers and Marine Cartographers need strong IT skills.
Availability/scarcity	Marine Spatial Planning is a new occupation globally and especially in South Africa and there are a very limited number of people with qualifications and/or experience in this field.
Associated SETA	No information found in SETA documents

<table>
<tr><th colspan="4">(g) Information Technology Practitioners</th></tr>
<tr><td>MPG initative(s)</td><td colspan="3">6, 8, 9, 10</td></tr>
<tr><td>OFO major group</td><td>OFO sub-major group</td><td>OFO Minor group</td><td>Unit group</td></tr>
<tr><td rowspan="11">2 – Professionals

3 – Technicians and Associate Professionals</td><td>25 – Information and Communications Technology Professionals</td><td>251 – Software and applications developers and analysts
252 – Database and network professionals</td><td>2511 – Systems analysts
2512 – Software developers
2513 – Web and multi-media developers
2514 – Applications programmers
2521 – Database designers & administrators
2522 – Systems administrators
2529 – Database & network professionals not elsewhere classified</td></tr>
<tr><td>35 – Information and Communications Technicians</td><td>351 – Information and Communications Technology Operations and User Support Technicians</td><td>3513 – Computer Network and Systems Technicians</td></tr>
<tr><td>OFO occupations</td><td colspan="2">Relevant specialisations</td></tr>
<tr><td>251101 – ICT systems analysts
251201/202/203 – Software developer/ Programme analyst/ developer programmer</td><td colspan="2">Numerous specialisations, but not specifically marine</td></tr>
<tr><td>251301/302 - Web and multi-media developers</td><td colspan="2">Numerous specialisations, but not specifically marine</td></tr>
<tr><td>251401 – Applications programmer</td><td colspan="2">Applications Integrator
Software and Applications Developer</td></tr>
<tr><td>252101 – Database designer & administrator</td><td colspan="2">Numerous specialisations, but not specifically marine</td></tr>
<tr><td>252201 – Systems administrators</td><td colspan="2">Numerous specialisations, but not specifically marine</td></tr>
<tr><td>351101/201/301 – computer technicians</td><td colspan="2">Numerous specialisations, but not specifically marine</td></tr>
<tr><td>351302- GIS technicians</td><td colspan="2">GIS analyst
Remote sensing scientists and technologists
GIS coordinator
GIS assistant/officer/operator/specialist/technician
GIS specialist</td></tr>
<tr><td>351303 – Marine GIS technician</td><td colspan="2"></td></tr>
<tr><td>Occupation description and purpose</td><td colspan="3">Systems analysts conduct research, analyse and evaluate client information technology requirements, procedures or problems, and develop and implement proposals, recommendations, and plans to improve current or future information systems.</td></tr>
</table>

	Software developers research, analyse and evaluate requirements for existing or new software applications and operating systems, and design, develop, test and maintain software solutions to meet these requirements.
	Web and multimedia development professionals combine design and technical knowledge to research, analyse, evaluate, design, programme and modify websites, and applications that draw together text, graphics, animations, imaging, audio and video displays, and other interactive media.
	Applications programmer: write and maintain programmable code outlined in technical instructions and specifications for software applications and operating systems.
	Database designer and administrator: design, develop, control, maintain and support the optimal performance and security of databases.
	Systems administrator: develop, control, maintain and support the optimal performance and security of information technology systems.
	Computer technicians: Information and communications technology operations technicians support the day-to-day processing, operation and monitoring of information and communications technology systems, peripherals, hardware, software and related computer equipment to ensure optimal performance and identify any problems.
	GIS technicians: Assist scientists, technologists, or related professionals in building, maintaining, modifying, or using geographic information system (GIS) databases. May also perform some custom application development or provide user support. A **Marine GIS technician** has the specific skills required to build GIS databases for the marine environment.
Tasks relevant to MPG	Apart from the Marine GIS technician, none of these occupations are specific to the marine environment. However, they are critical to the management and application of information on marine biodiversity, ecosystems and specific events in the marine and maritime sector. For example, the Ocean and Coasts Information Management System (OCIMS) which has been established under Initiative 6 of MPG.
Required/available qualifications	General IT – including GIS – qualifications are widely available. Details can be found in Appendix 7. However, there is no specific training available for Marine GIS applications with the few that have these skills having learnt them on the job.
Additional skills required	It is probably useful for people working on marine applications to have some understanding of the marine environment.
Availability/scarcity	Marine GIS Technicians are scarce.
Associated SETA	MICT Seta (Media, Information and Communications Technology)/ ICTSETA (2018?)

<table>
<tr><th colspan="5">(h) Legal Professionals</th></tr>
<tr><td>MPG initiative(s)</td><td colspan="4">2,3,5,7,8,10</td></tr>
<tr><td>OFO major group</td><td>OFO sub-major group</td><td colspan="2">OFO minor group</td><td>OFO Unit Group</td></tr>
<tr><td rowspan="5">2 - Professionals</td><td>2017-26 - Legal Professionals</td><td colspan="2">2017 – 261 Legal Professionals</td><td>2017 – 2611 Lawyers</td></tr>
<tr><td colspan="2">OFO Occupations</td><td colspan="2">Relevant Specialisations</td></tr>
<tr><td colspan="2">261101 – Attorney</td><td colspan="2">Maritime Law Attorney
Marine Law attorney
Environmental Law Attorney</td></tr>
<tr><td colspan="2">261102 – Administrative lawyer</td><td colspan="2">Enforcement Advisor
Enforcement Analyst
Law/legal researcher</td></tr>
<tr><td colspan="2">261107 - Legal Manager</td><td colspan="2"></td></tr>
<tr><td>OFO Occupation description and purpose</td><td colspan="4">Attorney: Provides legal advice, prepares and drafts legal documents and conducts negotiations on behalf of clients on matters associated with the law.</td></tr>
<tr><td colspan="4">Administrative lawyer: Conducts criminal and civil lawsuits, draws up legal documents, advises clients as to legal rights and practices other phases of law.</td></tr>
<tr><td colspan="4">Legal Manager: Provides legal advice and /strategic direction on the interpretation and application of relevant legislation, investigations into proposed merger and alleged and competitive conduct and the implementation of business plans for the legal service division. Define performance measures to evaluate the success of strategies. Monitor and evaluate the success of strategies. Manage and review all monthly and quarterly reports of divisional administration policies and procedures. Oversee compliance with systems and processes for efficient functioning of the legal
Service Division. Oversee the allocation of Divisional resources and tasks. Conduct regular feedback and status meetings with Legal Services Division staff.</td></tr>
<tr><td>Tasks relevant to MPG[5]</td><td colspan="4">• Drawing up legal documents such as contracts (e.g. for management of research or fisheries patrol vessels)
• Preparing legal opinions on interpretation of internal and external legislation
• Reviewing decisions and providing advice when government is sued
• Dealing with appeals against government decisions
• Acting as prosecutor on behalf of the Government
• Accepting briefs and pleading in the higher court
• Negotiating settlements in matters which involve legal disputes
• Evaluate findings and develop strategies and arguments in preparation for presentation of cases
• Drafting legislation and preparing government regulations based on existing laws
• Facilitating the passage of Bills through Parliament
• Researching legal principles, statutes and previous court decisions related to specific cases
• Providing legal advice to Government on relevant subjects and undertaking legal business on their behalf
• Provision of legal services to the OCIMS Entity including development of legal agreements for cooperation between entities regarding data and systems.
• Provision of support to the OCIMS entity in ensuring that any operations follow due course so that activities and efforts facilitated through the OCIMS Entity lead to conviction and prosecution and possible claim support in the event of illegal activity as well as natural disasters.</td></tr>
</table>

[5] Based on tasks as described in OFO, but adapted where possible to include MPG specific responsibilities. NOTE: Tasks are described per OFO Unit Group and not for individual occupations.

