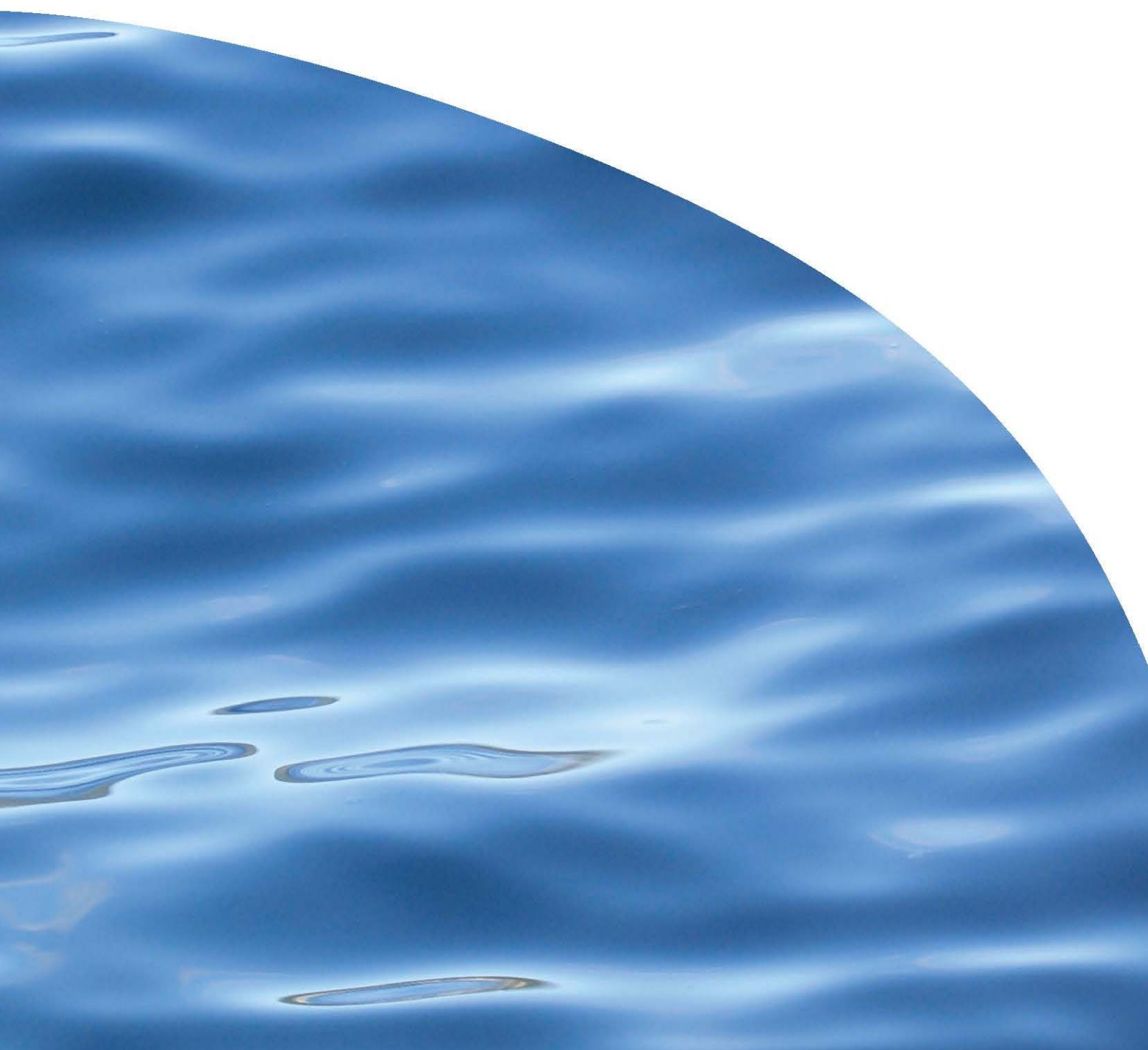


REPORT NO. 2199

**COASTAL MONITORING USING MOORED  
PLATFORMS: REGIONAL TO NATIONAL  
CONSIDERATIONS**





# COASTAL MONITORING USING MOORED PLATFORMS: REGIONAL TO NATIONAL CONSIDERATIONS

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## EXECUTIVE SUMMARY

Standardised, long-term datasets on coastal water quality and environmental conditions are critical to assessing and monitoring the health of coastal receiving waters and identifying environmental changes that may be occurring in response to a range of anthropogenic stressors. Largely absent from coastal monitoring programmes in New Zealand is the collection of time-series data for basic water quality variables, such as water temperature, salinity, turbidity, and biological indicators such as dissolved oxygen and chlorophyll-a (proxy for phytoplankton biomass). These data can be collected efficiently using moored instrumentation capable of transmitting data in real-time to a land-based station.

Hawke's Bay Regional Council (HBRC) is in the process of deploying the Hawke's Bay Water Quality information buoy (HAWQi) that was developed in part through a previous Envirolink project. This Cawthron report builds on this earlier work and aims to: 1) assist in the deployment/placement of HAWQi and the integration of data derived from the buoy with other monitoring data collected by HBRC, and 2) demonstrate how HBRC's regional efforts can be aligned within a national network for widely sharing coastal monitoring data collected by similar platforms across councils. In addition to drawing on international examples, this report incorporates information gathered during discussions at the July 2012 Coastal Special Interest Group (SIG) meeting and responses from a number of councils to questions regarding future implementation and use of moored instrumentation such as HAWQi.

Representatives from five regional councils identified over eight important uses for the data collected by coastal monitoring platforms such as HAWQi, including contributions toward State of the Environment (SOE) monitoring, validation and calibration of models, ground-truthing remote sensing data, and long-term baseline data for Assessment of Environmental Effects (AEEs) and consent monitoring programmes. In addition to these applications, accessible time-series data collected in 'real-time' can be used to assist in driving models for forecasting water and shellfish quality, monitoring for trends related to climate change, and are also of value to port authorities and recreational ocean users.

HAWQi is ideal for collecting long-term datasets on basic water quality parameters within the 12 mile territorial limit in New Zealand coastal waters and sits nicely between the smaller, nearshore buoys and the much larger coastal alternatives. As part of SOE monitoring in the coastal environment, HBRC currently monitors erosion, ecology, water quality and metal and sediment accumulation. Sampling stations are currently limited to shore side locations; hence, the deployment of HAWQi will extend SOE monitoring into the coastal zone. In the context of developing a regional coastal ocean observation system, HAWQi can serve as a sentinel station and provide long-term data series for the uses identified above. In addition to platforms such as HAWQi, nearshore systems with similar technologies can be periodically deployed and rotated among various locations in order to focus on times and/or areas of interest.

From a national perspective, the placement of HAWQi serves as a good example of how to choose the best locations for fixed coastal monitoring platforms. Rather than focusing initially on where a coastal monitoring platform could be placed, it is often easier to rule out where it cannot be located and let constraints narrow down the selection process. For HAWQi, a number of regional constraints narrowed down the location(s) that could be used. Typical constraints and considerations include, depth range, distance from nearest harbour, shipping lanes, and commercial fishing/aquaculture activity. The outcome of the placement for HAWQi was the identification of two zones to the north and south of Napier for deployment, with the northern zone preferred due to reduced fishing pressure.

Coastal ocean monitoring and observation efforts at a regional level through HBRC can be scaled up to a national level; however, this will require a standardised approach and common vision. Future development of a national network of coastal monitoring platforms includes consideration of how the data will be managed at the local (regional) level and how it will be disseminated. HBRC's shore side data is presently managed using third party software including Hydrotel<sup>®</sup> and Hilltop<sup>®</sup>. These systems are used by most councils throughout New Zealand. Therefore, if a coastal platform can be shown to work effectively within these programmes, additional platforms could be easily added both by HBRC and other councils. Data dissemination could be facilitated by integrating coastal monitoring information within existing land-based data systems. Of relevance to managing NZ's coastal catchments is the need to integrate regional coastal monitoring data with monitoring data from upland terrestrial and freshwater systems. Currently there are a number of databases that host freshwater and catchment data including LAWNZ (Land and Water Forum New Zealand; [www.landandwater.co.nz](http://www.landandwater.co.nz)) and NIWA's EDENZ website (Environmental Data Explorer New Zealand; [edenz.niwa.co.nz](http://edenz.niwa.co.nz)).

