

**Appendix 1**

**Single Site Reports**

**Part 7**

**Manukau Harbour**

# Explanatory notes

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This appendix provides a summary of the sediment chemistry and particle size distribution data for each monitoring site. The appendix has been divided according to “Marine Reporting Areas” (MRAs):

- Part 1: Central Waitemata Harbour
- Part 2: Upper Waitemata Harbour
- Part 3: East Coast Bays
- Part 4: Hibiscus Coast
- Part 5: Tamaki Estuary
- Part 6: Tamaki Strait
- Part 7: Manukau Harbour

The summaries are given as “Single Site Reports” (SSRs), in which the key physical and chemistry data are provided in 2 pages:

1. The first page provides a brief description of the site: its location; classification in terms of sediment and contaminant transport/accumulation – “Settling Zone” (SZ) or “Outer Zone” (OZ), as described in ARC Technical Publication TP 170 (ARC 2002); key physical characteristics; notable features and relevant monitoring information (e.g. location of nearby sites).
2. The second page gives a summary of the sediment contaminant and sediment texture data: results from each year of monitoring for Cu, Pb, Zn, “high molecular weight” PAH (HWP AH), total organic carbon (TOC), and “mud content” (defined below). The contaminant results have been compared with sediment quality guidelines (the ARC “Environmental Response Criteria”, ERC). Indicative trends over time (see below), and a brief interpretative summary on key features of the data, have also been given.

Plots and summary statistics include all data reported to end of 2010, unless otherwise stated (e.g. occasional clear outlier removed before plotting & analysis). Where replicate analyses have been performed, data have been summarised as medians.

Trend data given in the SSRs have been determined by linear regression. The trend plots have been fitted with a quadratic curve “line of best fit” as an aid for visually assessing the nature of changes over time in the data series. Trend indicators, using “arrow” symbols, have been used to show the magnitude and direction of trends. No statistical significance associated with these trends is given (this is discussed in detail in the body of the Status and Trends Report). The trend indicators should be interpreted as follows:

- $<\pm 1\%$  per annum change probably indicates no (or very little) trend;
- $\pm 1\text{--}2\%$  per annum indicates a small, or emerging, trend. Changes of this magnitude could be largely associated with analytical and/or sampling variation, so trends in this range may not have any “real world” significance; and
- $>\pm 2\%$  indicates a stronger trend, equivalent to  $> \pm 20\%$  per decade, which is probably worth investigating further to better understand possible causes.

Mud content is given as the % of the  $<500\ \mu\text{m}$  fraction of the sediment that is  $<63\ \mu\text{m}$ . Where this has been determined by more than one method in any year, the average of the values has been used.

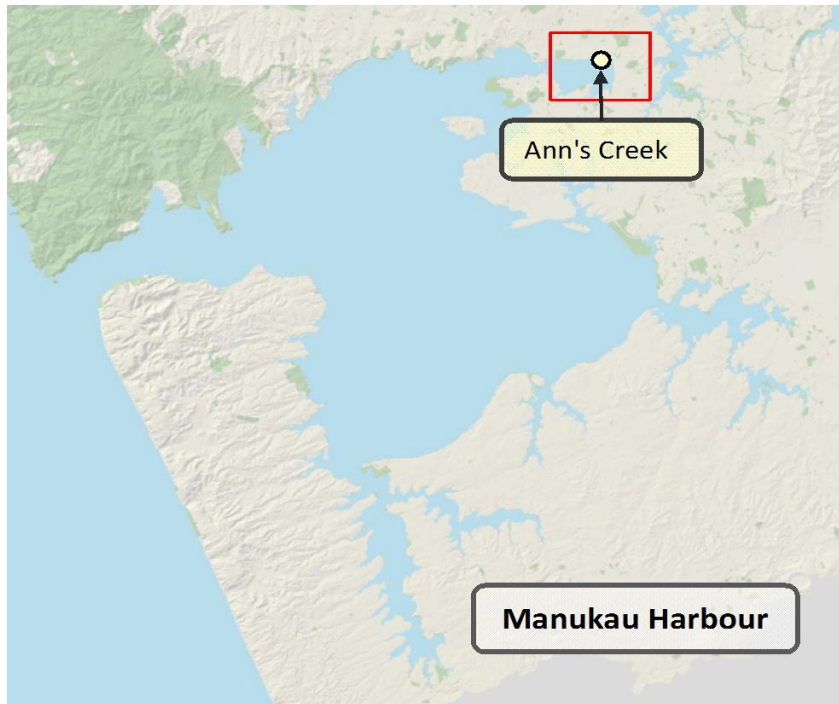
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### 1.1 Ann's Creek, Mangere Inlet (SoE)

| Site            | Type     | Description & Notes   |
|-----------------|----------|---|
| Ann's Creek     | Muddy OZ |   |
| Reporting Area  | Land Use | Site is located at the mouth of Ann's Creek, in the northern headwater reach of Mangere Inlet, Manukau Harbour. Adjacent land use is urban (commercial/industrial), with long history of heavy industry. Site is muddy. Extensive mangroves adjacent to site. |
| Manukau Harbour | Urban    |   |

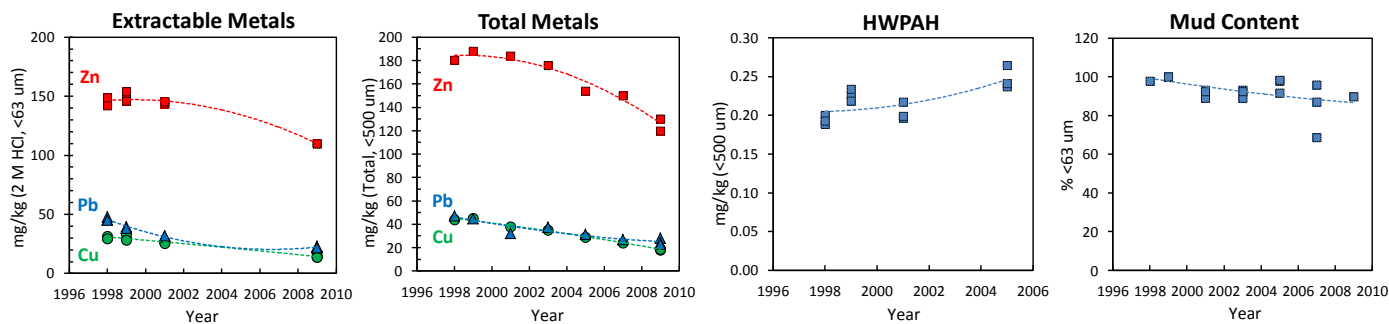


**Additional Notes**

SoE site. Mangrove encroachment necessitated site relocation in 2007.

| Site            | Description   | ERC Status  | Trends & Comments   |
|-----------------|---|---|---|
| Ann's Creek     | Muddy OZ site at head of Mangere Inlet.<br>Old industrial catchment.<br>Historical contamination. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 11 year monitoring period. Extractable metals' data for 2003-2007 may be unreliable, therefore not shown. Assess metals' trends from Total Metals. Metals decreasing over time. Current contaminant status - ERC Amber. |
| Reporting Area  |   |   |   |
| Manukau Harbour |   |   |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |         |         | Total Metals (mg/kg, <500 µm) |        |        | HWPAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|---------|---------|-------------------------------|--------|--------|------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb      | Zn      | Cu                            | Pb     | Zn     | mg/kg                  | at 1% TOC |
| 1998                            | 97.9                    | no data                             | 30.0                               | 45.7    | 143     | 43.8                          | 47.1   | 181    | 0.193                  | no data   |
| 1999                            | 100.0                   | no data                             | 29.6                               | 38.5    | 150     | 45.3                          | 45.0   | 188    | 0.225                  | no data   |
| 2001                            | 92.6                    | no data                             | 26.2                               | 31.7    | 145     | 37.8                          | 32.1   | 184    | 0.199                  | no data   |
| 2003                            | 92.6                    | 1.63                                | no data                            | no data | no data | 35.0                          | 37.3   | 176    | no data                | no data   |
| 2005                            | 97.8                    | 1.58                                | no data                            | no data | no data | 29.1                          | 31.5   | 154    | 0.241                  | 0.154     |
| 2007                            | 87.0                    | 1.50                                | no data                            | no data | no data | 24.0                          | 27.0   | 150    | no data                | no data   |
| 2009                            | 89.8                    | no data                             | 14.0                               | 22.0    | 110     | 19.0                          | 24.0   | 130    | no data                | no data   |
| Median                          | 93.3                    | 1.57                                | 27.7                               | 35.0    | 144     | 29.1                          | 31.5   | 154    | 0.218                  | 0.154     |
| Trend (absolute units per year) | -1.2                    | -0.04                               | -1.5                               | -1.9    | -3.6    | -2.4                          | -1.8   | -5.7   | 0.006                  | no value  |
| Trend (% of median per year)    | ↘ -1.2                  | ↘ -2.3                              | ↘ -5.5                             | ↘ -5.4  | ↘ -2.5  | ↘ -8.4                        | ↘ -5.9 | ↘ -3.7 | ↗ 2.8                  | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66
Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7
Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction data

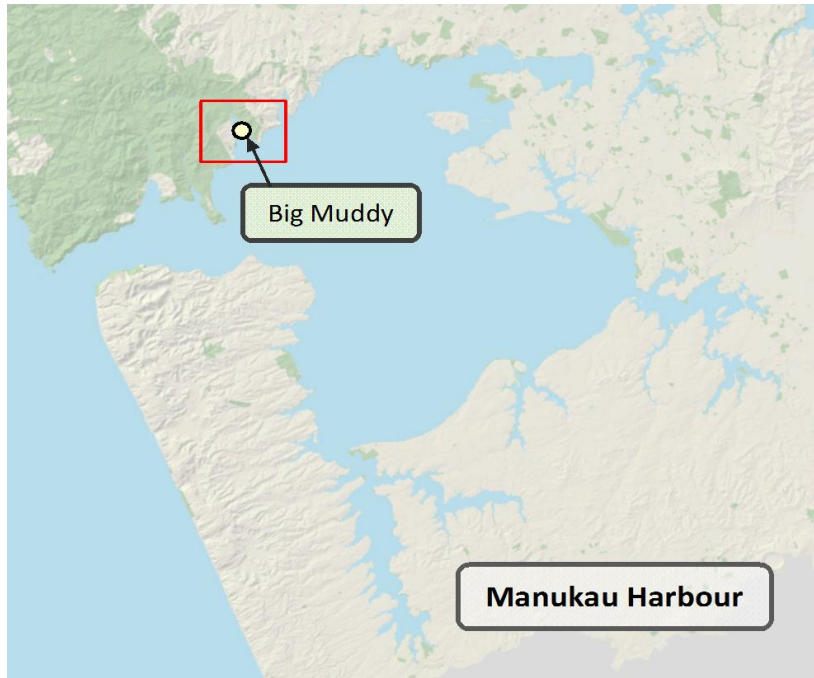
**Trend Indicators**

↔ < ±1%
↘ ↗ ±1 - 2%
↕ > ±2%

Average annual rate of change, as % of median per year

## 1.2 Big Muddy Creek (SoE)

| Site            | Type     | Description & Notes   |
|-----------------|----------|---|
| Big Muddy       | Muddy SZ |   |
| Reporting Area  | Land Use | Site is located on the northern shore of the outer reaches of the Manukau Harbour, in a rural/low density residential catchment. Catchment includes Nihotupu water supply reservoirs. Reference site. |
| Manukau Harbour | Rural    |   |

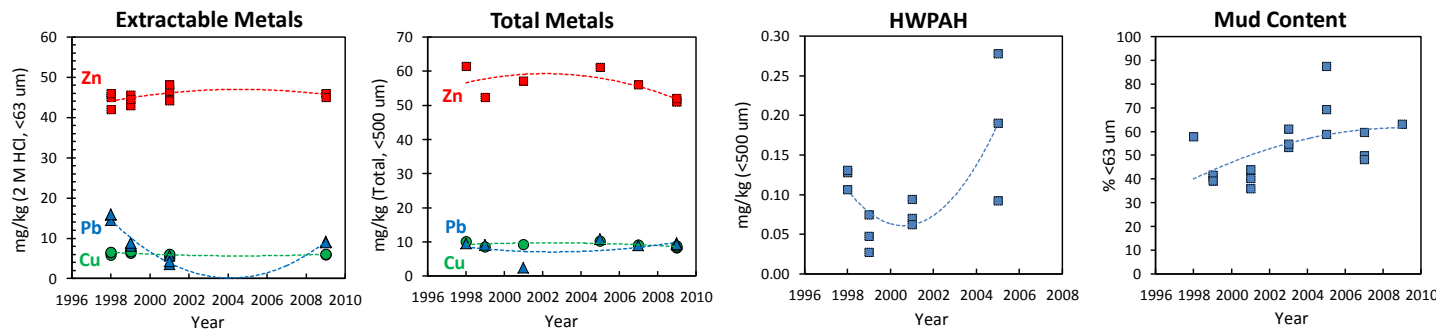


**Additional Notes**

SoE reference site.

| Site            | Description   | ERC Status  | Trends & Comments  |
|-----------------|---|---|--|
| Big Muddy Creek | Muddy SZ site in the outer reaches of Manukau Harbour. Rural catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">PAH</div> </div> | 11 year monitoring period. Extractable metals' data for 2003-2007 may be unreliable, therefore not shown. Assess metals' trends from Total Metals. No major changes over time. PAH low & variable. Current contaminant status - ERC Green. |
| Reporting Area  |   |   |  |
| Manukau Harbour |   |   |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content % <63 µm | Organic Carbon TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |         |         | Total Metals (mg/kg, <500 µm) |         |         | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|----------------------|--------------------------------|------------------------------------|---------|---------|-------------------------------|---------|---------|-------------------------|-----------|
|                                 |                      |                                | Cu                                 | Pb      | Zn      | Cu                            | Pb      | Zn      | mg/kg                   | at 1% TOC |
| 1998                            | 57.8                 | no data                        | 6.4                                | 15.8    | 45      | 10.1                          | 9.6     | 62      | 0.128                   | no data   |
| 1999                            | 40.7                 | no data                        | 6.7                                | 8.7     | 45      | 8.6                           | 9.1     | 52      | 0.048                   | no data   |
| 2001                            | 40.3                 | no data                        | 6.0                                | 4.3     | 47      | 9.2                           | 2.4     | 57      | 0.071                   | no data   |
| 2003                            | 54.8                 | 1.36                           | no data                            | no data | no data | no data                       | no data | no data | no data                 | no data   |
| 2005                            | 69.4                 | 1.29                           | no data                            | no data | no data | 10.3                          | 10.8    | 61      | 0.190                   | 0.156     |
| 2007                            | 49.8                 | 1.10                           | no data                            | no data | no data | 9.1                           | 9.0     | 56      | no data                 | no data   |
| 2009                            | 63.2                 | no data                        | 6.0                                | 9.1     | 46      | 8.5                           | 9.3     | 51      | no data                 | no data   |
| Median                          | 53.4                 | 1.29                           | 6.1                                | 9.0     | 45      | 9.0                           | 9.3     | 54      | 0.093                   | 0.156     |
| Trend (absolute units per year) | 2.1                  | -0.07                          | 0.0                                | -0.3    | 0.1     | -0.1                          | 0.2     | -0.5    | 0.014                   | no value  |
| Trend (% of median per year)    | ↑ 3.9                | ↓ -5.0                         | → -0.5                             | ↓ -2.8  | → 0.2   | → -0.8                        | → 1.8   | → -1.0  | ↑ 14.5                  | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66
Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7
Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction data

**Trend Indicators**

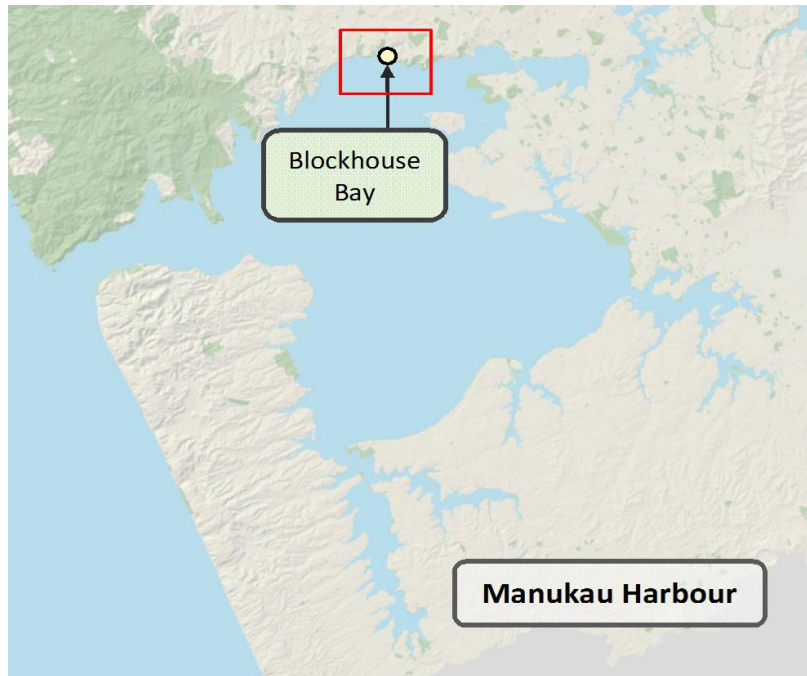
↔ < ±1%
↗ ↘ ±1 - 2%
↑ ↓ > ±2%

Average annual rate of change, as % of median per year



### 1.3 Blockhouse Bay

| Site            | Type     | Description & Notes   |
|-----------------|----------|---|
| Blockhouse Bay  | Sandy OZ |   |
| Reporting Area  | Land Use | Site is located on the open sand flats of Lynfield Cove, Blockhouse Bay. Site lies inside the muddy oyster beds which line the low tide margins of the Manukau Hbr channel. Firm sand with slightly muddier sand beneath surface. Urban residential catchment . |
| Manukau Harbour | Mixed    |   |



