ABU DHABI STATE OF ENVIRONMENT REPORT 2017

MARINE WATER QUALITY

LEAD AUTHOR – AZZA AHMED NASSER AL RAISI
Assistant Scientist – Marine Water Quality
Environment Quality
Environment Agency – Abu Dhabi
Population growth and economic development are driving a change in the state of marine water quality. Coastal development, industrialisation and tourism and their associated activities are a result of these drivers. The impacts on mainland coastal areas appear to be stable, except for certain confined areas. Previous impacts, measured in terms of fish kills and beach closures, are diminished. However, incidences of harmful algal blooms, which can negatively affect human health and marine organisms, appear to be increasing. Management interventions aim to limit the impacts mentioned above. These include water quality monitoring, proposed ambient marine water and sediment quality limits, and regulation of dredging and industrial discharges.

KEY MESSAGES

**DRIVERS**
Population growth and economic development are driving a change in the state of marine water quality.

**PRESSURES**
Coastal development, industrialisation and tourism and their associated activities are a result of these drivers.

**STATE**
Marine water quality in the Emirate of Abu Dhabi is generally good. However, there is a trend toward increasing eutrophication, primarily from coastal industry and treated wastewater discharges in Abu Dhabi City areas.

**IMPACTS**
The impacts on mainland coastal areas appear to be stable, except for certain confined areas. Previous impacts, measured in terms of fish kills and beach closures, are diminished. However, incidences of harmful algal blooms, which can negatively affect human health and marine organisms, appear to be increasing.

**RESPONSES**
Management interventions aim to limit the impacts mentioned above. These include water quality monitoring, proposed ambient marine water and sediment quality limits, and regulation of dredging and industrial discharges.

6 Introduction

The Arabian Gulf coastline of Abu Dhabi Emirate is approximately 700 km [1], accounting for 76 % of the entire Arabian Gulf coastline in the UAE. The emirate’s numerous desert islands are home to dynamic, diverse and complex ecosystems with rich biodiversity.

The marine environment of Abu Dhabi Emirate contributes significantly to the economic and social wellbeing of the population. Prior to the discovery of oil and gas, the region’s main economic pillars included fishing, pearl diving and sea trade. Today, the emirate’s dependence on coastal activities has expanded, with the development of major recreational, industrial, transportation and tourism activities.

As the coastline continues to be impacted by rapid economic development and urbanisation, protection of marine water quality in the Emirate of Abu Dhabi is essential to maintaining the health of fisheries, recreational beaches, coral reefs, mangrove forests and seagrass beds, as well as iconic native species such as Dugong and Sea Turtles [2, 3, 4].

As a result, preserving Abu Dhabi Emirate’s marine water quality is of particular importance for sustainable coastal development.
6.1 State

The condition of Abu Dhabi Emirate’s marine waters, as reflected in their physical, chemical and biological characteristics, is generally good. However, increasing trends in the concentrations of nutrients (nitrate, phosphate) and chlorophyll-a indicate that eutrophication is an ongoing threat to water quality in the emirate, as it is in many other nations around the world [5, 6]. EAD has taken significant steps to curtail the continued elevation of nutrients in Abu Dhabi Emirate’s marine waters, and the ongoing execution of regulations and limits should significantly abate this issue in the coming years. The implementation of ambient marine water quality limits will help improve and safeguard the health of the emirate’s marine waters. Knowledge gleaned from monitoring programmes (see Map 6.1) will assist in the design and development of strategies for reducing eutrophication.

Elevated Nutrient Levels

Nutrients found in marine waters are essential for sustaining marine flora and fauna. Their presence is beneficial at a certain level; however, an excessive amount of nutrients may lead to serious water issues (see the Impacts section). Since 2011, nutrient levels along the emirate’s coastline are considered to be within an acceptable range. This is with the exception of high concentrations of nutrients which appear to be in confined areas. This is the result of poor circulation, in addition to treated sewage effluent (TSE) disposal into the marine environment. Around 400,000 m³ of TSE per day is disposed into South Mussafah Channel [7]. As a result, the mean concentration of chlorophyll-a in these confined areas is also very high compared to the other locations. This is in addition to the high concentration of nutrients which act as fertilisers for chlorophyll-a containing phytoplankton (algae).