	• Supervision of other workers may be included (e.g. Legal Manager).
Required/available qualifications	The basic qualification for everyone in the legal profession is an LLB with specialisation taking place at postgraduate level. Relevant specialist qualifications for MPG include: ➢ LLM in Maritime Law ➢ LLM in Environmental Law ➢ LLM in Shipping Law ➢ LLM in Ocean Governance (starting 2019) See Appendix 7 for more detailed information.
Scarcity of qualified personnel and/or skills	According to SASSETA (no date on document?) administrative lawyers and attorneys are scarce skills. Top up skills required include: ▸ Business management ▸ Legislative drafting ▸ Conflict resolution ▸ Foreign languages ▸ Computer skills ▸ Conveyancing ▸ Court procedures ▸ New areas of practice i.e. ✓ Environmental Law ✓ Maritime law
	Based on stakeholder interviews/On-line survey: People with basic qualification (LLB) are not scarce – and probably even LLM degrees (need to get figures on graduates) - but many lack experience and specific skills including: ▸ Legal drafting (legislation as well as e.g. submissions to the Minister) ▸ Legal analysis and opinions ▸ Communication of legal concepts to lay people ▸ Understanding of relevant international law and implications for domestic law. Other new areas where lawyers are required include the development of regulations related to the use of satellite technology and support to the OCIMS entity.
Upskilling opportunities	IOI-SA Ocean Governance for Africa University of Pretoria/Cape Town – legislative drafting Law Society courses More detailed information can be found in Appendix 9.
Associated SETA	SASSETA – Safety and Security SETA: Legal Services Chamber
Additional Notes	The content of some of the existing courses should be reviewed by experts with practical experience (as opposed to academics) to see whether they meet the requirements of MPG. For example, i) some concerns have been expressed that the marine/environmental law qualifications do not include sufficient training on international law; and ii) legislative drafting courses should include 2 elements: a) design – which should be done in consultation with technical experts; and b) how to write.

<table>
<tr><th colspan="4">(i) Social Professionals</th></tr>
<tr><td>MPG Initiative(s)</td><td colspan="3">10</td></tr>
<tr><td>OFO major group</td><td>OFO sub-major group</td><td>OFO Minor Group</td><td>Unit Group</td></tr>
<tr><td rowspan="4">2 - Professionals</td><td>26 – Legal, Social and Cultural Professionals</td><td>263 – Social and Religious Professionals</td><td>2631 – Economists
2632 – Sociologists, Anthropologists & Related Professionals</td></tr>
<tr><td>OFO Occupations</td><td colspan="2">Relevant specialisations</td></tr>
<tr><td>263101 – Economist</td><td colspan="2">Resource Economist (Natural Resource Economist)
Environmental Economist</td></tr>
<tr><td>263204 - Sociologist</td><td colspan="2"></td></tr>
<tr><td>Occupation description and purpose</td><td colspan="3">Economist: Performs economic research and analysis; develops and applies theories about production and distribution of goods and services, and people's spending and financial behaviour; and provides advice to governments and organisations on subjects relating to economic policies.</td></tr>
<tr><td></td><td colspan="3">Sociologist: Researches the science of society, social institutions and social relationships, and specifically the systematic study of development, structure, interaction and collective behaviour of organised human groups.</td></tr>
<tr><td>Tasks relevant to MPG</td><td colspan="3">Natural Resource/Environmental Economist:
Economic research to address the connections and interdependence between human economies and natural marine ecosystems and resources.
Application of economic theory and methods to environmental issues and problems with a view to improving management strategies.
Application of methods such as cost-benefit and cost effectiveness analysis; sectoral environmental policy impact analysis; modelling and simulation; and resource pricing and the valuation of environmental goods.</td></tr>
<tr><td></td><td colspan="3">Sociologist:
Social impact assessments for development projects in marine and coastal environments.
Sustainable livelihoods.</td></tr>
<tr><td>Required/available qualifications</td><td colspan="3">Natural Resource/Environmental Economist: Economics degree</td></tr>
<tr><td>Availability/scarcity</td><td colspan="3">There are a limited number of Natural Resource Economists, but there are also no posts for them in government.
Sociologists are more generally available, but there is also a limited number of posts.</td></tr>
<tr><td>Associated SETA</td><td colspan="3">Unknown</td></tr>
</table>

10.5 Employment data for MPG occupations

(a): MANAGERS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Managers (those dealing with MPG only)								
Senior government official (Chief Directors, Directors)	111204	19[6]	19	8				
Senior police officer	111205							
Senior government manager (HODs, DGs, DDGs etc)	111207	2[7]	2	2				
Harbour Manager	132407	7[8]						
Maritime search & rescue mission personnel	132410	5[9]	4				1	Resignation
Information technology managers (data/applications/systems)	133102 – 133106	1[10]	1					
Environmental manager (wildlife management/protection services manager/species protection/pollution & waste/conservation)	134901	3[11]	3	1				
MPA Managers	No Code	5[12]	5	4				
Coastal zone managers	No code	2[13]	2					
Laboratory manager	134902	1[14]	1					
Specialist Advisors [15]	No code	2	1	1			1	

[6] **DEA** (4 x CDs [Oceans Sec; LACE, Monitoring; Research]; 8 x Directors [MPG delivery, Oceans Sec, Ocean Conservation, OCIMS, Monitoring, LACE, Biodiversity, Research]; 5 Deputy Directors [LACE – Monitoring, Pollution Monitoring, Ocean Conservation, LACE, Reg/Int Programmes]; 1 x Assistant Director [Oceans Econ]; and **DIRCO** – 1 DD – Int relations).

[7] DEA [DDG Oceans and Coasts); SANBI – Head of Marine Unit.

[8] Assume 1 in each commercial port (TNPA)

[9] SAMSA

[10] SAMSA

[11] SAMSA (Navigation, Security & Environment), & Ezemvelo KZN Wildlife

[12] SANParks & Ezemvelo KZN Wildlife

[13] City of Cape Town

[14] Walter Sisulu University – National Pollution Laboratory

[15] For example, those in the Oceans Secretariat : DEA at least one employed, others advertised.

(b) : PHYSICAL AND EARTH SCIENCE PROFESSIONALS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Physical & earth science professionals & technicians (marine applications)								
Physicist (nanotechnology engineering technologists)	211101							
Meteorologist	211201	1[16]					1	New post
Climate change scientist	211205/06							
Chemist (analytical/laboratory chemist)	211301							
Geologist (petroleum/mining/exploration geologist)	211401							
Marine Geologist	211401 spec							
Oceanographer (physical or other)	211407							
Marine scientist	211402 spec							
Air pollution analyst (air quality technician)	213305	4[17]	4					
Water quality analyst (water quality technician)	213306	12[18]	3	2	3		9	
Other technicians	No code	6[19]	6					

(c) : MATHEMATICIANS AND STATISTICIANS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Mathematicians & statisticians (marine applications)								
Statistician (population analyst – e.g. fisheries)	212103 spec	5[20]	5					
Statistician (statistical GIS specialist)	212103 spec							
Statistician (statistical modeller)	212103 spec							

[16] eThekwiniMunicipality

[17] eThekwiniMunicipality

[18] Walter Sisulu University – National Pollution Laboratory

[19] DEA [bio-optics/remote sensing, chemistry, hydrography, electronics)

[20] Employed by MARAM at UCT but contracted as a group by DAFF to provide resource assessments and management advice.