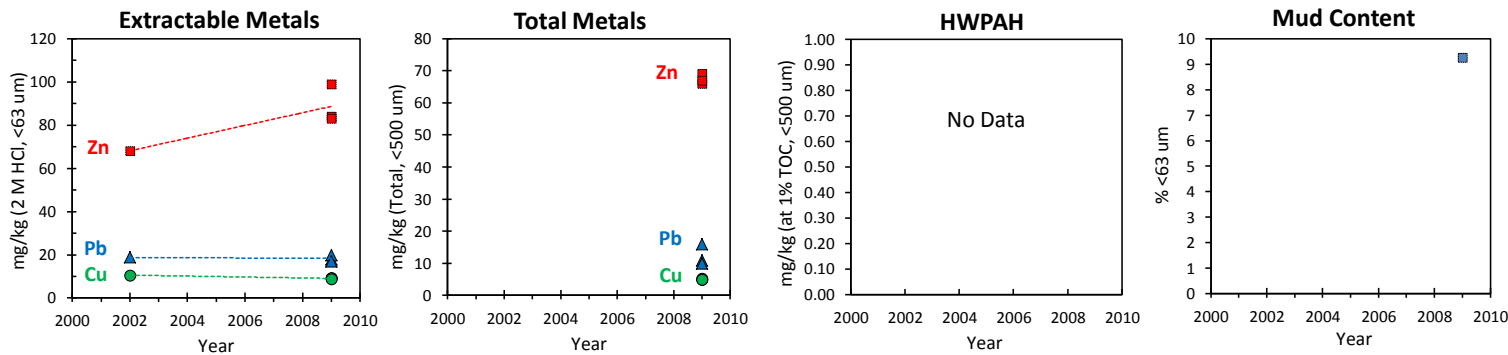
**Additional Notes**

2002 sampling by NIWA (for ACC/Metrowater). 2009 sampling by DSL for RDP (see 2009 RDP report).



| Site            | Description                     | ERC Status  | Trends & Comments   |
|-----------------|---------------------------------|---|---|
| Blockhouse Bay  | Sandy OZ site. Urban catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. Current contaminant status ERC-Green. No total metals or particle size (mud content) analysed in 2002. |
| Reporting Area  |                                 |   |   |
| Manukau Harbour |                                 |   |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |        |       | Total Metals (mg/kg, <500 µm) |          |          | HWPAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|-------|-------------------------------|----------|----------|------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn    | Cu                            | Pb       | Zn       | mg/kg                  | at 1% TOC |
| 2002                            | no data                 | no data                           | 10.6                               | 18.8   | 68    | no data                       | no data  | no data  | no data                | no data   |
| 2009                            | 9.3                     | no data                           | 9.2                                | 18.0   | 84    | 5.0                           | 11.0     | 67       | no data                | no data   |
| Median                          | 9.3                     | no data                           | 9.2                                | 18.4   | 84    | 5.0                           | 11.0     | 67       | no data                | no data   |
| Trend (absolute units per year) | no value                | no value                          | -0.2                               | -0.1   | 2.9   | no value                      | no value | no value | no value               | no value  |
| Trend (% of median per year)    | no value                | no value                          | ↓ -2.4                             | → -0.4 | ↑ 3.5 | no value                      | no value | no value | no value               | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66
Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7
Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction data

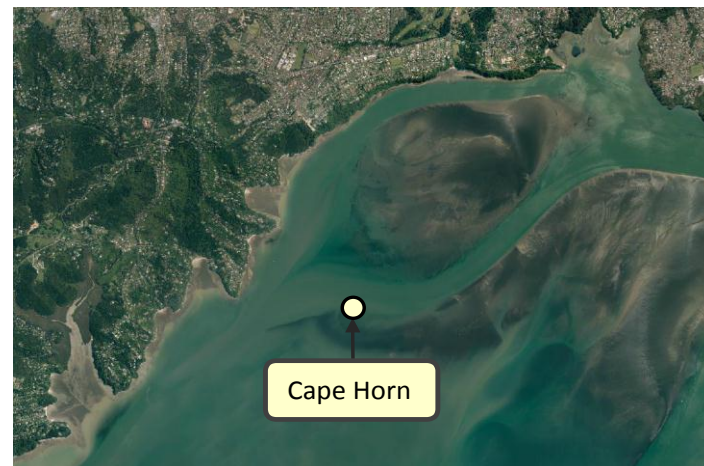
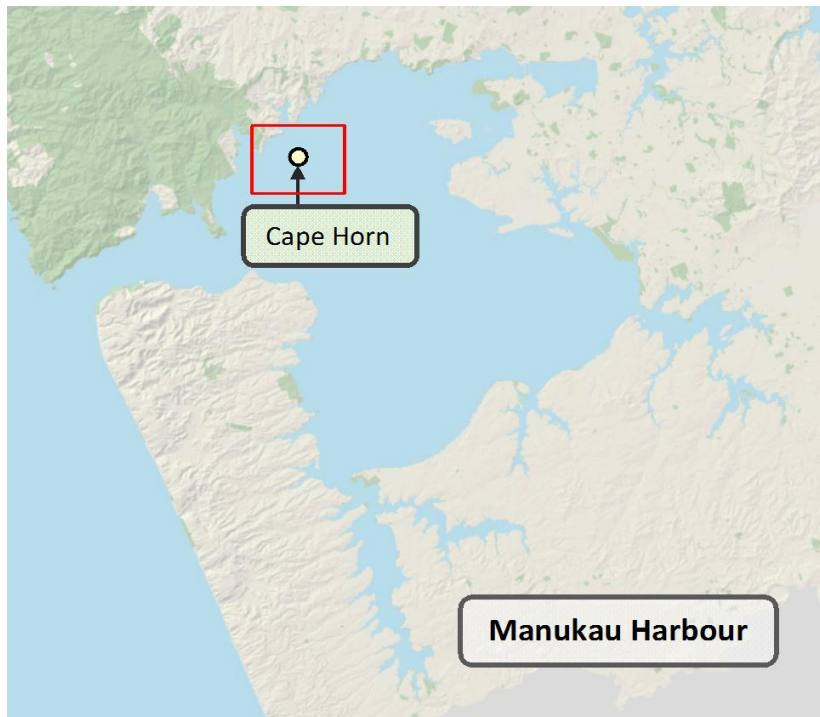
**Trend Indicators**

↔ < ±1%
↗ ↘ ±1 - 2%
↑ ↓ > ±2%

Average annual rate of change, as % of median per year

### 1.4 Cape Horn

| Site            | Type     | Description & Notes   |
|-----------------|----------|---|
| Cape Horn       | Sandy OZ |   |
| Reporting Area  | Land Use | Site is located in the mid-reaches of Manukau Harbour, on the edge of the Te Tau Bank, off Titirangi. Large mixed catchment influences. |
| Manukau Harbour | Mixed    |   |

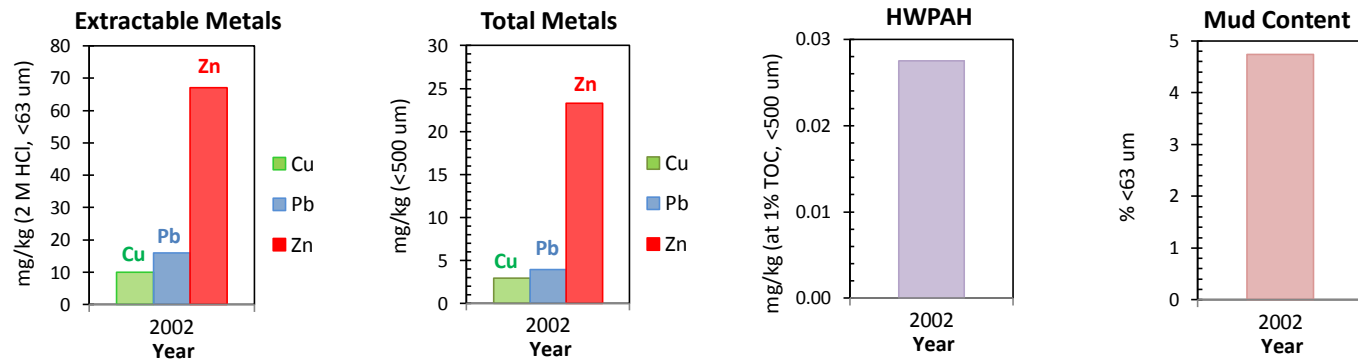


**Additional Notes**

Site sampled once only, in 2002.

| Site            | Description   | ERC Status  | Trends & Comments   |
|-----------------|---|---|---|
| Cape Horn       | Sandy OZ harbour site, mid-reaches of Manukau Harbour (Te Tau Bank, off Titirangi). Large mixed catchment influences. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 1 year of monitoring only. Not sampled since 2002. No trends can therefore be assessed. Current contaminant status ERC-Green. |
| Reporting Area  |   |   |   |
| Manukau Harbour |   |   |   |

### Sediment chemistry summary



### Annual median concentrations. Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |          |          | Total Metals (mg/kg, <500 µm) |          |          | HWPAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|----------|----------|-------------------------------|----------|----------|------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb       | Zn       | Cu                            | Pb       | Zn       | mg/kg                  | at 1% TOC |
| 2002                            | 4.7                     | 0.23                                | 10.0                               | 15.9     | 67       | 2.9                           | 3.9      | 23       | 0.003                  | 0.028     |
| Trend (absolute units per year) | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value               | no value  |
| Trend (% of median per year)    | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value               | no value  |

### Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

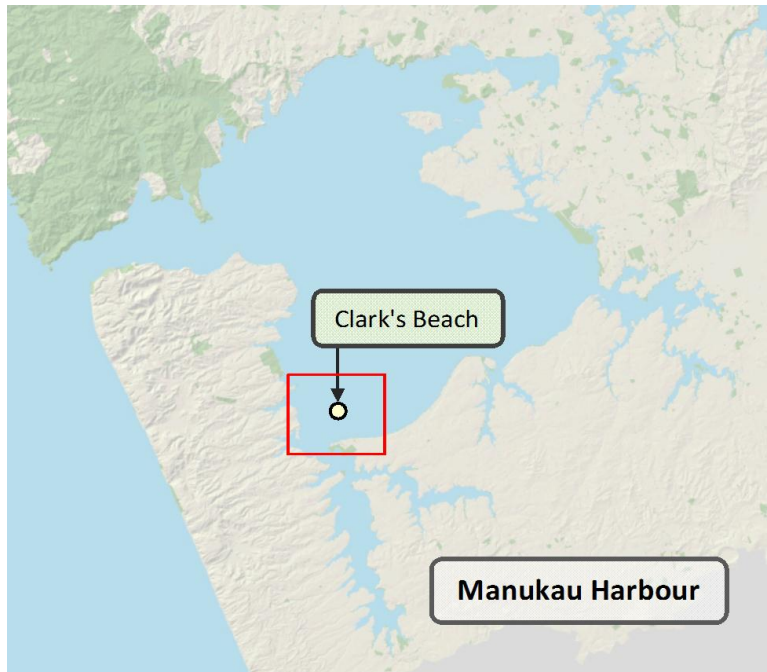
Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fractions. Settling Zones - the <500 µm fraction

## 1.5 Clark's Beach

| Site            | Type                 | Description & Notes  |
|-----------------|----------------------|--|
| Clarks Beach    | Sandy OZ             |  |
| Reporting Area  | Land Use             | Site is located on the southern shore of Manukau Harbour, approximately 1.5 km north of Clark's Beach settlement, and 2.5 km north-east of the Waiuku River mouth. Large mixed (largely rural) catchment influences. |
| Manukau Harbour | Mixed (mostly rural) |  |

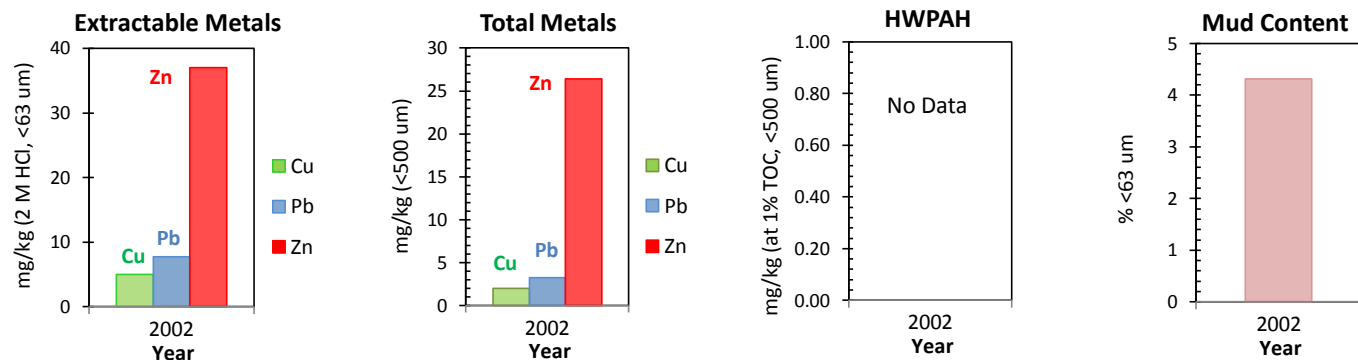


**Additional Notes**

Site sampled once only, in 2002.

| Site            | Description  | ERC Status  | Trends & Comments   |
|-----------------|--|---|---|
| Clark's Beach   | Sandy OZ harbour site, southern shores of Manukau Harbour. Large mixed catchment influences. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 1 year of monitoring only. Not sampled since 2002. No trends can therefore be assessed. Current contaminant status ERC-Green. |
| Reporting Area  |  |   |   |
| Manukau Harbour |  |   |   |

### Sediment chemistry summary



### Annual median concentrations. Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |          |          | Total Metals (mg/kg, <500 µm) |          |          | HWPAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|----------|----------|-------------------------------|----------|----------|------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb       | Zn       | Cu                            | Pb       | Zn       | mg/kg                  | at 1% TOC |
| 2002                            | 4.3                     | no data                             | 5.0                                | 7.7      | 37       | 2.0                           | 3.2      | 26       | no data                | no data   |
| Trend (absolute units per year) | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value               | no value  |
| Trend (% of median per year)    | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value               | no value  |

### Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

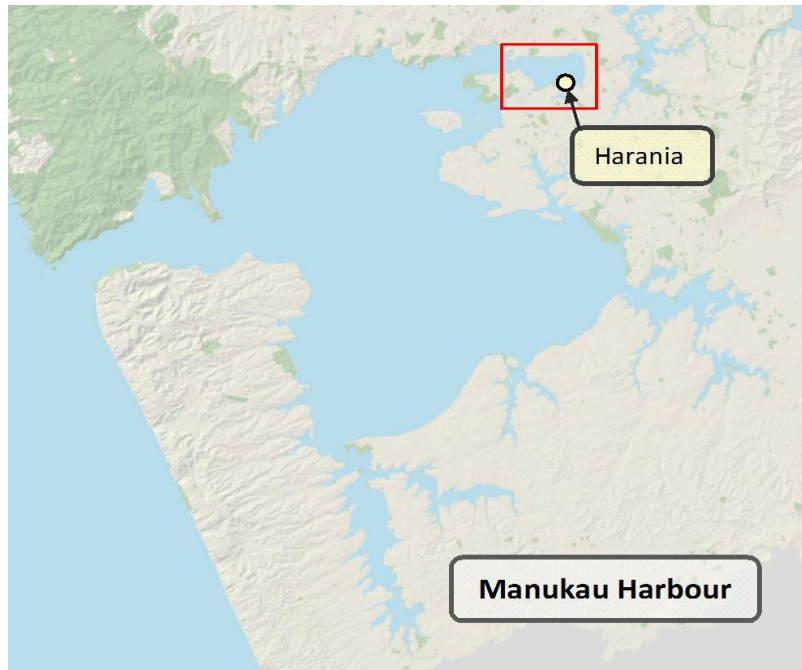
Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fractions. Settling Zones - the <500 µm fraction

## 1.6 Harania Creek, Mangere Inlet

| Site            | Type     | Description & Notes  |
|-----------------|----------|--|
| Harania         | Muddy SZ |  |
| Reporting Area  | Land Use | Site is located on the southern shore of Mangere Inlet, at the mouth of Harania Creek . Inlet area is heavily infilled with mangroves. Established industrial catchment. |
| Manukau Harbour | Urban    |  |



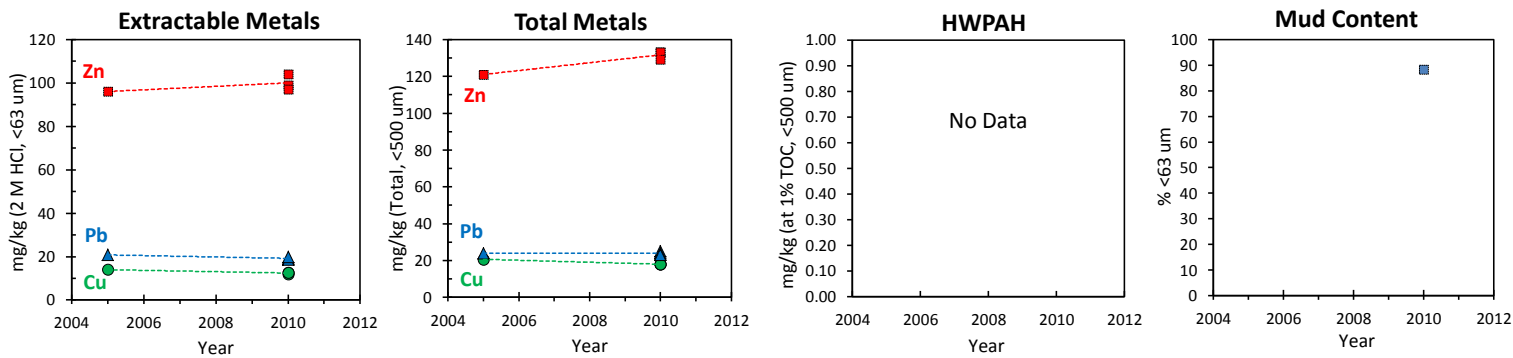
**Additional Notes**

Site sampled in 2005 & 2010. Site is on the mudflats, which are perched well above (and approx. 150 m away from) the deeply incised low tide channel - does this influence the direct effects from Harania Creek?