Confined areas have lower water clarity due to poor water circulation and the impacts of industrial discharges, dredging and ship repair activities. These activities cause sediments to become re-suspended in the water, leading to increased turbidity. Poor water clarity can also be caused by high concentrations of nitrate and phosphorus, stimulating algal bloom formation. Maximum water clarity is observed in the largely pristine Marine Protected Areas in the Al Dhafran Region of the emirate.

MAP 6.1 MWQ Monitoring Stations

CONFINED AREAS
S001 Al Salmiyyah Channel
S002 Mussafah South Channel
S003 Mussafah Industrial Area
S004 Mangrove Area - Eastern Corniche
PUBLIC BEACHES
S007 Al Bateen Beach
S008 Emirates Palace Public Beach
S009 Coraline Beach
PORTS AND MARINAS
S0030 Intercontinental Jetty
S0031 Port Maya Zayed
S0032 Rosacea

MARINE PROTECTED AREAS
S0001 Marine
S0011 Al Rasas
S0016 Butina
S0018 Al Yasat
S0022 Reference

DESLINATION PLANTS
S0012 Um Al Nar
S0014 Tawela
S0015 Mirhah

ARABIAN GULF

ABU DHABI EMIRATE


FIGURE 6.2 Monthly Mean Ammonia Levels in Marine Water in Abu Dhabi Emirate, 2011-2015
EAD monitors levels of 38 parameters in selected ecologically important areas to assess eutrophication due to nutrient loading, including: nitrate (see Figure 6.1); phosphate (Figure 6.1); ammonia (Figure 6.2); chlorophyll-a (Figure 6.3); dissolved oxygen (DO) (Figure 6.3); and water clarity (Figure 6.4).

EAD’s monitoring programme uses a Marine Water Quality Index on an ongoing basis to indicate the status of marine water quality related to eutrophication and microbial levels in water and heavy metals in sediment (see Figure 6.5, Figure 6.6 and Figure 6.7 respectively). Scores are grouped into three condition rating categories: ‘Good’ (a score of 75 and higher), ‘Fair’ (a score of 50 to 74), and ‘Poor’ (a score of 0 to 49).

As indicated in Figure 6.6, marine water microbial levels are very low, indicating that beach waters are generally safe for recreational use. However, routine monitoring of all beaches and other recreational areas should be undertaken to ensure that public health is protected.

Generally, eutrophication is less prevalent in waters distant from Abu Dhabi City and industrial areas. However, there are increased nutrient levels due to limited water circulation in confined areas such as channels and marinas (see Figure 6.5).

Additionally, nutrient levels in some Marine Protected Areas have risen slightly in recent years. This phenomenon warrants investigation to ascertain what factors (whether natural or anthropogenic) may be causing such changes at these remote and protected locations, where pristine water quality is generally the norm.

Marine water quality monitoring data collected by EAD over the past 10 years on heavy metal contamination in the water column and sediments, shows that mean metal concentrations in sediment are low and relatively stable or modestly decreasing around Abu Dhabi City, and are very low in Marine Protected Areas (see Figure 6.7).
6.2 Drivers & Pressures

Drivers
As described in Chapter 2 – Driving Forces of Environmental Change, the Emirate of Abu Dhabi has a high population growth rate, which puts demand on resources. Economic development generates an increase in commercial shipping traffic and the need for dredging to deepen existing channels and create new channels and harbours. Effluent discharges from construction projects and industrial facilities can introduce excess nutrients, sediments and chemical contaminants into marine waters, impacting environmental health. Economic development and population growth also spur demand for increased electric power and potable water from power generation and seawater desalination plants, as well as a greater need to treat increasing volumes of wastewater.

Pressures
Current pressures on the emirate’s marine waters include: coastal development and construction activities; commercial shipping and port development; increased wastewater discharges; surface run-off; industrial and wastewater discharges; desalination plant discharges; and atmospheric deposition [4]. Climate change and a rise in sea level may also interact synergistically with these other pressures to modify the state of marine water quality.

