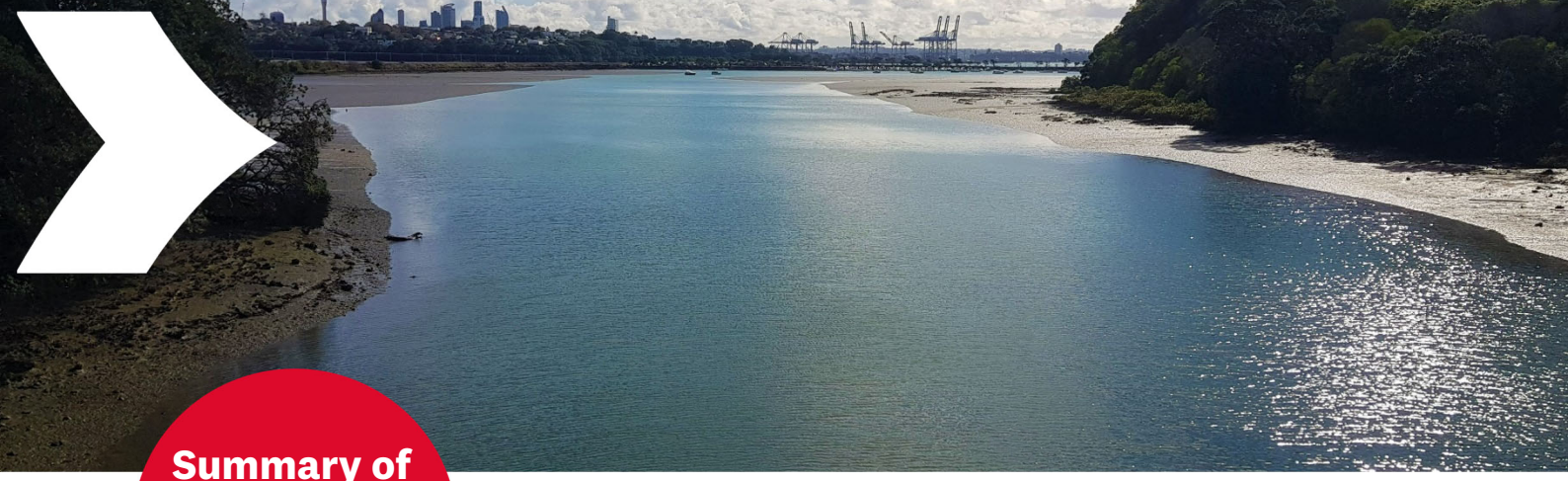


Summary of TR2023/14 December 2023

Arsenic and mercury in marine sediment: state and preliminary trends in Tāmaki Makaurau / Auckland 2012-2021

Summary report

This document summarises the findings from the technical report *Arsenic and mercury in marine sediment: state and preliminary trends in Tāmaki Makaurau 2012-2021,* TR2023/14. For a detailed assessment of marine sediment contaminant state and changes over time up until 2019 for the metals copper, lead and zinc, see TR2021/10, *Marine sediment contaminant state and trends in Tāmaki Makaurau / Auckland 2004-2019*.

Key findings from 122 sites assessed include:

Concentrations of mercury are generally low across the region and based on sediment quality guidelines are below levels where impacts on benthic organisms would be expected. There are some sites with moderately elevated concentrations in the muddy, inner estuary zones of the Central and Upper Waitematā Harbour and Tāmaki Estuary.

Spatial patterns of mercury largely follow that of the metals associated with urban stormwater (i.e., copper, lead, and zinc), and concentrations are strongly correlated. This means that where mercury is elevated, generally other metals are too, and suggests mercury shares urban stormwater/wastewater as a common conduit into the marine environment.

Arsenic concentrations are, for the most part, at levels close to or below what would be expected to be 'natural' for Auckland marine sediments.

Arsenic concentration in marine sediment does not appear to follow any spatial pattern and differs from that of the other chemical contaminants monitored.

Relatively few sites showed meaningful trends for either chemical, and there doesn't appear to be any spatial patterns associated with increasing or decreasing trends.

