

# Marine Water Quality Annual Report 2017

Melanie R Vaughan

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Technical Report 2019/003





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Auckland Council  
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## Executive summary

Auckland Council operates a long-term, region-wide marine water quality monitoring programme. The main objective of this programme is to gather data to inform the state of the environment trends and reporting as required under section 35 of the Resource Management Act 1991 (RMA). The data are collected to look at long-term trends to identify and monitor water quality changes and to assess the efficiency of council initiatives, policies and strategies. This report documents changes to the monitoring programme and provides a summary of the data collected during 2017.

Marine water quality samples are collected monthly by helicopter, boat and from beaches, and use a combination of field and laboratory analysis to investigate 16 parameters across 32 sites around the Auckland region. Grouped into six geographically distinct sampling runs, the results collected are presented in box plots, displaying the variation in the measured parameters at each site, and in statistical summary tables for each site and parameter.

The data collected under this programme are summarised by a Water Quality Index (WQI), a metric which integrates multiple types of data to assign a water quality class of excellent, good, fair, marginal or poor. This analysis combines water quality measures and compares them against selected “reference” sites to provide a readily understood description of the water quality for the site. For the 2017 reporting year, the method of calculating WQI has changed to account for the variation between open coast and estuarine environments, and to standardise the objectives that the water quality data is compared to. A further change for 2017 data is that the WQI is now grouped into five classes (excellent, good, fair, marginal, poor), rather than the previous four (excellent, good, fair, poor).

In 2017, WQI decreased at seven sites compared to 2016 results. The sites with change included Goat Island, Orewa, Hoteo River Mouth, Kaipara Heads, Dawsons Creek, Mahurangi Heads and Chelsea.

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## 1.0 Introduction

The marine environment in the Auckland region encompasses two oceans, four major harbours and numerous estuaries. Within these are a wide variety of marine habitats which support a diverse range of plants and animals, including seaweeds, invertebrates, mangroves, seagrass, shellfish, marine mammals, fish and sea birds. The beaches also provide many options for recreational activities across the region.

The aesthetics, use, and health of coastal marine waters are influenced by the quality of surface water that runs from the land through streams, rivers, overland flow paths and the stormwater system. The microbiological contamination of beaches after heavy rainfall and the sedimentation of harbours and estuaries (Auckland Council, 2015) illustrate the connections between inland and coastal waters. These pressures from the land also have the potential to affect sensitive ecosystems and can cause a decline in their health.

Auckland Council's marine water quality programme monitors parameters that can change with natural variation in ocean hydrodynamics, land erosion and biological waste (organic material and faecal contaminants) in the water column. Along with two other monitoring programmes, benthic ecology and sediment contaminant monitoring, they provide an integrated overview of the physical, chemical and biological condition of the region's marine environment.

In addition to the marine programmes, the overall picture is strengthened further by the council's river monitoring programme which monitors similar water quality parameters.

The marine water quality programme is designed to meet the following objectives:

- Satisfy Auckland Council's Resource Management Act 1991 section 35 obligations with respect to the state of the environment reporting.
- Contribute to the need to maintain and enhance the quality of the environment (Local Government Act 2002).
- Help inform the efficacy and efficiency of policy initiatives and strategies.
- Assist with the identification of large scale and/or cumulative impacts of contaminants associated with varying land uses and disturbance regimes and link these to particular activities.
- Provide baseline, regionally representative data to support the resource consent process and compliance monitoring.



- Answer queries from the public and promote awareness of marine water quality issues.

## 1.1 Council directives

Monitoring of marine water quality falls under directives of Auckland Council policies. The programme fits under the “Environment and Cultural Heritage” component of the Auckland Plan 2050. A key issue for the region is to manage the effects of growth and development on our natural environment.

Specific objectives include managing and minimising the effects of present and future urban and rural development, growth, and intensification across the region (e.g. sedimentation). The water quality parameters provide information on the condition of the region’s marine environment, and feedback on management actions. This is necessary to confirm that Auckland Council’s management strategies are effective in sustaining ecosystem functions and uses. By achieving this outcome, we are working towards Auckland Council’s vision of being a world-class city.

Information from the marine water quality programme is also used to measure the success of strategic directives in the Auckland Plan 2050 including

- **Outcome:** Environment and Cultural Heritage, **Direction 1:** Ensure Auckland’s natural environment and cultural heritage is valued and cared for (Auckland Plan 2050, Auckland Council 2018).

## 1.2 Report content

This report provides summary data for the 2017 calendar year collected from 32 monitoring sites across the Auckland region. Data from these sites are provided as summary statistics tabulated by parameter and grouped by spatial proximity along with results from WQI calculations. For further trends and analysis on Auckland’s water quality please refer to *Marine water quality state and trends in the Auckland region from 2007-2016*, Foley, et al., (2018) Auckland Council technical report, TR2018/15.

## **2.0 Methods**

### **2.1 Programme design**

Marine water quality samples are collected from surface waters monthly by Auckland Council's Research and Evaluation Unit (RIMU), from a combination of helicopter, boat and land-based sampling. Collection of water samples by helicopter enables sites spread over a broad area to be sampled within a short time frame to work within tidal constraints. Sites in the inner Hauraki Gulf, Kaipara Harbour, Central Waitematā Harbour, Tamaki Strait and Manukau Harbour are collected by helicopter, sites in the Upper Waitematā Harbour are collected by boat and Tamaki Estuary sites are collected from land.

At each site, water samples are collected from the surface (top 1m) by lowering a two litre plastic bottle into the water. The samples are then sent to a laboratory for analysis of a variety of parameters (see Appendix A for the full list). In 2017 samples were sent to Watercare Laboratory Services (WLS) from January to June and then to Hills Laboratory from thereon.

Temporal variation is avoided as much as possible by maintaining a consistent sampling time relative to tidal cycle. Samples are collected approximately 10 minutes – 2.5 hours after high tide for the Kaipara Harbour, Waitematā Harbour and Hauraki Gulf sites and 2.5 to 4 hours after high tide for the Manukau Harbour. Maintaining a consistent sample time improves the power of long-term trend detection.

### **2.2 Site locations**

Sampling is organised in six geographically distinct runs. Monitoring locations are summarised in Table 2-1 and shown on the map in Figure 2-1. Table 7-4, Appendix C, is a list of all sites that have been included in the programme from its inception in 1987.

Locations:

- six sites in the inner Hauraki Gulf (including two sites in Mahurangi Harbour)
- six sites in the Kaipara Harbour
- eight sites in the Waitematā Harbour
- two sites in the Tamaki Estuary
- one site in the Tamaki Strait (at the mouth of the Wairoa River)

- nine sites in the Manukau Harbour.

Each monitoring site was selected to provide information on:

- A range of exposure levels including open coast, sheltered coast, harbours, large estuaries and tidal creeks.
- The main harbours and large estuaries.
- Areas with a variety of adjacent land uses, ranging from urban/industrial to rural.

Table 2-1 Current marine water quality sites grouped by location. Spatial reference is in NZTM coordinates and the year which sampling began is also listed.

Site	Location	Easting	Northing	Year initiated
Goat Island	East Coast	1761835	5984910	1993
Ti Point	East Coast	1760222	5978524	1991
Mahurangi Heads	East Coast	1754382	5959892	1993
Dawsons Creek	East Coast	1753554	5966410	1993
Orewa	East Coast	1753273	5949612	1991
Browns Bay	East Coast	1757934	5935780	1991
Shelly Beach	Kaipara Harbour	1723526	5951872	1991
Kaipara River	Kaipara Harbour	1726372	5946975	2009
Makarau Estuary	Kaipara Harbour	1728450	5953472	2009
Kaipara Heads	Kaipara Harbour	1709351	5970137	2009
Tauhoa Channel	Kaipara Harbour	1717979	5969681	2009
Hoteo River	Kaipara Harbour	1726690	5967497	2009
Chelsea	Waitematā Harbour	1753944	5922872	1991
Whau Creek	Waitematā Harbour	1748289	5920291	1991
Henderson Creek	Waitematā Harbour	1746712	5923648	1991
Hobsonville Jetty	Waitematā Harbour	1749321	5927317	1993
Paremoremo Ski Club	Waitematā Harbour	1745746	5930178	1993
Rangitopuni Creek	Waitematā Harbour	1742836	5929868	1993
Brighams Creek	Waitematā Harbour	1742758	5928019	1996
Lucas Creek	Waitematā Harbour	1750045	5932471	1993
Tāmaki	Tāmaki Estuary	1769372	5917448	1992
Panmure	Tāmaki Estuary	1765295	5913934	1992
Wairoa River	Tāmaki Strait	1786443	5909850	2009
Grahams Beach	Manukau Harbour	1749651	5888082	1987
Clarks Beach	Manukau Harbour	1748630	5897349	1987
Waiuku Town Basin	Manukau Harbour	1753690	5878187	2012
Shag Point	Manukau Harbour	1748379	5908452	1987
Puketutu Point	Manukau Harbour	1753877	5908724	1987
Weymouth	Manukau Harbour	1764925	5897672	1987
Mangere Bridge	Manukau Harbour	1758588	5910714	1987
Manukau Heads	Manukau Harbour	1708915	5970600	2009
Manukau Outer Heads	Manukau Harbour	1725645	5903140	2017



Figure 2-1 Location of the 32 marine water quality monitoring sites

## **2.3 Marine water quality parameters**

The quality of marine water around the region's coastal environment is determined based on an assessment of 16 parameters. Some of these parameters are measured in the field but most are analysed in the laboratory (see Appendix A). The number and type of parameters has varied since the programme's inception, as new technology has become more affordable, instrument sensitivity improved, and the programme objectives modified.

## **2.4 Programme changes**

### **2.4.1 Sites**

This section briefly outlines some of the key changes that have occurred during the programme (a complete account is provided in Appendix C).

In January 2009, six new sites were established and added to the programme in the Kaipara Harbour. In addition, one site at the Manukau Heads, one site at Turanga Estuary, and one site at the mouth of the Wairoa River were also added. In August 2012, a site at Waiuku Town Basin was created in response to a request from the Franklin Local Board.

In June 2014, the monitoring site "Confluence" in the Upper Waitematā Harbour was dropped from the sampling programme and in July 2015 a further four sites were dropped from the sampling programme due to budget constraints, Omokiti Beacon in the Kaipara, Turanga Estuary in the Tamaki Strait, Rarawaru and Waimarie in the Upper Waitematā Harbour. These sites were removed following an analysis of the relevance of the data that each site was providing.

In 2017, Manukau Harbour Heads site was added to gain an understanding of the offshore water quality.

### **2.4.2 Parameters**

Faecal coliforms were removed from the list of laboratory tests in 2009 as enterococci were considered a more appropriate faecal indicator bacteria in coastal marine waters. However, a decision was made to remove enterococci from sampling parameters in 2014 because an analysis of the results showed that the temporal variability requires a programme focussed on risk associated with recreational use. For this information Auckland Council (along with Watercare, Surf Lifesaving Northern Region and Auckland Regional Public Health Service) runs Safeswim, a programme which provides water quality forecasts and up-to-date information on

risks to human health and safety at 84 beaches and eight freshwater locations around Auckland ([www.safeswim.org.nz](http://www.safeswim.org.nz)).

A 2005 review of the programme resulted in the removal of biological oxygen demand (BOD) parameter from the list of analytical laboratory tests. This was due to laboratory analysis consistently returning results at the detection limit (<2ppm) and no improved methodology was forthcoming or available.

The measurement of water clarity using a Secchi disk also ceased in July 2005 due to the difficulty of accurately estimating readings from the helicopter. Turbidity (measured in NTU) was deemed to be a useful approximate parameter instead.

Total nitrogen (TN) was added to the list of chemical variables in 2009 as the current nitrogen species analysed allow for it to be calculated.

### **2.4.3 Sampling equipment**

In November 2008, a hand-held multi-parameter water probe was introduced to the programme. The hand-held probe (YSI 556 MPS) was used to take in situ measures of salinity, conductivity, temperature and two dissolved oxygen readings (% saturation and concentration recorded in mg/L<sup>-1</sup>). Previously, these parameters were measured in the lab by Watercare Laboratory Services. In December 2014, the YSI 556 MPS multi-parameter meter was upgraded to the EXO 2 multi-parameter sonde (Xylem Analytics).