In addition to a loss of important habitats, such as coastal lagoons and mangroves and their associated ecosystem services (benefits that humans derive from nature), activities associated with coastal development (such as dredging) and other types of construction can result in excess sediments in the water column. This reduces light for seagrasses and can potentially smother benthic organisms, such as corals. Dredging can cause the presence of excess sediment in the water column, which may activate toxic algal cysts and release sediment pollutants. A restriction of water flow, due to construction or the creation of limited or no-outflow channels, also reduces marine water circulation and flushing, resulting in high pollution concentrations due to slow dispersion.

Pollutants from roads and other impervious surfaces, as well as fertiliser run-off from landscape maintenance and agriculture, have the potential to be swept up by stormwater, water from vehicle washing, and other water-related activities, and be carried into waterways or stormwater drains, which discharge into waterways.

Abu Dhabi Emirate has thriving industrial facilities, including power generation, iron and steel works, and many other factories and plants. These are concentrated mainly in the Industrial City of Abu Dhabi (ICAD), Mussafah Industrial Area, Khalifa Industrial Zone Abu Dhabi (KIZAD) and Al Ain. Effluent discharges from industrial facilities may introduce excess nutrients, sediments, heavy metals and other potentially toxic chemical contaminants into waterways, which can alter the pH level of the waters. These pollutants have the potential to reduce biodiversity, create conditions which lead to fish kills and reduced fish landings, and affect the water’s ability to be used in processes such as desalination and cooling. Heavy metals and other toxins may accumulate in fish and seafood, potentially posing a risk to humans through consumption.

An increasing human population in Abu Dhabi Emirate also means greater volumes of wastewater discharges through outfalls. These discharges potentially introduce pathogens and nutrients into the marine environment, which can affect industrial and recreational uses.

Abu Dhabi Emirate has seven major desalination plants which are capable of producing nearly 3.2 billion litres per day [7]. In addition, several smaller desalination plants line the emirate’s coast. Desalination plants discharge high-temperature brines, detergents and metals into marine water, which can adversely affect marine habitats, such as coral reefs and seagrass meadows. The intakes of desalination plants can kill marine fauna by impinging these organisms on intake screens. In addition, the larvae of fish and other marine invertebrates, including corals, molluscs and crustaceans, can be entrained in the water cooling system of desalination plants and killed by heated water, which has a negative effect on the adult populations of these species.

In 2014, the emirate’s waters hosted approximately 35,000 commercial vessels and nearly 100 cruise ships [8]. Shipping can result in the release of several types of discharge into the marine water, such as ballast water, wastewater, ship anti-fouling chemicals (e.g. copper or detergents), oil and grease, and fuel spills. Insufficient shore-side facilities for sewage and waste transfer in marinas can also cause waste to be dumped at sea.

Dredging places additional pressures on marine water quality because it can re-suspend bottom sediment into the water column, releasing contaminants and re-suspending algal cysts, thereby reducing water clarity. In addition, the transfer and release of ship ballast water can cause the release of exotic species of phytoplankton and marine larval fish of crustaceans, molluscs and zooplankton, which may become invasive alien species in the Arabian Gulf.

Atmospheric deposition (when pollutants are transferred from the air to the earth’s surface) has been shown to be a significant source of pollutants to coastal waters in many areas of the world [9]. Pollutants (trace metals, toxic organic compounds and nutrients) can transfer from the air into the water through rain, falling particles, dust events and the absorption of gaseous pollutants into the water.
6.3 Impacts

Eutrophication

The changes in or deterioration of marine water quality in Abu Dhabi Emirate influences not only the marine ecosystem but also the emirate’s economy. Currently, eutrophication (the excessive nutrient enrichment of a water body) is a major concern in the emirate’s waters, because it stimulates algal growth, causing subsequent environmental issues.