(d) : LIFE SCIENCE PROFESSIONAL AND TECHNICIANS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Life science professionals & technicians (marine)								
Marine biologist/scientist	213107	11[21]	11	4	3			
Fisheries scientist	213107 spec							
Conservation scientist/ marine ecologist	213301	3[22]	2	1				
Biodiversity planner	213310	2[23]	1					
Environmental scientist (including marine pollution specialist)	213302	19[24]	15	6	3		2	Cost of employment cap
Climate change scientist	211205/06[25]							
Life science/biological technician	314101	7[26]	7	4	2			
Environmental technician	314102							
Community workers (coastal monitors)	No code		18[27]					

[21] DEA [3 – biodiversity, remote sensing] , SANParks and SANBI

[22] DEA [1 Science Manager: Research]; SANParks [1] and N.Cape DNEC [1].

[23] DEA [1 Control Environmental Officer – MPAs] and SANBI [1]

[24] SANParks and W.Cape DEA & DP

[25] No code under Life Sciences

[26] DEA [5] and SANParks [2]

[27] Walter Sisulu University – National Water Quality Monitoring Programme

(e) : COMPLIANCE AND ENFORCEMENT OFFICERS

Occupation		OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Compliance & enforcement officers									
Naval architect		214405		2[28]	1				
Ship's Surveyor (various specialisations)		315203	54[29]	43				11	Resignations, transfers & new posts
Marine Certification and Surveillance Manager/Principal Officers[30]		315204	10[31]	9				1	Retirement
Environmental Practices Inspector (EMI)		335906	23[32]	15	4	7		8	Moratorium on filling of posts
Fisheries Officer/ Fisheries Control Officer	National	335912	313[33]	226	4	20		87	Posts frozen till 2023
	Provincial		8[34]	8					
	Municipal		183[35]	183					
Marine/Coastal Monitoring Officers (e.g. water quality, fisheries/scientific observers)		No code	34[36]	0				34	New posts
Marine Law Enforcement Officers (Municipal)		No code	8[37]	4		1		4	Funding/admin shortfalls
Park Rangers (fish/beach/estuary wardens)/Field Officers	National	213307	13[38]	12	2	2		1	Advertised – not filled
	Provincial		70[39]						
	Municipal								

[28] SAMSA
[29] SAMSA
[30] Includes various other "Managers" from SAMSA: Dangerous Goods, Fishing, Boating, Regional, Deputy Principal, Senior Technical.
[31] SAMSA
[32] WCape DEA & DP
[33] DAFF and SANParks (SANParks = Rangers). All vacancies are at DAFF.
[34] Ezemvelo KZN Wildlife, NCape DNEC, CapeNature.
[35] City of Cape Town and Ethekweni (these may be Marine Law Enforcement Officers rather than FCO's).
[36] DEA – 29 Coastal Monitors, 5 Senior Coastal Monitors
[37] Nelson Mandela Metro
[38] SANParks
[39] Ezemvelo KZN Wildlife

(f) : SURVEYORS AND PLANNERS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Spatial Planners								
Urban & regional planners (environmental policy/consent planner in coastal areas)	216401	2[40]	1	1			1	
Marine spatial planners	216403	1[41]	1					
Cartographer (marine)	216501	8[42]	8					
Hydrographer	216502 spec	1[43]	1					

(g) : INFORMATION TECHNOLOGY PRACTITIONERS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Information technology practitioners (marine applications)								
ICT systems/software/programme/applications analyst/developer	251101/ 251201-03/ 251301-02/ 251401	3[44]	3					
Database designer & administrator	252101	2[45]	1	1				
Systems administrators	252201	2[46]	2					
ICT technicians	351101/201/301	5[47]	3				2	1 resignation, 1 dismissal
GIS Technicians (marine)	351303	2[48]	2					

[40] SANParks (this could rather be a Biodiversity Planner)
[41] DEA – 1 Control Environmental Officer - MSP
[42] SA Navy
[43] SA Navy
[44] SAMSA
[45] SAMSA + DEA (1 Specialist Scientists – Data Management)
[46] SAMSA
[47] SAMSA
[48] DEA (Oceans & Coasts) and Ezemvelo KZN Wildlife.

(h) : LEGAL PROFESSIONALS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Legal professionals								
Attorney (marine/environmental law attorney)	261101 spec	2[49]	2	1				
Attorney (maritime/shipping law attorney)	261101 spec	3[50]					3	New positions
Administrative lawyer (contracts advisor/analyst/researcher)	261102							
Legal Manager (marine/maritime with management responsibilities)	261107	3[51]	3	1				
Legal specialist (satellite/earth observation systems)[52]	No code							

(i) : SOCIAL PROFESSIONALS

Occupation	OFO Code	# of posts	Current # employed	# of women	# of youth (< 35yrs)	# with disabilities	Current # of vacancies	Reason for vacancy (e.g. post frozen)
Social professionals								
Sociologist (social impact assessments/sustainable livelihoods etc)	263204	1[53]	1					
Economist (natural marine resources/ fisheries)	263101 spec							
Economist (marine environment)	263101 spec							

[49] DEA (Oceans & Coasts – also support DEA:EP)
[50] SAMSA
[51] DEA (Oceans & Coasts – also support DEA:EP) and SAMSA.
[52] DST - check
[53] CoCT

10.6 Predictions

(a) Managers Occupation	OFO Code	Current # of posts [54]	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Senior government official (Chief Directors, Directors)	111204	11		
Senior government manager (HODs, DGs, DDGs etc)	111207	1	1[55]	
Harbour Manager	132407	?		Demand will increase with increase in number of small/fishing harbours
Maritime search & rescue mission personnel	132410	10		
Information technology managers (data/applications/systems)	133102 – 133106		Manager needed for OCIMS	
Environmental manager (wildlife management/protection services manager/species protection/pollution & waste/conservation)	134901			
MPA Managers	No Code	1	14[56]	Will increase with increase in number of MPAs
Coastal zone managers	No code			Needed to fulfil ICM Act responsibilities
Laboratory manager	134902			
Specialist Advisors	No code	3?[57]		

[54] Numbers reflect only those in organisations for which predictions were made.

[55] SANBI

[56] Ezemvelo KZN Wildlife

[57] Oceans Secretariat

(b) Physical & Earth Science Professionals Occupation	OFO Code	Current # of posts	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Physicist (nanotechnology engineering technologists)	211101			
Meteorologist	211201		1[58]	
Climate change scientist	211205/06			Demand should increase as impacts of climate change worsen
Chemist (analytical/laboratory chemist)	211301			
Marine Geologist	211401 spec	0	10 (5 yrs), 50 (10 yrs), 100 (20 yrs)[59]	
Oceanographer (physical or other)	211407			
Marine scientist	211402 spec			
Air pollution analyst (air quality technician)	213305	4		
Water quality analyst (water quality technician)	213306		10 (min)[60]	

(c) Life Science Professionals & Technicians Occupation	OFO Code	Current # of posts	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Marine biologist	213107	2	4[61]	
Fisheries scientist	213107 spec			
Conservation scientist/ marine ecologist	213301			
Biodiversity planner	213310			
Environmental scientist (including marine pollution specialist)	213302			
Climate change scientist	211205/06[62]			
Life science/biological technician	314101			
Environmental technician	314102			

[58] eThekwini Municipality
[59] UKZN
[60] For National Pollution Laboratory
[61] SANBI
[62] No code under Life Sciences

(d) Compliance & Enforcement Officers Occupation		OFO Code	Current # of posts	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Naval architect		214405	2	7[63]	May increase with growth in SA shipping Register, ship building industry etc
Ship's Surveyor (various specialisations)		315203	54		
Marine Certification and Surveillance Manager/Principal Officers[64]		315204	10		
Environmental Practices Inspector (EMI)		335906	23[65]		
Fisheries Officer/ Fisheries Control Officer	National - DAFF	335912	270		
	Provincial		8		
	Municipal		181[66]		
Marine/Coastal Monitoring Officers (e.g. water quality, fisheries/scientific observers)		No code	34		
Marine Law Enforcement Officers (Municipal)		No code	8		
Park Rangers (fish/beach/estuary wardens)/Field Officers	National	213307	13		Likely to increase with increased number of MPAs
	Provincial		70		
	Municipal				

(f) Surveyors and Planners Occupation	OFO Code	Current # employed	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Urban & regional planners (environmental policy/consent planner in coastal areas)	216401	1		
Marine spatial planners	216403	0	6[67]	Dependent on approach to implementation of MSP Act – may also be a demand at provincial & local government levels
Cartographer (marine)	216501	8		
Hydrographer	216502 spec	1		

[63] SAMSA

[64] Includes various other "Managers" from SAMSA: Dangerous Goods, Fishing, Boating, Regional, Deputy Principal, Senior Technical.