Within this report the main barriers and next steps to implementation of a network of coastal monitoring platforms are also reviewed. Limited resources in terms of funding and staff time were identified as significant barriers by councils. We therefore review funding possibilities as well as cost savings from standardisation of instrumentation across regions. Key steps to implementation of a network of coastal monitoring platforms will include development of governance structures, establishment of a technical advisory group and the identification of a consistent core of environmental variables to be monitored. Proof-of-concept from HAWQi will assist in the implementation of similar coastal monitoring platforms in other regions, which collectively could support a nationally significant database for use by multiple end users.

## TABLE OF CONTENTS

1. INTRODUCTION .....	1
1.1. Monitoring our coasts .....	1
1.2. Report objectives and scope .....	2
1.3. Current efforts in New Zealand.....	3
1.4. Importance and value of long-term, time-series data.....	5
1.5. Types of coastal monitoring platforms .....	7
2. REGIONAL CONSIDERATIONS FOR HAWKE'S BAY .....	10
2.1. Existing Hawke's Bay State of the Environment monitoring programmes .....	11
2.2. Placement of a buoy within Hawke's Bay .....	12
3. TOWARD A NATIONAL NETWORK .....	14
3.1. Marine Environmental Monitoring Programme NZ.....	14
3.2. International examples .....	15
3.2.1. <i>Australia's Integrated Marine Observing System</i> .....	15
3.2.2. <i>U.S. Integrated Ocean Observing System</i> .....	16
3.2.3. <i>Global Ocean Observing System</i> .....	17
3.3. Overview of international programmes .....	17
3.4. Considerations for implementation .....	18
3.4.1. <i>Data management and dissemination</i> .....	18
3.4.2. <i>Creating a governance structure</i> .....	20
3.4.3. <i>Key parameters to measure</i> .....	20
3.4.4. <i>Funding a network of coastal monitoring platforms</i> .....	20
3.4.5. <i>International partnerships</i> .....	22
4. NEXT STEPS AND RECOMMENDATIONS.....	24
5. ACKNOWLEDGEMENTS .....	27
6. REFERENCES .....	28
7. APPENDIX.....	29

## LIST OF FIGURES

Figure 1.	Existing coastal monitoring stations for water quality surface temperatures and other stations for collecting data on waves and currents. ....	4
Figure 2.	Attributes of different moored monitoring platforms for use in nearshore, coastal and offshore waters. ....	9
Figure 3.	Consented discharges, marine farms, water quality sampling stations and other activities near Napier and within the Hawke's Bay coastal area. ....	11
Figure 4.	Schematic of Australia's Integrated Marine Observation System.....	15
Figure 5.	An example configuration of a network of coastal monitoring platforms nested within a broader ocean observation system for New Zealand. ....	24

## LIST OF TABLES

Table 1.	Example applications of time-series data from moored platforms.....	6
Table 2.	Key consented activities and associated monitoring requirements in the Hawke's Bay CMA and a 3 km land buffer area around the coastal margin. ....	10
Table 3.	Proposed core variables identified for coastal monitoring by U.S. Commission on Ocean Policy. ....	18
Table 4.	Recommended steps for developing, implementing and managing a network of coastal monitoring platforms. ....	26

## LIST OF APPENDICES

Appendix 1.	Responses to questions regarding use of moored instrumentation posed to council representatives from the Coastal Special Interest Group. ....	29
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# 1. INTRODUCTION

## 1.1. Monitoring our coasts

Standardised, long-term datasets on coastal water quality and environmental conditions are critical to assessing and monitoring the health of coastal receiving waters and identifying environmental changes that may be occurring in response to a range of anthropogenic stressors. New Zealand has primarily focused on monitoring the environmental quality of its lands, rivers and lakes, with far less attention given to coastal waters. As outlined under the 2010 New Zealand Coastal Policy Statement (NZCPS), regional policy statements, plans and consent considerations must aim to *safeguard the integrity, form, functioning and resilience of the coastal environment and sustain ecosystems, including marine and intertidal areas, estuaries, dunes and land*. Monitoring of the environmental conditions of coastal waters is a critical component to measuring the effectiveness of management measures aimed at achieving this objective.

Under the NZCPS, regional and local authorities (*i.e.* councils) are also required to maintain coastal water quality and identify risks associated with adverse cumulative effects. Nationally there is a requirement to measure cumulative effects, establish baselines, identify stressors and monitor trends over time. Monitoring of cumulative environmental change (CEC) requires datasets that transcend jurisdictional boundaries and are of sufficient duration to determine baselines and measure CEC in response to anthropogenic stressors occurring over varying time scales (*e.g.* dredging activities vs climate change).

The types of data as well as the spatial and temporal resolutions of data derived from coastal monitoring programmes vary considerably. Types of SOE monitoring data collected by regional councils range from point measurements of water quality variables (*e.g.* turbidity and faecal bacteria) to spatial distribution of habitats within estuaries (Robertson *et al.* 2002). Largely absent from coastal monitoring programmes in New Zealand is the collection of continuous time-series data for basic water quality variables, such as water temperature, salinity, turbidity, and biological indicators such as dissolved oxygen and chlorophyll-*a* (proxy for phytoplankton biomass). These data provide a critical backdrop to consent-based and SOE monitoring as well as broader coastal ocean observation systems, and they can be collected efficiently using moored instrumentation capable of transmitting data in real-time to a land-based station.

The jurisdictional boundaries of regional councils are largely delineated by catchments and include waters out to 12 miles offshore; councils therefore have a unique opportunity to monitor at 'whole of catchment' scales by linking information on the conditions of downstream receiving waters with what is occurring on the land as well as in the sea. Furthermore, the small size of New Zealand combined with the

connectivity of regional councils through mechanisms such as the Coastal Special Interest Group (Coastal SIG) provide opportunities for standardising and sharing data at a national level. Establishing a network, particularly with regard to moored instrumentation (e.g. monitoring buoys) for collecting time-series data on water quality conditions, would facilitate more robust monitoring of NZ's coastal environment and strengthen SOE reporting from regional to national levels. Consideration and alignment with International best practice and standards will also facilitate future linkages with larger-scale ocean observation initiatives.

## 1.2. Report objectives and scope

Hawke's Bay Regional Council (HBRC) is in the process of deploying the Hawke's Bay Water Quality information buoy (HAWQi) that was developed in part through a previous Envirolink project (see Barter 2011). This report builds on this earlier work and aims to: 1) assist in the deployment/placement of HAWQi and the integration of data derived from the buoy with other data and information collected by HBRC, and 2) demonstrate how HBRC's regional efforts can be aligned within a national network for widely sharing coastal monitoring data collected by similar platforms across the country. This second objective acknowledges that a coastal water monitoring strategy needs to firstly address regional needs, but also be future proofed for national needs. In addition to drawing on institutional knowledge and international examples, this report incorporates information gathered during discussions at the July 2012 Coastal SIG meeting and responses from a number of councils to questions relating to the future implementation and use of coastal monitoring buoys.

As background we first provide information on the use of moored instrumentation to inform coastal observation and monitoring programmes. Taking into consideration current monitoring efforts, a regional framework for HBRC including placement of HAWQi and data management and dissemination is then outlined in Section 2. In order for regional water quality monitoring to be effective, regional information should also align with a national strategy and framework. Section 3 therefore provides an overview of existing international efforts and provides a synthesis of key considerations for developing a network of coastal monitoring platforms for New Zealand. This includes selection of sentinel sites, and nesting of national efforts within regional to global ocean observation initiatives. Finally, Section 4 incorporates feedback from a number of councils to identify the needs, potential barriers, and next steps for establishing a network of coastal monitoring platforms that can meet regional and national monitoring needs, and in turn contribute to international ocean observation initiatives.

### 1.3. Current efforts in New Zealand

There are numerous types of sensor platforms for monitoring and observing ocean processes, including satellites, aircraft, ships, autonomous underwater vehicles and moored arrays on fixed structures (e.g. piers) or beneath surface buoys. This report focuses on platforms involving moored arrays of instruments deployed in the coastal environment (estuaries and coastal waters within 12 mile territorial limit).