Overview

Chemical contaminants such as mercury and arsenic can accumulate in the sediment of our harbours, estuaries, and beaches. They can originate from natural processes and man-made activities and can be transported into the marine environment in numerous ways, including in stream and riverine systems, in wastewater and stormwater discharge and as leachate from decommissioned landfills. At elevated levels, these chemicals can be harmful, either directly or by contributing to already stressed ecosystems, affecting ecological health and functioning by reducing the number and/or the diversity of animals able to live there. Identifying areas where concentrations of arsenic and mercury exceed what would occur naturally provides a useful indicator of the possible sources of these chemicals, and the impact of land use on marine receiving environments.

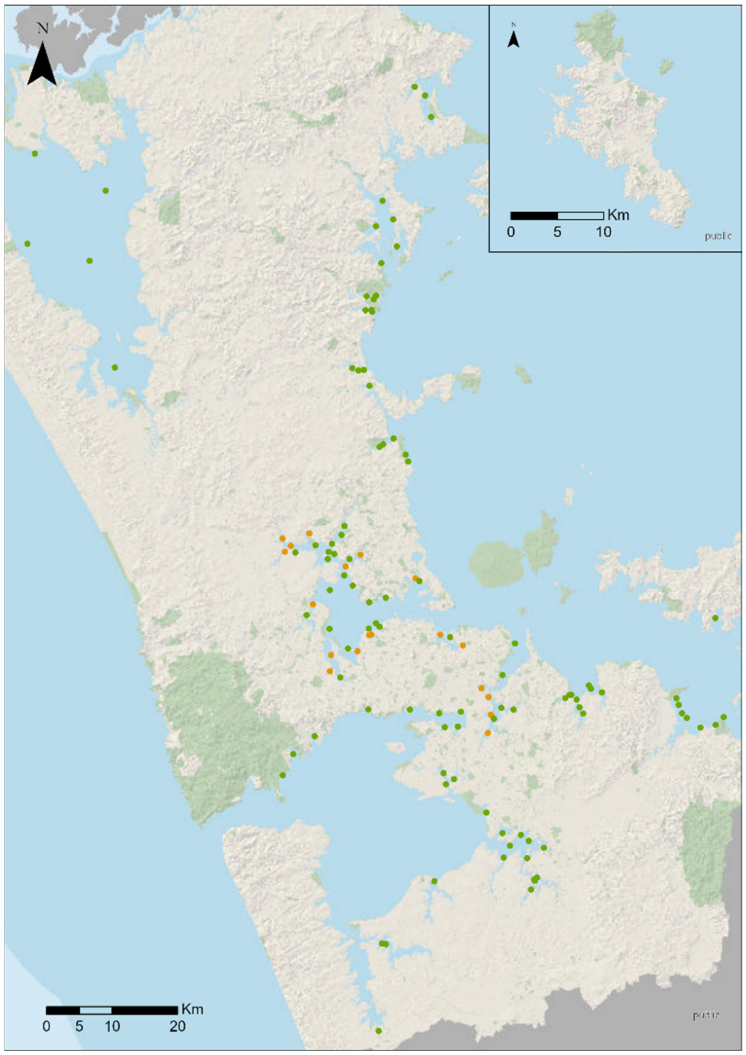
What we monitor

Auckland Council's Regional Sediment Contaminant Monitoring Programme (RSCMP) has primarily focused monitoring and reporting on the metals associated with urban stormwater: copper (Cu), lead (Pb) and zinc (Zn). In the early 2000s, Intermittent testing of arsenic (As; a metalloid) and mercury (Hg) had shown that these contaminants were sometimes present at elevated concentrations. As sources and trends were unclear, routine monitoring was instituted in 2012 to obtain more information.

Concentrations are compared with Sediment Quality Guidelines (SQGs) to assess the potential impact of sediment contamination on aquatic life. SQGs use a traffic light system to indicate the contaminant level and associated impact on ecological health, where Green indicates a low level of contaminants, Amber indicates moderately elevated levels where adverse effects on ecology may be beginning to appear, and Red indicates levels of contamination where ecological degradation is likely to be occurring.

Concentrations are compared with the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG). The more conservative *Threshold Effect Level* (TEL) guidelines are also used to assess mercury levels. ANZG values are higher than those used in the TEL, so fewer sites will trigger the ANZG thresholds than the TEL. In addition to SQGs, 'background' concentrations derived from reference sites (located in largely native forested catchments with little urban impact) can also be used to assess concentrations.