If moderate levels of nutrients enter a body of water, then the consumer community (such as fish, shellfish, benthic organisms and bacteria) can benefit from the added nourishment. Increasingly, however, human activities are over-enriching coastal waters with excessive amounts of nutrients, particularly various compounds of nitrogen and phosphorus (5, 10). As a result, phytoplankton populations increase rapidly to levels that exceed the consumption capacity of the community of zooplankton, shellfish and fish, which can lead to outbreaks of harmful algal blooms (HABs). The excess, unconsumed plant material can result in secondary problems such as diminished water clarity and dissolved oxygen (DO) depletion in bottom waters (i.e., hypoxia) as the phytoplankton population dies and sinks to the bottom, where it is decomposed by bacteria. Hypoxic waters often result in the death of shellfish and other aquatic organisms that are unable to tolerate the low oxygen concentrations.

Harmful Algal Blooms

HABs occur when phytoplankton species increase rapidly to high population numbers, with damaging effects on other marine organisms or humans. Although HABs may form as a result of natural conditions, severe eutrophication in marine waters may also result in favourable conditions for the formation of HABs.

Some HAB species produce toxins harmful to other marine organisms and to humans (11). HABs can cause fish kills and shellfish poisoning and can disrupt normal operation of desalination plants by blocking seawater filtration systems.

HABs have been responsible for mass mortalities of fish worldwide, causing catastrophic impacts to aquaculture and local fish and shellfish economies (11). Fish kill incidents have been recorded in the waters of Abu Dhabi Emirate since 2002. EAD recorded the highest number of fish kill incidents in 2011. However, not all fish kill incidents in the emirate’s waters are caused by HABs.

Additionally, toxic and nuisance blooms may limit recreational and industrial use of marine waters. The UAE has experienced severe and widespread HAB outbreaks in the Arabian Gulf and the Gulf of Oman in 2008 and 2009. The number of HAB incidents has been increasing in Abu Dhabi Emirate’s waters since 2002, reaching up to 30 incidents during 2015 (see Figure 6.9).

In particular, water quality analyses have routinely shown that the Mussafah South Channel is impacted by nutrient enrichment, low DO concentrations in bottom waters, phytoplankton blooms and fish-kill incidents throughout the year (13). These outbreaks have increased over the past decade and are likely associated, in part, with the eutrophic conditions caused by discharges into the marine environment.

Health Impacts

Monitoring programme results indicate that Abu Dhabi Emirate’s waters have historically enjoyed excellent microbial water quality, including all public beaches. In line with the generally good microbiological quality of marine water environments in the UAE, the expected effect on human health is low.
What We Aim to Achieve
In line with Abu Dhabi Environment Vision 2030, EAD’s main goals are to protect the emirate’s marine environment and maintain good marine water quality, so as to protect human and marine life and the economy.

EAD implements a robust marine water quality programme to continuously develop and improve the holistic understanding of the current status and changes in marine water quality. Data gathered and analysed by EAD guides decision-making by key stakeholders, with EAD also developing and enforcing regulations and policies to protect marine water quality from the sources of impacts. Additionally, EAD develops and implements effective response plans to mitigate the impacts of marine water quality emergencies, such as algal blooms, sewage spills, and fish kills.

EAD serves as the secretariat organisation for the Government of Abu Dhabi’s Higher Committee on Marine Water Quality. Founded in 2012, this comprises the top leadership of all Abu Dhabi Government entities that have responsibility for monitoring, regulating and protecting the emirate’s marine water quality. The Higher Committee develops and oversees the design and implementation of inter-agency marine water quality protection initiatives.

In combination with Abu Dhabi Sewerage Services Company’s (ADSSC) planned Strategic Tunnel Enhancement Programme (STEP), which is anticipated to improve sewage treatment capacity and divert treated water to be used for irrigation, EAD aims to reduce the probability and extent of such marine water quality emergencies.

Sustaining healthy marine water quality requires the support of all stakeholders and the general public in Abu Dhabi Emirate. Therefore, one of EAD’s key initiatives is to increase awareness of the importance of maintaining high marine water quality and protecting it from deterioration. EAD has developed several water quality outreach materials, such as reports and press releases, to help inform the public about the significance of Abu Dhabi Emirate’s marine water quality.