Situated at the land-sea interface, coastal waters are exposed to multiple stressors imposed from both adjacent land uses and marine-based activities such as dredging and fishing. Despite their high susceptibility to cumulative effects, coastal waters receive far less attention in New Zealand in terms of environmental monitoring than terrestrial, freshwater, or open ocean systems. Current efforts utilising the deployment of moored instruments for the purpose of obtaining continuous, long time-series data on physical and biological parameters are primarily limited to the following (Figure 1):

- Sea surface temperatures (SSTs) at 9 coastal stations (seven operated by NIWA, and two by Universities);
- Ocean waves at five coastal sites around New Zealand (NIWA);
- Water temperatures and salinity at 9 sites in Doubtful Sound and 1 site in Milford Sound as part of consent monitoring for Meridian Energy (NIWA/Cawthron);
- Coastal buoys for measuring water quality parameters and currents in the Firth of Thames (NIWA), Golden Bay (NIWA) and Tasman Bay (Cawthron).

In addition to the above, there are also two instrumentation platforms being deployed in Kaipara Harbour for use in understanding and modelling effects of sedimentation on water quality. A number of ports also monitor waves and currents using wave rider buoys and moored Acoustic Doppler Current Profilers (ADCPs). There are roughly 50 sea-level gauges scattered around New Zealand and operated by various agencies, including NIWA, port companies and regional authorities. According to Ministry for the Environment's website, there is no formal network for centralising and administering data from these gauges. In summary, the bulk of the data collected in the coastal waters are dominated by physical data (waves, sea level), and there are very few locations where long-term, time-series data on water quality parameters other than sea surface temperature are collected (see Figure 1)

In open seas beyond the 12 mile territorial limit, monitoring efforts by New Zealand have included collection of long-term, time-series data at two global reference mooring network sites (Ocean SITES) operated by NIWA and located on either side of the Chatham Rise. Apparently, moorings at these locations have been removed. There was also a third site northeast of New Zealand where time-series data was obtained between 1998 and 2005 (Ministry for the Environment). New Zealand (NIWA) participates in an ongoing international ocean observation programme using

Argo floats, which are deployed by NIWA in the Southern Ocean. MetService also maintains a small network of free-drifting buoys in the Tasman Sea.



Figure 1. Existing coastal monitoring stations for water quality (e.g. water temperature, salinity, turbidity, chlorophyll-a), surface temperatures (SSTs) and other stations for collecting data on waves and currents.

## 1.4. Importance and value of long-term, time-series data

Regional council representatives from the Coastal SIG were posed a number of questions relating to the usefulness of moored instrument platforms for collecting time-series data on basic water quality parameters (see Appendix 1). In addition to acknowledging the basic need for such systems, the five respondents highlighted the following applications for the data:

- SOE monitoring
- Validation and calibration of models
- Ground-truthing remote sensing data
- Long-term baseline data for AEEs and consent monitoring programmes
- Support for marine spatial planning
- Notification of algal blooms
- Targeted studies on nutrient and sediment inputs
- Compliance monitoring (e.g. dredging)
- Facilitating informed aquaculture development.

In addition to the above, accessible time-series data collected in ‘real-time’ can also be used to assist in driving models for forecasting water and shellfish quality, monitoring for trends related to climate change, and are also of value to port authorities and recreational ocean users. In terms of council-led monitoring, the use of instrumentation for collecting time-series data has assisted Northland Regional Council in understanding limitations of discrete, manually collected samples as a function of natural variability (Cornelisen *et al.* 2011b).

Datasets from moored instrumentation provide high temporal resolution, however, are less suited to describe spatial variability because they are fixed. Nonetheless, they are required to assess long-term environmental trends, and at the same time provide the underlying data for validating, and in some cases driving, additional tools and methods of data collection within broader ocean observation systems (see Section 3). Ocean observation systems integrate data from a number of platforms beyond moored instrumentation, including Argo floats (drifting buoys), ships of opportunity, deep water moorings, ocean gliders, autonomous underwater vehicles, ocean radar, animal tagging and monitoring, wireless sensor networks and satellite remote sensing. Each of these platforms in isolation has limitations, but combined they dramatically increase our ability to understand and visualise environmental change over a range of temporal and spatial scales.

There is an initial investment to deploy moored instrumentation; however, cost benefits can occur over time as traditional water sampling costs associated with boat hire and ongoing sample analysis are reduced. While not represented in dollar terms,

the value of time-series data is highlighted in the following examples (Table 1) from both freshwater and marine environments in New Zealand.

Table 1. Example applications of time-series data from moored platforms.

**Rotorua Lakes:** Telemetred data from buoys has increased understanding of lake dynamics and enabled the setting of targets bridging ecosystem health with land-use impacts (nutrient loading), and for understanding toxic algal blooms (go to [www.lernz.co.nz](http://www.lernz.co.nz) for more information).



**Motueka River Plume:** Time-series data from a monitoring buoy in Tasman Bay ([www.cawthron.org.nz/coastal-freshwater-resources/tascam.php](http://www.cawthron.org.nz/coastal-freshwater-resources/tascam.php)) have enabled a greater understanding of coastal processes in response to river flows, which in turn affect varying ecosystem processes ranging from condition and quality of water and shellfish (Cornelisen *et al.* 2011a; Gillespie *et al.* 2011). Time-series turbidity and meteorological data have also informed strategies for restoring shellfish fisheries in Tasman and Golden Bays (Michael *et al.* in prep).



**Doubtful Sound:** Time-series data on water temperature and meteorological variables has been used to delineate the roles of climate versus anthropogenic freshwater inputs in driving conditions thought to influence population trends in bottlenose dolphin populations (Goodwin & Cornelisen 2012).



**Golden Bay shellfish harvesting:** The Marlborough Shellfish Quality Programme and shellfish sanitation experts utilise times series data collected using small telemetered buoys to manage harvest restrictions in Golden Bay associated with river discharges.





## 1.5. Types of coastal monitoring platforms

There are a variety of coastal monitoring platforms, ranging from those suited for nearshore waters to those that can withstand open ocean conditions (Figure 2). This report focuses on systems most useful to councils; hence those that can be used to monitor conditions in ports, estuaries and coastal waters (e.g. nearshore and coastal but not offshore types in Figure 1).

It is beyond the scope of this report to make specific recommendations around makes and models of buoys or instrumentation; however, some generic discussion on different types is warranted. Nearshore platforms are typically the smallest and least expensive of the three types and are located in protected inland waterways (e.g. fjords, sounds, enclosed bays, estuaries etc.) or ports and harbours. They can be either fixed to a wharf/seabed or moored below a surface buoy. The biggest advantage to these types of platforms is that they are more easily serviced and accessible than the other two types. For example, the small roto-formed polyethylene buoys recently developed by Cawthron Institute (nicknamed the  $\mu$ WQ or 'mu dub que') are able to be deployed and retrieved via a davit on a small vessel (e.g. 7 m). Ease of deployment, recovery, and servicing may be advantageous for councils that only have small craft like those used by many harbour masters. The disadvantages are that they will have a more limited capacity for instrument configurations and are restricted to more sheltered waters than larger alternatives.

In contrast, coastal platforms are more robust and able to withstand greater swells and adverse sea conditions, but this stability comes at a cost both monetarily and in the type of vessel required for deployment, recovery and servicing. The Hawke's Bay Water Quality information buoy (HAWQi) is a good example of this type of platform. It is 1.2 m in diameter and requires a boat with sufficient deck space and a davit or other hydraulics to deploy safely. General servicing and cleaning may therefore be more efficiently done *in-situ* by SCUBA divers. For collecting long-term datasets within the 12 mile territorial limit in New Zealand coastal waters, this type of buoy is ideal and sits nicely between the smaller nearshore buoys and the much larger coastal alternatives. The possible instrument arrays for this style of buoy are really only limited by budget and routinely include weather stations, downward-looking Acoustic Doppler Current Profilers (ADCPs), single point current meters and a wide range of water quality sensors.

In the context of developing a regional coastal ocean observation system, HAWQi can serve as a sentinel station and provide long-term data series for contextualising monitoring datasets. In addition to permanent platforms such as HAWQi, nearshore systems sharing similar technologies can be deployed for short durations and rotated among various locations in order to focus on times and/or areas of interest. The management and dissemination of data from these systems can be integrated within

regional data management systems, and if standardised, shared across wider, national databases (see Sections 2 and 3).