The RSCMP assesses sediment contamination with regards to ecological impact, it does not assess chemical concentrations with regards to human health. Marine ecology and sediment mud content are measured at all sites in conjunction with sediment contaminant monitoring. See TR2021/09 for the most recent analysis of RSCMP ecology data.



Map showing locations of the monitoring sites where arsenic and mercury were sampled between 2012 and 2021, and mercury contamination state based on the Threshold Effect Level (TEL) sediment quality guideline.

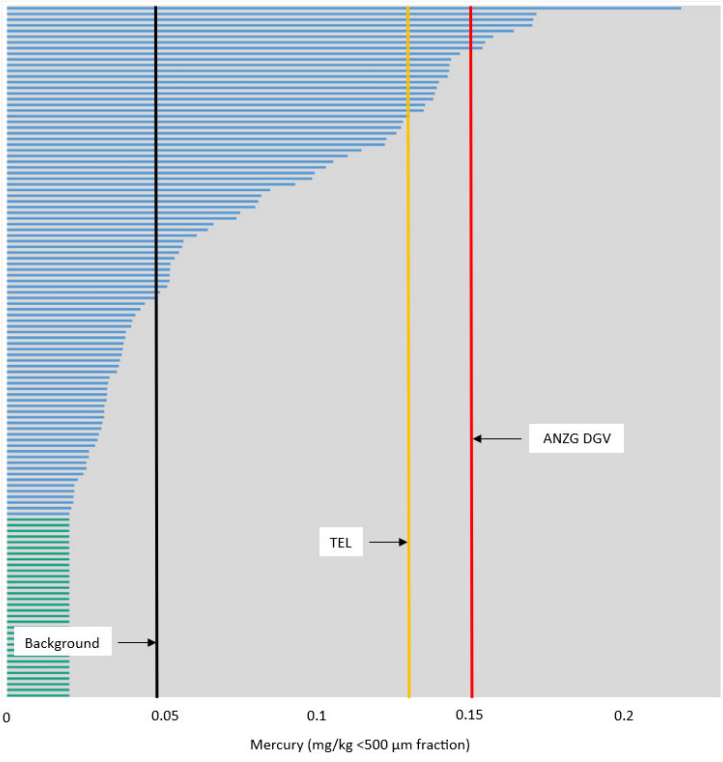
Where we monitor

The RSCMP conducts regular monitoring in the intertidal sand/mud flats at around 80 sites across the region's harbours, estuaries, and beaches. As a key objective is to monitor the impacts of urban development, most of the sites are in areas receiving run-off from predominantly urban catchments. In addition to this, other marine monitoring programmes have also collected sediment contaminant data in recent years. This has significantly expanded the spatial coverage of metal contaminant monitoring, particularly in more rural catchments.

Overall, 122 sites were available for arsenic and mercury state assessment.

What we found: Mercury

Concentrations of mercury are generally low across the region, with just 19 sites (16%) above TEL guideline thresholds. Moderately elevated concentrations are observed at some sites in the muddy, highly urbanised, inner estuary zones of the Central Waitematā and Tāmaki Estuary, and in the Upper Waitematā.



Mercury concentrations at all sites. Yellow line is the TEL, red line is the ANZG, black line is the 'Background' level. Bars in green represent sites that were below the laboratory detection limit.

Spatial patterns of mercury largely follow that of the metals associated with urban stormwater (i.e., Cu, Pb, and Zn), and concentrations are strongly correlated. Mercury is rarely elevated in isolation and is typically found at elevated levels alongside at least one other metal. This suggests that urban activities are contributing to some degree to these observed elevated levels, and that the stormwater network is a likely conduit for mercury into the marine receiving environment.

At sites in predominantly rural catchments, or at open coastal sites, mercury concentrations are generally low, and at 32 sites (26%) are below lab detection levels.

What we found: Arsenic

At all sites across the region, arsenic concentrations are below thresholds where impacts on benthic ecology might be expected to occur. The majority of sites (103 out of 122; 84%) fell below 'background' concentrations, while no exceedances of the ANZG guidelines were observed at any sites. The use of TEL guidelines is considered unsuitable for arsenic in Auckland marine sediment, as the threshold level is well below recorded background concentrations.