## **2.5 Quality control, data storage and analysis**

Quality control is undertaken in accordance with Auckland Council's internal standards, including procedures for the collection, transport and storage of samples, and methods for data verification and quality assurance to ensure consistency across the monitoring programme. Samples have been analysed under contract to Watercare Laboratory Services (January to June), and Hills Laboratories; both International Accreditation New Zealand (IANZ) and ISO accredited laboratories. Analytical methods follow the "Standard Methods for the Examination of Water and Wastewater" 22<sup>nd</sup> Edition (APHA, 2012). All field and laboratory data are stored in the Auckland Council's archiving database, HYDSTRA which complies with ISO 9001:2008 certifications.

Data collected for each variable are analysed to check for erroneous data and repair (if data is incorrect) or comment as appropriate.

The data are collated and used to produce:

- Box plots which display variation in the measured parameters at each of the sites. The boxplots were produced using the software package SigmaPlot version 14.0, using the default percentile functions. The boxes represent the inter-quartile range (25<sup>th</sup> and 75<sup>th</sup> percentiles) and the whiskers represent the 10<sup>th</sup> and 90<sup>th</sup> percentiles. The median is shown as a line within each box.
- Summary tables which provide a basic statistical summary for each parameter at each site using Statistica version 14.
- Water Quality Indices (WQI) are produced using data from seven water quality parameters to assign a quality class. Indices are classed as Excellent, Good, Fair, Marginal and Poor. These are produced using an excel workbook developed by the Canadian Council of Ministers of the Environment (2001). The application of this method to the council's marine water quality data is described in Appendix B.

## 2.6 Reports

This is the 28<sup>th</sup> data report since the inception of the monitoring programme, and it is the eleventh time since 2000 that the data has been reported separately from the rivers, streams and lakes water quality monitoring programmes. Previous reports can be obtained from Auckland Council's Knowledge Auckland website [www.knowledgeauckland.org.nz](http://www.knowledgeauckland.org.nz). To obtain raw water quality data please email: [environmentaldata@aucklandcouncil.govt.nz](mailto:environmentaldata@aucklandcouncil.govt.nz)

A comprehensive trend analysis is conducted periodically, the last report was recently published (Foley et al, 2018 TR2018/015). Prior to this two other state and trends reports have been published, Scarsbrook, 2008, (TR2008/005) and Vant and Lee, 1998. Recommendations are made in these reports along with analyses of long term changes for the Auckland region. All reports are available on Knowledge Auckland ([www.knowledgeauckland.org.nz](http://www.knowledgeauckland.org.nz)).

A snap shot of the water quality status can be found in Auckland Council's *The health of Auckland's natural environment in 2015* report which briefly summaries marine water quality issues and the pressures facing the Auckland region and its ecological health (Auckland Council, 2015).

A specific review of the Mahurangi Harbour, Upper Waitematā Harbour and Tāmaki Estuary was undertaken in 2001 (Wilcock and Kemp, 2001).



## 3.0 Results

Data from the 2017 calendar year are presented in box plots (section 3.1) to display the variation in the marine water quality parameter results. These plots compare parameter variation and across sites and locations. Data tables of basic summary statistics (sample sizes, maximum/minimum, means and standard error) are presented in section 5.0. For box plots and data tables, sites are grouped by location (e.g. all sites within the Manukau Harbour are grouped) and then listed from north to south. Water quality indices (WQI) are summarised in section 4.0.

### 3.1 Box plots

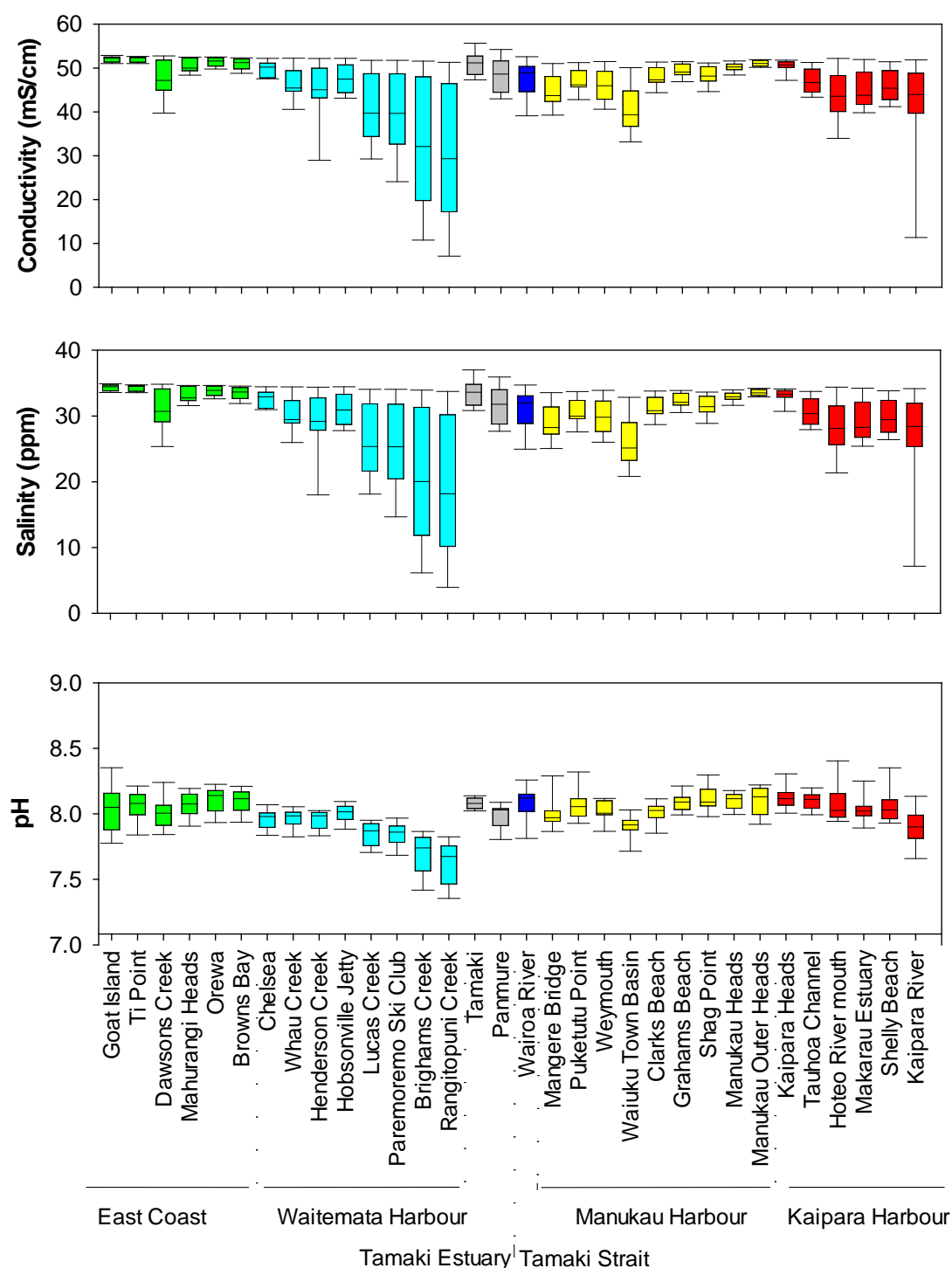


Figure 3-1 Spatial patterns in conductivity, salinity and pH. Boxes represent the median, 25<sup>th</sup> and 75<sup>th</sup> percentiles while whiskers are 10<sup>th</sup> and 90<sup>th</sup> percentiles for data collected from January 2017 to December 2017. Percentile values calculated using the standard method in SigmaPlot (v14).

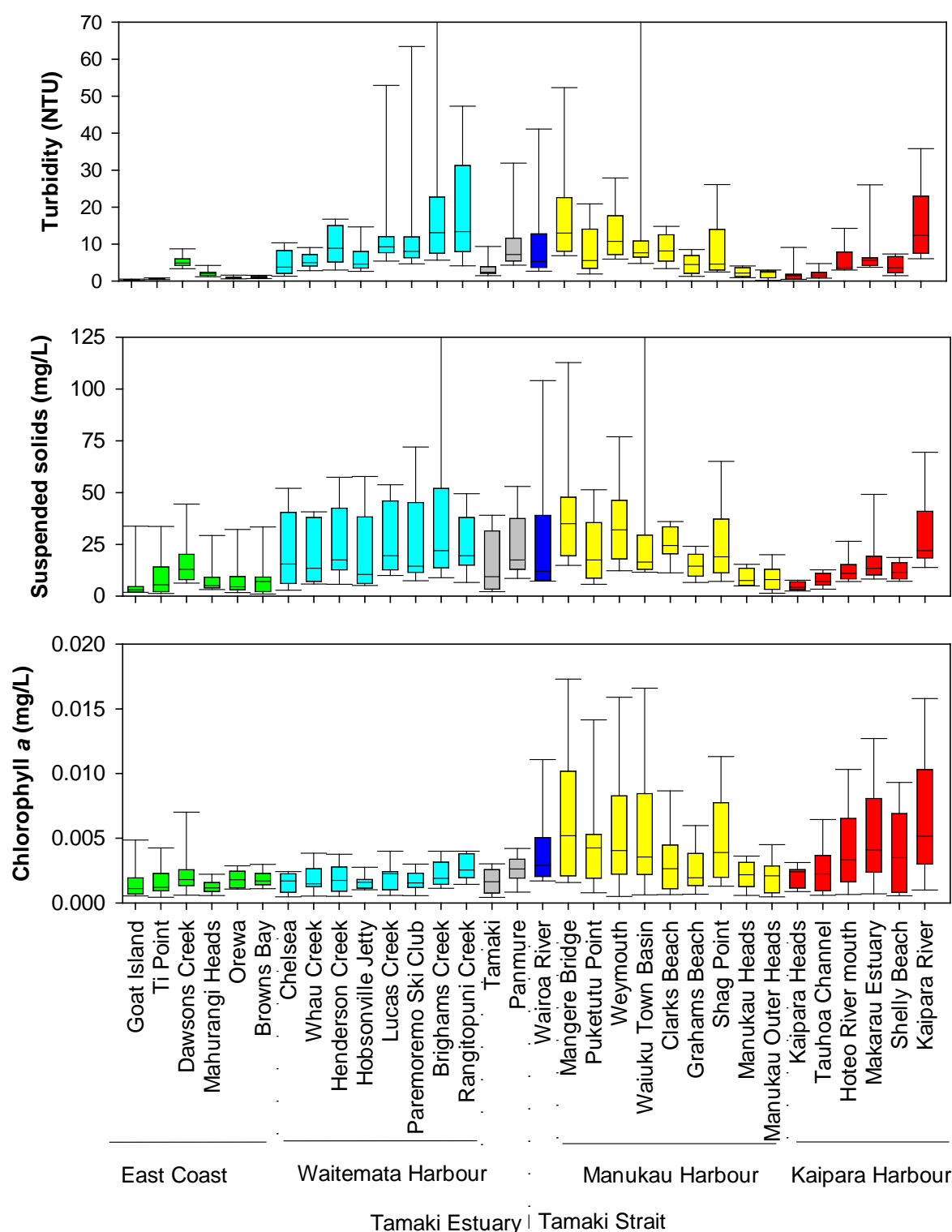


Figure 3-2 Spatial patterns in turbidity, suspended sediment, and chlorophyll a. Boxes represent the median, 25th and 75th percentiles while whiskers are 10th and 90th percentiles for data collected from January 2017 to December 2017. Percentile values calculated using the standard method in SigmaPlot (v14). Actual values for Brighams Creek and Waiuku Town Basin where 90<sup>th</sup> percentiles are beyond the extent of the x axis are 129.7, 91.5 and 166.5 and 280.7 for turbidity and suspended sediment respectively.