Coastal Monitoring Platforms	Type		
	Nearshore	Coastal	Offshore
Description	Typically in protected inland waterways (e.g. fjords or sounds) or ports harbours. Can be either fixed to a wharf/seabed or moored	Typically in shallow water out to the 12 mile territorial limit. Usually mid-range in size between nearshore and offshore platforms	Large moored platforms typically in deep water outside the 12 mile limit and out to the EEZ (or beyond). Need to be very robust to withstand oceanic conditions
Examples	Tide gauges, weather (met) stations, wave riders, small water quality buoys	Water quality moorings, wave/tide gauges, current meters, weather (met) stations, etc.	Tsunami early warning (DART), weather (met), global warming
Communication	Cellular or UHF Radio	Cellular, UHF Radio, Satellite	Satellite (Iridium, Argos, Orbcomm etc. )
Price Range (\$ = approx \$25k NZD)	\$ - \$\$\$	\$\$\$ - \$\$\$\$\$	\$\$\$\$ - \$\$\$\$\$\$\$\$
Image(s)			

Figure 2. Attributes of different moored monitoring platforms for use in nearshore, coastal and offshore waters.

## 2. REGIONAL CONSIDERATIONS FOR HAWKE'S BAY

Integration of HAWQi within a broader regional coastal ocean observation system will require a framework that builds on past and current SOE and consent monitoring programmes. This section therefore focuses on monitoring in the Hawke's Bay region that is undertaken as part of HBRC-related consent monitoring.

HBRC has compiled key information relating to coastal resource consents. The major consented activities within the Coastal Marine Area (CMA), as well as a 3 km buffer zone landward of that area, are listed in Table 2. It should be noted that the main activities occurring within the CMA are summarised only and that hundreds of smaller consented activities also occur which are not reported in the summary table. The 3 km distance is intended to reflect activities that could have measurable effects within the CMA. The database indicates 54 major consents in the combined CMA and 3 km zone of which seven require CMA monitoring. The main anthropogenic activities occurring within the CMA are also presented graphically (Figure 3).

Table 2. Key consented activities and associated monitoring requirements in the Hawke's Bay CMA and a 3 km land buffer area around the coastal margin. The summary data were provided by Hawke's Bay Regional Council for major activities only.

Activity type	Number of consents	Consents requiring CMA monitoring
Marine farm–mussels	4	1
Discharge to water–stormwater	10	2
Discharge to water–treated wastewater	2	1
Discharge to water–washwater	2	
Discharge to water–other	4	
Discharge to water–treated domestic sewerage	1	1
Discharge to water–treated domestic sewerage and industrial wastewater	1	1
Discharge to land–farm dairy effluent	2	
Disturbance–dredging	6	1
Deposit–deposition of dredged material	3	
Deposit–beach nourishment	2	
Reclamations and sea defence construction	17	

The majority of the consents are for discharge of water for stormwater, wastewater, treated domestic sewerage and dairy effluent as well as reclamation and sea defence constructions within the CMA. The requirement for monitoring differs within and among the types of activity. While some discharge types (e.g. stormwater, domestic wastewater) require monitoring of effluent quality, few consented activities other than marine farming specify monitoring of receiving environment effects within the CMA.

HAWQi will provide long-term data series information for contextualising these monitoring datasets. Furthermore, there is a need for long-term baseline data to facilitate informed aquaculture development. A lack of baseline environmental data can represent a significant barrier to development of consent monitoring programmes.

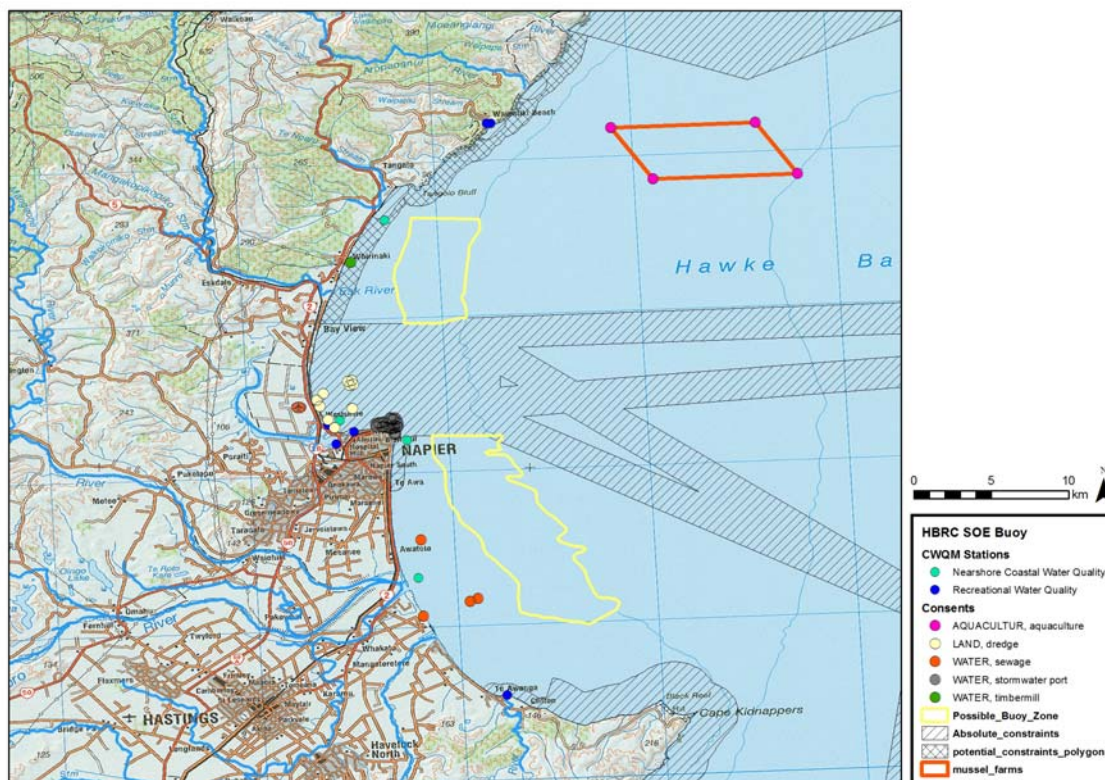


Figure 3. Consented discharges, marine farms, water quality sampling stations and other activities near Napier and within the Hawke's Bay coastal area. Yellow polygons represent possible zones north and south of Napier where the HAWQi buoy could be placed, based on criteria outlined in Section 2.2.

## 2.1. Existing Hawke's Bay State of the Environment monitoring programmes

HBRC produces SOE reports using data derived from routine monitoring programmes to assess current status and long-term trends. Land, wetlands, fish passage, fresh water, coastal ecology, coasts, air and recreational water quality are all included in regional monitoring programmes. These coastal monitoring programmes have a number of components: 1) coastal erosion and inundation, 2) coastal water quality monitoring, 3) coastal ecology including hard, soft shore and estuarine monitoring, and 4) accumulation of sediment and heavy metals in estuaries. Coastal erosion and inundation research and management of coastal hazards includes monitoring and analysis of coastal movement, wave climate and sea level rise. Collection and

analysis of water samples from selected beach sites along the coastline are used to assess water quality in terms of the level of nutrients, bacteria and phytoplankton (see Figure 3 for nearshore and recreational water quality sampling stations). Accumulation of fine sediments and heavy metals are monitored at six sediment sites in the Ahuriri Estuary, the results of which are used to assess impacts of land based activities on the receiving environment.

Coastal monitoring components (erosion, ecology, water quality and metal and sediment accumulation) are summarised in SOE annual reports. Sampling stations are currently limited to shore side locations (Figure 3); hence, the deployment of a moored coastal buoy will extend the SOE monitoring programme into the coastal zone. In future the time-series data collected at the buoy site can be nested within larger-scale monitoring initiatives that incorporate additional monitoring platforms (see Section 3). However, in the immediate future, focusing on generating time-series data on water quality from coastal buoys for basic parameters such as temperature, salinity and turbidity, will provide datasets required to assess long-term trends in the coastal environment.

## 2.2. Placement of a buoy within Hawke's Bay

HBRC is deploying a coastal monitoring buoy (HAWQi) based on the TASCAM (Tasman Bay–Cawthron and MBARI Mooring) design but with a slightly different set of instruments. The considerations made with regard to placement of this buoy are the same as those that would be required for similar style buoys in any part of the country. From a national perspective, the placement of HAWQi serves as a good case study of how to choose the best location. Correspondingly, the criteria used to select a good regional monitoring platform location, will by default, make a good location from a national perspective. A detailed discussion on the site-specific factors considered was outlined in the original scoping report (Barter 2011) and is summarised below.

When considering the ideal location for a coastal monitoring platform, rather than focusing initially on where it could be placed, it is often easier to rule out where it cannot be located and let constraints narrow down the selection process.