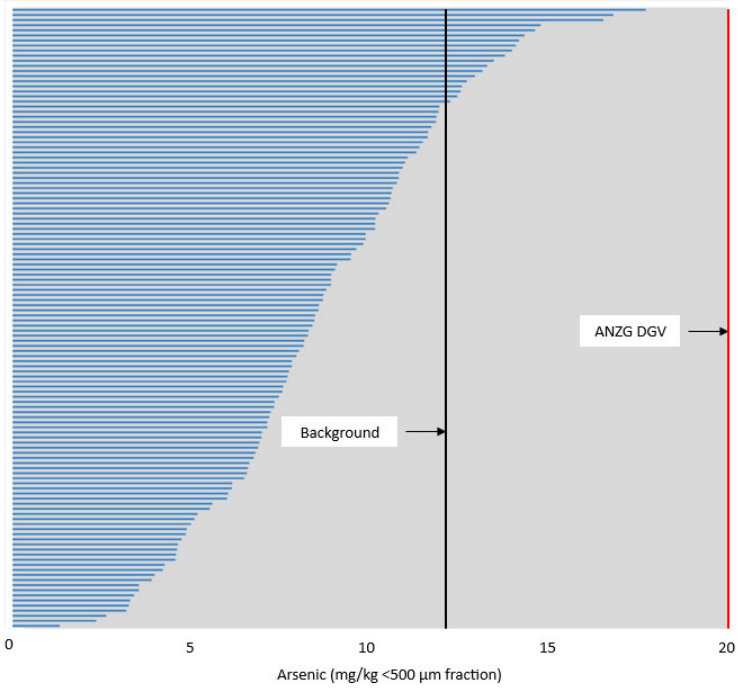
Arsenic concentration does not appear to follow any spatial pattern and differs from that of the other chemical contaminants monitored. A lack of correlation with other contaminants known to be present and derived from stormwater, indicates that current land use and activities that end in stormwater/wastewater discharge are not contributing significantly to arsenic levels in marine sediment. Notably, arsenic was higher at several sandy, rural locations than it was at muddy, highly urbanised and otherwise relatively 'contaminated' sites.

Changes over time

A total of 48 sites had a sufficient sampling record (a minimum of four samples was considered adequate) for preliminary trend analysis to be conducted.

Concentrations of arsenic and mercury were generally similar to those reported previously from monitoring undertaken in 2005, and relatively few sites showed meaningful trends over the time period

analysed here (just eleven for mercury and seven for arsenic). These results suggest there has been little meaningful change at most sites, although a small general improvement in mercury contamination might be inferred from decreases at most of the sites where meaningful change was measured. The overall lack of change observed at most sites is encouraging given the increasing intensity of urban activity in Auckland over the monitoring time frame (e.g., increased numbers of motor vehicles, ongoing land development and residential intensification). This may be due to increasing pressures being offset by improvements in stormwater management and improving industrial practices.



Arsenic concentrations at all sites. Red line is the ANZG, black line is the 'Background' level.

No broad spatial patterns can be inferred for either arsenic or mercury. As this is the first assessment of trends for these contaminants, no comparisons with previous reporting can be made. Whilst these results serve as a useful preliminary assessment, the sample size is too small to be considered robust, and further analyses are required to have a more definitive understanding of trend direction and magnitude for these chemicals.

Summary

Based on this assessment, current levels of arsenic and mercury in Auckland's marine sediments individually pose only a low level of risk to benthic ecology, apart from a handful of sites where mercury levels are at higher concentrations. However, even at slightly elevated concentrations, these chemicals can be contributing to cumulative and multiple stressor impacts and may be negatively impacting benthic ecosystems.

Further monitoring of these chemicals will strengthen our understanding of arsenic and mercury concentration and distribution, allow a more robust analysis of changes over time, and ensure that no widespread (or otherwise) increases are occurring.

Find out more:

Allen, H. (2023). *Arsenic and mercury in marine sediment: state and preliminary trends in Tāmaki Makaurau / Auckland 2012–2021.* Auckland Council technical report, TR2023/14

Mills, G N and H Allen (2021). *Marine sediment contaminant state and trends in Tāmaki Makaurau / Auckland 2004-2019. State of the environment reporting.* Auckland Council technical report, TR2021/10

For more information or to request data, email environmentaldata@aklc.govt.nz
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