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Committee Regulatory
Author Juliet Milne, Team Leader – Environmental Science

Key findings from the Wellington Harbour marine sediment quality investigation

1. Purpose

To report the key findings of a marine sediment quality investigation undertaken in Wellington Harbour during 2006/07.

2. Background

Wellington Harbour (Te Whanga nui a Tara) is regionally significant, offering a multitude of landscape, ecological, cultural, geological and recreational values. However, like other coastal environments surrounded by densely populated areas, the harbour receives significant stormwater inputs with the potential to adversely impact on the health of its ecosystems.

The most significant medium to long-term impact of urban stormwater discharges on the Wellington Harbour environment is likely to be the accumulation of stormwater-related contaminants in the sediments. This is because the contaminants can, over time, build up to concentrations that are toxic to sediment-dwelling organisms. Sediment-dwelling organisms are a major component of harbour and coastal ecosystems; they provide food for fish and other organisms, affect nutrient cycling and contribute significantly to marine productivity.

The Wellington Harbour marine sediment quality investigation was partially funded by Wellington City Council and Hutt City Council and follows earlier assessments of sediment quality in the Porirua Harbour (see reports 05.42 and 06.313). The investigation links in with Greater Wellington's study of chemical contaminants in stormwater systems and the effects of urban stormwater discharges on aquatic receiving environments in the Wellington region.

2.1 Aims of the investigation

1. To make an assessment of the Wellington Harbour receiving environment in terms of sediment quality and benthic community health that will provide a sound scientific basis for any management response in relation to urban stormwater discharges; and
2. To select the monitoring sites that might be used to detect changes in sediment quality and benthic community health over time, thereby allowing the ongoing evaluation of urban stormwater management actions directed at maintaining or enhancing the Wellington Harbour receiving environment.

3. Sampling sites and methodology

Samples of surface sediment (top 30 mm) were collected in late 2006 at 17 sub-tidal sites (Figure 1) and tested for:

- Particle size distribution and total organic carbon;
- Heavy metals;
- Polycyclic aromatic hydrocarbons (PAHs);
- Organochlorine pesticides (e.g., DDT); and
- Organotin (marine antifouling) compounds.

Samples of benthic fauna were also collected adjacent to each sampling site. The fauna in these samples were identified and counted, with measurements made of the shell lengths of selected key species (e.g., bivalve molluscs).

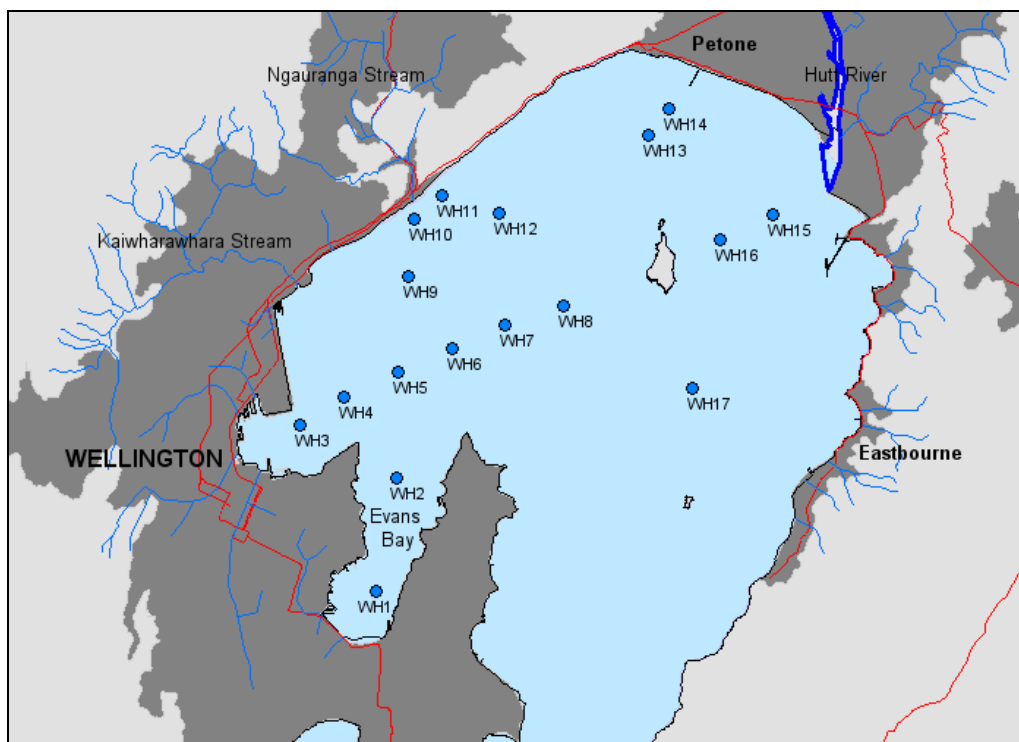


Figure 1: Map of Wellington Harbour showing the 17 sampling locations.