Existing Responses
The importance of Abu Dhabi Emirate’s marine water quality is rising with the increasing developmental pressures on the marine environment. In 2008, EAD commenced its ongoing Marine Water Quality Monitoring Programme (MWQMP) to ensure that the emirate’s coastal waters remain safe for people, plants and animals.

The backbone of the MWQMP is the collection of marine water and sediment samples from several locations along the emirate’s coast. In-situ analysis is performed to measure physical parameters, followed by additional laboratory testing for nutrients, organics, microbes and heavy metals. The objective is to detect and analyse both historical and present trends in pollutant levels and the resulting pressures on the marine environment.

To ensure that the MWQMP continues to meet the current and future needs of Abu Dhabi Emirate, periodically EAD conducts comprehensive reviews of the monitoring stations, parameters, sampling protocols and analysis methods. The latest network review was completed in 2015. The analysis and reporting of water quality data is performed to enable EAD to make science-based decisions that protect marine resources from the environmental impacts of rapid development, as well as support EAD’s enforcement operations. This includes compelling developers to mitigate and, in some cases, halt actions which could result in unreasonable environmental impacts.

EAD develops and publishes quarterly and annual marine water quality reports which communicate the results of the MWQMP.

In addition to the MWQMP, EAD has developed an early warning system to forecast the formation of HABs, in response to the severity of this threat. The system relies on automated buoys which are equipped with sensors that collect data on ambient water characteristics every hour, seven days per week. This data is transmitted in real time to EAD headquarters for evaluation. Similar automated marine data buoys are currently available under Abu Dhabi Water and Electricity Authority (ADWEA), Department of Urban Planning and Municipalities (DURM) and Abu Dhabi Ports Company (ADPC), so as to provide a continuous data stream on marine water quality parameters.

Every five years EAD carries out a comprehensive study to forecast the formation of HABs, in response to the severity of this threat. The system relies on automated buoys which are equipped with sensors that collect data on ambient water characteristics every hour, seven days per week. This data is transmitted in real time to EAD headquarters for evaluation. Similar automated marine data buoys are currently available under Abu Dhabi Water and Electricity Authority (ADWEA), Department of Urban Planning and Municipalities (DURM) and Abu Dhabi Ports Company (ADPC), so as to provide a continuous data stream on marine water quality parameters.

EAD also issues marine water quality permits to ensure that new developments are appropriately regulated. A permit is required for any project in which a discharge of effluent into the marine environment is expected. In addition, EAD reviews permits for existing operations, ensuring that new measures are introduced for compliance.

What We Aim to Achieve
In line with Abu Dhabi Environment Vision 2030, EAD’s main goals are to protect the emirate’s marine environment and maintain good marine water quality, so as to protect human and marine life and the economy.

EAD implements a robust marine water quality programme to continuously develop and improve the holistic understanding of the current status and changes in marine water quality. Data gathered and analysed by EAD guides decision-making by key stakeholders, with EAD also developing and enforcing regulations and policies to protect marine water quality from the sources of impacts. Additionally, EAD develops and implements effective response plans to mitigate the impacts of marine water quality emergencies, such as algal blooms, sewage spills, and fish kills.

EAD serves as the secretariat organisation for the Government of Abu Dhabi’s Higher Committee on Marine Water Quality. Founded in 2012, this comprises the top leadership of all Abu Dhabi Government entities that have responsibility for monitoring, regulating and protecting the emirate’s marine water quality. The Higher Committee develops and oversees the design and implementation of inter-agency marine water quality protection initiatives.

In combination with Abu Dhabi Sewerage Services Company’s (ADSSC) planned Strategic Tunnel Enhancement Programme (STEP), which is anticipated to improve sewage treatment capacity and divert treated water to be used for irrigation, EAD aims to reduce the probability and extent of such marine water quality emergencies.

Sustaining healthy marine water quality requires the support of all stakeholders and the general public in Abu Dhabi Emirate. Therefore, one of EAD’s key initiatives is to increase awareness of the importance of maintaining high marine water quality and protecting it from deterioration. EAD has developed several water quality outreach materials, such as reports and press releases, to help inform the public about the significance of Abu Dhabi Emirate’s marine water quality.