[65] WCape DEA & DP

[66] City of Cape Town

[67] DEA, SANBI, SANParks

(g) IT practitioners Occupation	OFO Code	Current # employed	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
ICT systems/software/programme/applications analyst/developer	251101/ 251201-03/ 251301-02/ 251401			Will be required to administer and maintain OCIMS
Database designer & administrator	252101			
Systems administrators	252201			2[68]
ICT technicians	351101/201/301			
GIS Technicians (marine)	351303	1[69]		3

(h) Legal Professionals Occupation	OFO Code	Current # of posts	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Attorney (marine/environmental law attorney)	261101 spec	3	6[70]	
Attorney (maritime/shipping law attorney)	261101 spec	5		
Administrative lawyer (contracts advisor/analyst/researcher)	261102			
Legal specialist (satellite/earth observation systems)[71]	No code			

(i) Social professionals Occupation	OFO Code	Current # employed	Predictions – 2018: On-line survey & interviews	Predictions – 2018: reports, strategies etc
Sociologist (social impact assessments/sustainable livelihoods etc)	263204	0	2[72]	
Economist (natural marine resources/ fisheries)	263101 spec			
Economist (marine environment)	263101 spec			

68 DEA (OCIMS)
69 DEA (OCIMS)
70 DEA
71 DST
72 DEA

10.7 Changes to OFO codes in 2017 version

Occupations	Codes proposed by MPG skills WG	Descriptors	OFO Codes (2017)
Marine Atmospheric Scientist	211202	New: Studies the physics and dynamics of the atmosphere to increase understanding of weather and climate, and to forecast changes in the weather and long-term climatic trends.	No specific code, but an Atmospheric scientist is listed as a specialisation of Meteorologist (211201).
Climate Change Scientist	211203	New: Evaluate scientific data carries out research on the climate to create predictive models of likely changes in the earth's climate, and concomitant impacts on natural ecosystems and civilisation	211205 and 211206 are both listed as Climate Change Scientists with the same descriptors. There is no code 211203.
Marine Geologist	211408	Studies the composition, structure and other physical attributes of the earth to increase scientific knowledge and to develop practical applications in fields such as mineral exploration, civil engineering, environmental protection and rehabilitation of land after mining.	No specific code, but a Marine Geologist is listed as a specialisation of Geologist (211401)
Statistical Ecologist	212104	New: Designs and applies statistical principles and techniques for collecting, organising and interpreting quantifiable data, and uses statistical methodologies to produce statistical reports and analyses for government, commercial and other purposes.	No specific code, but a Statistician (212103) has several relevant specialisations: population analyst (e.g. fisheries), statistical GIS specialist and statistical modeller.
Biodiversity Planner	213310	New: Identifies geographic area of biodiversity importance and develops strategies and tools that support management of these areas to promote persistence of biodiversity patterns and processes.	Same code but the new descriptor is more appropriate.
Marine Ecologist	213311	Studies the anatomy, physiology, functions, characteristics, behaviour and environments of all forms of life living in the sea and connected water bodies.	No specific code, but a Marine Ecologist is listed as a specialisation of a Conservation Scientist (213301). This is not necessarily appropriate as it includes a regulatory function.

Marine Protected Area Manager	213312	New: (as per Park Ranger): Controls state or national parks, scenic areas, historic sites, nature reserves, recreation areas and conservation reserves in accordance with authorised policies and priorities.	There is no such code, but it could be covered by 134901 – Environmental Manager, which includes various specialisations e.g. Wildlife Management/ Protection. However, the descriptor is not appropriate.
Environmental Impact Assessor	214303		No such code, but should anyway rather be a specialisation – or task - of one or more other occupations e.g. Environmental Scientist.
Maritime-Law Attorney	261107	Provides legal advice, prepares and drafts legal documents and conducts negotiations on behalf of clients on matters arising in the field of maritime law.	This code is now used for a Legal Manager (see below), while Maritime Law Attorneys, Marine Law Attorneys and Environmental Law Attorneys are now all specialisations of Attorney (261101**).**
Marine-Law Attorney	261108	Provides legal advice, prepares and drafts legal documents and conducts negotiations on behalf of clients on matters arising in the field of marine law.	This is a specialisation of Attorney (261101**).**
Maritime-Law State Law Adviser	261109	Provides legal advice, prepares and drafts legal documents for the State on matters arising in the field of maritime law.	No such code – covered by Attorney specialisations.
Marine-Law State Law Adviser	261110	Provides legal advice, prepares and drafts legal documents for the State on matters arising in the field of marine law.	No such code – covered by Attorney specialisations.
Environmental-Law Attorney	261111	Provides legal advice, prepares and drafts legal documents and conducts negotiations on behalf of clients on matters arising in the field of environmental law.	This is a specialisation of Attorney (261101**).**
Environmental-Law State Law Adviser	261112	Provides legal advice, prepares and drafts legal documents for the State on matters arising in the field of environmental law.	No such code – covered by Attorney specialisations.

Legal Manager	261107	New: Provides legal advice and /strategic direction on the interpretation and application of relevant legislation, investigations into proposed merger and alleged and competitive conduct and the implementation of business plans for the legal service division. Responsible for management of the Legal Services Division. Oversee the allocation of Divisional resources and tasks. Conduct regular feedback and status meetings with Legal Services Division staff.	New occupation.
Biodiversity Information Management Specialist	262203	Designs, implements and administers record systems and related information services, to support efficient access, movement, updating, storage, retention and disposal of files and other organisational records.	No such code, and the previous code was inappropriate as it falls under Minor Group 262 which is libraries & museums. This should rather be a specialisation under an IT occupation.
Resource Economist	263102	Performs economic research and analysis; develops and applies theories about production and distribution of goods and services, and people's spending and financial behaviour; and provides advice to governments and organisations on subjects relating to economic policies.	This descriptor is applicable to an Economist in general (263101), one of the specialisations of which is Resource Economist. 263101 is therefore more appropriate.