| Site            | Description                     | ERC Status  | Trends & Comments   |
|-----------------|---------------------------------|---|---|
| Harania         | Muddy SZ site. Urban catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2005 & 2010 metals' results similar. Current contaminant status ERC-Amber. Note 2005 data are from a single composite sample only. |
| Reporting Area  |                                 |   |   |
| Manukau Harbour |                                 |   |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 μm | Organic Carbon<br>TOC (% <500 μm) | Extractable Metals (mg/kg, <63 μm) |        |       | Total Metals (mg/kg, <500 μm) |       |       | HWPAAH (mg/kg, <500 μm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|-------|-------------------------------|-------|-------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn    | Cu                            | Pb    | Zn    | mg/kg                   | at 1% TOC |
| 2005                            | no data                 | no data                           | 14.0                               | 20.8   | 96    | 20.7                          | 24.0  | 121   | no data                 | no data   |
| 2010                            | 88.4                    | no data                           | 12.7                               | 19.1   | 99    | 18.0                          | 24.0  | 133   | no data                 | no data   |
| Median                          | 88.4                    | no data                           | 12.7                               | 19.5   | 98    | 18.0                          | 24.0  | 131   | no data                 | no data   |
| Trend (absolute units per year) | no value                | no value                          | -0.3                               | -0.3   | 0.8   | -0.5                          | 0.0   | 2.1   | no value                | no value  |
| Trend (% of median per year)    | no value                | no value                          | ↓ -2.5                             | ↘ -1.6 | → 0.8 | ↓ -3.0                        | → 0.0 | ↗ 1.6 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 μm and <500 μm fraction data. Settling Zones - the <500 μm fraction

Trend Indicators

→ < ±1% ↘ ↗ ±1 - 2% ↑ ↓ > ±2%

Average annual rate of change, as % of median per year

## 1.7 Hillsborough

| Site            | Type     | Description & Notes   |
|-----------------|----------|---|
| Hillsborough    | OZ       |   |
| Reporting Area  | Land Use | Site is located on the northern shore of Manukau Harbour. Established residential catchment. Monitoring site is close to shore, landward of the oyster beds lying between the shore and the harbour low tide channel. Sediment texture is variable - thin muddy layer over hard sand/clay base. |
| Manukau Harbour | Urban    |   |

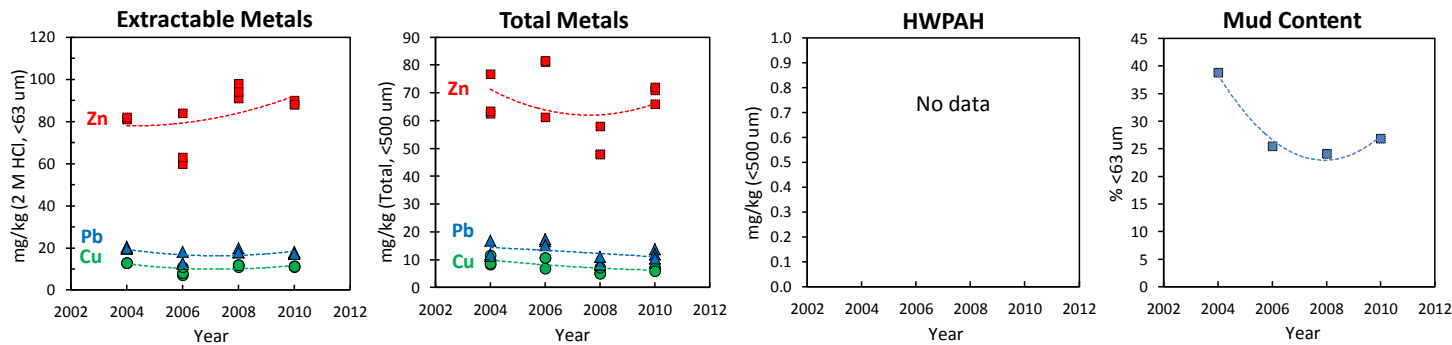


**Additional Notes**

Site probably directly affected by the small stream that enters the bay at the western end. The stream has changed course over the years, meandering across the flats adjacent to the monitoring site. Site is moved slightly each sampling to avoid any stream channel zones.

| Site            | Description  | ERC Status | Trends & Comments   |
|-----------------|--|------------|---|
| Hillsborough    | OZ site. Residential catchment. Texture variable (thin mud & grit over hard basement). | Cu         | 6 year monitoring period (2002 data not included because data comparability uncertain). Current contaminant status - ERC Green. PAH not measured to date. No major changes in metals (extractable) over time. Mud content higher in 2004. |
| Reporting Area  |  | Pb         |   |
| Manukau Harbour |  | Zn         |   |
|                 |  | PAH        |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |        |       | Total Metals (mg/kg, <500 µm) |        |        | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|-------|-------------------------------|--------|--------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn    | Cu                            | Pb     | Zn     | mg/kg                   | at 1% TOC |
| 2004                            | 38.8                    | no data                           | 13.0                               | 20.0   | 81    | 8.6                           | 11.9   | 64     | no data                 | no data   |
| 2006                            | 25.5                    | no data                           | 8.0                                | 12.8   | 63    | 10.6                          | 16.7   | 81     | no data                 | no data   |
| 2008                            | 24.1                    | no data                           | 12.0                               | 18.0   | 94    | 5.1                           | 8.3    | 48     | no data                 | no data   |
| 2010                            | 26.9                    | no data                           | 11.2                               | 17.8   | 88    | 7.0                           | 11.9   | 71     | no data                 | no data   |
| Median                          | 26.2                    | no data                           | 11.3                               | 18.1   | 86    | 7.1                           | 11.9   | 65     | no data                 | no data   |
| Trend (absolute units per year) | -1.9                    | no value                          | -0.1                               | -0.1   | 2.4   | -0.6                          | -0.6   | -0.9   | no value                | no value  |
| Trend (% of median per year)    | ↓ -7.1                  | no value                          | ↔ -1.1                             | ↔ -0.7 | ↑ 2.8 | ↓ -8.6                        | ↓ -4.7 | ↔ -1.3 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

Trend Indicators

↔ < ±1%

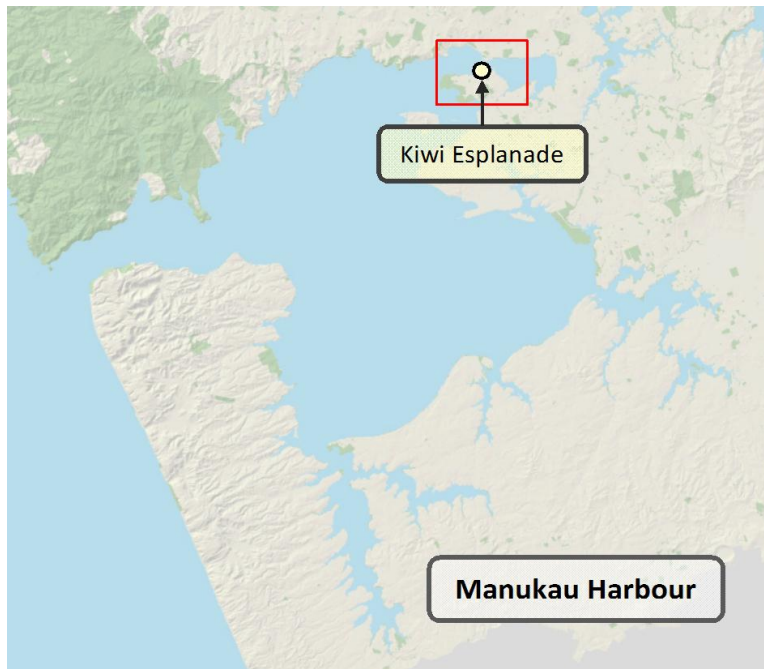
↔ ↗ ↘ ±1 - 2%

↕ > ±2%

Average annual rate of change, as % of median per year

## 1.8 Kiwi Esplanade, Mangere

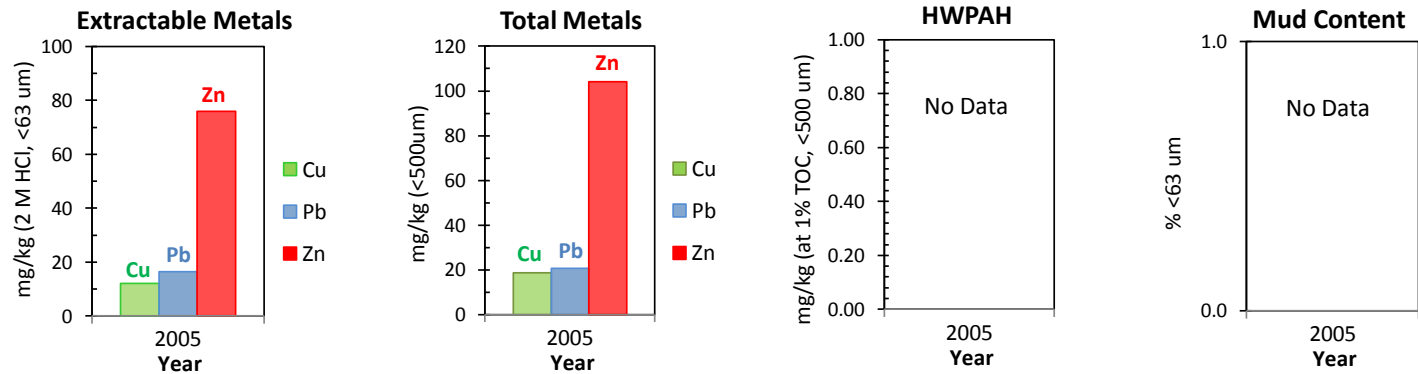
| Site                    | Type     | Description & Notes   |
|-------------------------|----------|---|
| Kiwi Esplanade, Mangere | Muddy SZ |   |
| Reporting Area          | Land Use | Site is located on the southern shore of Manukau Harbour, just outside the entrance to Mangere Inlet. Established urban (mainly residential) catchment. |
| Manukau Harbour         | Urban    |   |



**Additional Notes**  
 Site sampled in 2005 only.

| Site                    | Description  | ERC Status  | Trends & Comments  |
|-------------------------|--|---|--|
| Kiwi Esplanade, Mangere | Muddy OZ site, just outside entrance to Mangere Inlet. Mature urban catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 5px; margin: 5px;">Cu</div> <div style="border: 1px solid black; padding: 5px; margin: 5px;">Pb</div> <div style="border: 1px solid black; padding: 5px; margin: 5px;">Zn</div> <div style="border: 1px solid black; padding: 5px; margin: 5px;">PAH</div> </div> | 1 year of monitoring only (2005). No trends can therefore be assessed. Current contaminant status ERC-Green. |
| <b>Reporting Area</b>   |  |   |  |
| Manukau Harbour         |  |   |  |

### Sediment chemistry summary



### Annual median concentrations. Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |          |          | Total Metals (mg/kg, <500 µm) |          |          | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|----------|----------|-------------------------------|----------|----------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb       | Zn       | Cu                            | Pb       | Zn       | mg/kg                   | at 1% TOC |
| 2005                            | no data                 | no data                             | 12.0                               | 16.5     | 76       | 18.7                          | 20.6     | 104      | no data                 | no data   |
| Trend (absolute units per year) | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value                | no value  |
| Trend (% of median per year)    | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value                | no value  |

### Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

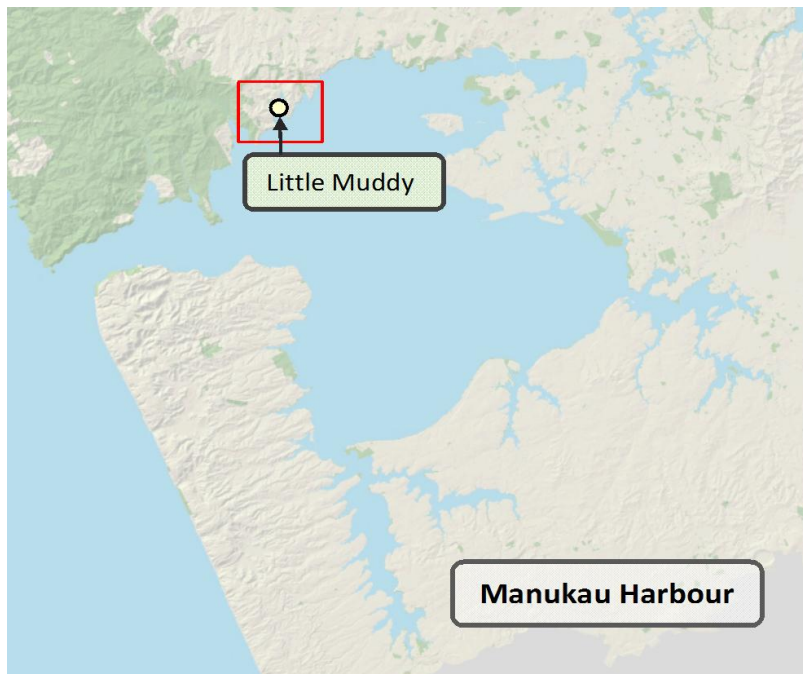
Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fractions. Settling Zones - the <500 µm fraction

## 1.9 Little Muddy Creek

| Site            | Type              | Description & Notes   |
|-----------------|-------------------|---|
| Little Muddy    | Muddy SZ          |   |
| Reporting Area  | Land Use          | Site is located on the northern shore of Manukau Harbour, in a rural/low density residential catchment between Titirangi and Laingholm. |
| Manukau Harbour | Rural/residential |   |



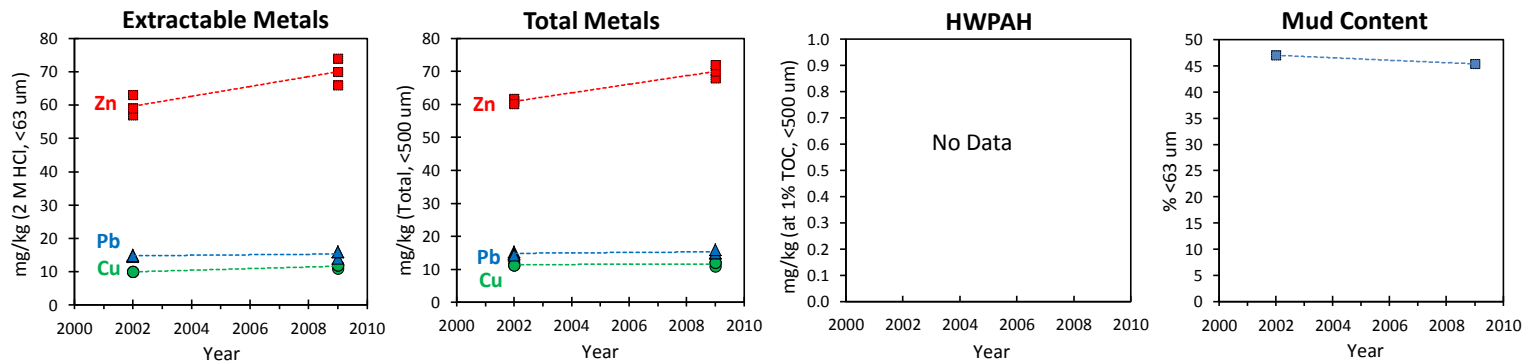
**Additional Notes**

Site sampled in 2002 and 2009 only.



| Site  | Description  | ERC Status            | Trends & Comments  |
|---|--|-----------------------|--|
| Little Muddy Creek<br>Reporting Area<br>Manukau Harbour | Muddy SZ site. Rural catchment, with some low density residential. | Cu<br>Pb<br>Zn<br>PAH | 2 years of monitoring only. No trends can therefore be assessed. 2002& 2009 results similar. Current contaminant status ERC-Green. |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |       |       | Total Metals (mg/kg, <500 µm) |       |       | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|-------|-------|-------------------------------|-------|-------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb    | Zn    | Cu                            | Pb    | Zn    | mg/kg                   | at 1% TOC |
| 2002                            | 47.0                    | no data                           | 10.0                               | 14.8  | 59    | 11.3                          | 14.9  | 61    | no data                 | no data   |
| 2009                            | 45.4                    | no data                           | 12.0                               | 16.0  | 70    | 12.0                          | 15.0  | 70    | no data                 | no data   |
| Median                          | 46.2                    | no data                           | 10.5                               | 14.9  | 65    | 11.5                          | 15.0  | 65    | no data                 | no data   |
| Trend (absolute units per year) | -0.2                    | no value                          | 0.2                                | 0.1   | 1.5   | 0.0                           | 0.1   | 1.3   | no value                | no value  |
| Trend (% of median per year)    | → -0.5                  | no value                          | ↑ 2.3                              | → 0.5 | ↑ 2.3 | → 0.3                         | → 0.4 | ↗ 2.0 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

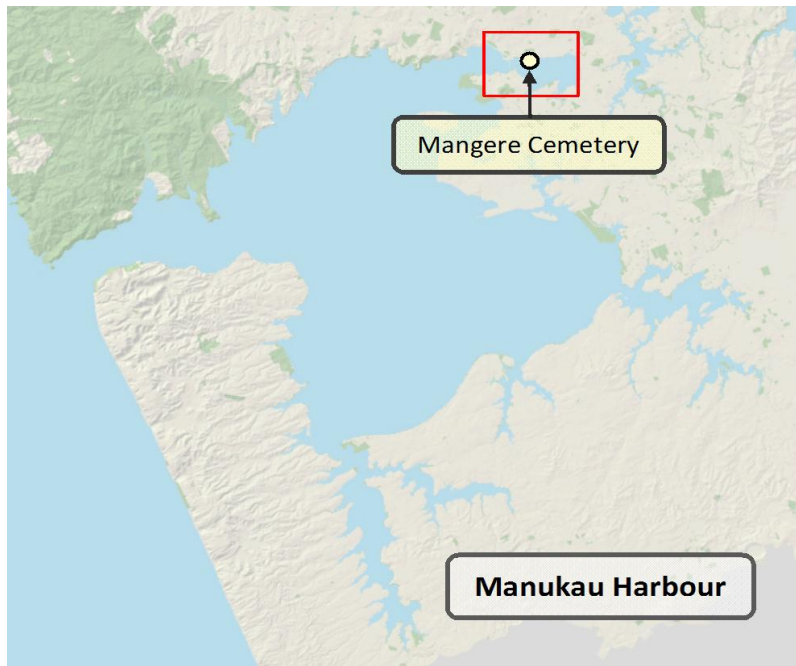
Trend Indicators

→ < ±1% ↗ ↘ ±1 - 2% ↑ ↓ > ±2%

Average annual rate of change, as % of median per year

### 1.10 Mangere Cemetery, Mangere Inlet (SoE)

| Site             | Type     | Description & Notes   |
|------------------|----------|---|
| Mangere Cemetery | Muddy OZ |   |
| Reporting Area   | Land Use | Site is located on the northern shore of Mangere Inlet, Manukau Harbour. Adjacent land use is urban (commercial/industrial), and immediately adjacent is Waikaraka Cemetery. Site is muddy. |
| Manukau Harbour  | Urban    |   |