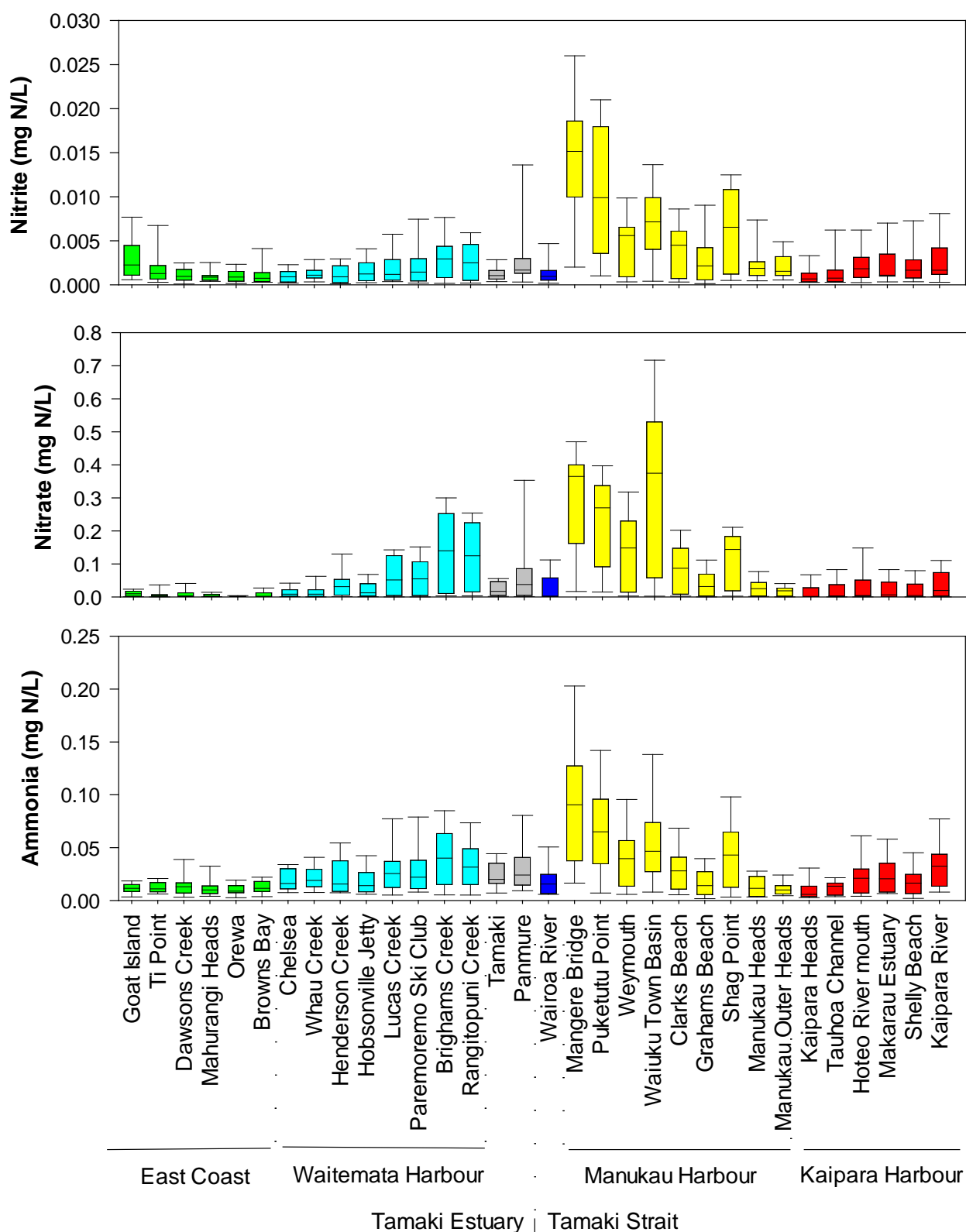


Figure 3-3 Spatial patterns in nitrite, nitrate and ammonia. Boxes represent the median, 25th and 75th percentiles while whiskers are 10th and 90th percentiles for data collected from January 2017 to December 2017. Percentile values are calculated using the standard method in SigmaPlot (v14).

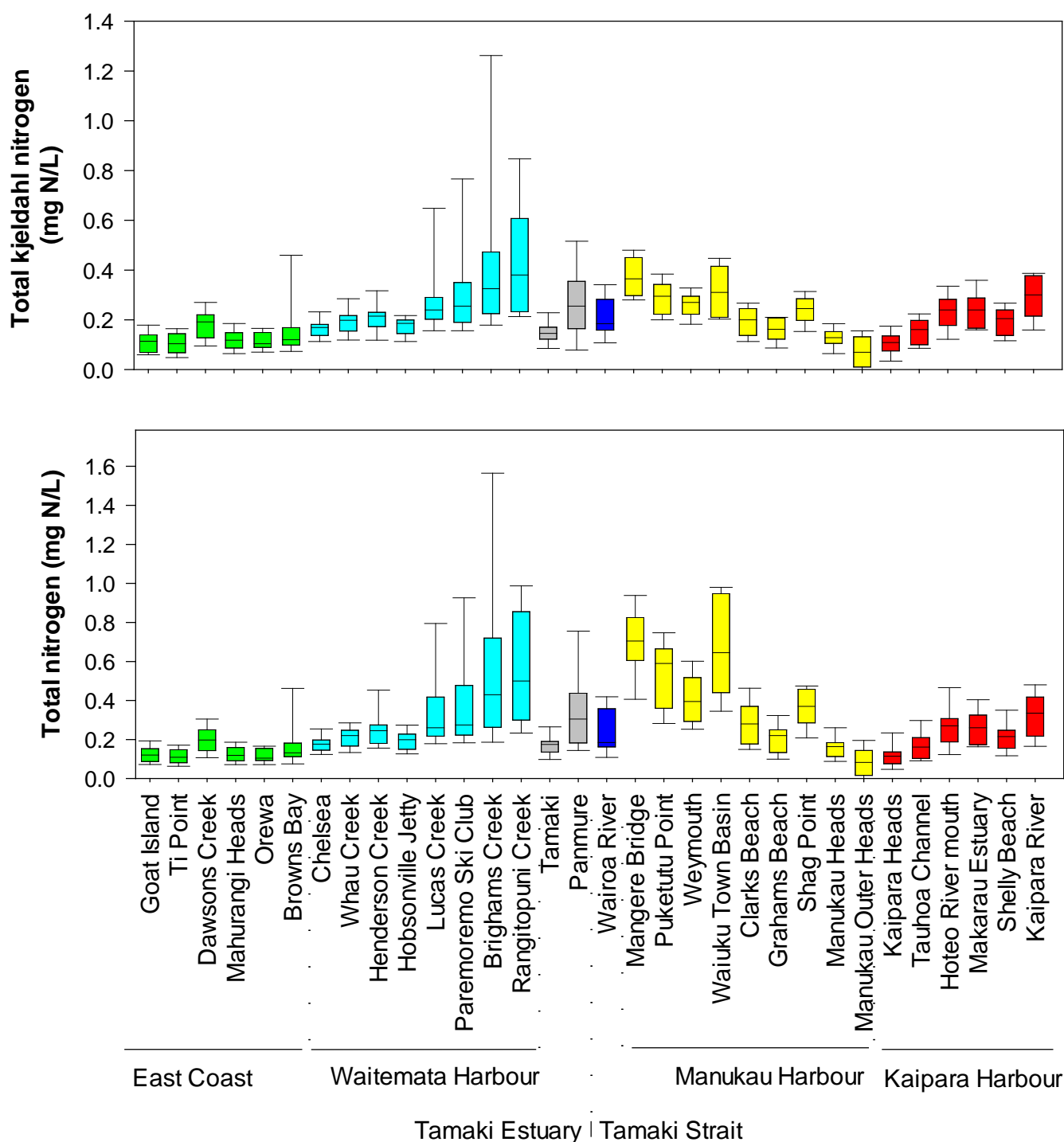


Figure 3-4 Spatial patterns in total kjeldahl nitrogen and total nitrogen. Boxes represent the median, 25th and 75th percentiles while whiskers are 10<sup>th</sup> and 90<sup>th</sup> percentiles for data collected from January 2017 to December 2017. Percentile values are calculated using the standard method in SigmaPlot (v14).

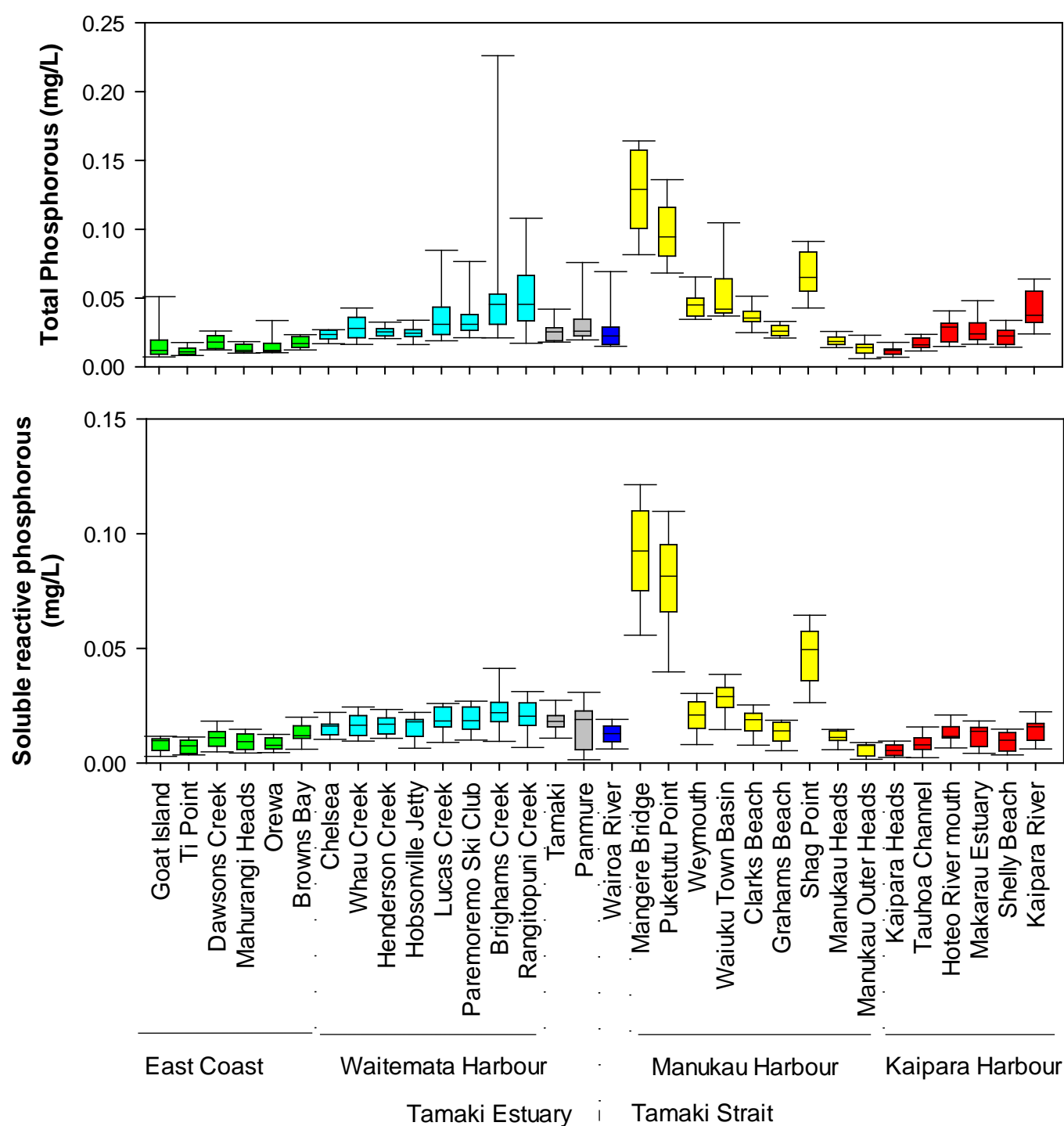


Figure 3-5 Spatial patterns in total phosphorus and soluble reactive phosphorus. Boxes represent the median, 25th and 75th percentiles while whiskers are 10<sup>th</sup> and 90<sup>th</sup> percentiles for data collected from January 2017 to December 2017. Percentile values are calculated using the standard method in SigmaPlot (v12).