For example, for HAWQi, a number of regional constraints quickly narrowed down the location(s) that could be used. Typical constraints and considerations include:

1. Depth range — a buoy the size of HAWQi is ideally situated in the 15–20 m depth range. This zone is considered deep enough that it has some protection from large swells, but shallow enough (*i.e.* close enough to shore) that it will lie within the influence of river plumes and other anthropogenic sources.
2. Distance from nearest harbour — close proximity facilitates repair and maintenance. In the case of HAWQi, being within range of the existing radio

communications tower(s) on either Bluff Hill or the HBRC building was also considered.

3. Shipping lanes — port and harbour approaches should be avoided for obvious vessel navigation and safety reasons.
4. Commercial fishing/aquaculture activity — while this does not represent an absolute constraint, placing a buoy amongst an area subject to heavy trawling activity could cause problems. Similarly, areas for aquaculture could pose similar concerns<sup>1</sup>.
5. Existing monitoring data — proximity to existing SOE or other water quality monitoring sites should be considered for comparison to existing datasets where practical.

The outcome of the placement for HAWQi was the identification of two zones to the north and south of Napier which met the criteria for locating a coastal monitoring buoy (see yellow polygons in Figure 3). At this stage the northern zone is preferred because of reduced fishing pressure and proximity to Napier Harbour. The actual location for deployment is yet to be selected, but it is understood to be on the southern end of this northern zone (*i.e.* closest part) and at the deeper end of the bathymetric range due to the large swells sometimes encountered in Hawke's Bay.

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<sup>1</sup> Unless of course the purpose of the monitoring platform is to ascertain water quality around these activities.



### 3. TOWARD A NATIONAL NETWORK

Coastal ocean monitoring and observation efforts at a regional level through HBRC can be scaled up to a national level; however, this requires a standardised approach and common vision. In the following sections we identify an emerging national framework through the Marine Environmental Monitoring Programme (MEMP) and describe existing overseas networks that can be used as models for further development of a New Zealand network of coastal monitoring platforms. While international programmes have larger funding resources and scope they provide a context for the types of frameworks and variables that are consistently monitored. There are many international examples of monitoring and observing networks, including the UK Integrated Marine Observing Network (UKIMON), Australia's Integrated Marine Observing System (IMOS), South Africa's Data Centre for Oceanography (SADCO), and the U.S. Integrated Ocean Observation System (IOOS). Many of these in turn contribute to global observation networks, such as the Global Ocean Observing System (GOOS) and OceanSITES.

#### 3.1. Marine Environmental Monitoring Programme NZ

In response to the need for comprehensive monitoring, the Ministry for Primary Industries has contracted the development of a Marine Environmental Monitoring Programme (MEMP). The long term objective is to design a national MEMP that will track the physical, chemical and biological changes taking place across New Zealand's marine environment over the long term. A starting point to the assessment and reporting of broad-scale changes in New Zealand's marine environment was to locate existing and past time-series of marine environmental data and, where data owners approved, to place high level information about these data into a searchable online meta-database (catalogue). The database will improve awareness and access to these datasets and allow an evaluation of their fitness-for-purpose in contributing towards a national MEMP. The next phase was a review of policy requirements of local and national government bodies, of international obligations and commitments to international monitoring programmes. This was followed by workshops and questionnaires to identify key variables for monitoring on a national scale. Key variables were split into biological, seafloor and water column categories. Of relevance to this report are the water column variables that were identified. A total of 63 variables including depth, salinity, sea surface temperature, suspended solids, currents, pH, dissolved oxygen (DO), total phosphorus (TP) and total organic carbon (TOC) were identified. Currently 59 of these water column variables are measured in one or more regions within New Zealand using a range of methodologies. Sea level is the most widely monitored variable across New Zealand being measured at approximately 50 locations around the country, in a consistent way. The next most commonly measured variables, monitored across seven to nine regions (defined as

regional or unitary council boundaries) include sea surface temperature, conductivity, salinity, chlorophyll-a, dissolved oxygen, total phosphorous, wave activity, nitrates and ammonia. The research programme is led by NIWA with research partners including Cawthron Institute, Pacific Eco-Logic Ltd and the University of Auckland. Outcomes from this project are expected in June 2013.

## 3.2. International examples

### 3.2.1. *Australia's Integrated Marine Observing System*

Australia's Integrated Marine Observing System (IMOS) is designed to be a fully-integrated, national system, observing at ocean-basin and regional scales, and covering physical, chemical and biological variables. Metadata from IMOS are managed within the Australian Ocean Data Network (AODN) which is primarily aimed at automating the real-time publication of data from research vessels. Within IMOS sits the Australian National Moorings Network (ANMN) Facility, which consists of national reference moorings, regional moorings, and moorings for acoustic and acidification monitoring. The framework used for AMNM represents a good model for further developing a network of moored instrumentation in New Zealand. IMOS also integrates data collected from platforms such as Argo floats, ships of opportunity, deep water moorings, ocean gliders, autonomous underwater vehicles, ocean radar, animal tagging and monitoring, submerged wireless sensor networks and satellite remote sensing (Figure 4).



Figure 4. Schematic of Australia's Integrated Marine Observation System (IMOS). See [imos.aodn.org.au](http://imos.aodn.org.au) for more information.

IMOS is guided by science planning undertaken collaboratively across the Australian marine and climate science community. The programme and science planning is organised by a series of integrated nodes — the Bluewater and Climate Node; focused on the open ocean, and five regional nodes covering the continental shelf and coastal seas of Western Australia (WA-IMOS Node), Queensland (Q-IMOS Node), New South Wales (NSW-IMOS Node), Southern Australia (SA-IMOS Node) and Tasmania (TasIMOS Node). The Bluewater and Climate Node has research interests in the tropical and western Pacific, the Indian Ocean, and the Southern Ocean (to the Antarctic coast). While open ocean monitoring is not specifically relevant to the needs of regional councils who are required to monitor coastal water quality, it is relevant in monitoring larger scale processes. Specifically nesting regional coastal ocean observation systems within these international networks provides good time-series information on large scale oceanic processes such as climate change. Currently NIWA has a joint initiative with IMOS to share data infrastructure. This is of significance to New Zealand given the spatial extent of monitoring down into the Southern Ocean as far South as the Antarctic coast.

### **3.2.2. U.S. Integrated Ocean Observing System**

The U.S. Integrated Ocean Observing System (IOOS) catalogues data from roughly 2,000 *in situ* platforms such as moorings and gliders, as well as data generated from numerical models and satellite imagery. It includes eleven regional systems that are organised regionally. The primary focus of IOOS is integration and access to ocean observation data for improved decision making. Data from IOOS partners, including the eleven regional associations and sixteen federal agencies, are integrated and made available through the IOOS Data Catalog and Asset Viewer (go to [www.ioos.gov](http://www.ioos.gov) for more information). Nested within IOOS lies long-term, continuous data collected at 28 National Estuarine Research Reserves across the U.S. Within each reserve (estuary), continuous monitoring of core water quality parameters, including pH, turbidity, DO, temperature, and salinity are collected at stations located within proximity of sentinel sites that have been established for understanding regional and national environmental trends ([www.nerrs.noaa.gov](http://www.nerrs.noaa.gov)).

In response to recommendations in the 2004 U.S. Commission on Ocean Policy report, a coordinated national monitoring network was initiated for coastal waters and their upland regions (watersheds) that affect them. Because of the inherent overlap among inland, coastal, and open-ocean monitoring and observing, the network is closely linked with the IOOS. Leadership of the network was assumed by the National Water Quality Monitoring Council and the network design was developed by approximately 80 individuals who represented 40 different organisations. These included federal and state agencies, academia, interstate organisations, and the private sector. The network shares many attributes with ongoing monitoring efforts but is unique in that it uses a multidisciplinary approach and addresses a broad range of resource components, from upland watersheds to offshore waters using an integrated



approach. As a result, the monitoring network provides critical information about the quality of coastal waters and their tributaries at regional and national scales. The resource components include estuaries, nearshore, offshore, Great Lakes, rivers, ground water, atmospheric deposition and beaches.

### **3.2.3. *Global Ocean Observing System***

The above national-level examples in turn feed into global scale initiatives such as the Global Ocean Observing System (GOOS). GOOS is a permanent system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. GOOS also provides accurate descriptions of the present state of the oceans including forecasts of climate change. The GOOS network includes many observation platforms such as agro floats, drifting buoys, probes on commercial and private ships and fixed moorings. Because of the inherent overlap between inland, coastal and open-ocean monitoring and observing, national monitoring networks should be closely linked with, and contribute to, these wider GOOS and ultimately with a broad Earth observing system.