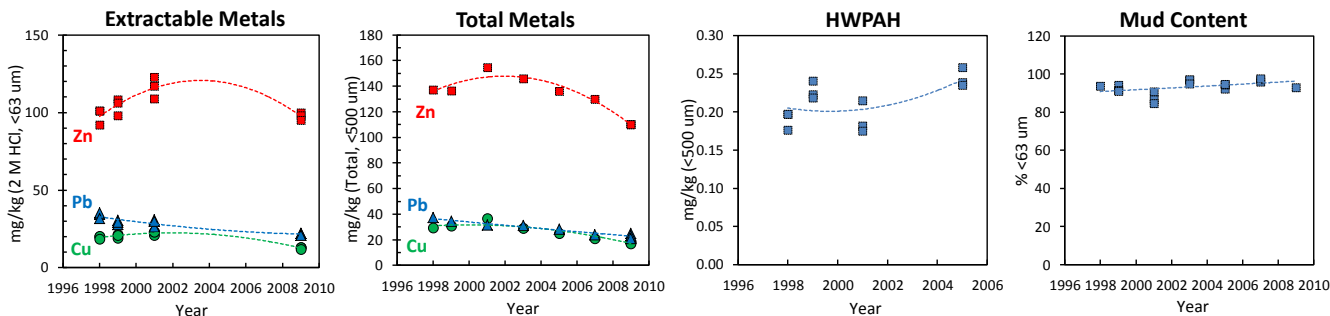


**Additional Notes**

SoE site.

| Site                        | Description  | ERC Status  | Trends & Comments  |
|-----------------------------|--|---|--|
| Mangere Cemetery (SoE site) | Muddy OZ site, northern shore Mangere Inlet. Old industrial catchment, historical pollution. | <div style="display: flex; flex-wrap: wrap;"> <div style="margin: 2px;">Cu</div> <div style="margin: 2px;">Pb</div> <div style="margin: 2px;">Zn</div> <div style="margin: 2px;">PAH</div> </div> | 11 year monitoring period. Extractable metals' data for 2003-2007 considered unreliable, therefore not shown. Assess metals' trends from Total Metals. Current contaminant status - ERC Green. Overall, no major changes over time, although metals may be decreasing? |
| Reporting Area              |  |   |  |
| Manukau Harbour             |  |   |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |         |         | Total Metals (mg/kg, <500 µm) |        |        | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|---------|---------|-------------------------------|--------|--------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb      | Zn      | Cu                            | Pb     | Zn     | mg/kg                   | at 1% TOC |
| 1998                            | 93.7                    | no data                             | 20.1                               | 34.6    | 101     | 29.4                          | 37.4   | 137    | 0.197                   | no data   |
| 1999                            | 91.6                    | no data                             | 20.8                               | 29.4    | 106     | 30.8                          | 34.3   | 137    | 0.223                   | no data   |
| 2001                            | 86.6                    | no data                             | 22.9                               | 29.9    | 117     | 36.8                          | 31.5   | 155    | 0.182                   | no data   |
| 2003                            | 96.9                    | 1.59                                | no data                            | no data | no data | 29.0                          | 31.2   | 146    | no data                 | no data   |
| 2005                            | 94.4                    | 1.59                                | no data                            | no data | no data | 25.1                          | 28.3   | 136    | 0.239                   | 0.152     |
| 2007                            | 97.2                    | 1.30                                | no data                            | no data | no data | 21.0                          | 24.0   | 130    | no data                 | no data   |
| 2009                            | 92.9                    | no data                             | 13.0                               | 22.0    | 98      | 18.0                          | 23.0   | 110    | no data                 | no data   |
| Median                          | 94.2                    | 1.57                                | 20.3                               | 29.6    | 101     | 25.1                          | 28.3   | 136    | 0.217                   | 0.152     |
| Trend (absolute units per year) | 0.5                     | -0.07                               | -0.7                               | -1.0    | -0.4    | -1.4                          | -1.2   | -3.0   | 0.006                   | no value  |
| Trend (% of median per year)    | → 0.5                   | ↓ -4.4                              | ↓ -3.6                             | ↓ -3.3  | → -0.4  | ↓ -5.6                        | ↓ -4.3 | ↓ -2.2 | ↑ 2.6                   | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

**Trend Indicators**

→ < ±1%

↔ ±1 - 2%

↕ > ±2%

Average annual rate of change, as % of median per year

### 1.11 Mill Bay

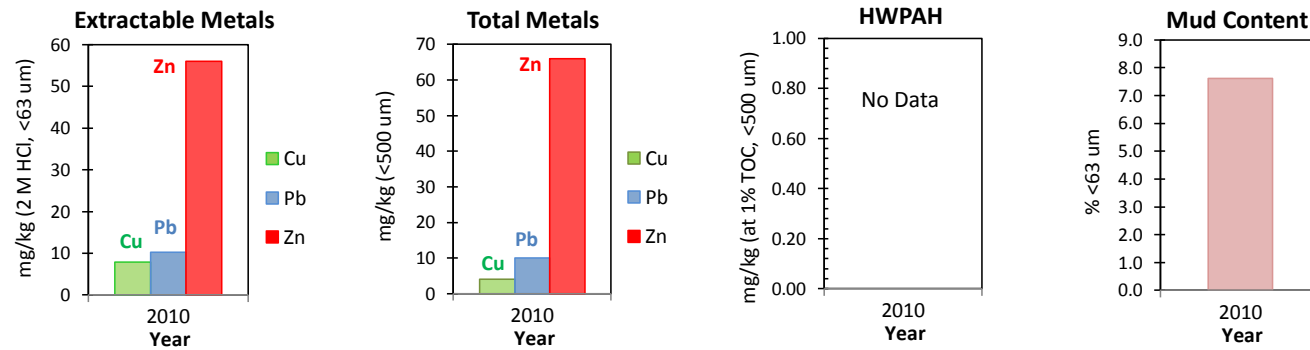
| Site            | Type                | Description & Notes  |
|-----------------|---------------------|--|
| Mill Bay        | Sandy OZ            |  |
| Reporting Area  | Land Use            | Site is located in a large sandy embayment on the outer reaches of Manukau Harbour. Site is on uniform sandflat inshore of sea grass patches along low tide harbour channel. The sediment here is firm sand, with a thin softer muddy sand surficial layer. Background reference site, including diffuse influences from wider harbour transported along Wairoa Channel. |
| Manukau Harbour | Regenerating forest |  |



**Additional Notes**  
 Site first sampled in 2010 (DSL 2010, RDP annual report). Sandy reference site for Manukau Hbr & for Cornwallis (oyster programme).

| Site  | Description  | ERC Status      | Trends & Comments  |
|---|--|-----------------|--|
| Mill Bay<br>Reporting Area<br>Manukau Harbour | Sandy OZ site, outer reaches of Manukau Harbour. Rural bush catchment. Diffuse harbour influences. | Cu Pb<br>Zn PAH | 1 year of monitoring only (2010). No trends can therefore be assessed. Current contaminant status ERC-Green. |

**Sediment chemistry summary**



Annual median concentrations. Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |          |          | Total Metals (mg/kg, <500 µm) |          |          | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|----------|----------|-------------------------------|----------|----------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb       | Zn       | Cu                            | Pb       | Zn       | mg/kg                   | at 1% TOC |
| 2010                            | 7.6                     | no data                             | 7.9                                | 10.3     | 56       | 4.0                           | 10.1     | 66       | no data                 | no data   |
| Trend (absolute units per year) | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value                | no value  |
| Trend (% of median per year)    | no value                | no value                            | no value                           | no value | no value | no value                      | no value | no value | no value                | no value  |

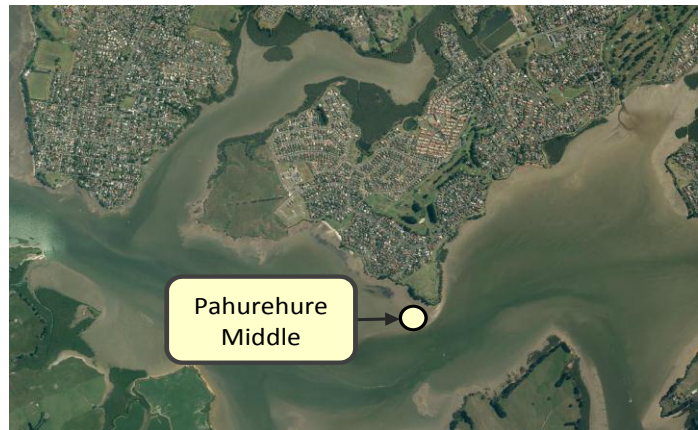
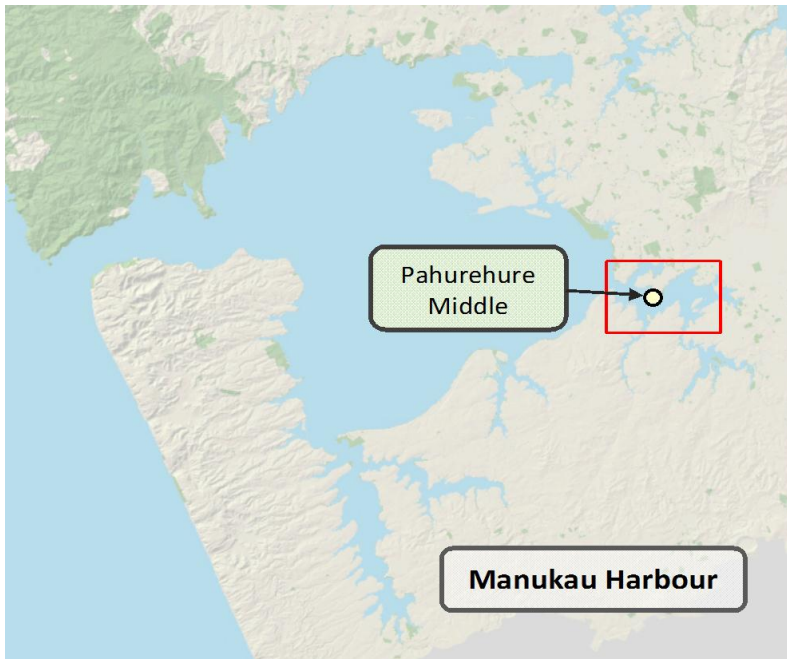
**Environmental Response Criteria (ERC)**

|                                 |   |                                |
|---------------------------------|---|--------------------------------|
| Cu <19 Pb <30 Zn <124 PAH <0.66 | Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7 | Cu >34 Pb >50 Zn >150 PAH >1.7 |
|---------------------------------|---|--------------------------------|

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fractions. Settling Zones - the <500 µm fraction

### 1.12 Pahurehure Middle

| Site              | Type     | Description & Notes  |
|-------------------|----------|--|
| Pahurehure Middle | Sandy OZ |  |
| Reporting Area    | Land Use | Site is located on the northern shore of the middle reaches of Pahurehure Inlet, Manukau Harbour. Adjacent land use is largely residential urban. Broader catchment is mixed urban/rural. Site is broad sand flat. |
| Manukau Harbour   | Urban    |  |

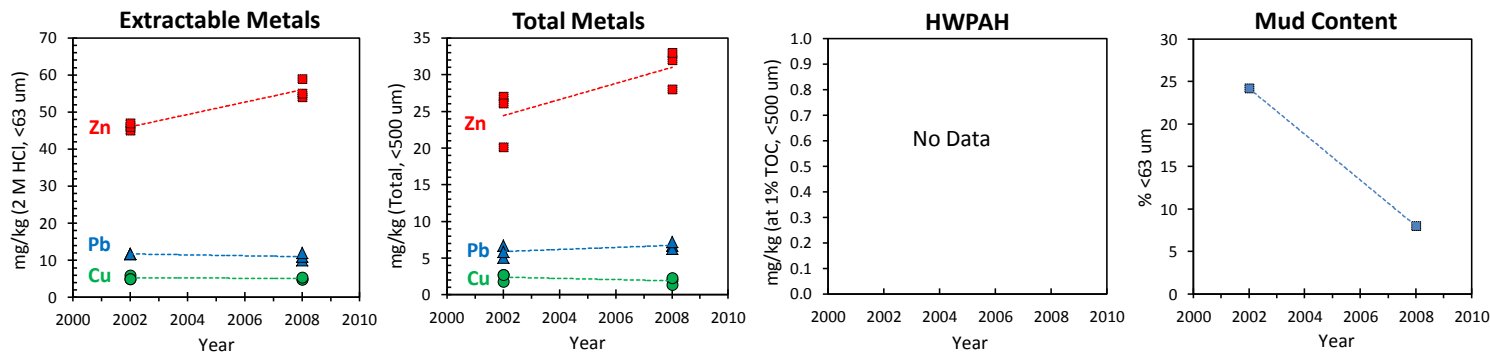


**Additional Notes**  
 Site sampled in 2002 & 2008.



| Site              | Description   | ERC Status   | Trends & Comments   |
|-------------------|---|--|---|
| Pahurehure Middle | Sandy OZ site. Large mixed land use (mostly urban) catchment. | <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002& 2008 metals' results similar. However, mud content much lower in 2008. Current contaminant status ERC-Green. |
| Reporting Area    |   |  |   |
| Manukau Harbour   |   |  |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |        |       | Total Metals (mg/kg, <500 µm) |       |       | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|-------|-------------------------------|-------|-------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn    | Cu                            | Pb    | Zn    | mg/kg                   | at 1% TOC |
| 2002                            | 24.2                    | no data                           | 5.0                                | 11.7   | 46    | 2.7                           | 5.9   | 26    | no data                 | no data   |
| 2008                            | 8.0                     | no data                           | 5.0                                | 11.0   | 55    | 2.0                           | 6.7   | 32    | no data                 | no data   |
| Median                          | 16.1                    | no data                           | 5.0                                | 11.7   | 51    | 2.2                           | 6.5   | 28    | no data                 | no data   |
| Trend (absolute units per year) | -2.7                    | no value                          | 0.0                                | -0.1   | 1.7   | -0.1                          | 0.1   | 1.1   | no value                | no value  |
| Trend (% of median per year)    | ↓ -16.7                 | no value                          | → -0.8                             | ↘ -1.0 | ↑ 3.3 | ↓ -3.9                        | ↑ 2.2 | ↑ 4.0 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

Trend Indicators

⇒ < ±1%

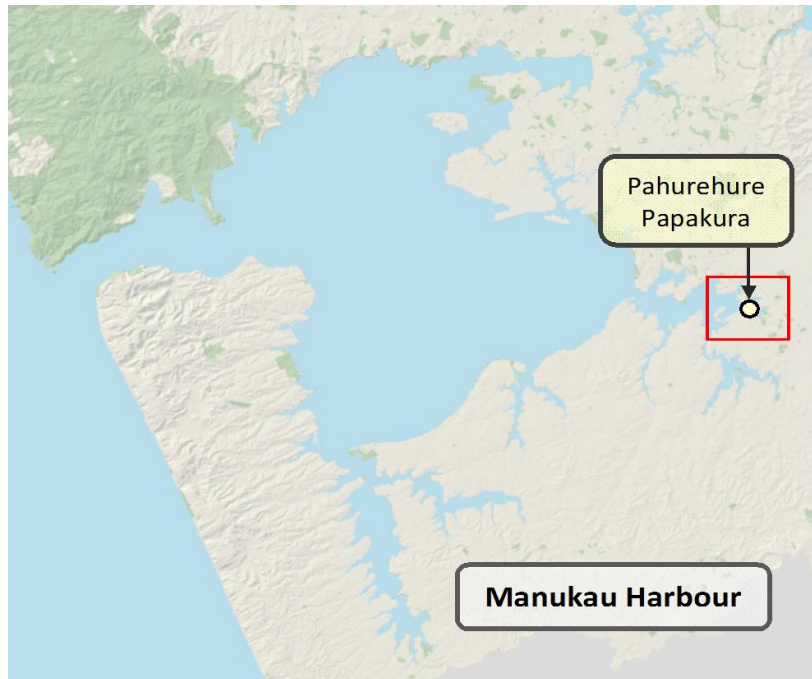
↔ ±1 - 2%

↕ > ±2%

Average annual rate of change, as % of median per year

### 1.13 Pahurehure Papakura (SoE)

| Site                | Type            | Description & Notes  |
|---------------------|-----------------|--|
| Pahurehure Papakura | Muddy SZ ("DZ") |  |
| Reporting Area      | Land Use        | Site is located in the upper reaches of the Pahurehure Inlet, Manukau Harbour. Site is approximately 200 m above SH1 motorway. Catchment land use is urban (residential & commercial). Site is shallow mud over hard basement. Active mangrove removal programme adjacent to site. |
| Manukau Harbour     | Urban           |  |

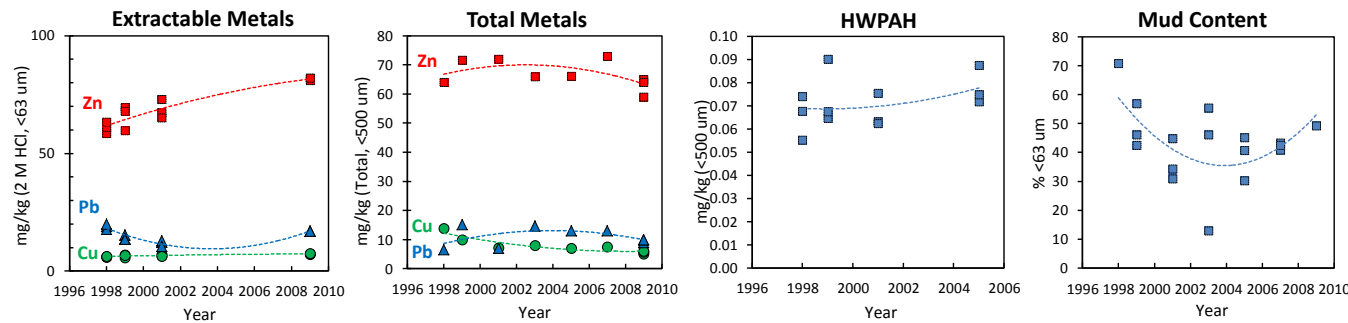


**Additional Notes**

SoE site. Designated as "Deposition Zone" (DZ) rather than a Settling Zone (SZ), as not all SZ requirements met. Treated as a SZ for status assessment.