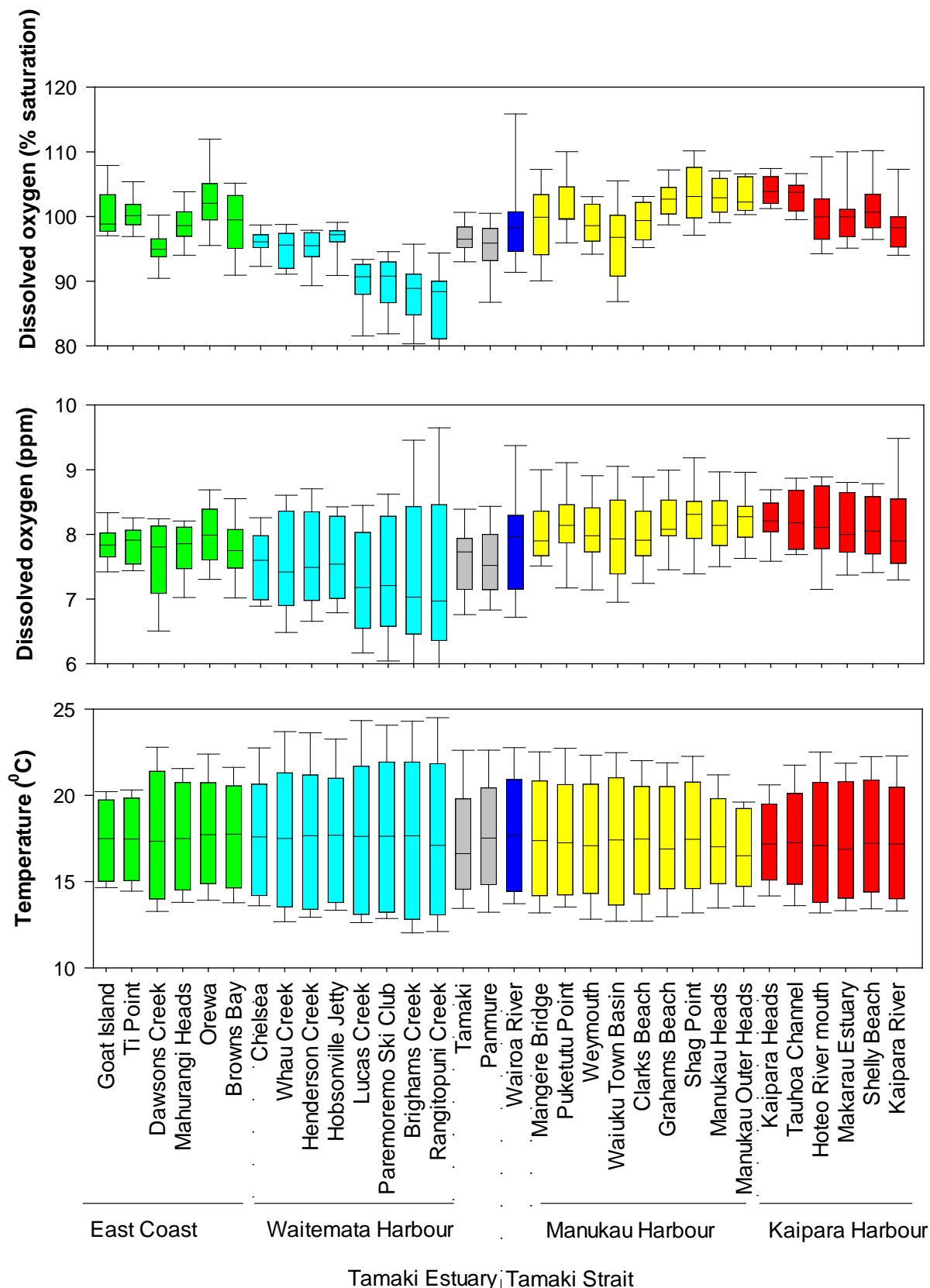


Figure 3-6 Spatial patterns in two indices of dissolved oxygen (ppm and % saturation) and sea surface temperature. Boxes represent the median, 25th and 75th percentiles while whiskers are 10th and 90th percentiles for data collected January 2017 to December 2017. Percentile values are calculated using the standard method in SigmaPlot (v14).

## 4.0 Marine Water Quality Index

A Water Quality Index is a way of communicating complex data in a simplified manner to provide an indication of how healthy the water is. In this report, a water quality index developed by the Canadian Council of Ministers for the Environment (CCME) (2001) was applied to the marine water quality data collected by Auckland Council to enable improved understanding and communication of the work. The CCME approach uses water quality results to produce four water quality indices, and these indices can be used to assign a water quality class to each monitoring site (further explanation is provided in Appendix B). First applied in the 2009 annual marine water quality report, marine water quality indices and classes were generated for each of the 32 sites.

Before an index can be calculated, appropriate objectives need to be defined. The way Auckland Council has calculated the objectives has recently been reviewed (Foley, M, 2018). New recommendations have been provided to use static guidelines from the least modified sites. Prior to this, in 2007 and 2008, data from 2002 to 2006 were used to define the guidelines for the WQI. In 2009, that approach was modified, and a rolling five-year timeframe was used to define the guidelines based on values from sites with the best water quality (specific sites used varied year to year) in the Auckland region. Defining water quality objectives using different reference sites each year and a rolling five-year average makes it impossible to compare WQI scores from year to year as the baseline was always moving.

In order to move away from guidelines that changed every year, a set of static terms using data from sites that have the least impact from activities on land, have been developed from data in the Auckland region from 2007 to 2016, as well as the existing ANZECC guidelines (ANZECC 2000). We used Auckland Council data when the 80th percentile exceeded ANZECC guidelines; and the ANZECC guidelines when they were more permissive than Auckland Council data. Defining guidelines based on sites in Auckland is reflective of conditions and represent guidelines that are achievable.

To calculate objectives the region is now split into open water sites and estuary sites (Table 4-1). Guidelines were defined using the 80th percentile value for each parameter (and the 20th percentile value for parameters with lower and upper bounds, such as dissolved oxygen) for open coast and estuary sites, respectively.



Table 4-1 Reference sites used to calculate objectives

Open coast sites	Estuary sites
Ti Point	Chelsea
Goat Island	Hobsonville
	Manukau Harbour @ Mouth

A three-year rolling average was used to calculate the final 2017 WQI score, incorporating the WQIs from the previous two years (2015 and 2016). This averaging eliminates any major inter annual variations due to natural environmental changes (e.g. heavy rain fall and storms) or human impacts such as development. The decision to present a three-year averaged WQI aligns with the State of Auckland marine report cards and allows for greater consistency in the communication of marine water quality data and the relevant changes in the environment.

In addition, the WQI scores have been divided into five categories (excellent, good, fair, marginal, poor) as originally outlined in the CCME WQI publication (2001) instead of the four categories (excellent, good, fair, poor) previously used. Considering these changes in methodology, we recalculated all WQI scores since 2007. For further details on this change of methodology refer to the report “A review of and update on the methodology used to calculate water quality sites in the Auckland Region”, Foley, M. (2018), TR2018/027.

The water quality class changed at seven sites from 2016 (when recalculated using the refined methodology), all of which decreased by one water quality class. These sites included Goat Island, Orewa, Hoteo River Mouth, Kaipara Heads, Dawsons Creek, Mahurangi Heads and Chelsea (Table 4-2). Most sites in 2017 fell within the “Fair” water quality class (Table 4-3).

Table 4-2 Water Quality Index calculations over the past 11 years (2007-2017).

\*\*Excellent=blue, Good=green, Fair=yellow, Marginal=orange, Poor=Red)

Site	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>East Coast (Open coast sites)</b>											
Browns Bay	38.3	36.8	38.7	47.4	58.6	67.5	58.1	57.4	59.5	78	68.9
Goat Island	50.6	40.8	40.9	41.5	51.3	61	80.3	80.6	80.6	80.1	70.6
Orewa	48.7	38.5	39.3	48.8	68.9	68.6	78.1	78.5	79.4	80.1	70.4
Ti Point	50.1	39.6	49.9	40.9	70.7	70.7	80.3	80.3	90.1	70.7	70.7
<b>Kaipara Harbour (Deep subtidal-dominated estuary)</b>											
Hoteo River Mouth	-	-	-	-	55.1	56.6	57.8	67.8	67.1	65	64.7
Kaipara Heads	-	-	-	-	70.3	70.8	70.9	80.6	70.9	90.3	71
Kaipara River	-	-	-	-	39.7	47.5	49.5	49.4	49.7	48.3	49.1
Makarau Estuary	-	-	-	-	54.9	56.4	47.8	47.3	56.3	55	55.8
Omokoiti Beacon	-	-	-	-	-	-	-	-	-	-	-
Shelly Beach	25.5	23.8	28.3	33.3	56.4	66.6	67.1	68	67.5	67.5	67.3
Tauhoa Channel	-	-	-	-	68.9	79.4	78.6	79.8	70.2	70.2	70
<b>Mahurangi Harbour (Deep, subtidal-dominated estuary)</b>											
Dawsons Creek	48.1	48.2	59.4	59.9	70.5	80.3	70.7	70.7	89.8	80.3	70.8
Mahurangi Heads	60.6	40.4	41.5	60.9	90.3	100	100	100	100	100	90.3
<b>Manukau Harbour (Deep, subtidal-dominated estuary)</b>											
Clarks Beach	34.1	33.4	34.7	44.4	44.4	44.1	44.5	46.2	46.5	54.8	44.3
Grahams Beach	66.4	57.2	57.9	56.9	58.7	58.9	59.9	60.4	60.7	70.3	69.4
Mangere Bridge	15.6	15	16.7	25.2	25.3	25.2	18.2	17.1	16.9	23.8	16.8
Manukau Harbour Mouth	-	-	-	-	78.7	79.6	79.7	80.1	80.3	70.6	70.6
Puketutu Point	16.3	24.6	32.2	27.4	27.2	19.7	20.4	26.4	18.4	25.9	20.8
Shag Point	28.2	27.9	31.7	35.9	28.2	27.4	36.3	37.8	29.7	36.8	29
Waiuku Town Basin	-	-	-	-	-	-	-	-	23	29.4	29.2
Weymouth	34	23.7	23.2	32.8	33.1	25.6	34.1	36.1	37.6	37.2	35.6
<b>Tāmaki Estuary (Shallow, intertidal-dominated estuary)</b>											
Panmure	28.3	25.9	28.4	28.8	25.9	24.3	23.4	30.6	32.6	31.9	42.3
Tāmaki	45.7	35.6	56.2	57.9	50.8	60.4	50.7	59.7	58.9	67.6	67.6
<b>Tāmaki Strait</b>											
Turanga Estuary Mouth	-	-	-	-	70.8	80.2	90.3	80.6	100	-	-
Wairoa River Mouth	-	-	-	-	49.1	48.4	50	51.5	60.8	60.9	59.1
<b>Waitematā Harbour (Shallow, intertidal-dominated estuary)</b>											
Brighams Creek	23	23.7	27.1	28.5	25.9	23.3	24.7	31.5	31.2	27.5	25.2
Chelsea	50.7	49.4	50.5	50.5	80.5	90.3	80.7	71	80.6	80.7	79.9
Confluence	31.5	32.7	36.3	33.7	35	34.9	38.2	48	-	-	-
Henderson Creek	56.3	48.1	40.5	40.7	70.8	61	70.9	60.9	60.8	58.6	48.2
Hobsonville Jetty	50.3	50	50.9	50.4	70.9	80.5	80.3	70.9	70.9	70.7	70.4
Lucas Creek	34.5	33.6	37	37.6	38.7	45.8	45.7	37.7	38.4	35.9	33.8
Paremoremo Ski Club	43.1	33.1	37.2	37.6	39.4	57.8	50	39.4	38.8	35.9	34.2
Rangitopuni Creek	22.4	23.7	27.3	30.5	31.4	29.1	28.9	30.2	26.5	25	24.8
Rawawaru Creek	33.6	32.8	36.4	37.1	36.9	36.5	35.2	37.5	47.1	-	-
Waimarie Road	45.5	44.6	48.3	49	50	68.9	60	41.1	48.7	-	-
Whau	49.7	49.7	41.4	41.1	70.8	71	80.7	70.9	70.7	70.1	69.2

Table 4-3 Percentage of sites per water quality class from 2007-2017. \*\*WQI are presented as three-year rolling averages

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Excellent</b>	0	0	0	0	0	3	3	3	6	3	0
<b>Good</b>	0	0	0	0	6	11	17	14	14	16	3
<b>Fair</b>	4	0	0	0	29	26	20	23	20	32	45
<b>Marginal</b>	42	23	27	35	29	31	31	29	31	13	16
<b>Poor</b>	54	77	73	65	37	29	29	31	29	35	35

## 5.0 Data tables

Table 5-1 Electrical conductivity (mS.cm-1) for data collected January 2017 to December 2017.