## **3.3. Overview of international programmes**

In reviewing existing ocean observation systems and networks, a number of themes become apparent which could inform the development of a New Zealand coastal monitoring network and broader ocean observation system. Firstly, most frameworks include approaches that link data generated from both land and sea-based monitoring initiatives so that ecosystem based management approaches can be adopted. Secondly, within coastal observation systems a nested approach is generally adopted. This includes splitting habitats by rivers, estuaries, nearshore and offshore components. Within these habitats varying sampling and instrumentation approaches are appropriate that sample from the fine, site-specific scale (e.g. estuarine benthic core sampling) to large-scale regional sampling (e.g. remote sensing of oceanic water bodies). Coastal and ocean frameworks also tend to include: 1) sentinel stations which are located to provide early warnings of the impacts of both land-based inputs and oceanic inputs related to processes such as upwelling and ENSO events, and 2) reference stations located at sites where impacts on water quality are minimal. Finally a set of key physical, chemical and biological parameters are identified by these programmes. For coastal ocean observing systems the key physical and chemical variables that are routinely monitored internationally are outlined in Table 3. In general, biologically related variables are under-represented in observation programmes. In a few cases, sensor networks include application of sophisticated instruments for remotely detecting presence of organisms and their gene products (e.g. Environmental Sample Processor; [www.mbari.org](http://www.mbari.org)). These types of instruments are evolving and will likely play an increasingly important role in monitoring and observation programmes.

Table 3. Proposed core variables identified for coastal monitoring by U.S. Commission on Ocean Policy (2004). Source: National Ocean Research Leadership Council. Building Consensus: Toward an Integrated and Sustained Ocean Observing System (2002).

Physical	Chemical
Salinity	Contaminants: water
Water temperature	Dissolved nutrients
Bathymetry	Dissolved oxygen
Sea level	Carbon: total organic
Directional wave spectra	Contaminants: sediments
Vector currents	pCO <sub>2</sub>
Ice concentration	Carbon: total inorganic
Surface heat flux	Total nitrogen: water
Bottom characteristics	
Sea floor seismicity	
Sea surface height	

### 3.4. Considerations for implementation

#### 3.4.1. Data management and dissemination

Coastal research, observing, and monitoring activities are generating data at ever-increasing rates; data which in turn must be analysed, distributed, and archived. Key requirements for data management and wide dissemination include:

- Selection of open source, well-documented methodologies to ensure consistency between datasets
- Inter-regional integration
- Collection, maintenance and dissemination of standardised metadata
- Integration with existing data management systems
- Consistency with national and international networks.

Future development of a national network of coastal monitoring platforms includes consideration of how the data will be managed at the local (regional) level and secondly how it will be disseminated. Firstly, HBRC's shore side data is presently managed using third party software including Hydrotel© and Hilltop©. These systems are used by most councils throughout New Zealand. Therefore, if a coastal platform can be shown to work effectively within these programmes, additional platforms could be easily added both by HBRC and other councils. Secondly, data dissemination could be facilitated by integrating coastal monitoring information within existing land-based data systems. Of relevance to managing NZ's coastal catchments is the need to integrate regional coastal monitoring data with monitoring data from upland terrestrial and freshwater systems. Currently there are a number of databases that host freshwater and catchment data including LAWNZ (Land and Water Forum New

Zealand; [www.landandwater.co.nz](http://www.landandwater.co.nz)) and NIWA's EDENZ website (Environmental Data Explorer New Zealand; [edenz.niwa.co.nz](http://edenz.niwa.co.nz)).

LAWNZ is a collaborative initiative between 16 regional councils aimed at disseminating water quality information in a standardised and easily understood fashion. At present, data on the LAWNZ website ([www.landandwater.co.nz](http://www.landandwater.co.nz)) is limited to individual catchments within each region. The 12 mile territorial limit is also presented as a layer within the map and coastal platforms could be included within these 12 mile polygons. Hosting coastal water quality data within existing land-based systems (such as LAWNZ or EDENZ) would facilitate our understanding of land/sea interactions and inform ecosystem-based planning and management efforts. Data management and dissemination at a regional level within existing land-based databases would in turn provide logical platforms for networking coastal monitoring platforms at a national level. In order to facilitate input of data within open web-based platforms such as LAWNZ, time-series datasets will need to follow standardised formats consistent with those suitable for the Sensor Observation Service (SOS), which is the official Open Geospatial Consortium (OGC) standard web service for simplifying access to time-series data. Currently, Crown Research Institutes (CRIs) and Land Information NZ (LINZ) are working on SOS standards for New Zealand, which will in turn underpin will underpin initiatives such as LAWNZ.

While the concept of a 'national data management network' sounds unwieldy and monolithic, it needn't be. The simplest and ultimately only effective way to handle large and ever-changing datasets is not to have them managed from a centralised location, but rather have individual datasets managed by the data creator (e.g. council, CRI, industry, NGO *etc.*). In this case, establishment of a 'national network' is merely ensuring that certain data standards are defined and maintained and that individual data can either be harvested or translated from the supply source. This is what is commonly referred to as a 'federated' approach (e.g. data is managed locally, but shared widely) as opposed to a monolithic approach (data from multiple owners managed by a centralised body).

When considering a national coastal network, proximity to shore and existing terrestrial networks/infrastructure are an attractive option. In other words, rather than investigating solutions often used for offshore oceanic platforms, a much easier and cost-effective approach would be the integration into existing land-based systems. The coastal network will form an extension of the existing terrestrial network to create a seamless link between the land-ocean interface (out to the 12 mile territorial limit). Advantages are that the existing telemetry, infrastructure, and data handling already exist within most councils and coastal platforms would merely represent another site within the existing monitoring framework. As far as a national network is concerned, the first step is to have a proof of concept platform established and investigate the efficacy of incorporating it into an existing terrestrial framework. The HAWQi buoy currently under development by HBRC is a logical choice for this.

### **3.4.2. *Creating a governance structure***

A strong governance structure is required to establish policy and provide oversight for all components of a national coastal monitoring network. As a component and contributor, a network of coastal monitoring platforms (such as HAWQi) requires specific governance for implementation and coordination. Representation by regional and national bodies would facilitate standardised approaches and sharing of data across regions (councils) and ensure strong integration with national and international initiatives. Centralised initiatives to implement a network of coastal monitoring platforms include LAWNZ and/or EDENZ, which are already established nationally for land-based and freshwater monitoring. In addition, a technical advisory group would need to be implemented with likely representation from councils (*i.e.* Coastal SIG), science providers and industry. Similar advisory groups are used in the international examples described in Section 3.

### **3.4.3. *Key parameters to measure***

To establish a national network of coastal monitoring platforms, a consistent core of environmental variables must be measured. This core should endeavor to strike a balance, remaining manageable and affordable while including enough parameters to address land-based and ocean interconnections and support resource management needs, research requirements, and enable practical use by multiple stakeholders.

As in the case of international examples (see Section 3.3), we would recommend that New Zealand select an initial priority subset of key parameters that can be measured using moored instrumentation across regions. Identification of key physical, chemical and biological environmental parameters is one of the expected outcomes from the development of a New Zealand MEMP (Section 3.1). The MEMP report will therefore help inform selection of key parameters, many of which can be collected using moored instrumentation platforms such as HAWQi.

### **3.4.4. *Funding a network of coastal monitoring platforms***

The implementation and ongoing operation of a network of coastal monitoring platforms requires significant funding. As described earlier, a network of coastal monitoring platforms such as telemetered buoys represent one component of overarching ocean observation systems that in large countries requires 100s of millions of dollars to implement and manage. For example, the cost of implementing the U.S. IOOS was estimated at \$231 million USD for the first year, rising over a period of five years to an ongoing annual cost of \$753 million USD — including satellite operations, data systems, and technology development (U.S. COP 2004). A second example is Australia's IMOS which was established in 2007 with initial government funding of \$50 million AUD and co-investment of \$44 million AUD from partners. IMOS has subsequently had an additional \$52 million AUD from the Education Investment Fund (EIF) in 2009, and up to \$66 million AUD in further co-

investment by research institutions, state governments and industry partners, bringing the total investment to more than \$200 million ([www.imos.org.au](http://www.imos.org.au)). These examples provide an overview of the expense of implementing, managing and operating major ocean observation systems that involve multiple data collecting platforms.