10.8 University qualifications & graduate numbers

Legal qualifications: degrees, diplomas and post-graduate qualifications

Institution: Nelson Mandela University – Faculty of Law									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Department of Public Law	Higher Certificate in Criminal Justice	190599	1 year	NSC, Languages (49%), Maths (30-39%) or Maths Lit (50-69%)	98	79	124	50	37
	Master of Law (Public Law)	1205	1 year	60% for LLB	5	9	17		1
	Doctor of Law (Public Law)	1205	2 years	60% for LLM	1	4	12		
Institution: University of Cape Town – Faculty of Law									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Shipping Law Unit	Post graduate Diploma in Law - Shipping Law	120313	1 year	Law degree; enrolled advocate; a Master's cert & approp experience	2	3	1		
	Masters of Laws - Shipping Law	120313	1 year	LLB	24	21	9	13	11
Institute of Marine & Enviro Law	Postgraduate Dip in Marine and Environmental Law	120510	1 year	LLB	1	Discontinued?			
	Masters of Laws - Marine and Environmental Law	120510	1 year	LLB	12	3	7	7	
Institution: University of KwaZulu-Natal – College of Law and Management Studies									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Unit of Maritime Law and Maritime Studies	LLM in Maritime Law	120301 (mercantile law general)	1 year	Bachelor degree in related field, postgraduate diploma in related field	44	36	38	2	5
School of Law	LLM in Environmental Law				41	23	24	6	2
Institution: UNISA									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Law	BA in Criminology	98681		NSC					

Institution: University of Fort Hare									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Faculty of Social Sciences & Humanities	Hons in Criminology								
	Masters in Criminology								
	Doctorate in Criminology								

Life Sciences

Institution: Cape Peninsula University of Technology – Applied Sciences									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Nature Conservation	National Diploma in Nature Conservation	010103 / 041701/ 131207	3 years	ECP 26 with Math	174	113	31	40	29
Nature Conservation	Diploma Nature Conservation		3 years	Appropriate Matric pass		57	7		
Nature Conservation	B Tech in Nature Conservation		1 year	Diploma	28	28	29	10	15
Nature Conservation	Master in Nature Conservation		1 year	Appropriate degree		7	10		
Nature Conservation	MTech in Nature Conservation		1 year	Appropriate Honours degree	12	4	2	4	1
Marine Sciences	National Diploma in Marine Sciences	131202 (Marine Biology)	1 year	APS SCORE =32; ENG(HL OR FAL)=4; MATH=4;LIFE SCI=4; PHYSICAL SCI=4	102	123	15	9	19
Institution: Mangosuthu University of Technology – Faculty of Natural Sciences									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Nature Conservation	National Diploma in Nature Conservation		3 years	NSC	165	151	137	43	42
Nature Conservation	Advanced Diploma in Nature Conservation		1 year	National Diploma	33	37	34	25	22

Nature Conservation	BTech in Nature Conservation (phasing out)		1 year	National Diploma	7	4	1	7	3
Nature Conservation	Postgraduate diploma in Nature Conservation		1 year	National Diploma	15	14	14	10	14
Nature Conservation	Master in Nature Conservation		1 year	BTech	0	8	9	0	6
Institution: Nelson Mandela University – Faculty of Science									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
School of Environmental Sciences	BSc Honours in Zoology	130601	1 year	BSc	8	8	8	8	8
Ocean Sciences	MSc (Biological Oceanography)	131202	1 year	Appropriate BSc	2	7	5	1	2
Institution: Rhodes University – Faculty of Science									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Department of Ichthyology and Fisheries Science	BSc (Honours) in Ichthyology and Fisheries	130399	1 year	Appropriate BSc				12	12[73]
	MSc in Ichthyology	130601	1 year	BSc (Honours)					
	PhD in Ichthyology	131202	2 year	Appropriate MSc					
Institution: Stellenbosch University – Faculty of Science									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Department of Botany and Zoology	BSc (Hons) Biodiversity and Ecology	130101	1 year	Appropriate BSc	19	16	19	19	16
	MSc in Zoology	130601	1 year	BSc (Honours)	11	5	21	11	5
	MSc in Zoology/Botany	130301	1 year	BSc (Honours)	9	6	11	9	6

[73] Average – K.Cochrane *pers.comm.*

Institution: University of Cape Town – Faculty of Science									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Department of Biological Sciences	BSc Marine Biology	131202	3 years	NSC - Life Science with at least 60%	85	79	79	27	26
	BSc Marine Biology Hons	131202	1 year	BSc Marine Biology	7	15	1	7	15
	MSc/MPhil -Applied Marine Biology/ Ocean Sciences	131202	2 years	Relevant Honours Degree of equivalent		6	6		
	MSc/MPhil – Conservation Biology	131202	2 years	Relevant Hons degree	15	20	17	9	4
Institution: University of KwaZulu-Natal – College of Agriculture, Engineering and Science									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
School of Life Sciences	BSc Major in Marine Biology	131202	3 years	NSC degree pass with Maths, English, Life Orientation and Agricultural Science Physical Science/Life Science at level 4.					
School of Life Sciences	BSc Marine Biology Honours	131202	1 year	A minimum of 55% must be achieved at BSc level to gain admittance to Honours	12	12	10	8	12
Institution: University of South Africa – Faculty of Science									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Department of Biological Sciences	Postgraduate Diploma in Nature Conservation		1 year	Appropriate diploma					

Natural Resource Economics

Institution: University of Cape Town									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Economics	MCom in Applied Economics (Natural Resource Economics)	040407			34	30	12	7	6
Institution: University of KwaZulu-Natal									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Economics	Master of Economics (Environmental and Natural Resource Economics)	040407							
Institution: University of Pretoria									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Economics	MSc in Environmental Economics	040499			3		2		
	PhD in Environmental Economics	040499			3	5	3		

Physical and Earth Sciences

Institution: Cape Peninsula University of Technology									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Applied Science	BTech Oceanography	140607	1 year	National Diploma in appropriate subject	2	20	14	1	16
	National Diploma in Oceanography	140607	3 years	NSC	9	2	1	5	
	MTech Oceanography	140607	1 year (min)	BTech or equivalent	7	9	7	1	
Institution: Nelson Mandela University – Faculty of Science									
Unit/department	Qualifications offered	CESM code	Qualification length	Entry requirements	**# of students enrolled**			**# of students graduated**	
					2016	2017	2018	2016	2017
	MSc in Geology	140601	1 year	Appropriate Honours degree	5	12	8	8	8
	MSc in Chemical and Physical Oceanography	140607	1 year	Appropriate Honours degree		1	2		
	PhD in Geology	140601	2 years	MSc degree	2	1	1		
	PhD in Oceanography	140607	2 years	MSc degree	4	3	8		
Institution: University of Cape Town									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Oceanography	BSc Oceanography & Atmospheric Science	140607	3 years	Related BSc (60% for Major)	100	101	79	25	38
	BSc (Hons) - Ocean and Atmosphere Science		1 year	Relevant BSc degree	18	10	10	17	9
	MSc/MPhil in Applied Ocean Studies	140607	2 years	Relevant Honours degree		5	6		
	MSc/MPHil in Ocean and Atmosphere Science		2 years	Relevant Honours degree	8	14	17	1	
	MSc/MPhil in Physical Oceanography	140607	2 years	Relevant Honours degree	7	7	3	1	3
	MSc/MPhil in Ocean and Climate Science	140607	2 years	Relevant Honours degree	3	1		2	1
Geology	MSc/MPhil in Geology		2 years	Relevant Honours degree	28	23	16	10	3

Institution: University of KwaZulu-Natal									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**[74]
	BSc Marine Geology	140699	3 years	NSC					Ave 70
	BSc (Hons) Marine Geology	140501/140 504	1 year	Relevant BSc					4
	MSc/ PhD in Marine Geology (research)								2 MSc /1PhD
Institution: University of Pretoria									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Meteorology	140304	1 year	BSc in Meteorology or equivalent					
	MSc Meteorology	140304	2 years	BSc Hons and 65%					
	PhD Meterology	140304	2 years	MSc and 75%					
Institution: University of Stellenbosch									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) in Earth Science	140501	1 year	BSc and 65% for geology	24	26	21	22	26