| Site                              | Description  | ERC Status | Trends & Comments  |
|-----------------------------------|--|------------|--|
| Pahurehure Papakura (SoE)         | Muddy "DZ" site. Urban catchment. Mangrove encroachment & clearance around site. | Cu Pb      | 11 year monitoring period. Extractable metals' data for 2003-2007 considered unreliable, therefore not shown. Assess metals' trends from Total Metals. Current contaminant status - ERC Green. No major changes over time. Mud content variable. |
| Reporting Area<br>Manukau Harbour |  | Zn PAH     |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |         |         | Total Metals (mg/kg, <500 µm) |       |        | HWPAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|---------|---------|-------------------------------|-------|--------|------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb      | Zn      | Cu                            | Pb    | Zn     | mg/kg                  | at 1% TOC |
| 1998                            | 70.9                    | no data                           | 6.2                                | 19.0    | 61      | 13.8                          | 6.5   | 64     | 0.068                  | no data   |
| 1999                            | 46.1                    | no data                           | 6.7                                | 13.7    | 68      | 10.0                          | 15.2  | 72     | 0.068                  | no data   |
| 2001                            | 34.4                    | no data                           | 6.6                                | 12.3    | 67      | 7.3                           | 7.1   | 72     | 0.063                  | no data   |
| 2003                            | 46.1                    | 1.04                              | no data                            | no data | no data | 8.0                           | 14.6  | 66     | no data                | no data   |
| 2005                            | 40.7                    | 1.06                              | no data                            | no data | no data | 7.0                           | 13.0  | 66     | 0.075                  | 0.071     |
| 2007                            | 42.5                    | 1.10                              | no data                            | no data | no data | 7.6                           | 13.0  | 73     | no data                | no data   |
| 2009                            | 49.2                    | no data                           | 7.3                                | 17.0    | 82      | 5.8                           | 10.0  | 64     | no data                | no data   |
| Median                          | 43.4                    | 1.06                              | 6.6                                | 16.2    | 68      | 7.3                           | 10.0  | 66     | 0.070                  | 0.071     |
| Trend (absolute units per year) | -0.9                    | 0.01                              | 0.1                                | 0.1     | 1.8     | -0.5                          | 0.0   | -0.4   | 0.001                  | no value  |
| Trend (% of median per year)    | ↘ -2.1                  | ↔ 0.9                             | ↗ 1.4                              | ↗ 0.4   | ↗ 2.6   | ↘ -7.1                        | ↔ 0.2 | ↘ -0.7 | ↗ 1.9                  | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66
Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7
Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

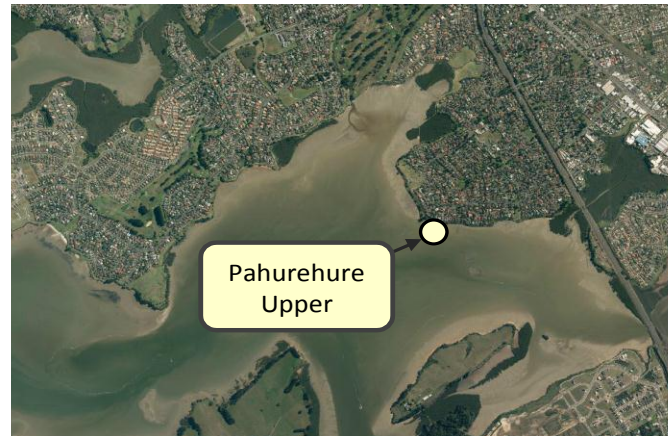
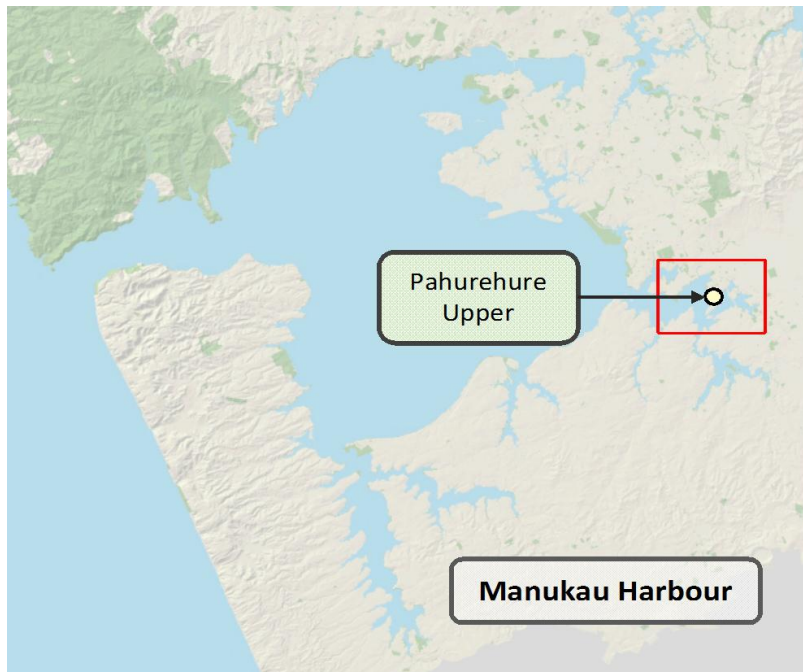
**Trend Indicators**

↔ < ±1%
↗ ↘ ±1 - 2%
↕ > ±2%

Average annual rate of change, as % of median per year

### 1.14 Pahurehure Upper

| Site             | Type         | Description & Notes   |
|------------------|--------------|---|
| Pahurehure Upper | Muddy (?) OZ |   |
| Reporting Area   | Land Use     | Site is located on the northern shore of the upper reaches of Pahurehure Inlet, Manukau Harbour. Adjacent land use is largely residential urban. Broader catchment is mixed urban/rural. Site sampled in 2008 was muddy (but in 2002 texture data indicate it was sandy). |
| Manukau Harbour  | Urban        |   |

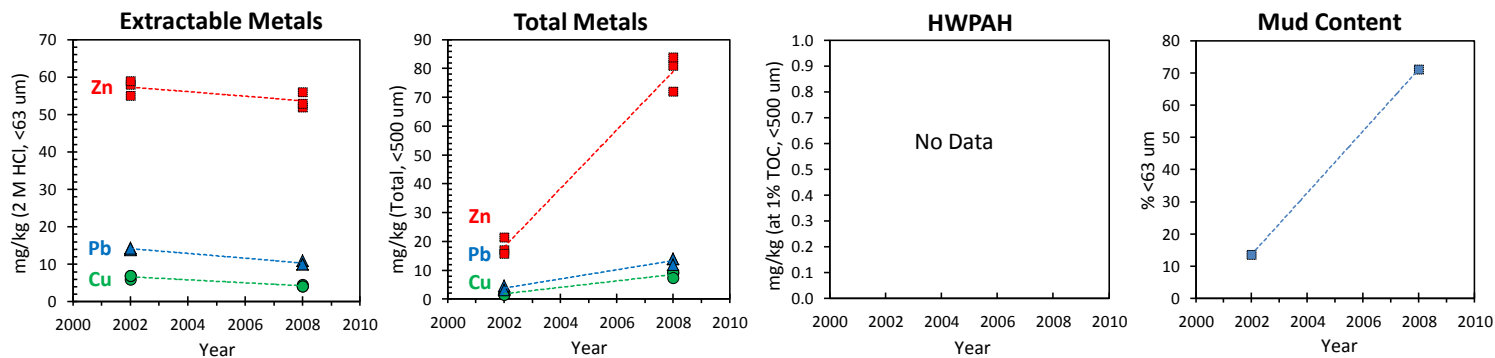


**Additional Notes**

Site sampled in 2002 & 2008. Big difference in texture results, indicating major change from sand to mud. **Requires further investigation.**

| Site             | Description   | ERC Status  | Trends & Comments  |
|------------------|---|---|--|
| Pahurehure Upper | OZ site. Large mixed land use (mostly urban) catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002& 2008 extractable metals' results similar. However, <b>mud content &amp; total metals much higher in 2008. This needs further investigation.</b> Current contaminant status ERC-Green. |
| Reporting Area   |   |   |  |
| Manukau Harbour  |   |   |  |

**Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.**



**Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).**

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |        |        | Total Metals (mg/kg, <500 µm) |        |        | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|--------|--------|-------------------------------|--------|--------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb     | Zn     | Cu                            | Pb     | Zn     | mg/kg                   | at 1% TOC |
| 2002                            | 13.6                    | no data                             | 7.0                                | 14.3   | 58     | 1.7                           | 3.6    | 17     | no data                 | no data   |
| 2008                            | 71.2                    | no data                             | 4.2                                | 10.0   | 53     | 9.0                           | 14.0   | 81     | no data                 | no data   |
| Median                          | 42.4                    | no data                             | 5.3                                | 12.5   | 56     | 4.8                           | 8.3    | 47     | no data                 | no data   |
| Trend (absolute units per year) | 9.6                     | no value                            | -0.4                               | -0.6   | -0.6   | 1.1                           | 1.6    | 10.2   | no value                | no value  |
| Trend (% of median per year)    | ↑ 22.6                  | no value                            | ↓ -7.6                             | ↓ -5.2 | ↓ -1.1 | ↑ 23.3                        | ↑ 19.1 | ↑ 21.8 | no value                | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

**Trend Indicators**

↔ < ±1%

↕ ±1 - 2%

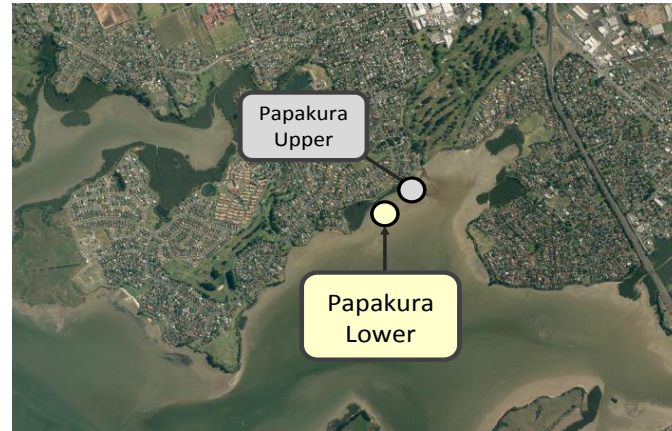
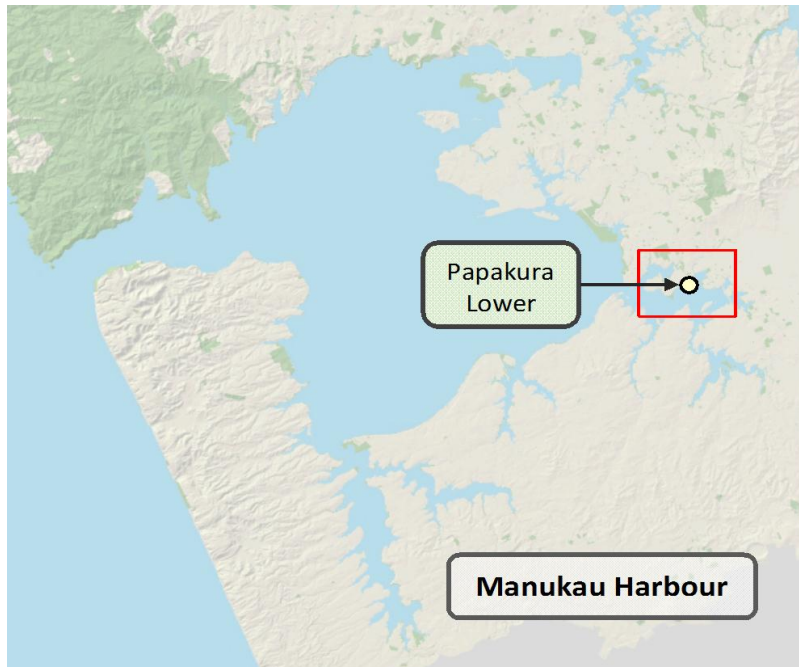
↕ > ±2%

Average annual rate of change, as % of median per year



### 1.15 Papakura Lower

| Site            | Type              | Description & Notes  |
|-----------------|-------------------|--|
| Papakura Lower  | Muddy SZ          |  |
| Reporting Area  | Land Use          | Site is located on the northern shore of Pahurehure Inlet, Manukau Harbour, approximately 400 m south west of the Papakura Stream mouth. Adjacent land use is largely residential urban, but also significant rural/greenspace. Site is muddy. |
| Manukau Harbour | Mixed urban/rural |  |



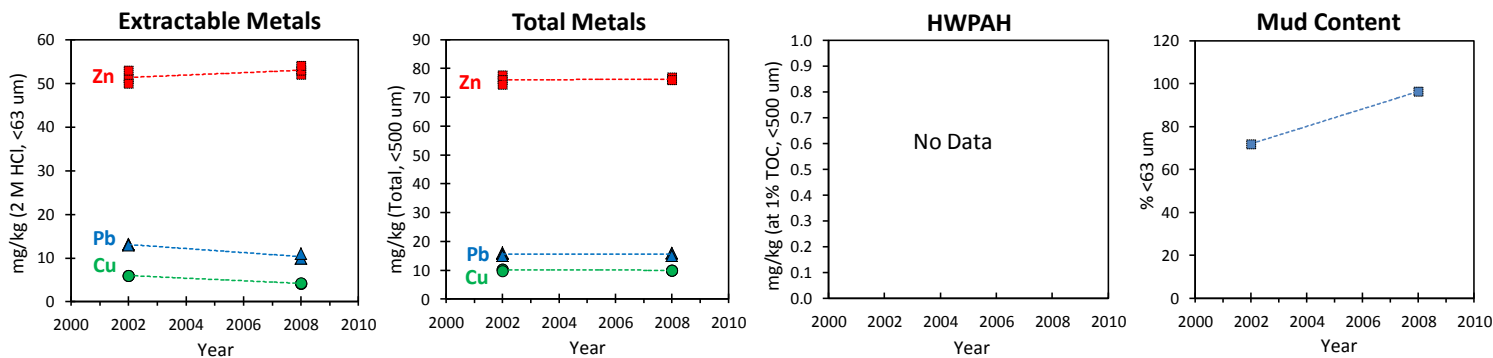
**Additional Notes**

Site sampled in 2002 & 2008.



| Site            | Description                                 | ERC Status  | Trends & Comments  |
|-----------------|---|---|--|
| Papakura Lower  | Muddy SZ site. Mixed urban/rural catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid gray; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002 & 2008 metals' results very similar. Mud content higher in 2008. Current contaminant status ERC-Green. |
| Reporting Area  |   |   |  |
| Manukau Harbour |   |   |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 μm | Organic Carbon<br>TOC (% , <500 μm) | Extractable Metals (mg/kg, <63 μm) |        |       | Total Metals (mg/kg, <500 μm) |       |       | HWPAAH (mg/kg, <500 μm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|--------|-------|-------------------------------|-------|-------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb     | Zn    | Cu                            | Pb    | Zn    | mg/kg                   | at 1% TOC |
| 2002                            | 72.0                    | no data                             | 6.0                                | 13.2   | 51    | 10.3                          | 15.8  | 76    | no data                 | no data   |
| 2008                            | 96.4                    | no data                             | 4.2                                | 10.0   | 53    | 10.0                          | 16.0  | 76    | no data                 | no data   |
| Median                          | 84.2                    | no data                             | 5.2                                | 12.0   | 53    | 10.0                          | 15.9  | 76    | no data                 | no data   |
| Trend (absolute units per year) | 4.1                     | no value                            | -0.3                               | -0.5   | 0.3   | 0.0                           | 0.0   | 0.0   | no value                | no value  |
| Trend (% of median per year)    | ↑ 4.8                   | no value                            | ↓ -5.8                             | ↓ -3.9 | → 0.5 | → -0.2                        | → 0.0 | → 0.1 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 μm and <500 μm fraction data. Settling Zones - the <500 μm fraction

Trend Indicators

⇒ < ±1%

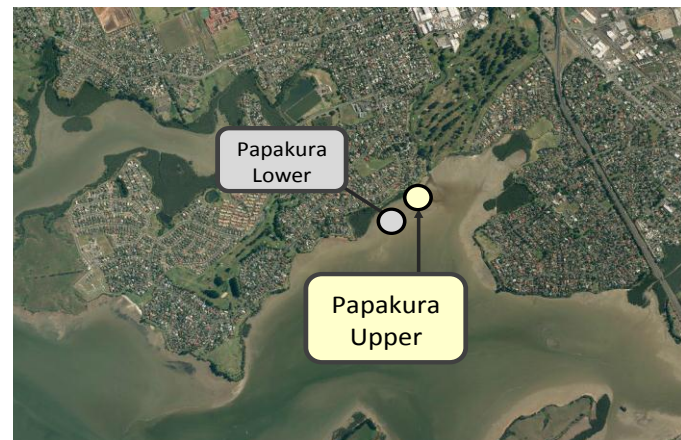
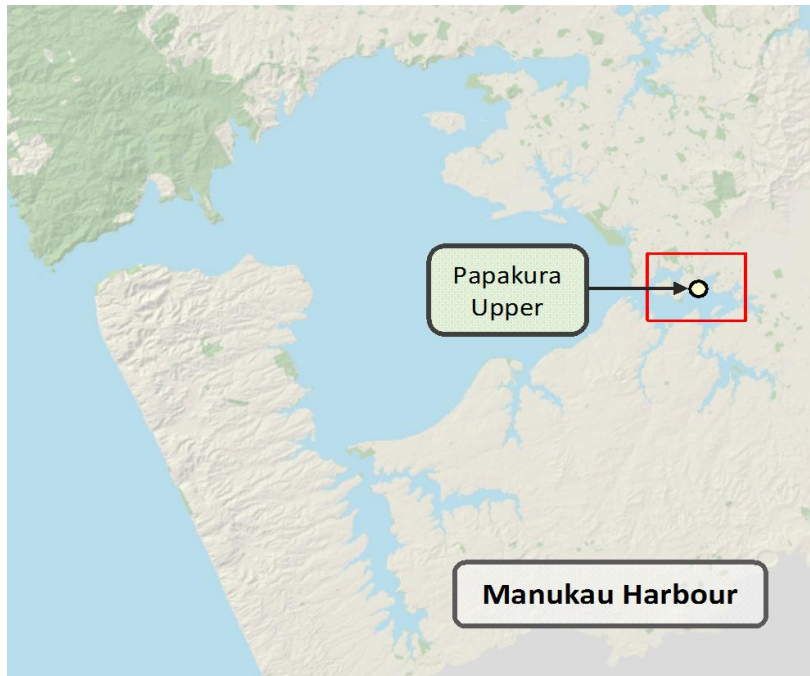
↔ ±1 - 2%