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	11	50.99	52.96	52.24	52.02	0.20
Ti Point	12	50.95	52.71	52.33	52.01	0.18
Dawsons Creek	12	38.32	52.82	47.17	47.40	1.27
Mahurangi Heads	12	48.28	52.51	50.00	50.49	0.44
Orewa	12	49.54	52.54	51.60	51.35	0.29
Browns Bay	12	48.44	52.41	51.23	50.91	0.38
Chelsea	12	47.53	52.40	50.21	49.77	0.50
Whau Creek	12	40.09	52.56	45.46	46.38	1.07
Henderson Creek	12	23.89	52.52	45.06	44.58	2.15
Hobsonville Jetty	12	42.89	52.50	47.50	47.71	0.93
Lucas Creek	12	28.31	52.24	39.71	40.70	2.25
Paramoremo Ski Club	12	20.89	52.30	39.67	39.87	2.65
Brighams Creek	12	8.37	52.25	32.09	33.10	4.17
Rangitopuni Creek	12	5.67	52.05	29.33	30.05	4.59
Tamaki	11	47.25	55.83	51.17	50.85	0.86
Panmure	11	42.63	54.63	48.62	48.46	1.13
Wairoa River Mouth	12	37.68	52.70	48.91	47.54	1.27
Mangere Bridge	12	38.16	51.21	43.73	44.86	1.11
Puketutu Point	12	41.78	51.33	46.15	47.06	0.79
Weymouth	12	40.17	51.83	45.96	45.96	1.05
Waiuku Town Basin	12	32.79	50.35	39.36	40.42	1.63
Clarks Beach	12	43.46	51.47	47.31	47.96	0.65
Grahams Beach	12	46.22	51.50	49.06	49.32	0.44
Shag Point	12	43.70	51.15	48.15	48.29	0.62
Manukau Hbr @ Mouth	12	47.95	51.72	50.25	50.21	0.28
Kaipara Heads	9	50.14	51.90	51.02	51.07	0.23
Tauhoa Channel	12	46.12	51.82	50.68	50.40	0.43
Hoteo River Mouth	12	43.19	51.41	46.67	46.93	0.82
Makarau Estuary	12	33.02	52.50	43.57	43.59	1.69
Shelly Beach	12	39.56	52.22	43.76	45.08	1.22
Kaipara River	12	40.77	51.57	45.38	45.97	1.03

Table 5-2 Salinity (ppt) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	33.52	34.93	34.45	34.33	0.14
Ti Point	12	33.51	34.75	34.50	34.27	0.13
Dawsons Creek	12	24.36	34.88	30.71	30.90	0.92
Mahurangi Heads	12	31.54	34.66	32.77	33.14	0.33
Orewa	12	32.47	34.65	33.91	33.77	0.21
Browns Bay	12	31.67	34.58	33.65	33.45	0.28
Chelsea	12	30.94	34.58	32.93	32.61	0.37
Whau Creek	12	25.65	34.68	29.45	30.15	0.78
Henderson Creek	12	14.53	34.66	29.18	28.90	1.51
Hobsonville Jetty	12	27.59	34.65	30.92	31.12	0.68
Lucas Creek	12	17.49	34.44	25.36	26.14	1.60
Paramoremo Ski Club	12	12.55	34.48	25.33	25.58	1.86
Brighams Creek	12	4.68	34.44	20.05	21.02	2.85
Rangitopuni Creek	12	3.09	34.29	18.18	19.01	3.11
Tamaki	11	30.80	37.13	33.61	33.41	0.63
Panmure	11	27.43	36.22	31.78	31.67	0.83
Wairoa River Mouth	12	23.94	34.79	31.99	31.01	0.92
Mangere Bridge	12	24.29	33.67	28.24	29.06	0.80
Puketutu Point	12	26.85	33.76	29.97	30.64	0.57
Weymouth	12	25.71	34.13	29.81	29.85	0.76
Waiuku Town Basin	12	20.55	33.04	25.14	25.91	1.17
Clarks Beach	12	28.06	33.87	30.81	31.29	0.48
Grahams Beach	12	30.05	33.90	32.09	32.28	0.32
Shag Point	12	28.23	33.64	31.41	31.53	0.45
Manukau Hbr @ Mouth	12	31.30	34.07	32.92	32.93	0.21
Kaipara Heads	9	32.90	34.21	33.50	33.57	0.16
Tauhoa Channel	12	29.93	34.14	33.27	33.08	0.32
Hoteo River Mouth	12	27.82	33.83	30.37	30.56	0.60
Makarau Estuary	12	20.68	34.62	28.13	28.18	1.21
Shelly Beach	12	25.23	34.43	28.27	29.23	0.89
Kaipara River	12	26.11	33.94	29.44	29.87	0.75

Table 5-3 pH (pH units) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	7.77	8.40	8.05	8.03	0.05
Ti Point	12	7.80	8.23	8.08	8.06	0.03
Dawsons Creek	12	7.83	8.30	8.01	8.01	0.04
Mahurangi Heads	12	7.90	8.20	8.08	8.07	0.03
Orewa	12	7.91	8.24	8.14	8.11	0.03
Browns Bay	12	7.90	8.21	8.12	8.10	0.03
Chelsea	12	7.83	8.09	7.98	7.96	0.02
Whau Creek	12	7.81	8.06	7.99	7.97	0.02
Henderson Creek	12	7.83	8.03	7.99	7.96	0.02
Hobsonville Jetty	12	7.88	8.10	8.02	8.00	0.02
Lucas Creek	12	7.69	7.96	7.87	7.85	0.03
Paramoremo Ski Club	12	7.66	7.97	7.86	7.85	0.03
Brighams Creek	12	7.40	7.88	7.74	7.69	0.05
Rangitopuni Creek	12	7.33	7.84	7.68	7.63	0.05
Tamaki	11	8.02	8.14	8.08	8.08	0.01
Panmure	11	7.80	8.09	8.03	7.98	0.03
Wairoa River Mouth	12	7.74	8.27	8.12	8.08	0.04
Mangere Bridge	12	7.85	8.38	7.97	8.00	0.04
Puketutu Point	12	7.91	8.40	8.06	8.07	0.04
Weymouth	12	7.83	8.12	8.01	8.02	0.02
Waiuku Town Basin	12	7.66	8.03	7.92	7.91	0.03
Clarks Beach	12	7.81	8.12	8.03	8.01	0.02
Grahams Beach	12	7.98	8.23	8.09	8.09	0.02
Shag Point	12	7.97	8.30	8.09	8.12	0.03
Manukau Hbr @ Mouth	12	7.98	8.18	8.12	8.10	0.02
Kaipara Heads	9	7.92	8.22	8.13	8.10	0.04
Tauhoa Channel	12	7.99	8.35	8.12	8.12	0.03
Hoteo River Mouth	12	7.99	8.21	8.11	8.10	0.02
Makarau Estuary	12	7.94	8.47	8.03	8.08	0.04
Shelly Beach	12	7.88	8.25	8.02	8.04	0.03
Kaipara River	12	7.92	8.42	8.03	8.06	0.04

Table 5-4 Turbidity (NTU) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.16	0.64	0.30	0.32	0.03
Ti Point	12	0.37	0.90	0.65	0.62	0.04
Dawsons Creek	12	3.00	9.60	4.90	5.28	0.49
Mahurangi Heads	12	1.10	4.80	2.05	2.19	0.28
Orewa	12	0.59	1.80	0.80	0.93	0.10
Browns Bay	12	0.70	1.60	1.02	1.07	0.08
Chelsea	12	1.10	10.60	3.80	4.93	0.95
Whau Creek	12	2.60	9.70	5.00	5.45	0.59
Henderson Creek	12	2.80	17.00	8.90	9.58	1.42
Hobsonville Jetty	12	2.50	17.10	4.60	6.00	1.17
Lucas Creek	12	5.10	70.00	9.30	14.17	5.12
Paramoremo Ski Club	12	4.30	85.00	8.05	14.87	6.43
Brighams Creek	12	5.30	160.00	13.10	29.05	12.64
Rangitopuni Creek	12	3.90	50.00	13.40	18.73	4.37
Tamaki	12	1.40	11.00	2.40	3.43	0.76
Panmure	12	4.20	40.00	7.20	10.35	2.82
Wairoa River Mouth	12	2.40	48.00	5.30	10.78	3.85
Mangere Bridge	12	6.60	55.00	13.00	18.53	4.57
Puketutu Point	12	1.90	23.00	5.55	8.21	1.93
Weymouth	12	5.70	30.00	10.75	12.97	2.15
Waiuku Town Basin	12	4.30	120.00	7.65	18.41	9.36
Clarks Beach	12	3.00	15.50	8.15	8.86	1.13
Grahams Beach	12	1.10	8.60	4.50	4.67	0.74
Shag Point	12	2.40	30.00	4.60	8.73	2.41
Manukau Hbr @ Mouth	12	0.95	4.20	2.20	2.38	0.33
Kaipara Heads	9	0.20	3.00	2.40	1.87	0.35
Tauhoa Channel	12	0.45	12.00	1.47	2.19	0.91
Hoteo River Mouth	12	0.70	5.50	1.59	1.97	0.37
Makarau Estuary	12	3.00	14.80	3.75	5.88	1.18
Shelly Beach	12	3.70	33.00	5.55	7.84	2.33
Kaipara River	12	1.40	7.50	3.60	4.33	0.64

Table 5-5 Suspended sediment (mg/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	1.80	35.00	3.09	7.98	3.39
Ti Point	12	1.20	34.00	5.50	10.09	3.36
Dawsons Creek	12	6.00	49.00	13.00	16.85	3.70
Mahurangi Heads	12	2.90	35.00	5.10	8.91	2.59
Orewa	12	1.50	34.00	4.55	9.27	3.04
Browns Bay	12	0.80	34.00	7.10	9.76	3.25
Chelsea	12	2.40	53.00	15.50	20.92	5.36
Whau Creek	12	5.80	41.00	13.50	19.62	4.23
Henderson Creek	12	5.60	58.00	17.50	25.55	5.34
Hobsonville Jetty	12	5.00	62.00	10.50	19.87	5.76
Lucas Creek	12	9.60	55.00	19.50	26.30	4.85
Paramoremo Ski Club	12	7.20	81.00	14.50	25.93	6.65
Brighams Creek	12	7.60	210.00	22.00	43.63	16.04
Rangitopuni Creek	12	4.80	51.00	19.50	25.98	4.27
Tamaki	12	1.95	40.00	9.40	15.48	4.27
Panmure	12	8.00	53.00	17.50	24.08	4.66
Wairoa River Mouth	12	7.10	132.00	12.00	27.39	10.24
Mangere Bridge	12	14.00	120.00	35.00	43.67	9.38
Puketutu Point	12	5.20	58.00	17.50	22.85	4.53
Weymouth	12	12.00	89.00	32.00	35.42	6.16
Waiuku Town Basin	12	11.00	380.00	16.50	49.83	30.18
Clarks Beach	12	8.40	36.00	24.50	25.53	2.37
Grahams Beach	12	6.20	25.00	14.50	14.83	1.70
Shag Point	12	7.00	69.00	19.00	26.95	5.70
Manukau Hbr @ Mouth	12	5.00	16.00	7.60	9.08	1.18
Kaipara Heads	9	1.40	20.00	8.00	8.70	1.98
Tauhoa Channel	12	2.30	8.00	4.35	4.88	0.55
Hoteo River Mouth	12	2.98	13.00	7.00	7.69	0.91
Makarau Estuary	12	7.00	28.00	11.00	12.95	1.87
Shelly Beach	12	8.00	60.00	13.50	17.83	4.07
Kaipara River	12	7.00	19.00	11.50	12.28	1.17