Existing Responses
The importance of Abu Dhabi Emirate’s marine water quality is rising with the increasing developmental pressures on the marine environment. In 2008, EAD commenced its ongoing Marine Water Quality Monitoring Programme (MWQMP) to ensure that the emirate’s coastal waters remain safe for people, plants and animals.

The backbone of the MWQMP is the collection of marine water and sediment samples from several locations along the emirate’s coast. In-situ analysis is performed to measure physical parameters, followed by additional laboratory testing for nutrients, organics, microbes and heavy metals. The objective is to detect and analyse both historical and present trends in pollutant levels and the resulting pressures on the marine environment.

To ensure that the MWQMP continues to meet the current and future needs of Abu Dhabi Emirate, periodically EAD conducts comprehensive reviews of the monitoring stations, parameters, sampling protocols and analysis methods. The latest network review was completed in 2015. The analysis and reporting of water quality data is performed to enable EAD to make science-based decisions that protect marine resources from the environmental impacts of rapid development, as well as support EAD’s enforcement operations. This includes compelling developers to mitigate and, in some cases, halt actions which could result in unreasonable environmental impacts.

EAD develops and publishes quarterly and annual marine water quality reports which communicate the results of the MWQMP.

In addition to the MWQMP, EAD has developed an early warning system to forecast the formation of HABs, in response to the severity of this threat. The system relies on automated buoys which are equipped with sensors that collect data on ambient water characteristics every hour, seven days per week. This data is transmitted in real time to EAD headquarters for evaluation. Similar automated marine data buoys are currently available under Abu Dhabi Water and Electricity Authority (ADWEA), Department of Urban Planning and Municipalities (DURM) and Abu Dhabi Ports Company (ADPC), so as to provide a continuous data stream on marine water quality parameters.

Every five years EAD carries out a comprehensive study to forecast the formation of HABs, in response to the severity of this threat. The system relies on automated buoys which are equipped with sensors that collect data on ambient water characteristics every hour, seven days per week. This data is transmitted in real time to EAD headquarters for evaluation. Similar automated marine data buoys are currently available under Abu Dhabi Water and Electricity Authority (ADWEA), Department of Urban Planning and Municipalities (DURM) and Abu Dhabi Ports Company (ADPC), so as to provide a continuous data stream on marine water quality parameters.

EAD also issues marine water quality permits to ensure that new developments are appropriately regulated. A permit is required for any project in which a discharge of effluent into the marine environment is expected. In addition, EAD reviews permits for existing operations, ensuring that new measures are introduced for compliance.

What We Aim to Achieve
In line with Abu Dhabi Environment Vision 2030, EAD’s main goals are to protect the emirate’s marine environment and maintain good marine water quality, so as to protect human and marine life and the economy.

EAD implements a robust marine water quality programme to continuously develop and improve the holistic understanding of the current status and changes in marine water quality. Data gathered and analysed by EAD guides decision-making by key stakeholders, with EAD also developing and enforcing regulations and policies to protect marine water quality from the sources of impacts. Additionally, EAD develops and implements effective response plans to mitigate the impacts of marine water quality emergencies, such as algal blooms, sewage spills, and fish kills.

EAD serves as the secretariat organisation for the Government of Abu Dhabi’s Higher Committee on Marine Water Quality. Founded in 2012, this comprises the top leadership of all Abu Dhabi Government entities that have responsibility for monitoring, regulating and protecting the emirate’s marine water quality. The Higher Committee develops and oversees the design and implementation of inter-agency marine water quality protection initiatives.

In combination with Abu Dhabi Sewerage Services Company’s (ADSSC) planned Strategic Tunnel Enhancement Programme (STEP), which is anticipated to improve sewage treatment capacity and divert treated water to be used for irrigation, EAD aims to reduce the probability and extent of such marine water quality emergencies.

Sustaining healthy marine water quality requires the support of all stakeholders and the general public in Abu Dhabi Emirate. Therefore, one of EAD’s key initiatives is to increase awareness of the importance of maintaining high marine water quality and protecting it from deterioration. EAD has developed several water quality outreach materials, such as reports and press releases, to help inform the public about the significance of Abu Dhabi Emirate’s marine water quality.