[74] Numbers provided by Prof. A. Green

e) Maritime Studies

Institution: Nelson Mandela University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Development Studies	Postgraduate Diploma in Maritime Studies				20	8	2	11	3
Institution: Durban University of Technology									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Maritime Studies	National Diploma Maritime Studies				260	215	65	59	75
	National Diploma Maritime studies (Foundation)				41	30	13		
	Diploma Nautical Studies				61	134	243		
Institution: CPUT									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Maritime Studies	National Diploma Maritime Studies		3 years	ENGLISH=4;MATHS=4;PHYSICAL SCIENCE=4	195	166	62	31	31
Institution: UKZN									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Unit of Law & Maritime Studies	Postgraduate Diploma in Maritime Studies		1 year	Undergraduate degree in relevant field or Certificate of competency from recognised maritime agency	39	37	30	8	16
	Masters of Commerce in Maritime Studies	120301	1 year	Bachelor degree or Certificate of competency - maritime agency	59	62	42	5	5

Applied Mathematics and Statistics

Institution: Nelson Mandela University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc Honours - Applied Mathematics	150210	1 year	Appropriate BSc		1	1		1
	MSc (Mathematical Statistics)	150302	1 year	Appropriate Honours degree	5	6	5		2
	PhD Mathematical Statistics	150302	2 years	Appropriate MSc	2	2	4		
	PhD Applied Mathematics	150201	2 years	Appropriate MSc			2		
Institution: University of Cape Town									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Applied Mathematics	150201	1 year	Relevant BSc	8	5	7	7	4
	BSc (Hons) Statistical Science	150399	1 year	Relevant BSc	1	7	10	1	7
	MSc/MPhil in Statistical Ecology	150399	1 year	Relevant Hons degree	5	5	4	1	1
Institution: University of Western Cape									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Statistical Science	150399	1 year	Relevant Bachelors					
	MSc Bioinformatics		1 year	Relevant Honours					
	MSc Statistical Science	150301	1 year	Relevant Honours					

Information technology

Institution: Nelson Mandela University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Dept of Geosciences	BSC (Hons) in Geographical Information Systems	1405 - No code	1 year	Related BA/BSc degree, 60% for Geography III	12	10	5	10	8
Institution: Stellenbosch University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Department of Earth Sciences	BSc Honours Geoinformatics	1405 - No specific code	1 year	Related BSc (60% for Major)	9	7	9	9	7
	BA Honours Geographic Information Systems		1 year	Related BA degree (60% for GIS Major)		1	1		1
Institution: University of Cape Town									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Faculty of Engineering and the Built Environment	BSc in Geoinformatics	1405 - No code	3 years	NSC, Senior Certificate and faculty entrance requirements	22	33	44	4	1
	BSc Honours Geographic Information Systems	1405 - No code	1 year	Related BSc degree	8	25	31	5	7
Institution: University of Pretoria									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Faculty of Natural and Agricultural Sciences	BSc (Honours) Geoinformatics	1405 - No specific code	1 year	BSc in Geoinformatics or equivalent and 60% or more in relevant subjects	24	24	14	14	21
	MSc Geoinformatics		2 years	BSc Hons and 65%	15	20	18	1	7
	PhD Geoinformatics		2 years	Masters and 75%	21	17	16	4	1
Institution: University of KwaZulu-Natal									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc GIS and Earth Observation	140699	3 years	NSC					

Institution: University of Fort Hare									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Dept of GIS & Remote sensing	BSc Honours in Applied Remote Sensing & GIS								
	MSc in Applied Remote Sensing & GIS								

(a) Environmental management

Institution: Cape Peninsula University of Technology									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Applied Sciences	B Tech: Environmental Sciences		1 year	Diploma	42	44	29	36	31
Applied Sciences	Diploma Environmental Management	140504	3 years	APS SCORE =30; ENG(HL OR FAL)=4; MATH=4;LIFE SCI=4; PHYSICAL SCI=4		76	7		
Applied Sciences	Master of Environmental Management	140504	1 year	Honours degree		16	8		
Applied Sciences	M Tech Environmental Management	140504	Part time, 2 years	B Tech	39	29	18		
Institution: Rhodes University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Environmental Management	140504	1 Year	Appropriate Bachelors					
	BA (Hons) Environmental Management	140504	1 year	Appropriate Bachelors					
	BSocSci (Hons) Environmental Management	140504	1 year	Appropriate Bachelors					
Institution: Stellenbosch University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Geography and Environmental Studies	140503	1 Year	BA in Geography (60% for geography major)	16	25	27	16	24
	Postgraduate Diploma in Environmental Management	140504	1 year	Appropriate bachelor degree	30	36	45	18	16

	MPhil in Environmental Management	140504	1 year	Appropriate Honours degree	25	31	25	3	3
Institution: University of Cape Town									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Environmental & Geographical Science	140504	1 year	Appropriate BSc degree	11	10	10	11	8
	MSc/Mphil in Environmentl and Geographical Science	140503	2 years	Appropriate Honours degree	18	23	22	8	4
Institution: University of Johannesburg									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	MSc/MA Environmental Management	140504	1 year	Honours degree					
Institution: University of KwaZulu-Natal									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Environmental Science)	140503	3 years	NSC	444	442	356	105	134
	BSc (Hons) Geography and Environmental Management	140501/140504	1 year	Relevant BSc	25	23	16	28	24
	MSc (Environmental Sci)	140503	1 year	Appropriate Honours	75	61	33	27	27
	Masters in Environmental Management	140504	1 year	BSc (Hons) Environmental Management or similar					
Institution: University of Pretoria									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Geography and Enviro Science	140501	1 year	Appropriate BSc degree and 65% pass	10	18	16	9	15
	MSc Environmental Management	140504	2 years	BSc Hons and 65%	6	12	15	3	3

	PhD Environmental Management	140504	2 years	MSc and 75%		3	3		
	MSc Environmental Management	140504	1 year	BSc Hons and 65%	12	10	2		
	PhD Environmental Management	140504	2 years	MSc and 75%	3	3	3		
Institution: University of South Africa									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BA/BSc in Environmental Management	140504	3 years						
	BA/BSc (Hons) in Environmental Management	140504	1 year						
	BSc (Hons) Environmental Monitoring and Modelling		1 year						
	MSc in Environmental Management	140504	1 year						
	PhD in Environmental Management	140504	2 years						
Institution: University of Western Cape									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc Environmental and Water Science	140605	1 year						
	MSc Environmental and Water Science	140605	1 year						
Institution: University of Witwatersrand									
Unit/department	Qualifications offered	CESM code	Qualification length	Entry requirements	**# of students enrolled**			**# of students graduated**	
					2016	2017	2018	2016	2017
	BSc Zoology and Environmental Management	140504	3 years	NSC					
	BSc Geography and	140504	3 years	NSC					

	Environmental Management								
Institution: Walter Sisulu University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Hons) Environmental Studies		1 year	Relevant BSc					
Institution: Zululand University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BSc (Environmental Planning and Development)	190301	3 years	NSC 30 points					
	BA in Environmental Planning and Development		3 years	NSC 26 Points					

Public administration, management and governance

Institution: Cape Peninsula University of Technology									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Business and Management Sciences	National Diploma Public Management	190301	3 years	NSC APS score 26	905	867	238	207	202
	Diploma in Public Administration	190301	3 years				30		
	BTech Public Management	190301	1 year	National diploma	121	130	89	106	125
	MTech Public Management	190301	1 year	BTech	34	23	15	7	2
	DTech Public Management	190301	2 years	MTech	3	5	4	1	