The cost of a national network of coastal monitoring platforms for New Zealand would be proportionally small compared to an overarching ocean observation system, but nonetheless would provide the framework for future development and expansion of a broader system that includes multiple data platforms as resources allow. The cost for individual moored monitoring platforms for monitoring estuaries and coastal waters range roughly between \$25,000 and \$150,000 depending on the type of mooring and instrumentation used (see Figure 2). These systems also require ongoing maintenance, redundant instrumentation in case of instrument failure, and depreciation (and replacement) costs (which we approximate at 20% of the capital costs per annum for each platform). Based on these estimates, a network of coastal monitoring platforms consisting of say 12 sentinel coastal monitoring buoys (each at an initial cost of \$150,000 and ongoing yearly cost of \$30,000) and a subset of 12 smaller platforms for permanent or rotational deployment across representative estuaries and/or bays (each at an initial cost of \$50,000 and yearly ongoing cost of \$10,000) would equate to a total cost of roughly \$4.8 million over an initial 5-year period. The equivalent cost for routinely sampling at 24 sites on a weekly basis for 5 years needs to be considered against the costs and benefits of having real-time access to long-term, continuous datasets for parameters measured simultaneously across all sites. On face value and a national scale, the total cost could be considered a relatively small investment in return for what would likely become a nationally significant database for use by multiple end-users for a range of purposes (see Section 1.4).

So how can we cover the costs? Within New Zealand, SOE monitoring programmes are currently funded by regional councils or central government funding sources (e.g. MfE). However, these sources of funds are very limited due to the size of the rate payer base and tightening budgets. A 'user pays' approach may be part of the solution. The concept of industry levies or 'resource rents' that can be directed toward monitoring and improved ocean management is being considered both nationally and internationally (see U.S. COP 2004). Industries in New Zealand that could potentially contribute include oil and gas, fishing companies, aquaculture, sewage outfall companies, tourism, and land-based industries known to impact on downstream coastal waters (e.g., agriculture). As an example, the Waikato Regional Council is considering the use of levies for regional-scale monitoring programmes (pers. comm. Dr Hilke Giles, Waikato Regional Council). An example includes the aquaculture industry which is expanding within the Firth of Thames. Currently each farm is required to monitor effects on the receiving environment including consideration of wider cumulative effects under the Resource Management Act and NZCP legislation. Cumulative impacts are better assessed using regional monitoring approaches rather

than through consent-specific monitoring and reporting. Partial funding from consent monitoring to address cumulative effects could be redirected to fund the implementation and ongoing management of regional monitoring instrumentation and platforms for providing long-term datasets for contextualising consent activities against CEC and longer-term climate variability.

Other funding possibilities include sponsorship in exchange for advertising on web-based pages for data visualisation and dissemination to the wider public. Another source of funding is private funding through a range of mechanisms including philanthropic foundations. The Tindall Foundation is currently contributing towards the further development of a LAWNZ freshwater monitoring programme. The Forum's work has identified methods, tools and governance processes required for setting and managing limits on water quality and quantity. Specifically LAWNZ is developing methods and strategies required to achieve and manage those limits, through better land use management and improved allocation mechanisms. The Tindall Foundation funding will be used to provide increased data dissemination and public education and outreach for important freshwater ecosystems.

There are significant cost savings through a common vision and standardisation across regions. If councils are aligned with similar instrumentation and data management and dissemination systems, the costs associated with the required redundancy in equipment are significantly reduced. For example, sentinel buoys such as HAWQi and TASCAM require backup instrumentation to ensure continuous datasets in the event of systems failure and for maintenance purposes. Agreement on standard instrumentation hardware between regional jurisdictions would mean that the number of redundant systems (required for equipment maintenance and in the case of instrument failure) could be reduced with the costs shared across councils (perhaps using a consortium approach). For instance, in the example above, there could be three (as opposed to 12) redundant systems that are rotated among 12 locations according to a pre-determined servicing schedule.

#### **3.4.5. *International partnerships***

Atmospheric, terrestrial, and oceanic conditions and processes are inextricably intertwined. Progress in managing and protecting global resources will depend on understanding how those systems interact and what their impacts are on all scales, from local to global, over minutes or decades (U.S. Commission on Ocean Policy, 2004). Understanding such interactions is essential for accurately forecasting global climate change (long-term or abrupt), seasonal to decadal oscillations (like El Niño–La Niña or the Pacific Decadal Oscillation), and short- and long-term ecosystem responses to environmental change. The creation of a coastal monitoring network using moored instrumentation should be integrated with other environmental observing systems to link weather, climate, terrestrial, biological, watershed, and ocean observations into a unified Earth Observing System. Such a system would

improve understanding of environmental changes, processes, and interactions, making ecosystem-based management possible.

Within New Zealand integration of coastal monitoring data within a unified database such as LAWNZ should ultimately include catchment data, freshwater quality monitoring, potentially atmospheric based observations and coastal data. Ideally a broader New Zealand Ocean Observing System should also be linked to international programmes such as IMOS and GOOS.



## 4. NEXT STEPS AND RECOMMENDATIONS

This report outlines considerations for developing, implementing and managing moored instrumentation for the collection of time-series data for monitoring water quality conditions in coastal waters. Such data can make a significant contribution to regional monitoring efforts, and if standardised and networked, contribute to efforts across New Zealand and internationally (Figure 5). As described in Sections 1 and 3, time-series data collected using moored instrumentation have multiple applications for a range of end-users and form a critical component to broader ocean observation systems. Such systems require significant collaboration and inter-operability across a range of government agencies and organisations. A national network of coastal monitoring platforms coordinated across regional councils would provide the foundation for future implementation and development of a broader ocean observation system for New Zealand.

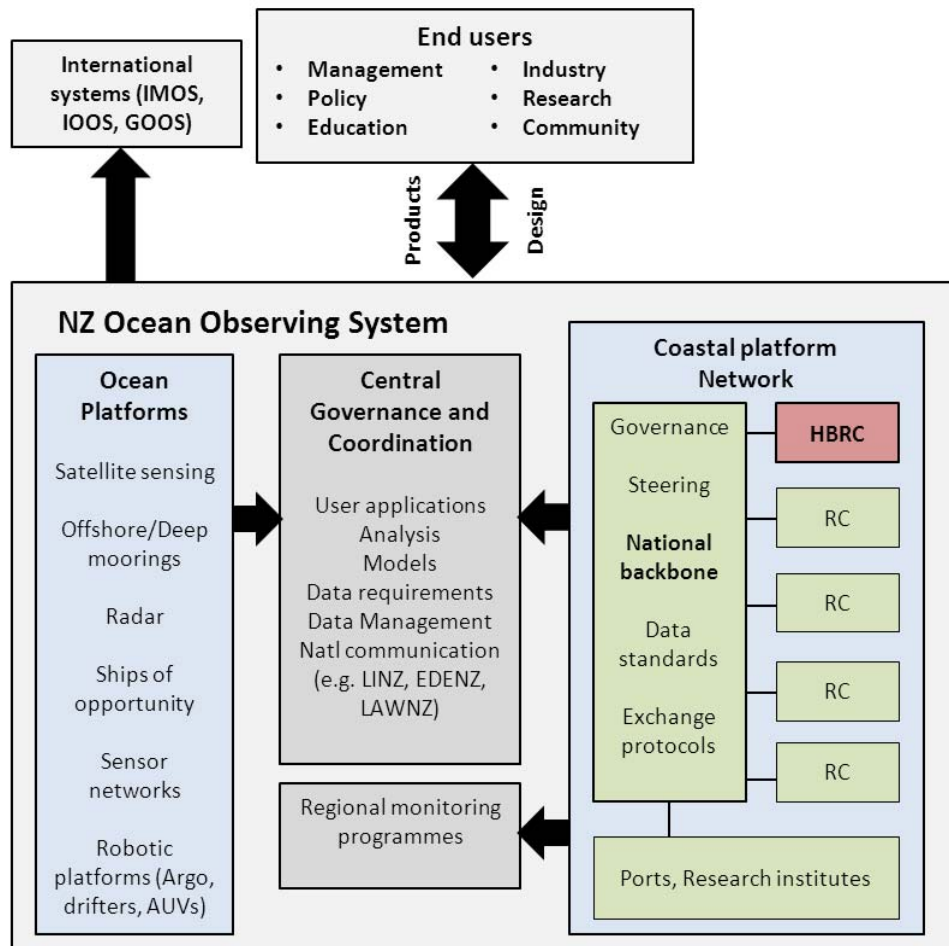


Figure 5. An example configuration of a network of coastal monitoring platforms nested within a broader ocean observation system for New Zealand. This figure is tailored from one used in early development of Australia's Integrated Marine Observation System (see [www.imos.org.au](http://www.imos.org.au) for more information).