↑↓ > ±2%

Average annual rate of change, as % of median per year

### 1.16 Papakura Upper

| Site            | Type              | Description & Notes  |
|-----------------|-------------------|--|
| Papakura Upper  | Muddy SZ          |  |
| Reporting Area  | Land Use          | Site is located on the northern shore of Pahurehure Inlet, Manukau Harbour, approximately 100 m south west of the Papakura Stream mouth. Adjacent land use is largely residential urban, but also significant rural/greenspace. Site is muddy. |
| Manukau Harbour | Mixed urban/rural |  |

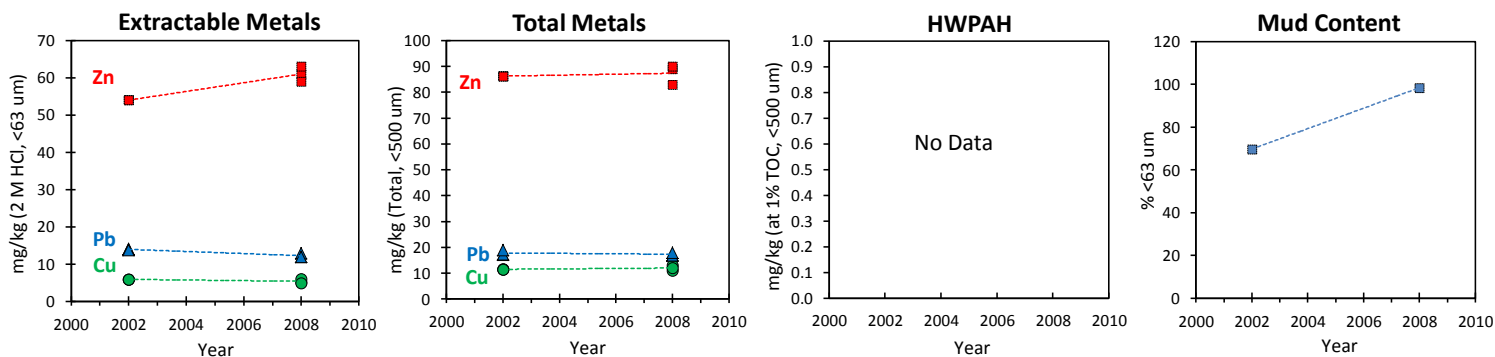


**Additional Notes**

Site sampled in 2002 & 2008.

| Site            | Description                                 | ERC Status  | Trends & Comments  |
|-----------------|---|---|--|
| Papakura Upper  | Muddy SZ site. Mixed urban/rural catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002 & 2008 metals' results very similar. Mud content higher in 2008. Current contaminant status ERC-Green. |
| Reporting Area  |   |   |  |
| Manukau Harbour |   |   |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 μm | Organic Carbon<br>TOC (% <500 μm) | Extractable Metals (mg/kg, <63 μm) |        |       | Total Metals (mg/kg, <500 μm) |        |       | HWPAAH (mg/kg, <500 μm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|-------|-------------------------------|--------|-------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn    | Cu                            | Pb     | Zn    | mg/kg                   | at 1% TOC |
| 2002                            | 69.8                    | no data                           | 6.0                                | 14.1   | 54    | 11.5                          | 17.4   | 86    | no data                 | no data   |
| 2008                            | 98.4                    | no data                           | 5.3                                | 12.0   | 61    | 12.0                          | 17.0   | 89    | no data                 | no data   |
| Median                          | 84.1                    | no data                           | 6.0                                | 13.5   | 57    | 11.6                          | 17.3   | 86    | no data                 | no data   |
| Trend (absolute units per year) | 4.8                     | no value                          | -0.1                               | -0.3   | 1.2   | 0.1                           | -0.1   | 0.2   | no value                | no value  |
| Trend (% of median per year)    | ↑ 5.7                   | no value                          | ↘ -1.5                             | ↘ -2.1 | ↑ 2.1 | → 0.7                         | → -0.5 | → 0.2 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 μm and <500 μm fraction data. Settling Zones - the <500 μm fraction

Trend Indicators

↔ < ±1%

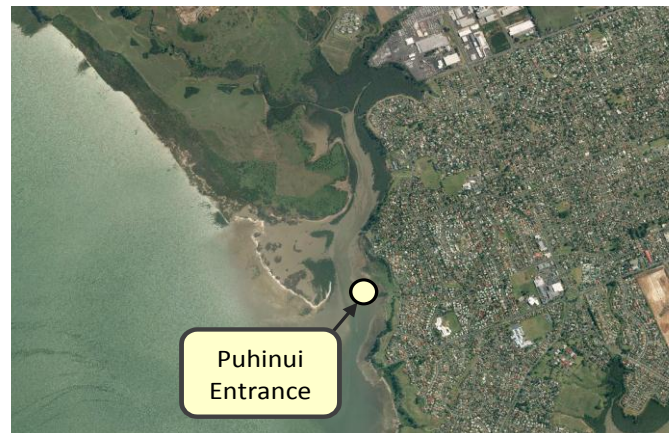
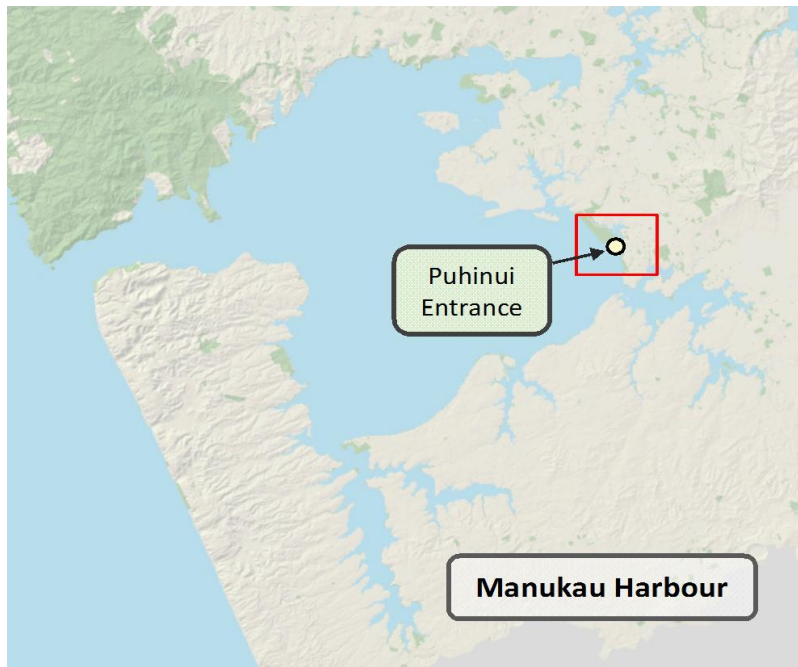
↘ ↗ ±1 - 2%

↑ ↓ > ±2%

Average annual rate of change, as % of median per year

### 1.17 Puhinui Entrance

| Site             | Type              | Description & Notes  |
|------------------|-------------------|--|
| Puhinui Entrance | Muddy SZ          |  |
| Reporting Area   | Land Use          | Site is located near the mouth of the Puhinui Stream, in the eastern shores of Manukau Harbour. Land use is mixed urban (residential & commercial) & rural. Site is muddy and heterogeneous. |
| Manukau Harbour  | Mixed urban/rural |  |

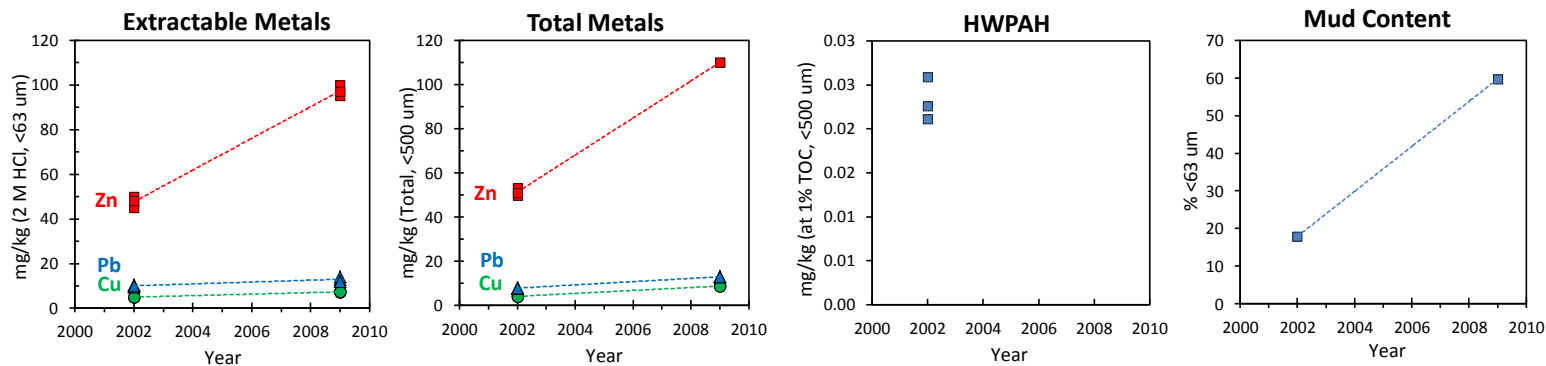


**Additional Notes**

Site sampled in 2002 & 2009.

| Site             | Description   | ERC Status   | Trends & Comments   |
|------------------|---|--|---|
| Puhinui Entrance | Muddy OZ site. Mixed urban/rural catchment. Physically unstable area, mud over rock basement. | <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002 & 2009 metals' results very different. Mud content & metals higher in 2009. Further investigation required. Current contaminant status ERC-Green. |
| Reporting Area   |   |  |   |
| Manukau Harbour  |   |  |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |       |       | Total Metals (mg/kg, <500 µm) |       |        | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|-------|-------|-------------------------------|-------|--------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb    | Zn    | Cu                            | Pb    | Zn     | mg/kg                   | at 1% TOC |
| 2002                            | 17.9                    | 0.49                                | 5.0                                | 10.1  | 48    | 4.1                           | 7.9   | 51     | 0.012                   | 0.023     |
| 2009                            | 59.7                    | no data                             | 7.3                                | 13.0  | 97    | 8.8                           | 13.0  | 110    | no data                 | no data   |
| Median                          | 38.8                    | 0.49                                | 6.1                                | 11.3  | 73    | 6.5                           | 10.6  | 82     | 0.012                   | 0.023     |
| Trend (absolute units per year) | 6.0                     | no value                            | 0.3                                | 0.4   | 7.1   | 0.7                           | 0.7   | 8.4    | no value                | no value  |
| Trend (% of median per year)    | ↑ 15.4                  | no value                            | ↑ 5.5                              | ↑ 3.7 | ↑ 9.8 | ↑ 10.3                        | ↑ 7.0 | ↑ 10.3 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

Trend Indicators

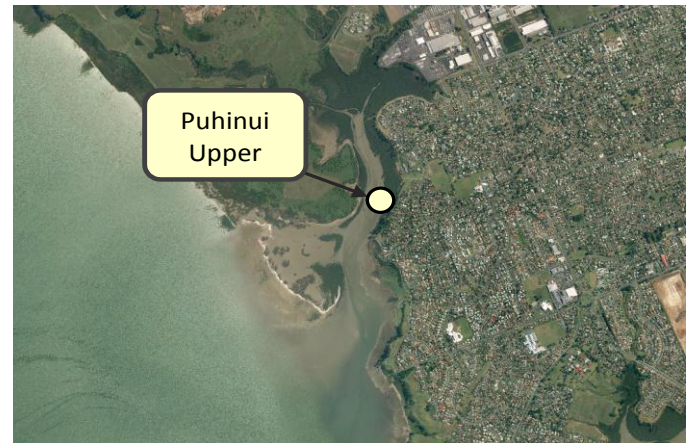
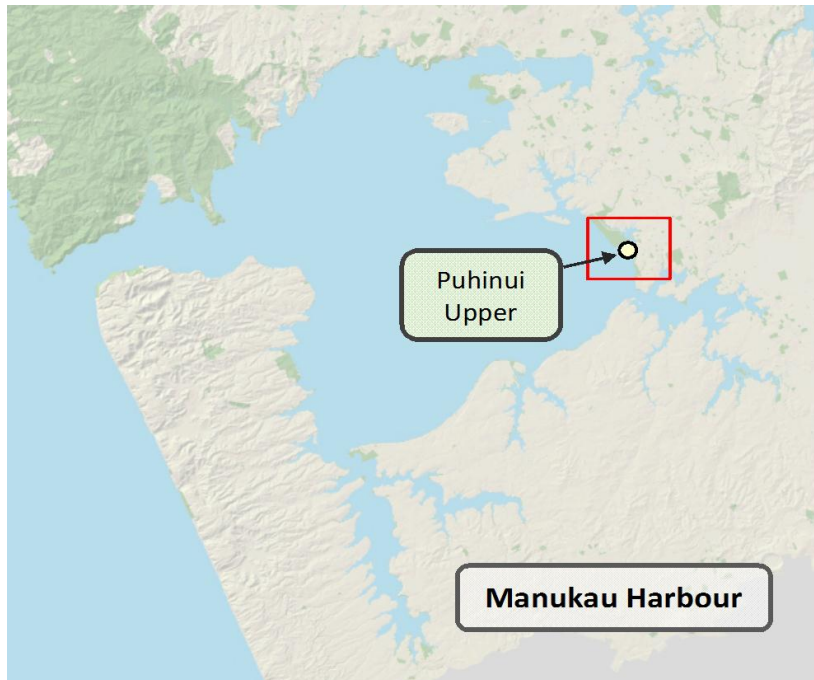
→ < ±1%   ↗ ↘ ±1 - 2%   ↑ ↓ > ±2%

Average annual rate of change, as % of median per year



### 1.18 Puhinui Upper (SoE)

| Site            | Type              | Description & Notes   |
|-----------------|-------------------|---|
| Puhinui Upper   | Muddy SZ          |   |
| Reporting Area  | Land Use          | Site is located approximately 1 km upstream of the mouth of the Puhinui Stream, in the eastern shores of Manukau Harbour. Land use is mixed urban (residential & commercial) & rural. Site is muddy and fairly heterogeneous. |
| Manukau Harbour | Mixed urban/rural |   |



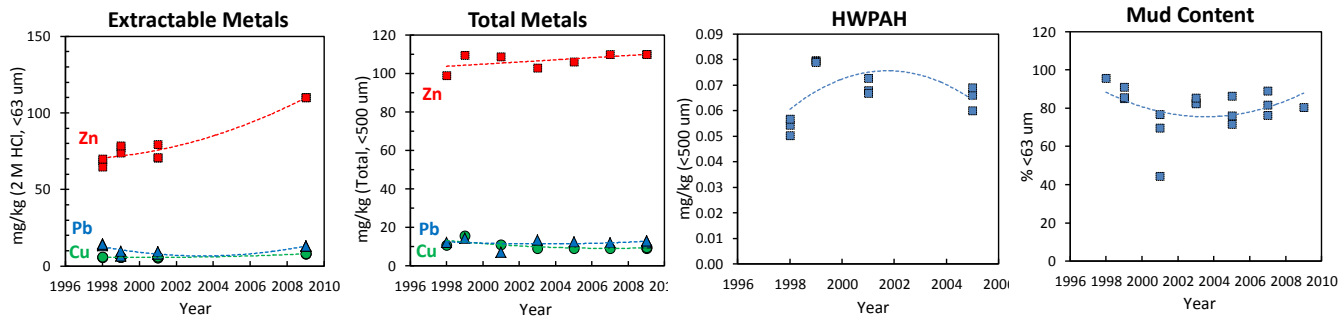
**Additional Notes**

SoE site.



| Site                | Description                     | ERC Status      | Trends & Comments  |
|---------------------|---------------------------------|-----------------|--|
| Puhinui Upper (SoE) | Muddy SZ site. Urban catchment. | Cu Pb<br>Zn PAH | 11 year monitoring period. Extractable metals' data for 2003-2007 considered unreliable, therefore not shown. Assess metals' trends from Total Metals. Current contaminant status - ERC Green. No major changes over time. Mud content analysis problem in 2001? |
| Reporting Area      |                                 |                 |  |
| Manukau Harbour     |                                 |                 |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |         |         | Total Metals (mg/kg, <500 µm) |       |       | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|---------|---------|-------------------------------|-------|-------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb      | Zn      | Cu                            | Pb    | Zn    | mg/kg                   | at 1% TOC |
| 1998                            | 95.8                    | no data                           | 5.6                                | 14.3    | 68      | 10.8                          | 12.4  | 99    | 0.054                   | no data   |
| 1999                            | 85.6                    | no data                           | 5.8                                | 8.3     | 77      | 15.7                          | 14.4  | 109   | 0.079                   | no data   |
| 2001                            | 69.7                    | no data                           | 5.5                                | 9.2     | 71      | 11.0                          | 7.2   | 109   | 0.068                   | no data   |
| 2003                            | 82.9                    | 1.10                              | no data                            | no data | no data | 9.0                           | 13.4  | 103   | no data                 | no data   |
| 2005                            | 76.1                    | 1.27                              | no data                            | no data | no data | 9.2                           | 12.5  | 106   | 0.066                   | 0.052     |
| 2007                            | 81.7                    | 1.20                              | no data                            | no data | no data | 9.2                           | 12.0  | 110   | no data                 | no data   |
| 2009                            | 80.5                    | no data                           | 8.0                                | 13.0    | 110     | 9.5                           | 13.0  | 110   | no data                 | no data   |
| Median                          | 82.5                    | 1.20                              | 5.9                                | 11.4    | 76      | 9.5                           | 12.5  | 109   | 0.067                   | 0.052     |
| Trend (absolute units per year) | -0.3                    | 0.02                              | 0.2                                | 0.2     | 3.7     | -0.3                          | 0.1   | 0.6   | 0.000                   | no value  |
| Trend (% of median per year)    | → -0.3                  | ↗ 1.9                             | ↗ 3.6                              | ↗ 1.4   | ↗ 4.9   | ↘ -3.3                        | → 0.4 | → 0.5 | → 0.4                   | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66    Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7    Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