Table 5-6 Chlorophyll a (mg/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.0005	0.0060	0.0011	0.0016	0.0004
Ti Point	12	0.0003	0.0050	0.0012	0.0017	0.0004
Dawsons Creek	12	0.0005	0.0087	0.0018	0.0023	0.0006
Mahurangi Heads	12	0.0005	0.0025	0.0012	0.0012	0.0002
Orewa	12	0.0011	0.0030	0.0018	0.0018	0.0002
Browns Bay	12	0.0010	0.0031	0.0017	0.0019	0.0002
Chelsea	12	0.0004	0.0024	0.0017	0.0015	0.0002
Whau Creek	12	0.0004	0.0043	0.0015	0.0018	0.0003
Henderson Creek	12	0.0004	0.0040	0.0017	0.0019	0.0003
Hobsonville Jetty	12	0.0010	0.0030	0.0016	0.0016	0.0002
Lucas Creek	12	0.0005	0.0040	0.0023	0.0021	0.0003
Paramoremo Ski Club	12	0.0003	0.0030	0.0015	0.0017	0.0002
Brighams Creek	12	0.0011	0.0040	0.0019	0.0023	0.0003
Rangitopuni Creek	12	0.0013	0.0040	0.0025	0.0027	0.0003
Tamaki	12	0.0003	0.0032	0.0016	0.0016	0.0003
Panmure	12	0.0007	0.0043	0.0026	0.0026	0.0003
Wairoa River Mouth	12	0.0016	0.0130	0.0029	0.0040	0.0009
Mangere Bridge	12	0.0015	0.0200	0.0052	0.0066	0.0015
Puketutu Point	12	0.0007	0.0170	0.0043	0.0047	0.0013
Weymouth	12	0.0005	0.0180	0.0041	0.0057	0.0015
Waiuku Town Basin	12	0.0005	0.0190	0.0036	0.0058	0.0016
Clarks Beach	12	0.0006	0.0098	0.0027	0.0032	0.0008
Grahams Beach	12	0.0013	0.0064	0.0020	0.0026	0.0005
Shag Point	12	0.0005	0.0120	0.0039	0.0051	0.0010
Manukau Hbr @ Mouth	12	0.0005	0.0038	0.0022	0.0022	0.0003
Kaipara Heads	9	0.0008	0.0045	0.0021	0.0021	0.0004
Tauhoa Channel	12	0.0006	0.0033	0.0024	0.0020	0.0002
Hoteo River Mouth	12	0.0004	0.0074	0.0022	0.0026	0.0006
Makarau Estuary	12	0.0006	0.0110	0.0034	0.0043	0.0009
Shelly Beach	12	0.0005	0.0130	0.0041	0.0055	0.0012
Kaipara River	12	0.0007	0.0100	0.0035	0.0040	0.0009



Table 5-7 Nitrite (mg N/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.0005	0.0078	0.0023	0.0030	0.0007
Ti Point	12	0.0002	0.0083	0.0013	0.0019	0.0006
Dawsons Creek	12	0.0001	0.0027	0.0010	0.0011	0.0002
Mahurangi Heads	12	0.0004	0.0031	0.0009	0.0010	0.0002
Orewa	12	0.0001	0.0025	0.0009	0.0010	0.0002
Browns Bay	12	0.0003	0.0046	0.0008	0.0012	0.0004
Chelsea	12	0.0002	0.0025	0.0009	0.0010	0.0002
Whau Creek	12	0.0002	0.0032	0.0011	0.0013	0.0002
Henderson Creek	12	0.0001	0.0031	0.0009	0.0012	0.0003
Hobsonville Jetty	12	0.0002	0.0046	0.0012	0.0015	0.0004
Lucas Creek	12	0.0003	0.0065	0.0012	0.0020	0.0005
Paramoremo Ski Club	12	0.0002	0.0089	0.0015	0.0022	0.0007
Brighams Creek	12	0.0001	0.0085	0.0030	0.0031	0.0007
Rangitopuni Creek	12	0.0001	0.0061	0.0025	0.0025	0.0006
Tamaki	12	0.0004	0.0031	0.0011	0.0013	0.0002
Panmure	12	0.0003	0.0180	0.0017	0.0031	0.0014
Wairoa River Mouth	12	0.0002	0.0054	0.0010	0.0014	0.0004
Mangere Bridge	12	0.0005	0.0290	0.0152	0.0143	0.0021
Puketutu Point	12	0.0010	0.0210	0.0099	0.0107	0.0022
Weymouth	12	0.0003	0.0099	0.0056	0.0047	0.0010
Waiuku Town Basin	12	0.0003	0.0150	0.0072	0.0071	0.0012
Clarks Beach	12	0.0003	0.0088	0.0045	0.0041	0.0009
Grahams Beach	12	0.0001	0.0091	0.0022	0.0030	0.0009
Shag Point	12	0.0003	0.0130	0.0066	0.0063	0.0014
Manukau Hbr @ Mouth	12	0.0005	0.0076	0.0019	0.0025	0.0007
Kaipara Heads	9	0.0005	0.0049	0.0015	0.0021	0.0005
Tauhoa Channel	12	0.0003	0.0034	0.0007	0.0011	0.0003
Hoteo River Mouth	12	0.0003	0.0071	0.0008	0.0016	0.0006
Makarau Estuary	12	0.0001	0.0073	0.0018	0.0022	0.0006
Shelly Beach	12	0.0001	0.0081	0.0011	0.0023	0.0006
Kaipara River	12	0.0003	0.0085	0.0017	0.0022	0.0007

Table 5-8 Nitrate (mg N/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.002	0.027	0.014	0.014	0.003
Ti Point	12	0.001	0.048	0.005	0.009	0.004
Dawsons Creek	12	0.000	0.045	0.004	0.011	0.004
Mahurangi Heads	12	0.000	0.016	0.003	0.005	0.002
Orewa	12	0.000	0.006	0.001	0.002	0.001
Browns Bay	12	0.001	0.037	0.003	0.008	0.003
Chelsea	12	0.001	0.050	0.009	0.014	0.004
Whau Creek	12	0.000	0.080	0.009	0.017	0.007
Henderson Creek	12	0.001	0.150	0.033	0.039	0.013
Hobsonville Jetty	12	0.001	0.080	0.014	0.024	0.007
Lucas Creek	12	0.001	0.147	0.054	0.058	0.017
Paramoremo Ski Club	12	0.000	0.160	0.058	0.061	0.017
Brighams Creek	12	0.002	0.310	0.143	0.137	0.034
Rangitopuni Creek	12	0.002	0.270	0.125	0.125	0.031
Tamaki	12	0.001	0.057	0.019	0.024	0.006
Panmure	12	0.000	0.460	0.040	0.081	0.037
Wairoa River Mouth	12	0.001	0.120	0.003	0.027	0.013
Mangere Bridge	12	0.001	0.500	0.380	0.318	0.048
Puketutu Point	12	0.001	0.420	0.275	0.241	0.042
Weymouth	12	0.001	0.340	0.155	0.147	0.034
Waiuku Town Basin	12	0.002	0.750	0.385	0.348	0.075
Clarks Beach	12	0.002	0.230	0.092	0.091	0.022
Grahams Beach	12	0.000	0.138	0.034	0.042	0.012
Shag Point	12	0.003	0.230	0.151	0.121	0.025
Manukau Hbr @ Mouth	12	0.000	0.096	0.027	0.030	0.008
Kaipara Heads	9	0.001	0.046	0.019	0.019	0.005
Tauhoa Channel	12	0.000	0.080	0.002	0.015	0.007
Hoteo River Mouth	12	0.000	0.096	0.003	0.020	0.010
Makarau Estuary	12	0.001	0.172	0.005	0.034	0.016
Shelly Beach	12	0.000	0.096	0.007	0.024	0.010
Kaipara River	12	0.001	0.085	0.005	0.022	0.009

Table 5-9 Ammonia (mg N/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.002	0.020	0.012	0.011	0.001
Ti Point	12	0.006	0.022	0.011	0.012	0.001
Dawsons Creek	12	0.003	0.046	0.013	0.014	0.003
Mahurangi Heads	12	0.003	0.040	0.010	0.012	0.003
Orewa	12	0.002	0.021	0.009	0.010	0.001
Browns Bay	12	0.002	0.022	0.012	0.013	0.002
Chelsea	12	0.007	0.034	0.016	0.019	0.003
Whau Creek	12	0.006	0.045	0.019	0.021	0.003
Henderson Creek	12	0.007	0.058	0.016	0.022	0.005
Hobsonville Jetty	12	0.006	0.048	0.014	0.018	0.004
Lucas Creek	12	0.004	0.089	0.026	0.029	0.007
Paramoremo Ski Club	12	0.007	0.084	0.022	0.029	0.007
Brighams Creek	12	0.004	0.093	0.040	0.040	0.008
Rangitopuni Creek	12	0.003	0.081	0.032	0.034	0.006
Tamaki	12	0.007	0.047	0.020	0.024	0.004
Panmure	12	0.008	0.093	0.024	0.031	0.007
Wairoa River Mouth	12	0.006	0.056	0.016	0.019	0.004
Mangere Bridge	12	0.012	0.230	0.091	0.091	0.018
Puketutu Point	12	0.004	0.160	0.065	0.067	0.012
Weymouth	12	0.005	0.110	0.040	0.039	0.009
Waiuku Town Basin	12	0.004	0.160	0.047	0.056	0.012
Clarks Beach	12	0.004	0.078	0.028	0.028	0.006
Grahams Beach	12	0.002	0.041	0.014	0.017	0.004
Shag Point	12	0.002	0.110	0.043	0.042	0.009
Manukau Hbr @ Mouth	12	0.003	0.029	0.012	0.013	0.003
Kaipara Heads	9	0.004	0.024	0.010	0.011	0.002
Tauhoa Channel	12	0.003	0.034	0.006	0.010	0.003
Hoteo River Mouth	12	0.003	0.023	0.014	0.012	0.002
Makarau Estuary	12	0.004	0.065	0.021	0.024	0.005
Shelly Beach	12	0.006	0.060	0.021	0.024	0.005
Kaipara River	12	0.001	0.052	0.017	0.018	0.004

Table 5-10 Total kjeldahl nitrogen (mg N/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.057	0.186	0.114	0.112	0.012
Ti Point	12	0.048	0.168	0.104	0.104	0.012
Dawsons Creek	12	0.089	0.270	0.192	0.185	0.017
Mahurangi Heads	12	0.060	0.195	0.119	0.120	0.012
Orewa	12	0.065	0.166	0.104	0.114	0.010
Browns Bay	12	0.064	0.580	0.120	0.162	0.039
Chelsea	12	0.110	0.250	0.169	0.166	0.011
Whau Creek	12	0.110	0.300	0.199	0.193	0.015
Henderson Creek	12	0.100	0.350	0.215	0.212	0.017
Hobsonville Jetty	12	0.110	0.220	0.186	0.175	0.010
Lucas Creek	12	0.150	0.780	0.240	0.281	0.048
Paramoremo Ski Club	12	0.150	0.940	0.255	0.308	0.061
Brighams Creek	12	0.170	1.400	0.325	0.450	0.105
Rangitopuni Creek	12	0.210	0.880	0.380	0.439	0.065
Tamaki	12	0.083	0.250	0.146	0.149	0.013
Panmure	12	0.069	0.570	0.255	0.263	0.040
Wairoa River Mouth	12	0.098	0.350	0.185	0.213	0.023
Mangere Bridge	12	0.280	0.480	0.365	0.375	0.021
Puketutu Point	12	0.200	0.390	0.295	0.287	0.019
Weymouth	12	0.170	0.340	0.270	0.260	0.013
Waiuku Town Basin	12	0.200	0.450	0.310	0.315	0.027
Clarks Beach	12	0.110	0.270	0.200	0.195	0.016
Grahams Beach	12	0.077	0.210	0.162	0.159	0.013
Shag Point	12	0.150	0.320	0.245	0.239	0.015
Manukau Hbr @ Mouth	12	0.059	0.192	0.129	0.128	0.011
Kaipara Heads	9	0.041	0.164	0.098	0.098	0.015
Tauhoa Channel	12	0.034	0.179	0.109	0.104	0.013
Hoteo River Mouth	12	0.081	0.230	0.161	0.152	0.015
Makarau Estuary	12	0.110	0.350	0.240	0.232	0.020
Shelly Beach	12	0.160	0.380	0.240	0.239	0.020
Kaipara River	12	0.110	0.270	0.205	0.198	0.015