Institution: Durban University of Technology									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Public Management and Economics	Higher Certificate: Public Administration				184	275	62+10 (Durban +PMB)		417
	National Diploma Public Administration with specialisations in Public Management	190301	3 years	NSC/Senior Certificate with English (3/D), and Maths (3)/Maths lit (4)	586+503	398+323	206+159	153+134	163+119
	Diploma: Public Admin (Disaster Risk)					46	103		
	Diploma: Public Admin (Local Government)					34+29	85+74		
	Diploma: Public Admin (Public Management)					42+38	93+85		
	BTech Public Management	190301	1 year	relevant diploma	175+149	192+151	153+167	136+134	164+137
	Master of Management Science: Public Administration	190301	1 year	Relevant Btech, Two or more years work experience	28	44	39	2	5
	DTech: Public Management	190301	2 years	MTech	37	50	27	3	4
Institution: Mangosuthu University of Technology									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
Faculty of Management Sciences	National Diploma: Public Management	190301	3 years	NSc	666	791	814	144	145
Institution: Stellenbosch University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BPudAdmin (Hons) BCom in PDM	190301	1 year	Appropriate degree or 4-year diploma or 3-year diploma and 5 years work experience	188	172	208	93	87
	Masters Public Admini	190301	1 year	Appropriate Honours degree.	96	92	95	27	13

Institution: University of KwaZulu-Natal									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	Master of Public Administration	190301	1 year	Relevant Honours degree or Postgrad Diploma	102	87	58	7	21
	Doctor of Public Administration	190301	2 years	Masters degree	22	18	34	1	
Institution: University of Pretoria									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	Badmin(Hons) Public Administration and Management	190301	1 year	Appropriate BSc degree and 65% pass	194	161	128		12
	MAdmin Public Management and Policy	190301	1 year	BSc Hons and 65%			9		
	MAdmin: Public Management	190301	1 year	BSc Hons and 65%	2	1	1	1	
	Mphil Public Policy	190301	1 year	BSc Hons and 65%	12	11	3	2	4
	PhD Public Administration	190301	2 years	MSc and 75%	6	6	1	1	3
	PhD Public Administration and Management	190301	2 years	MSc and 75%			11	1	
Institution: University of South Africa									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	Master of Administration in Public Administration	190301	1 year						
	PhD Administration in Public Administration	190301	2 years						

Institution: Walter Sisulu University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	BAdmin (Hons) Public Affairs		1 year	Relevant degree					
Institution: Zululand University									
Unit/department	**Qualifications offered**	**CESM code**	**Qualification length**	**Entry requirements**	**# of students enrolled**			**# of students graduated**	
					2016	**2017**	**2018**	**2016**	**2017**
	Bachelor of Public Administration (Honours)	190301	1 year	Bachelor of Public Administration					
	Master of Public Administration	190301	1 year	Bachelor of Public Admin (Honours)					

10.9 Short courses

Information Technology:

Institution: Stellenbosch University			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Centre for Geographical Analysis	Introduction to GIS		3 weeks (accredited) 4 days (certificate)
	Introduction to GEOBIA		3 weeks (accredited) 4 days (certificate)
	Introduction to Spatial Analysis		3 weeks (accredited) 4 days (certificate)
	Spatial Data Acquisition		3 weeks (accredited) 4 days (certificate)
	Spatial Data Management		3 weeks (accredited) 4 days (certificate)
	Introduction to Spatial Modelling		3 weeks (accredited) 4 days (certificate)
	Advanced Spatial Modelling		3 weeks (accredited) 4 days (certificate)
Institution: University of Johannesburg			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Dept. Geography, Environmental and Management Science	Introduction to GIS		14 weeks
	Geo-Informatics 1. GIS		14 weeks
	Geo-Informatics 2. Remote Sensing		14 weeks
Institution: University of Pretoria			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Environmental Management and Geophysics	GIS Professional Practice		5 Days
	Advanced Programme in GIS		
	Basic GIS		
	Basic Meteorological Satellite Image Interpretation		
	Programme in GIS		
	Spatial Databases in PostGIS		
	Basic Meteorological Satellite Image interpretation		
Institution: University of South Africa			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Centre of Agriculture and Environmental Sciences	Course in Exploring Geographical Information Systems		6 months

Compliance and Enforcement:

Institution: Nelson Mandela University			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Faculty of Law	Introduction to the Principles of Law Enforcement for Peace Officers (LEPO)		5 days
	Law Enforcement by Peace Officers for Environmental Health Practitioners	091302	5 days
	Introduction to Environmental Management Inspections for EHPs		2 days

Legal Courses:

Institution: University of Cape Town			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
UCT Law @ Work	Legislative Drafting		4 days
Institution: University of Pretoria			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Enterprises: University of Pretoria	Programme in Legislative Drafting		15 weeks, 1 lecture per week
	Short Course in Environmental Law		5 days
Institution: University of South Africa			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Centre of Agriculture and Environmental Sciences	Short Course in Environmental Law and Liabilities for the Regulated Community		6 months
	Short Course in Environmental Law and Environmental Management Legal Enforcement		6 months

Environmental management /governance

Institution: Nelson Mandela University			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Faculty of Sciences	Management of Estuaries in South Africa		2 or 3 days
Institution: University of Cape Town			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
	Large Marine Ecosystems: Assessment and Management (on-line		
Institution: Rhodes University			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
	Introduction to Environmental Impact Procedures		
Institution: University of Pretoria			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Environmental Management and Geophysics	Water Quality Management and Effluent Treatment Water Analysis and Monitoring		5 days 5 days
	Environmental Compliance Monitoring and Enforcement		
	Environmental Impact Assessment Administration Training Course		
	Environmental Management and Regulation		
	Introduction to Air Quality Management		
	Programme in Environmental Management		

Institution: International Ocean Institute – Africa Region			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
IOI-SA	Course in Ocean Governance for Africa		4 weeks
Institution: WWF-SA			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
WWF-SA	MPA Training Responsible fisheries training		
Institution: WIOMSA			
WIOMSA	MPA Training		

Management and policy development

Institution: Nelson Mandela University			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Faculty of Business and Economic Science	Management and Supervisory Skills		3 days
Leadership Academy	Project Management		2 days
	Management skills for 21st Century		2 days
Institution: University of Pretoria			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
General Management and Leadership Development	Short Course in Effective Stakeholder Management		5 days
Institution: University of South Africa			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
Centre for Public Administration and Management	Middle Management Development Programme for Local Government		6 months
	Programme in Local Government Management		1 year
	Programme in Accelerated Public Administration and Management		6 months
Centre for Applied Information and Communication	Short Course in Practical Guidelines in Building Stakeholder Relations		6 months
Institution: University of Stellenbosch			
Dept/Centre	**Training and/or short course offered**	**CESM code**	**Course length**
School of Public Leadership	Public Policy Analysis, Development and Implementation		3 days
University of Cape Town			
	Public Management and Governance		8 weeks on-line course