**Trend Indicators**

→ < ±1%    ↗ ↘ ±1 - 2%    ↕ > ±2%

Average annual rate of change, as % of median per year

### 1.19 Pukaki at Airport (SoE)

| Site              | Type              | Description & Notes  |
|-------------------|-------------------|--|
| Pukaki at Airport | Muddy SZ          |  |
| Reporting Area    | Land Use          | Site is located in the lower reaches of the Pukaki Creek estuary, Manukau Harbour. Adjacent land use is mixed rural/urban (commercial), including Auckland Airport. Site is muddy. |
| Manukau Harbour   | Mixed urban/rural |  |

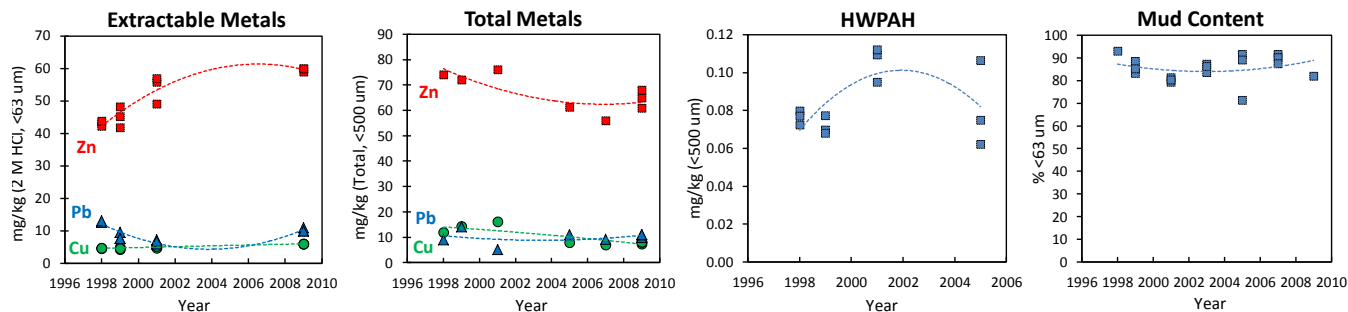


**Additional Notes**

SoE site.

| Site                    | Description                     | ERC Status  | Trends & Comments  |
|-------------------------|---------------------------------|---|--|
| Pukaki at Airport (SoE) | Muddy SZ site. Urban catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">PAH</div> </div> | 11 year monitoring period. Extractable metals' data for 2003-2007 considered unreliable, therefore not shown. Assess metals' trends from Total Metals. Current contaminant status - ERC Green. No major changes over time. Extractable metals' analysis problem in 2005? |
| Reporting Area          |                                 |   |  |
| Manukau Harbour         |                                 |   |  |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |         |         | Total Metals (mg/kg, <500 µm) |         |         | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|---------|---------|-------------------------------|---------|---------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb      | Zn      | Cu                            | Pb      | Zn      | mg/kg                   | at 1% TOC |
| 1998                            | 93.1                    | no data                           | 4.7                                | 12.7    | 43      | 11.9                          | 9.0     | 74      | 0.077                   | no data   |
| 1999                            | 85.3                    | no data                           | 4.5                                | 7.7     | 45      | 14.3                          | 14.2    | 72      | 0.070                   | no data   |
| 2001                            | 80.4                    | no data                           | 5.2                                | 6.7     | 56      | 16.2                          | 5.2     | 76      | 0.109                   | no data   |
| 2003                            | 86.3                    | 1.13                              | no data                            | no data | no data | no data                       | no data | no data | no data                 | no data   |
| 2005                            | 89.1                    | 1.32                              | no data                            | no data | no data | 7.9                           | 11.1    | 61      | 0.075                   | 0.055     |
| 2007                            | 90.2                    | 1.00                              | no data                            | no data | no data | 7.1                           | 9.3     | 56      | no data                 | no data   |
| 2009                            | 82.0                    | no data                           | 6.0                                | 10.0    | 60      | 8.1                           | 11.0    | 65      | no data                 | no data   |
| Median                          | 86.3                    | 1.13                              | 4.9                                | 9.8     | 49      | 8.2                           | 10.5    | 67      | 0.077                   | 0.055     |
| Trend (absolute units per year) | 0.1                     | -0.03                             | 0.1                                | 0.0     | 1.4     | -0.6                          | 0.0     | -1.1    | 0.001                   | no value  |
| Trend (% of median per year)    | → 0.1                   | ↓ -2.5                            | ↑ 2.6                              | → -0.1  | ↑ 2.9   | ↓ -7.6                        | → 0.5   | ↘ -1.6  | ↗ 1.6                   | no value  |

**Environmental Response Criteria (ERC)**

Cu <19 Pb <30 Zn <124 PAH <0.66
Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7
Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

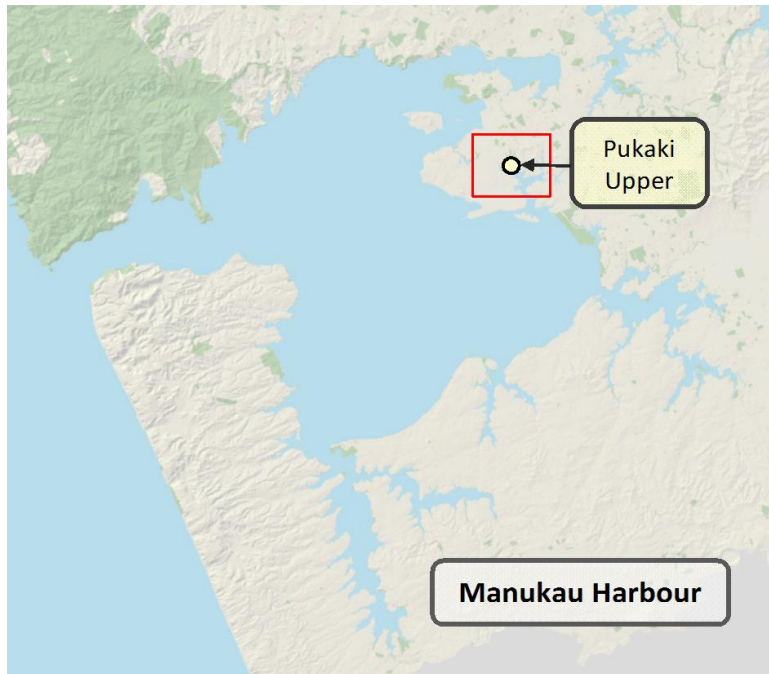
**Trend Indicators**

↔ < ±1%
↔ ±1 - 2%
↕ > ±2%

Average annual rate of change, as % of median per year

## 1.20 Pukaki Upper

| Site            | Type              | Description & Notes   |
|-----------------|-------------------|---|
| Pukaki Upper    | Muddy SZ          |   |
| Reporting Area  | Land Use          | Site is located in the upper reaches of the Pukaki Creek estuary, Manukau Harbour. Adjacent land use is mixed rural/urban. Site is muddy. |
| Manukau Harbour | Mixed urban/rural |   |

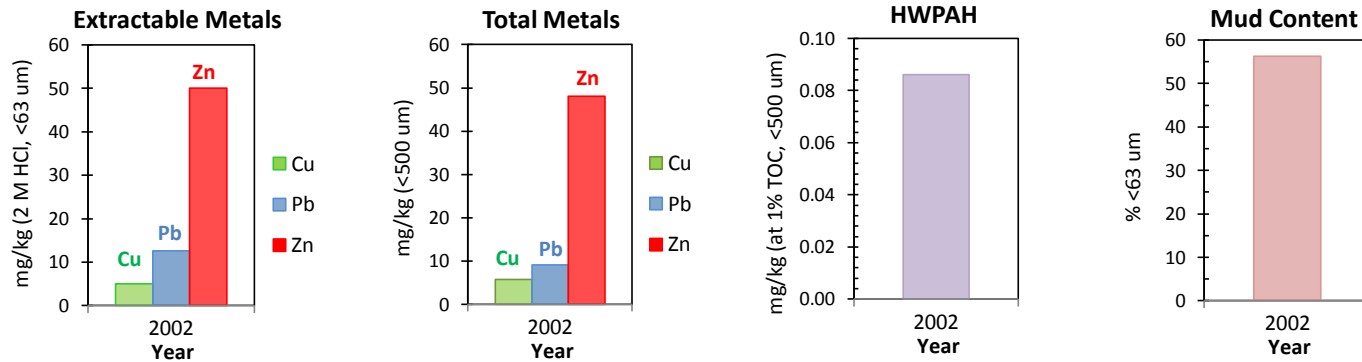


**Additional Notes**

Site sampled only in 2002.

| Site   | Description   | ERC Status                 | Trends & Comments  |
|--|---|----------------------------|--|
| <p>Pukaki Upper</p> <p>Reporting Area</p> <p>Manukau Harbour</p> | Muddy SZ site, in upper reaches of Pukaki Creek estuary. Mixed urban/rural catchment. | <p>Cu Pb</p> <p>Zn PAH</p> | 1 year of monitoring only (2002). No trends can therefore be assessed. Current contaminant status ERC-Green. |

### Sediment chemistry summary



### Annual median concentrations. Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |          |          | Total Metals (mg/kg, <500 µm) |          |          | HWPAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|----------|----------|-------------------------------|----------|----------|------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb       | Zn       | Cu                            | Pb       | Zn       | mg/kg                  | at 1% TOC |
| 2002                            | 56.2                    | 0.75                              | 5.0                                | 12.6     | 50       | 5.7                           | 9.1      | 48       | 0.073                  | 0.086     |
| Trend (absolute units per year) | no value                | no value                          | no value                           | no value | no value | no value                      | no value | no value | no value               | no value  |
| Trend (% of median per year)    | no value                | no value                          | no value                           | no value | no value | no value                      | no value | no value | no value               | no value  |

### Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

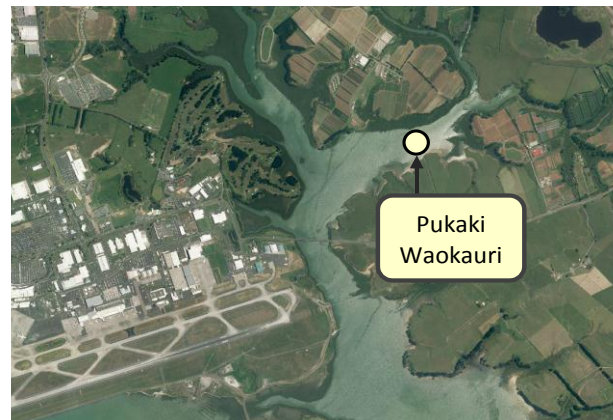
ERC: For Outer Zones - the greater of the <63 µm and <500 µm fractions. Settling Zones - the <500 µm fraction



### 1.21 Pukaki, Waokauri Creek

| Site            | Type              | Description & Notes |
|-----------------|-------------------|---------------------|
| Pukaki Waokauri | Muddy SZ          |                     |
| Reporting Area  | Land Use          |                     |
| Manukau Harbour | Mixed urban/rural |                     |

Site is located in the middle reaches of the Waokauri Creek estuary, Manukau Harbour. Adjacent land use is mixed rural/urban. Site is muddy.



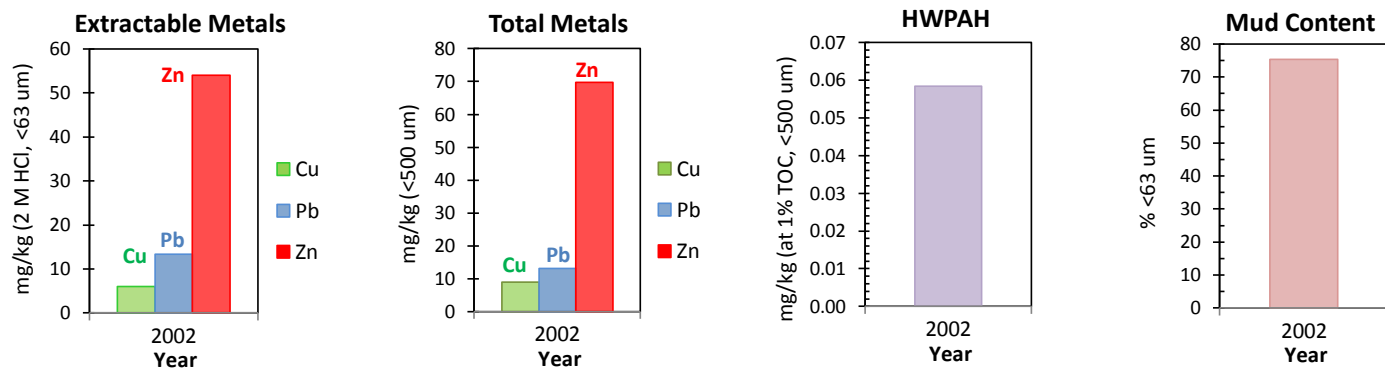
#### Additional Notes

Site sampled only in 2002.



| Site  | Description   | ERC Status   | Trends & Comments  |
|---|---|--|--|
| Pukaki, Waokauri Creek<br>Reporting Area<br>Manukau Harbour | Muddy SZ site, in mid-reaches of Waokauri Creek arm of Pukaki Estuary. Mixed urban/rural catchment. | <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 5px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 5px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 5px; margin: 2px;">PAH</div> </div> | 1 year of monitoring only (2002). No trends can therefore be assessed. Current contaminant status ERC-Green. |

### Sediment chemistry summary



### Annual median concentrations. Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |          |          | Total Metals (mg/kg, <500 µm) |          |          | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|----------|----------|-------------------------------|----------|----------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb       | Zn       | Cu                            | Pb       | Zn       | mg/kg                   | at 1% TOC |
| 2002                            | 75.4                    | 1.20                              | 6.0                                | 13.3     | 54       | 8.9                           | 13.1     | 70       | 0.070                   | 0.058     |
| Trend (absolute units per year) | no value                | no value                          | no value                           | no value | no value | no value                      | no value | no value | no value                | no value  |
| Trend (% of median per year)    | no value                | no value                          | no value                           | no value | no value | no value                      | no value | no value | no value                | no value  |

### Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

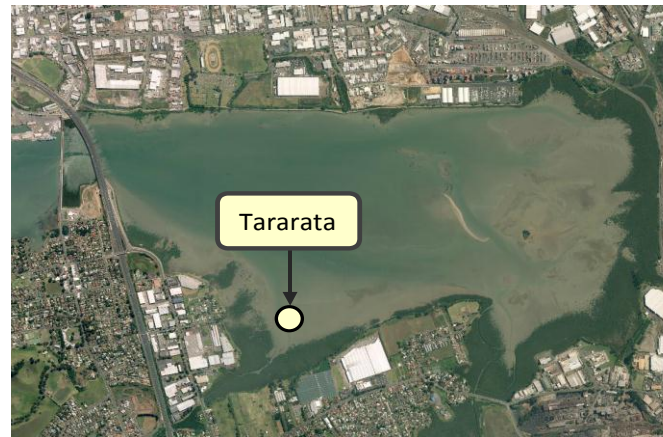
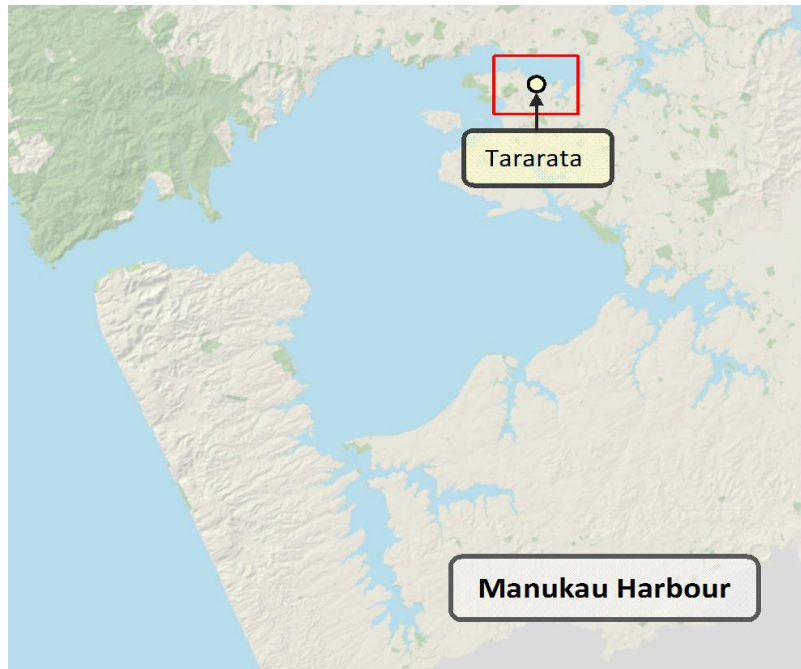
Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fractions. Settling Zones - the <500 µm fraction

## 1.22 Tararata Creek, Mangere Inlet

| Site            | Type     | Description & Notes  |
|-----------------|----------|--|
| Tararata        | Muddy SZ |  |
| Reporting Area  | Land Use | Site is located in Mangere Inlet, near the confluence with Tararata Creek. Adjacent land use is mature urban including commercial/industrial. Site is muddy. |
| Manukau Harbour | Urban    |  |