Table 5-11 Total nitrogen (by calculation, mg N/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.070	0.200	0.120	0.124	0.012
Ti Point	12	0.061	0.177	0.109	0.113	0.011
Dawsons Creek	12	0.100	0.320	0.198	0.197	0.019
Mahurangi Heads	12	0.064	0.195	0.119	0.124	0.012
Orewa	12	0.065	0.166	0.104	0.116	0.010
Browns Bay	12	0.064	0.580	0.131	0.170	0.039
Chelsea	12	0.120	0.260	0.177	0.180	0.012
Whau Creek	12	0.130	0.300	0.220	0.211	0.014
Henderson Creek	12	0.150	0.510	0.245	0.253	0.027
Hobsonville Jetty	12	0.120	0.280	0.199	0.196	0.014
Lucas Creek	12	0.170	0.930	0.260	0.341	0.060
Paramoremo Ski Club	12	0.180	1.100	0.275	0.374	0.074
Brighams Creek	12	0.180	1.700	0.430	0.587	0.134
Rangitopuni Creek	12	0.230	0.990	0.500	0.565	0.087
Tamaki	12	0.087	0.280	0.175	0.173	0.015
Panmure	12	0.140	0.830	0.305	0.347	0.058
Wairoa River Mouth	12	0.098	0.440	0.185	0.240	0.032
Mangere Bridge	12	0.400	0.980	0.705	0.693	0.049
Puketutu Point	12	0.270	0.780	0.590	0.528	0.049
Weymouth	12	0.250	0.610	0.395	0.408	0.037
Waiuku Town Basin	12	0.330	0.980	0.645	0.663	0.073
Clarks Beach	12	0.140	0.490	0.280	0.286	0.031
Grahams Beach	12	0.094	0.350	0.220	0.200	0.022
Shag Point	12	0.190	0.480	0.370	0.361	0.027
Manukau Hbr @ Mouth	12	0.082	0.290	0.164	0.159	0.016
Kaipara Heads	9	0.061	0.210	0.098	0.117	0.017
Tauhoa Channel	12	0.035	0.240	0.114	0.118	0.017
Hoteo River Mouth	12	0.086	0.300	0.161	0.172	0.021
Makarau Estuary	12	0.110	0.520	0.270	0.264	0.031
Shelly Beach	12	0.160	0.410	0.260	0.263	0.025
Kaipara River	12	0.110	0.350	0.215	0.219	0.022

Table 5-12 Total phosphorus (mg/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.007	0.064	0.012	0.017	0.004
Ti Point	12	0.008	0.018	0.011	0.012	0.001
Dawsons Creek	12	0.012	0.027	0.018	0.018	0.001
Mahurangi Heads	12	0.010	0.019	0.012	0.013	0.001
Orewa	12	0.010	0.040	0.012	0.015	0.002
Browns Bay	12	0.012	0.024	0.017	0.018	0.001
Chelsea	12	0.016	0.027	0.024	0.023	0.001
Whau Creek	12	0.016	0.044	0.028	0.028	0.003
Henderson Creek	12	0.020	0.034	0.026	0.026	0.001
Hobsonville Jetty	12	0.015	0.036	0.025	0.025	0.002
Lucas Creek	12	0.019	0.100	0.031	0.037	0.006
Paramoremo Ski Club	12	0.020	0.091	0.031	0.036	0.005
Brighams Creek	12	0.019	0.290	0.046	0.063	0.021
Rangitopuni Creek	12	0.016	0.120	0.046	0.051	0.008
Tamaki	12	0.018	0.045	0.026	0.026	0.002
Panmure	12	0.019	0.092	0.026	0.033	0.006
Wairoa River Mouth	12	0.015	0.084	0.023	0.027	0.005
Mangere Bridge	12	0.080	0.166	0.129	0.127	0.009
Puketutu Point	12	0.064	0.143	0.095	0.099	0.006
Weymouth	12	0.034	0.069	0.045	0.045	0.003
Waiuku Town Basin	12	0.037	0.120	0.042	0.054	0.007
Clarks Beach	12	0.024	0.055	0.036	0.036	0.002
Grahams Beach	12	0.021	0.034	0.026	0.027	0.001
Shag Point	12	0.038	0.093	0.065	0.067	0.005
Manukau Hbr @ Mouth	12	0.014	0.027	0.019	0.019	0.001
Kaipara Heads	9	0.006	0.023	0.014	0.014	0.002
Tauhoa Channel	12	0.007	0.019	0.012	0.012	0.001
Hoteo River Mouth	12	0.011	0.024	0.016	0.017	0.001
Makarau Estuary	12	0.014	0.041	0.029	0.027	0.003
Shelly Beach	12	0.015	0.049	0.024	0.028	0.003
Kaipara River	12	0.014	0.035	0.023	0.022	0.002

Table 5-13 Soluble reactive phosphorus (mg/L) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	0.003	0.012	0.010	0.008	0.001
Ti Point	12	0.004	0.012	0.008	0.007	0.001
Dawsons Creek	12	0.004	0.019	0.011	0.011	0.001
Mahurangi Heads	12	0.004	0.015	0.009	0.009	0.001
Orewa	12	0.004	0.013	0.008	0.008	0.001
Browns Bay	12	0.004	0.021	0.012	0.013	0.001
Chelsea	12	0.010	0.023	0.016	0.016	0.001
Whau Creek	12	0.009	0.026	0.017	0.017	0.001
Henderson Creek	12	0.011	0.024	0.017	0.017	0.001
Hobsonville Jetty	12	0.004	0.023	0.018	0.016	0.001
Lucas Creek	12	0.007	0.026	0.018	0.019	0.002
Paramoremo Ski Club	12	0.009	0.027	0.019	0.019	0.002
Brighams Creek	12	0.007	0.047	0.022	0.023	0.003
Rangitopuni Creek	12	0.005	0.033	0.021	0.020	0.002
Tamaki	12	0.009	0.028	0.018	0.019	0.001
Panmure	12	0.001	0.033	0.019	0.016	0.003
Wairoa River Mouth	12	0.005	0.020	0.013	0.013	0.001
Mangere Bridge	12	0.048	0.122	0.093	0.092	0.006
Puketutu Point	12	0.032	0.114	0.082	0.080	0.006
Weymouth	12	0.008	0.031	0.021	0.021	0.002
Waiuku Town Basin	12	0.011	0.039	0.029	0.029	0.002
Clarks Beach	12	0.006	0.026	0.019	0.018	0.002
Grahams Beach	12	0.004	0.019	0.014	0.013	0.001
Shag Point	12	0.024	0.066	0.050	0.047	0.004
Manukau Hbr @ Mouth	12	0.005	0.015	0.011	0.011	0.001
Kaipara Heads	9	0.002	0.009	0.008	0.006	0.001
Tauhoa Channel	12	0.002	0.010	0.006	0.006	0.001
Hoteo River Mouth	12	0.002	0.017	0.008	0.008	0.001
Makarau Estuary	12	0.005	0.021	0.012	0.013	0.001
Shelly Beach	12	0.004	0.019	0.014	0.012	0.001
Kaipara River	12	0.003	0.015	0.010	0.010	0.001

Table 5-14 Dissolved oxygen (% saturation) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	97.00	109.70	98.85	100.61	1.12
Ti Point	12	96.70	106.70	100.15	100.52	0.76
Dawsons Creek	12	90.40	101.00	94.95	95.08	0.85
Mahurangi Heads	12	93.00	105.10	98.60	98.82	0.86
Orewa	12	94.00	114.40	102.05	102.54	1.44
Browns Bay	12	90.30	105.40	99.50	98.96	1.42
Chelsea	11	92.20	98.80	96.10	95.99	0.62
Whau Creek	11	90.90	99.00	95.60	95.32	0.82
Henderson Creek	11	88.90	97.90	95.50	95.10	0.89
Hobsonville Jetty	11	90.70	99.30	97.20	96.29	0.81
Lucas Creek	11	81.40	93.50	90.70	89.30	1.23
Paramoremo Ski Club	11	81.80	94.80	90.80	89.51	1.35
Brighams Creek	11	80.30	95.90	88.90	88.58	1.54
Rangitopuni Creek	11	79.30	94.50	88.40	87.25	1.57
Tamaki	11	92.80	101.10	96.50	96.69	0.72
Panmure	12	86.10	101.40	95.90	95.13	1.26
Wairoa River Mouth	12	90.70	122.10	98.30	99.39	2.27
Mangere Bridge	11	89.50	107.80	99.90	99.10	1.66
Puketutu Point	11	95.80	110.90	99.70	101.49	1.33
Weymouth	11	93.90	103.20	98.60	98.91	0.91
Waiuku Town Basin	11	86.60	106.00	96.80	95.83	1.95
Clarks Beach	11	94.90	103.30	99.40	99.43	0.84
Grahams Beach	11	98.70	107.60	102.70	102.66	0.84
Shag Point	11	96.70	110.20	103.10	103.65	1.41
Manukau Hbr @ Mouth	11	98.70	107.20	102.90	103.21	0.84
Kaipara Heads	8	100.30	106.60	102.25	103.20	0.91
Tauhoa Channel	12	101.20	107.50	103.85	104.00	0.65
Hoteo River Mouth	12	99.00	107.00	103.75	103.11	0.71
Makarau Estuary	12	94.10	111.40	99.95	100.19	1.38
Shelly Beach	12	95.10	111.60	99.95	100.38	1.34
Kaipara River	12	95.80	111.60	100.70	101.54	1.26



Table 5-15 Dissolved oxygen (ppm) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	7.38	8.38	7.84	7.84	0.08
Ti Point	12	7.41	8.27	7.91	7.85	0.08
Dawsons Creek	12	6.36	8.26	7.81	7.57	0.18
Mahurangi Heads	12	7.00	8.21	7.86	7.76	0.12
Orewa	12	7.23	8.73	7.99	7.98	0.13
Browns Bay	12	7.01	8.64	7.75	7.76	0.14
Chelsea	11	6.89	8.31	7.60	7.48	0.15
Whau Creek	11	6.38	8.64	7.42	7.56	0.23
Henderson Creek	11	6.59	8.73	7.49	7.59	0.23
Hobsonville Jetty	11	6.74	8.45	7.54	7.56	0.19
Lucas Creek	11	6.14	8.51	7.18	7.23	0.25
Paramoremo Ski Club	11	6.02	8.68	7.21	7.29	0.29
Brighams Creek	11	5.86	9.53	7.03	7.43	0.38
Rangitopuni Creek	11	5.74	9.72	6.97	7.47	0.41
Tamaki	11	6.70	8.49	7.73	7.58	0.16
Panmure	12	6.79	8.60	7.52	7.59	0.15
Wairoa River Mouth	12	6.57	9.65	7.97	7.89	0.24
Mangere Bridge	11	7.48	9.11	7.90	8.04	0.14
Puketutu Point	11	7.06	9.23	8.14	8.15	0.17
Weymouth	11	7.00	9.02	7.98	8.01	0.16
Waiuku Town Basin	11	6.90	9.15	7.93	7.96	0.21
Clarks Beach	11	7.15	9.02	7.91	7.98	0.15
Grahams Beach	11	7.44	9.09	8.08	8.18	0.14
Shag Point	11	7.26	9.34	8.31	8.27	0.16
Manukau Hbr @ Mouth	11	7.48	9.08	8.14	8.18	0.14
Kaipara Heads	8	7.63	8.96	8.28	8.25	0.14
Tauhoa Channel	12	7.55	8.73	8.21	8.20	0.10
Hoteo River Mouth	12	7.68	8.90	8.18	8.22	0.13
Makarau Estuary	12	7.10	8.89	8.11	8.13	0.17
Shelly Beach	12	7.36	8.81	8.00	8.10	0.14
Kaipara River	12	7.35	8.79	8.05	8.11	0.14

Table 5-16 Summary table of temperature (°C) for data collected from January 2017 to December 2017