There are a number of steps required to expand on the Hawke's Bay example and develop, implement and manage a network of coastal ocean monitoring platforms using moored instrumentation (Table 4). Councils recognise the value of time-series data collected using moored instrumentation systems such as HAWQI; however, they also identify several barriers precluding their implementation (Appendix 1). Limited resources in terms of both funding and staff time (which are linked) are identified as significant barriers. In addition to having limited funding for the capital costs, councils have identified barriers associated with the logistical side of things, ranging from the deployment and maintenance of gear, to the storage, management and sharing of data. Sharing and standardisation of tools, and taking a consortium approach to running and maintaining a network may assist in more efficient inter-operability within and across councils. For example, significant capital savings can be had by meeting equipment redundancy requirements through a co-op approach and standardisation of equipment (see Section 3.4.4).

There are available tools that can assist in managing and disseminating data at the local level, and in turn sharing data at the national level. As discussed in Section 3.4.1, systems can be made compatible with existing data management systems used by councils. In addition, there are open-source data handling programmes ranging from those for data storage and display (e.g. MBARI's Shore Side Data System; [www.mbari.org/ssds/](http://www.mbari.org/ssds/)) to visualisation and dissemination at the national level (e.g. LAWNZ). Tools tailored to the needs of regional councils for data management and dissemination could also be developed through the Coastal SIG (e.g. Envirolink tools).

Ultimately, the steps outlined in Table 4 are only achievable with sufficient, long-term financial support, which in turn requires buy-in from a diverse range of stakeholders. To move forward, central government needs to acknowledge responsibility at the national level and provide supplementary support to stakeholder investment and management of regional systems by councils. As outlined in Section 3.4.4, there are a number of potential funding mechanisms that could also support implementation and ongoing management of coastal monitoring network. There are numerous stakeholders who stand to benefit, and proof-of-concept from Hawke's Bay will assist in championing further expansion of similar systems within HBRC as well as other regions.

Table 4. Recommended steps for developing, implementing and managing a network of coastal monitoring platforms.

<b>Network requirements</b>	Determine regional and national requirements of a coastal monitoring platform network based on needs of end users (councils, central govt, Industry, Iwi, researchers, etc) and align with MEMP priorities and recommendations.
<b>Business case</b>	Develop indicative budgets based on cost-benefit analyses of different approaches and adopt a national framework for inter-operability across regions.
<b>Funding</b>	Identify end-user champions and potential funding sources; acquire funding and in-kind resources to implement and manage platforms within regions (councils) and facilitate operability at a national level.
<b>Governance</b>	Establish inter-agency governance structure and advisory board including strong regional council representation/leadership.
<b>Design and standards</b>	Determine network design, including core measurements (identified by end users, MEMP), locations, performance requirements, etc. Adopt standards and requirements for time-series platforms consistent with Intl. best practice.
<b>Test and launch</b>	Test and launch Network on three emerging regional locations (Hawke Bay, Tasman Bay, and Firth of Thames) and interface with web-based platforms such as LAWNZ.
<b>Expand and integrate</b>	Expand to further regions as needed and resources allow. Integrate data from other on-going marine monitoring efforts with times-series data from the network to contribute toward a broader coastal ocean observation system for NZ

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## 7. APPENDIX

Appendix 1. Responses to questions regarding use of moored instrumentation posed to council representatives from the Coastal Special Interest Group.

Question	Auckland Council	Waikato Regional Council	Greater Wellington Regional Council
Does your council see the use of continuous, remotely-collected, time-series data playing an increasingly important role in monitoring coastal environments?	YES	YES	YES
For what purpose do you see datasets being used ( <i>i.e.</i> SoE monitoring, consents, planning, model validation, etc)?	SoE Monitoring. Model development, validation and calibration. Ground truth remote sensing data. Issue specific measurements of WQ, platform to Increase spatial coverage when used with remote sensing	SoE monitoring; model validation; context for AEE's and consent monitoring; support for spatial planning; validation of remote sensing data; event notification ( <i>e.g.</i> algal bloom).	SoE monitoring, targeted studies of nutrient and sediment inputs, compliance monitoring
What are some of the barriers (other than financial) within your region that need to be overcome/considered in order to utilise time-series instrumentation and in turn use/apply data they generate?	Considerations using optical sensors, environmental gradients influencing WQ,	Data management (storage space, database), data sharing with public (data display/access on website), maintenance required for some paramters ( <i>e.g.</i> chlorophyll), limitation of paramters that can be measured ( <i>i.e.</i> nutrients)	Lack of staff resources to maintain/deploy gear and process data. Heavy need to use gear in estuaries and not sure if gear suited to this. Also security and vandalism?
Under limited financial resources, what are the key types of data you would likely collect and where (broadly speaking – specific harbour, estuary, outfalls, river mouth, bathing beaches, etc.)?	Data: temp, salinity, conductivity, chl-a, turbidity, wave height and direction, pH, DO (% and Sat), light: from open coasts, harbours, estuaries	Data required to validate hydrodynamic models ( <i>e.g.</i> currents, salinity, temperature), chlorophyll (relevant for aquaculture WQ effects and remote sensing data), all in estuaries and open sea (we are considering purchasing permanent and re-locatable buoys)	Specific harbour/estuaries investigating nutrient and sediment sources
Under the ideal scenario (financial resources are not limiting), what types of data would you likely collect and where (beyond those in Q4)?	Nutrients (N+P), bacteria (Enterococcus and faecal), phytoplankton and zooplankton, suspended sediment, CDOM, PCR markers	All of it and everywhere! Would use data to validate models for all estuaries and open sea areas.	Yes, all of it!! I would have a network of buoys around the coast monitoring nutrients and TSS and a network within Wellington Harbour radiating out from the Hutt River. Also some in Porirua Harbour.

Question	Hawke's Bay Regional Council	Environment Canterbury
Does your council see the use of continuous, remotely-collected, time-series data playing an increasingly important role in monitoring coastal environments?	Yes	For monitoring - possibly – it will depend on the parameters that can be measured. "It would be nice to have a buoy to provide data to improve our understanding of the coastal waters of Canterbury."
For what purpose do you see datasets being used ( <i>i.e.</i> SoE monitoring, consents, planning, model validation, etc)?	SoE monitoring, event monitoring, context for AEE's and consent monitoring, planning, model development and validation, event notification ( <i>e.g.</i> algal bloom).	Investigations in areas where there are issues and we require more background information to understand the general functioning of the area - <i>eg</i> in the harbours of Banks Peninsula. Model development and validation particularly for the assessing the impact of river and coastal lake plumes on the nearshore waters of Canterbury
What are some of the barriers (other than financial) within your region that need to be overcome/considered in order to utilise time-series instrumentation and in turn use/apply data they generate?	Data management (integration know-how), usefulness of core data without bells and whistles ( <i>e.g.</i> salinity and temp),	Determination of how the data might be used prior to considering to get buoys. Ensuring that the parameters that we are interested in can be provided by such buoys.IT for managing the system and data management.
Under limited financial resources, what are the key types of data you would likely collect and where (broadly speaking – specific harbour, estuary, outfalls, river mouth, bathing beaches, etc.)?	SoE so that we can contextualise outfall data etc. Estuaries from integrated catchment planning perspective. Bathing beaches as this tends to be highest profile.	Investigations in areas where there are issues and we require more background information to understand the general functioning of the area - <i>eg</i> in the harbours of Banks Peninsula.
Under the ideal scenario (financial resources are not limiting), what types of data would you likely collect and where (beyond those in Q4)?	All of it! Similar to freshwater network, would like to have near replication in estuaries, nearshore coast. Too little known about state of coastal waters to make confident comments about effects on it of activities or predictions on improvements due to ICM planning.	Water temperature, salinity, Chlorophyll-a, Total suspended solids, nutrients, current direction and speed data. From estuaries, hapua, harbours and open coast. Datasets from multiple buoys.