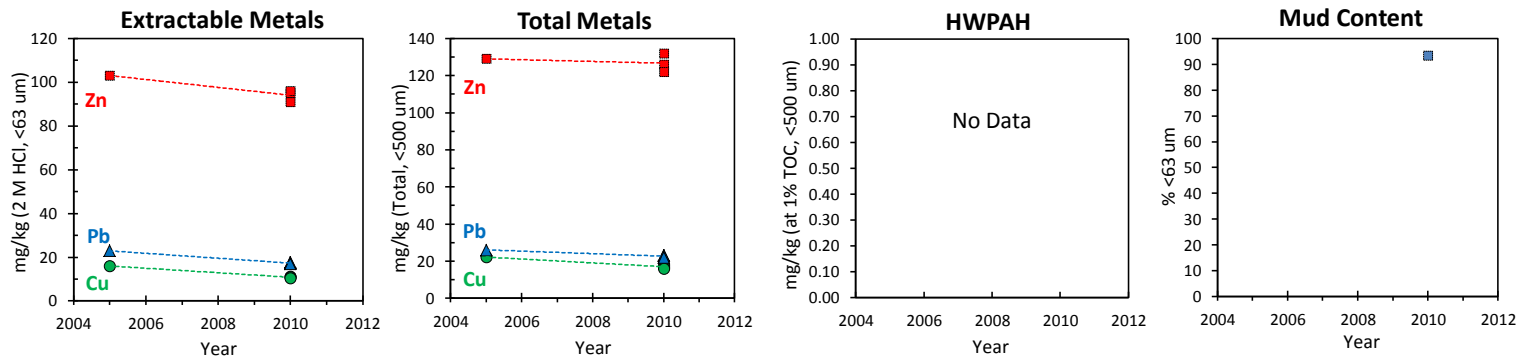


**Additional Notes**

Sampled in 2005 and 2010.

| Site            | Description                     | ERC Status | Trends & Comments   |
|-----------------|---------------------------------|------------|---|
| Tararata        | Muddy SZ site. Urban catchment. | Cu         | 2 years of monitoring only. No trends can therefore be assessed. 2005 & 2010 metals' results similar. Current contaminant status ERC-Amber. Note 2005 data are from a single composite sample only. |
| Reporting Area  |                                 | Pb         |   |
| Manukau Harbour |                                 | Zn         |   |
|                 |                                 | PAH        |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% <500 µm) | Extractable Metals (mg/kg, <63 µm) |        |        | Total Metals (mg/kg, <500 µm) |        |        | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|--------|-------------------------------|--------|--------|-------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn     | Cu                            | Pb     | Zn     | mg/kg                   | at 1% TOC |
| 2005                            | no data                 | no data                           | 16.0                               | 22.9   | 103    | 22.2                          | 26.1   | 129    | no data                 | no data   |
| 2010                            | 93.4                    | no data                           | 11.0                               | 17.4   | 95     | 17.0                          | 23.0   | 126    | no data                 | no data   |
| Median                          | 93.4                    | no data                           | 11.1                               | 17.5   | 96     | 17.5                          | 23.0   | 128    | no data                 | no data   |
| Trend (absolute units per year) | no value                | no value                          | -1.0                               | -1.1   | -1.8   | -1.0                          | -0.7   | -0.5   | no value                | no value  |
| Trend (% of median per year)    | no value                | no value                          | ↓ -9.4                             | ↓ -6.4 | ↓ -1.9 | ↓ -5.9                        | ↓ -3.0 | → -0.4 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

Trend Indicators

⇒ < ±1%

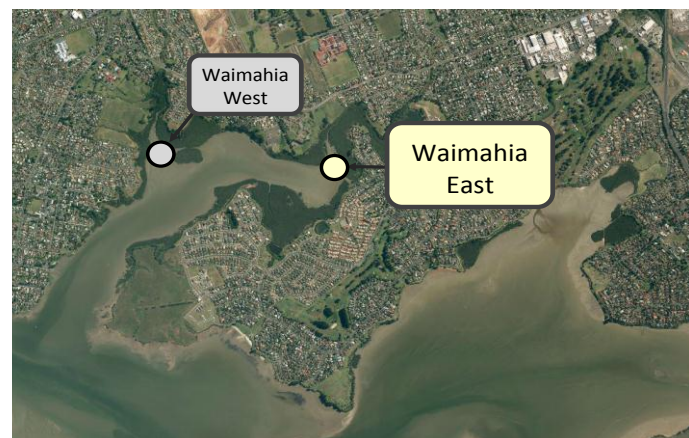
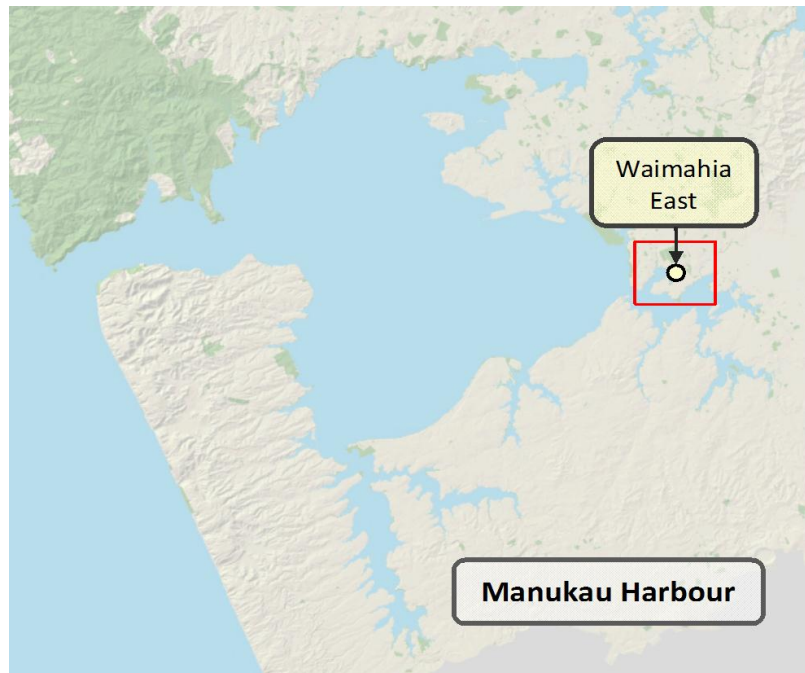
↔ ±1 - 2%

↕ > ±2%

Average annual rate of change, as % of median per year

### 1.23 Waimahia East

| Site            | Type     | Description & Notes  |
|-----------------|----------|--|
| Waimahia East   | Muddy SZ |  |
| Reporting Area  | Land Use | Site is located in the upper eastern reaches of Waimahia Creek estuary, Manukau Harbour. Adjacent land use is urban (residential). Site is muddy. Extensive mangroves adjacent to site, with clearance work evident in 2008. |
| Manukau Harbour | Urban    |  |

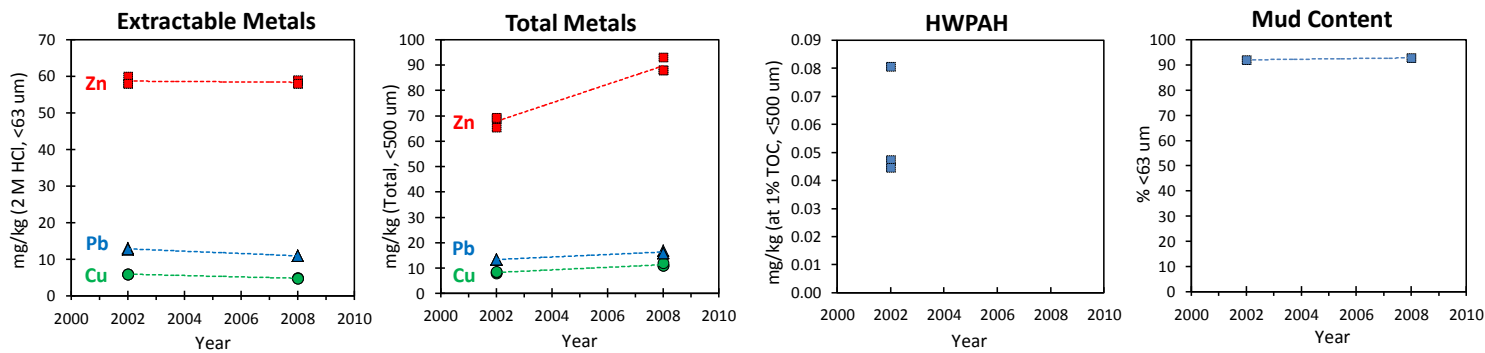


**Additional Notes**

Sampled in 2002 and 2008. Waimahia sites were called "Weymouth" in 2002 sampling report (KML 2003).

| Site            | Description                     | ERC Status  | Trends & Comments   |
|-----------------|---------------------------------|---|---|
| Waimahia East   | Muddy SZ site. Urban catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002 & 2008 extractable metals' results similar. Total metals higher in 2008 (reason unknown). Current contaminant status ERC-Green. |
| Reporting Area  |                                 |   |   |
| Manukau Harbour |                                 |   |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

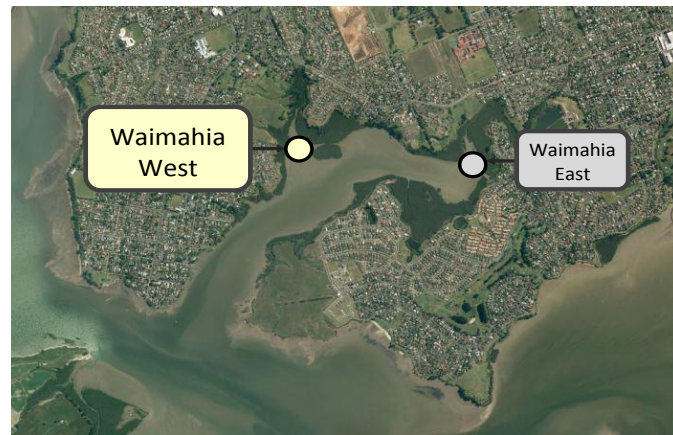
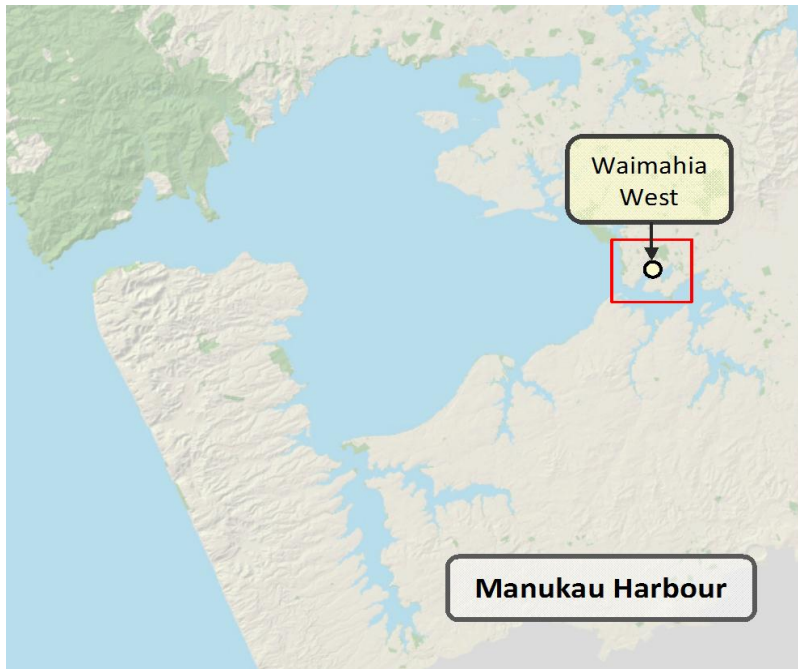
| Year                            | Mud Content<br>% <63 μm | Organic Carbon<br>TOC (% <500 μm) | Extractable Metals (mg/kg, <63 μm) |        |        | Total Metals (mg/kg, <500 μm) |       |       | HWPAH (mg/kg, <500 μm) |           |
|---------------------------------|-------------------------|-----------------------------------|------------------------------------|--------|--------|-------------------------------|-------|-------|------------------------|-----------|
|                                 |                         |                                   | Cu                                 | Pb     | Zn     | Cu                            | Pb    | Zn    | mg/kg                  | at 1% TOC |
| 2002                            | 92.0                    | 1.33                              | 6.0                                | 12.8   | 58     | 8.4                           | 13.5  | 69    | 0.063                  | 0.047     |
| 2008                            | 92.8                    | no data                           | 4.8                                | 11.0   | 58     | 11.0                          | 16.0  | 88    | no data                | no data   |
| Median                          | 92.4                    | 1.33                              | 5.5                                | 11.9   | 58     | 9.8                           | 14.8  | 79    | 0.063                  | 0.047     |
| Trend (absolute units per year) | 0.1                     | no value                          | -0.2                               | -0.3   | -0.1   | 0.5                           | 0.5   | 3.6   | no value               | no value  |
| Trend (% of median per year)    | → 0.1                   | no value                          | ↓ -3.4                             | ↓ -2.7 | → -0.1 | ↑ 5.2                         | ↑ 3.3 | ↑ 4.6 | no value               | no value  |

| Environmental Response Criteria (ERC)  | Trend Indicators  |
|--|---|
| <div style="border: 1px solid green; padding: 2px; display: inline-block;">Cu &lt;19 Pb &lt;30 Zn &lt;124 PAH &lt;0.66</div> <div style="border: 1px solid orange; padding: 2px; display: inline-block; margin-left: 10px;">Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7</div> <div style="border: 1px solid red; padding: 2px; display: inline-block; margin-left: 10px;">Cu &gt;34 Pb &gt;50 Zn &gt;150 PAH &gt;1.7</div> | <div style="border: 1px solid gray; padding: 2px; display: inline-block;">↔ &lt; ±1%</div> <div style="border: 1px solid gray; padding: 2px; display: inline-block; margin-left: 10px;">↔ ±1 - 2%</div> <div style="border: 1px solid gray; padding: 2px; display: inline-block; margin-left: 10px;">↕ &gt; ±2%</div> |
| ERC: For Outer Zones - the greater of the <63 μm and <500 μm fraction data. Settling Zones - the <500 μm fraction  | Average annual rate of change, as % of median per year  |



### 1.24 Waimahia West

| Site            | Type     | Description & Notes  |
|-----------------|----------|--|
| Waimahia West   | Muddy SZ |  |
| Reporting Area  | Land Use | Site is located in the lower reaches of the small western arm of Waimahia Creek estuary, Manukau Harbour. Adjacent land use is urban (residential). Site is muddy. Extensive mangroves adjacent to site. |
| Manukau Harbour | Urban    |  |



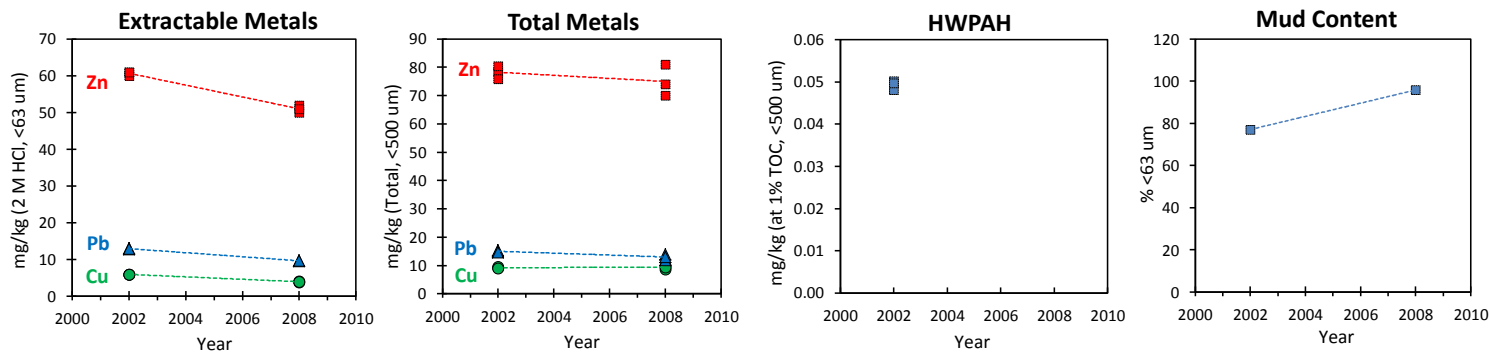
**Additional Notes**

Sampled in 2002 and 2008. Waimahia sites were called "Weymouth" in 2002 sampling report (KML 2003).



| Site            | Description                     | ERC Status  | Trends & Comments   |
|-----------------|---------------------------------|---|---|
| Waimahia West   | Muddy SZ site. Urban catchment. | <div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">PAH</div> </div> | 2 years of monitoring only. No trends can therefore be assessed. 2002 & 2008 metals' results similar. Current contaminant status ERC-Green. |
| Reporting Area  |                                 |   |   |
| Manukau Harbour |                                 |   |   |

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

| Year                            | Mud Content<br>% <63 µm | Organic Carbon<br>TOC (% , <500 µm) | Extractable Metals (mg/kg, <63 µm) |        |        | Total Metals (mg/kg, <500 µm) |        |        | HWPAAH (mg/kg, <500 µm) |           |
|---------------------------------|-------------------------|-------------------------------------|------------------------------------|--------|--------|-------------------------------|--------|--------|-------------------------|-----------|
|                                 |                         |                                     | Cu                                 | Pb     | Zn     | Cu                            | Pb     | Zn     | mg/kg                   | at 1% TOC |
| 2002                            | 77.1                    | 1.27                                | 6.0                                | 13.0   | 61     | 9.2                           | 15.0   | 78     | 0.063                   | 0.050     |
| 2008                            | 95.9                    | no data                             | 4.0                                | 9.7    | 51     | 9.3                           | 13.0   | 74     | no data                 | no data   |
| Median                          | 86.5                    | 1.27                                | 5.1                                | 11.4   | 56     | 9.3                           | 14.3   | 77     | 0.063                   | 0.050     |
| Trend (absolute units per year) | 3.1                     | no value                            | -0.3                               | -0.6   | -1.6   | 0.0                           | -0.3   | -0.5   | no value                | no value  |
| Trend (% of median per year)    | ↑ 3.6                   | no value                            | ↓ -6.6                             | ↓ -4.8 | ↓ -2.9 | → 0.1                         | ↓ -2.4 | → -0.7 | no value                | no value  |

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66

Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7

Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction

Trend Indicators

↔ < ±1%

↕ ±1 - 2%

↕ > ±2%

Average annual rate of change, as % of median per year