Site	Count	Min	Max	Median	Mean	Standard error
Goat Island	12	14.56	20.27	17.49	17.44	0.65
Ti Point	12	14.28	20.38	17.47	17.41	0.66
Dawsons Creek	12	13.18	23.07	17.34	17.67	1.06
Mahurangi Heads	12	13.68	21.67	17.49	17.51	0.87
Orewa	12	13.70	22.88	17.72	17.75	0.89
Browns Bay	12	13.63	21.82	17.75	17.49	0.85
Chelsea	12	13.43	22.76	17.59	17.79	0.98
Whau Creek	12	12.63	23.94	17.50	17.64	1.16
Henderson Creek	12	12.89	23.83	17.66	17.63	1.15
Hobsonville Jetty	12	13.29	23.32	17.69	17.78	1.07
Lucas Creek	12	12.58	24.68	17.62	17.73	1.24
Paramoremo Ski Club	12	12.76	24.36	17.63	17.77	1.22
Brighams Creek	12	11.81	24.58	17.65	17.65	1.30
Rangitopuni Creek	12	12.01	24.93	17.10	17.50	1.31
Tamaki	11	13.32	22.70	16.63	17.55	0.98
Panmure	12	13.03	22.94	17.52	17.74	0.94
Wairoa River Mouth	12	13.56	23.27	17.67	17.71	0.96
Mangere Bridge	12	13.16	22.59	17.38	17.61	1.00
Puketutu Point	12	13.51	22.82	17.25	17.65	0.99
Weymouth	12	12.66	22.51	17.08	17.47	0.98
Waiuku Town Basin	12	12.49	22.58	17.41	17.50	1.07
Clarks Beach	12	12.47	22.08	17.47	17.47	0.98
Grahams Beach	12	12.71	22.05	16.89	17.45	0.93
Shag Point	12	13.00	22.29	17.45	17.65	0.95
Manukau Hbr @ Mouth	12	13.09	21.54	17.02	17.37	0.79
Kaipara Heads	9	13.58	19.61	16.50	16.73	0.75
Tauhoa Channel	12	14.14	20.84	17.19	17.29	0.67
Hoteo River Mouth	12	13.52	22.07	17.25	17.59	0.86
Makarau Estuary	12	13.04	22.95	17.10	17.46	1.00
Shelly Beach	12	13.26	22.07	16.88	17.35	0.95
Kaipara River	12	13.37	22.72	17.22	17.69	0.95

## 6.0 References

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## Appendix A Physical-chemical measures

Table 7-1 Summary of marine water quality parameters, detection limits, analytical methods and two sources of data collection

Parameter	Unit	Detection Limit	Method	Source
Dissolved oxygen	ppm	0.1	EXO Sonde (Xylem Analytics)	Field
Dissolved oxygen saturation	% sat	0.01	EXO Sonde (Xylem Analytics)	Field
Temperature	°C	0.01	EXO Sonde (Xylem Analytics)	Field
Conductivity	mS cm	0.01	EXO Sonde (Xylem Analytics)	Field
Salinity	ppt	0.2	EXO Sonde (Xylem Analytics)	Field
pH	pH units	0.1	EXO Sonde (Xylem Analytics)	Field
Suspended sediment	mg/L	0.2	APHA (2012) 2540 D	Lab
Turbidity	NTU	0.1	APHA (2012) 2130 B (modified)	Lab
Chlorophyll a	mg/L	0.0006	APHA (2012) 10200 H (modified)	Lab
Nitrate nitrogen (NO <sub>3</sub> )	mg/L	0.002	Calculation (NNN – NO <sub>2</sub> )	Lab
Nitrite nitrogen (NO <sub>2</sub> )	mg/L	0.002	APHA (2012) 4500-NO <sub>2</sub> B (modified)	Lab
Ammoniacal nitrogen (NH <sub>4</sub> -N)	mg/L	0.005	APHA (2012) 4500-NH <sub>3</sub> G (modified)	Lab
Total kjeldahl nitrogen (TKN)	mg N/L	0.02	APHA (2012) 4500-org A, D (modified)	Lab
Total nitrogen (TN)	mg N/L	0.02	APHA (2012) 4500-P J, 4500 NO <sub>3</sub> F (modified)	Lab
Soluble reactive phosphorus	mg/L	0.0006	APHA (2012) 4500-P B, F (modified)	Lab
Total phosphorus	mg/L	0.005	APHA (2012) 4500-P B, J (modified)	Lab

## Appendix B Water Quality Indices

The communication of water quality data is often hampered by the volume of results and the complexity of the information. In this report, a water quality index developed by the Canadian Council of Ministers for the Environment (CCME) (2001) was applied to the marine water quality data collected by Auckland Council to enable improved understanding and communication of the work.

The CCME approach uses water quality results to produce four water quality indices, and these indices can be used to assign a water quality class to each monitoring site. The four indices are:

- Scope – this represents the percentage of parameters that failed to meet the objective at least once during the time period under consideration (the lower this index, the better).
- Frequency – this represents the percentage of all individual tests that failed to meet the objective during the time period under consideration (the lower this index, the better).
- Magnitude – this represents the amount by which failed tests exceeded the objective (the lower this index, the better). This is based on the collective amount by which individual tests are out of compliance with the objectives and is scaled to be between 1 and 100. This is the most complex part of the index derivation and the reader is referred to CCME (2001) for full details.
- WQI – this represents an overall water quality index based on a combination of the three indices described above. It is calculated thus:

$$WQI = 100 - \left[ \sqrt[3]{(Scope^2 + Frequency^2 + Magnitude^2)} \div 1.732 \right]$$

The divisor 1.732 normalises the resultant values to a range between 0 and 100, where 0 represents the “worst” water quality and 100 represents the “best” water quality.

The WQI is used by Auckland Council to assign a water quality class to each site using the following ranges:

- between 95 and 100 = excellent water quality
- between 80 and 94 = good water quality
- between 65 and 79 = fair water quality
- between 45 and 64 = marginal water quality
- lower than 44 = poor water quality.

The above indices are calculated for each site based on six water quality parameters presented in Table 7-2 and Table 7-3. A set of static terms using data from the least modified sites in the Auckland Region from 2007 to 2016, as well as the existing ANZECC guidelines (ANZECC, 2000). The Auckland Council data was used when the 80<sup>th</sup> percentile exceeded the ANZECC guidelines and used the ANZECC guidelines when they were more permissive than Auckland Council data.

The objectives are calculated for estuary sites and for open coast sites. The ranges for the reference sites for open water sites came from Ti Point and Goat Island and the estuary sites from Chelsea, Hobsonville and Manukau Harbour @ Mouth. Guidelines were calculated using the 80<sup>th</sup> percentile value for each parameter (and additionally the 20<sup>th</sup> percentile value for parameters with a lower and upper bound, such as dissolved oxygen).

The ranges at these reference sites were used, as this represents the best achievable water quality in the Auckland region. Therefore, the index represents the deviation from “natural” conditions in the Auckland region, rather than indicating whether the water quality is suitable for a particular purpose.

Table 7-2 The six water quality parameters, and their objectives, used to produce the estuary site water quality indices

Parameter	Objective (acceptable if)
Chlorophyll <i>a</i>	Less than 0.0031 mg/L
Soluble reactive phosphorus	Less than 0.040 mg/L
Nitrate + nitrite nitrogen	Less than 0.042 mg/L
Ammoniacal nitrogen	Less than 0.0150 mg/L
Dissolved oxygen	Between 90 and 110 % saturation
Turbidity	Less than 10 NTU

Table 7-3 The six water quality parameters, and their objectives, used to produce the open coast site water quality indices

Parameter	Objective (acceptable if)
Chlorophyll <i>a</i>	Less than 0.0023 mg/L
Soluble reactive phosphorus	Less than 0.012 mg/L
Nitrate + nitrite nitrogen	Less than 0.027 mg/L
Ammoniacal nitrogen	Less than 0.0150 mg/L
Dissolved oxygen	Between 90 and 110 % saturation
Turbidity	Less than 1 NTU

## Appendix C Historical sites

The table below contains a list of all sites that have been part of the marine water quality programme since its inception in 1987. The table includes when the site was initiated, location and current status in terms of sampling. N.B some of the details are missing due to absence of records for these sites.

Table 7-4 Marine water quality sites sorted from north to south, grouped by location. Spatial reference is NZTM coordinates.

Site #	Site	Location	Easting	Northing	Sampling Method	Year established	Status
6315	Goat Island	East Coast	1761835	5984910	Helicopter	1993	Current
6514	Ti Point	East Coast	1760222	5978524	Helicopter	1991	Current
	Kawau Bay (Algies Beach)	East Coast			Helicopter?	1991	Dropped 1999
	Warkworth (Town Basin)	East Coast	1749158	5970678	Boat	1993	Dropped 2007?
	Mahurangi	East Coast			Boat?	1991	Dropped 1999
6843	Mahurangi Heads	East Coast	1754382	5959892	Helicopter	1993	Current
6843	Dawsons Creek	East Coast	1753554	5966410	Helicopter	1993	Current
7207	Orewa	East Coast	1753273	5949612	Helicopter	1991	Current
7518	Browns Bay	East Coast	1757934	5935780	Helicopter	1991	Current
45214	Shelly Beach	Kaipara Harbour	1723526	5951872	Helicopter	1991	Current
45374	Kaipara River	Kaipara Harbour	1726372	5946975	Helicopter	2009	Current
45506	Makarau Estuary	Kaipara Harbour	1728450	5953472	Helicopter	2009	Current
45700	Omokoiti Beacon	Kaipara Harbour	1718659	5961178	Helicopter	2009	Dropped 2015
45103	Kaipara Heads	Kaipara Harbour	1709351	5970137	Helicopter	2009	Current
45801	Tauhoa Channel	Kaipara Harbour	1717979	5969681	Helicopter	2009	Current
45700	Hoteo River	Kaipara Harbour	1726690	5967497	Helicopter	2009	Current
7705	Chelsea	Waitematā Harbour	1753944	5922872	Boat	1991	Current
8005	Whau Creek	Waitematā Harbour	1748289	5920291	Boat	1991	Current
7919	Henderson Creek	Waitematā Harbour	1746714	5923648	Boat	1991	Current



Site #	Site	Location	Easting	Northing	Sampling Method	Year established	Status
	Hobsonville	Waitematā Harbour			Boat	1991	Dropped 1999
7702	Hobsonville Jetty	Waitematā Harbour	1749321	5927317	Boat	1993	Current
7703	Waimarie Road	Waitematā Harbour	1746213	5929089	Boat	1993	Dropped 2015
7821	Rawawaru Creek	Waitematā Harbour	1744434	5928653	Boat	1993	Dropped 2015
7704	Confluence	Waitematā Harbour	1743655	5929055	Boat	1993	Dropped 2014
7809	Paremoremo Ski Club	Waitematā Harbour	1745746	5930178	Boat	1993	Current
7884	Rangitopuni Creek	Waitematā Harbour	1742836	5929868	Boat	1993	Current
7883	Brighams Creek	Waitematā Harbour	1742758	5928019	Boat	1993	Current
7882	Lucas Creek	Waitematā Harbour	1750045	5932471	Boat	1993	Current
8221	Tamaki (No. 7 Buoy)	Tamaki Estuary	1769372	5917448	Land	1992	Current
8220	Panmure	Tamaki Estuary	1765295	5913934	Land	1992	Current
8413	Turanga Estuary	Tamaki Strait	1774464	5914091	Helicopter	2009	Dropped 2015
8569	Wairoa River	Tamaki Strait	1786443	5909850	Helicopter	2009	Current
43904	Papakura Channel	Manukau Harbour			Helicopter	1987	Dropped 1999
43507	Grahams Beach (Waiuku Channel)	Manukau Harbour	1749651	5888082	Helicopter	1987	Current
43506	Clarks Beach (Waiuku River)	Manukau Harbour	1748630	5897349	Helicopter	1987	Current
43519	Waiuku Town Basin	Manukau Harbour	1753690	5878187	Helicopter	2012	Current
44010	Shag Point (Titirangi)	Manukau Harbour	1748379	5908452	Helicopter	1987	Current
43906	Puketutu Point	Manukau Harbour	1753877	5908724	Helicopter	1987	Current
43904	Weymouth	Manukau Harbour	1764925	5897672	Helicopter	1987	Current
43905	Mangere Bridge	Manukau Harbour	1758588	5910714	Helicopter	1987	Current
43513	Manukau Heads	Manukau Harbour	1708915	5970600	Helicopter	2009	Current
	Manukau Outer Heads	Manukau Harbour			Helicopter	2017	Current



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