10.10 Proposed changes to the OFO codes

Occupation	OFO Code	Specialisations	Comments and recommendations
Compliance & enforcement officers			
Ship's Surveyor	315203	Marine Engineer Surveyor Nautical Information Advisor Nautical Surveyor	Specialisations need to be reviewed in line with SAMSA Job Descriptions: Surveyors include (Radio, Deck, Engine, Small Vessel, Fishing and Boating Officers).
Marine Certification and Surveillance Manager	315204		SAMSA does not employ anyone in this category and based on the tasks this would appear to be the same as a Ship's Surveyor but with management responsibilities. This would be equivalent to the post of a Principal Officer at SAMSA. Consideration should therefore, be given to changing the name of this occupation as well as changing it to a management level code.
Environmental Practices Inspector	335906		There is no code for Environmental Management Inspectors (EMI's) as provided for in NEMA legislation. It seems that this would be the closest of the current codes, although none of the tasks described are directly relevant and even the descriptors seem inappropriate. So, either a new code could be created for EMI's, or this code could be amended to include various specialisations and new descriptors and tasks.
Fisheries Officer	335912	Fisheries Investigator Fisheries Inspector	This code would seem to be appropriate for the Fisheries Control Officers appointed in terms of the MRLA. However, the job titles for most FCOs vary – even DAFF calls them Marine Conservation Officers. Moreover, while the descriptor is appropriate, none of the tasks described for this Unit Group cover FCO's.
Marine Monitoring Officers (e.g. water quality, fisheries observers)	No codes		This occupation seems to have been removed (was previously 335917). It is suggested that it be re-instated as Coastal and Marine Monitor (DEA have recently advertised such positions).
Marine Law Enforcement Officers	No codes		This is a municipal level occupation (City of Cape Town). Consideration should be given to adding it.
Information technology			
GIS Technicians	351302	Numerous specialisations – none marine	The descriptors for this are the same as for the Marine GIS technician (351303). So either the descriptors for the latter should be changed, or a Marine GIS technician should be a specialisation of 351302 (preferred). The specialisations of 351302 in any event need to be reviewed as there are duplications.
Marine GIS technician	351303		See above. At present there are no specific qualifications for a Marine GIS Technician.
Biodiversity Information Management	No code Proposed		The occupation Biodiversity Information Management (previously OFO 262203) has been removed in the 2017 OFO. But it was

	252903		misplaced anyway (262 is libraries, museums etc.), and should actually be placed in this IT grouping as it refers to database management (i.e. a database containing biodiversity information). Recommended as a new occupation under 2529. Marine could be a specialisation.
Legal professionals			
Attorney	261101	Maritime Law Attorney Marine Law attorney Environmental Law Attorney	Shipping Law and Space Law should be added as a specialisations
Administrative lawyer (advisor/analyst/researcher)	261102	Enforcement Advisor Enforcement Analyst Law/legal researcher	Add the following tasks: • Contracts btwn relevant department & service providers ((e.g. vessel management); • Legal opinions on external legislation; • Review/advice on decisions when department is sued.
Legal Manager	261107		Should have the same specialisations as 261101
Life science professionals & technicians (marine)			
Marine biologist	213107	Fisheries analyst Fisheries biologist Aquatic biologist Fisheries researcher Fisheries scientist	These specialisations are not consistent with the descriptor or tasks. It is proposed that a new occupation - namely Fisheries Scientist – be added and these specialisations be moved to this new code – except for aquatic biologist. Additional specialisations that could be added to Marine biologist include marine ecologist, environmental impact assessor; marine mammal specialist; seabird specialist etc.
Fisheries scientist	Proposed code: 213112 OR 213206	Above specialisations – except aquatic biologist – to be transferred here as well as Fisheries Advisor from below.	A new descriptor and tasks would need to be developed. Fisheries Science is linked to the management of marine living resources and requires special skills.
Conservation scientist	213301	Marine ecologist Conservancy Advisory Scientist Fisheries Advisor Conservation Officer Ecological Researcher Species Protection Officer	With regards the specialisations, it is proposed that Fisheries Advisor and Marine Ecologist be removed (see above) and Biodiversity Planner and Environmental Impact Assessor be added.
Environmental scientist	213302	Environmental Consultant Environmentalist Environmental Research Scientist Environmental Advisor	These specialisations should be reviewed as the distinction between them is unclear. On the other hand, it is proposed that Marine Pollution Specialist and Air Pollution Specialist be added. The tasks should similarly be reviewed.

		Environmental Office Environmental Auditor Climate Change Analyst Environmental Waste Officer	
Climate change scientist	No code under Life Sciences Proposed: 213303		Although there are 2 codes for Climate Change scientists under Physical and Earth Sciences - and a specialisation under 213302 above – it is proposed that a new Occupation be added here given that climate change has become, and will continue to be, a major threat to the marine environment. These scientists would primarily be concerned with the impacts of climate change on marine biodiversity.
Air pollution analyst	213305	Air quality technician	Given that the specialisation here says "technician", it is suggested that this should fall under 3 – Technicians. Further, that the term analyst implies that the occupation relates to the chemical analysis of air pollutants, which suggests that it should be transferred to the Physical and Earth Sciences and could perhaps be a specialisation under Chemical/analytical technicians. At the same time, someone who studies the biological impacts of air pollution, could be considered as a specialisation under Environmental Scientist (see above).
Water quality analyst	213306	Water quality technician	The same argument as for air quality technician applies to this occupation.
Park Ranger (fish/beach/estuary wardens)	213307		The listed tasks do not adequately cover this occupation.
Biodiversity Planner	213310		Propose that this be a specialisation of a Conservation Scientist (see above).
Managers (those dealing with marine protection & governance only)			
Harbour Manager	132407		Consideration should be given to splitting into two separate occupations: Managers of Commercial Ports (Port Managers?) and Fishing/Small Harbours (Harbour Masters? Tasks could be improved.
Environmental manager (wildlife management/protection services manager/species protection/pollution & waste/conservation)	134901	Wildlife Management/Protection Services Manager Species Protection Manager Pollution and Waste Manager Conservation Science Manager	The OFO description for this occupation suggests that this manager addresses internal operations of an organisation to ensure they comply with environmental legislation. However, the specialisations include occupations related to the management of wildlife, protected areas etc. It is suggested that there be three separate occupations: i) Environmental Compliance Manager (for organisations); ii) Protected Areas Managers – of which MPA Managers could be a specialisation;

			iii) Coastal Zone Managers. The descriptions and tasks would then need to be amended to be consistent. In fact, perhaps the whole Unit Group 1349 needs to be revisited and a specific Unit Group for Environmental Managers should be created.
MPA Managers	No code		The MPG Skills WG proposed this occupation be allocated a code under Life Science Professionals, namely 213312. However, it does not appear to have been included. A revised recommendation is shown above under Environmental Manager.
Coastal Zone Managers	No code		See above.
Laboratory manager	134902		See above, given that this occupation falls into the same Unit Group as Environmental Manager but comprises very different responsibilities and requires different qualifications.
Fisheries manager	No code		Should be added as a new occupation. Requires multi-disciplinary skills in fisheries science, economics, social aspects and regulatory framework.
Marine spatial planners			
Urban & regional planners (environmental policy/consent planner in coastal areas)	216401	Environmental policy/consent planner Natural Resource Management Officer/Planner	It is suggested that the Unit Group (2164) be changed from Town and Traffic Planners to the more generic Urban and Regional Planners (which could then accommodate MSP - 216403). The Occupation 216401 should be changed to the more specific Town and Traffic Planners
Map maker/cartographer	216501		Propose Marine Cartographer as a specialisation
Mathematicians & statisticians (marine applications)			
Statistician	212103	Population analyst Statistical GIS Specialist Statistical Modeller	Propose adding Marine Resource Assessment as an additional specialisation
Natural resource economist			
Economist	263101	Resource Economist Environmental economist	Propose adding Natural Resource Economist and Fisheries Economist as additional specialisations
Physical & earth science professionals & technicians (marine applications)			
Geologist (petroleum/mining/exploration geologist)	211401	Petroleum geologist Geological Oceanographer Environmental geologist Marine geologist Exploration geologist	
Geophysicist	211402	Geophysical scientist Hydrologist Physical Oceanographer	Physical oceanographer should be a specialisation of Oceanographer – not geophysicist Marine scientist should be removed – is a multi-disciplinary

		Seismologist Marine Scientists	occupation (biol/geol, chem/physical). Could be considered as a new occupation.
Oceanographer	211407		See above
Hydrographer (listed as a specialisation of Surveyor)	216502	Hydrographic Survey Advisor	Hydrographers require specialised training and should perhaps be an occupation in their own right.

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