Existing Responses
The importance of Abu Dhabi Emirate’s marine water quality is rising with the increasing developmental pressures on the marine environment. In 2008, EAD commenced its ongoing Marine Water Quality Monitoring Programme (MWQMP) to ensure that the emirate’s coastal waters remain safe for people, plants and animals.

The backbone of the MWQMP is the collection of marine water and sediment samples from several locations along the emirate’s coast. In-situ analysis is performed to measure physical parameters, followed by additional laboratory testing for nutrients, organics, microbes and heavy metals. The objective is to detect and analyse both historical and present trends in pollutant levels and the resulting pressures on the marine environment.

To ensure that the MWQMP continues to meet the current and future needs of Abu Dhabi Emirate, periodically EAD conducts comprehensive reviews of the monitoring stations, parameters, sampling protocols and analysis methods. The latest network review was completed in 2015. The analysis and reporting of water quality data is performed to enable EAD to make science-based decisions that protect marine resources from the environmental impacts of rapid development, as well as support EAD’s enforcement operations. This includes compelling developers to mitigate and, in some cases, halt actions which could result in unreasonable environmental impacts.

EAD develops and publishes quarterly and annual marine water quality reports which communicate the results of the MWQMP.

In addition to the MWQMP, EAD has developed an early warning system to forecast the formation of HABs, in response to the severity of this threat. The system relies on automated buoys which are equipped with sensors that collect data on ambient water characteristics every hour, seven days per week. This data is transmitted in real time to EAD headquarters for evaluation. Similar automated marine data buoys are currently available under Abu Dhabi Water and Electricity Authority (ADWEA), Department of Urban Planning and Municipalities (DURM) and Abu Dhabi Ports Company (ADPC), so as to provide a continuous data stream on marine water quality parameters.

Every five years EAD carries out a comprehensive study to forecast the formation of HABs, in response to the severity of this threat. The system relies on automated buoys which are equipped with sensors that collect data on ambient water characteristics every hour, seven days per week. This data is transmitted in real time to EAD headquarters for evaluation. Similar automated marine data buoys are currently available under Abu Dhabi Water and Electricity Authority (ADWEA), Department of Urban Planning and Municipalities (DURM) and Abu Dhabi Ports Company (ADPC), so as to provide a continuous data stream on marine water quality parameters.
6.5 Outlook

The condition of Abu Dhabi Emirate’s marine waters, as reflected by physical, chemical and biological characteristics, is generally very good. However, increasing trends in the concentrations of nutrients (nitrate, phosphate and chlorophyll-a) indicate that eutrophication is an ongoing threat to water quality in the emirate, as it is in many other nations around the world.

EAD has taken significant steps to curtail the continued elevation of nutrients, and the ongoing execution of regulations and limits will significantly help to abate this issue in the coming years. The implementation of ambient marine water quality limits will help improve and safeguard the health of the emirate’s marine waters. Knowledge gleaned from EAD’s comprehensive, world class marine water quality monitoring programme is central to the design and development of strategies for reducing eutrophication.

Future Responses
Although significant efforts have been made to manage and protect marine water quality in Abu Dhabi Emirate, EAD continuously plans and develops new initiatives to safeguard the marine environment. In-house capacity building in the field of marine water quality is essential to building and maintaining a strong, diverse team specialised in marine water quality, hydrodynamics and marine biology.

The development and refining of Marine Emergency Response Plans is essential. Further regulatory development, such as regulatory implementation of ambient limits and revised industrial effluent standards, is underway. Additionally, the sharing of marine water quality data through a unified portal with all stakeholders is under development with the UAE Ministry of Climate Change and Environment, which will effectively share knowledge and information among partners.

Lastly, educating the public on the status of marine water quality and related issues to increase their awareness will lend support to all Government of Abu Dhabi marine water quality initiatives. This is accomplished through awareness campaigns targeting communities at all levels. A collaboration with the Ministry of Education aims to inform the emirate’s youth by disseminating key messages on the importance of protecting Abu Dhabi Emirate’s rich marine water heritage.