The spread of the 17 sampling sites and the range of contaminants tested make this investigation the most comprehensive assessment of surface sediment quality in the harbour since that undertaken by Stoffers *et al.* (1986)¹. The sites were chosen to look at *far-field* effects of stormwater discharges rather than effects in areas close to the discharge points, reflecting Greater Wellington’s focus on the health of the wider harbour environment.

4. Results and discussion

4.1 Sediment quality

Both the ANZECC (2000) Interim Sediment Quality Guidelines (ISQG) and the Auckland Regional Council’s Environmental Response Criteria (ARC ERC 2004) were used to assess the sediment chemistry results. They are not “pass or fail” numbers; they are set at the concentrations which experimental and/or field evidence suggests are likely to result in impacts on aquatic life.

Concentrations of lead, mercury, and to a lesser extent copper and zinc, are present above sediment quality guidelines in the subtidal sediments of various parts of Wellington Harbour, especially those adjacent to Wellington City. Tributyltin (TBT) is only present above sediment quality guidelines at the entrance to the Lambton Basin and off Ngauranga, but its less toxic breakdown product dibutyltin is widespread. High molecular weight PAH compounds are above sediment quality guidelines in Evans Bay, and at the entrance to the Lambton Basin (Figure 2).

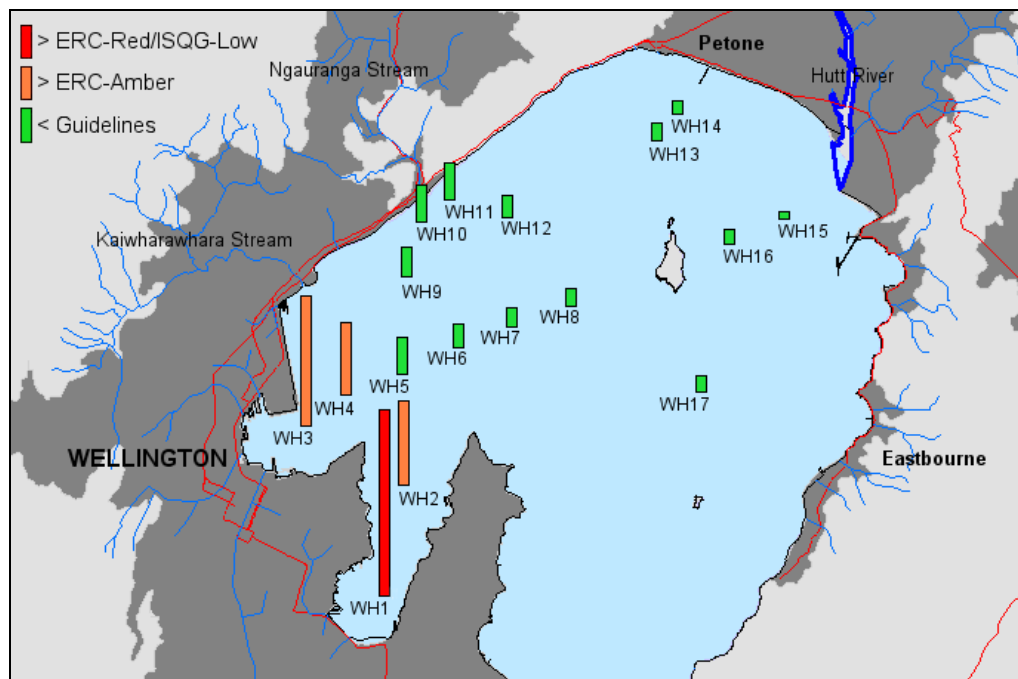


Figure 2: Mean concentrations of Total High Molecular Weight PAHs in sediments of 17 sites sampled in Wellington Harbour in 2006, based on the <500 micron fraction of five composite samples from each site.

¹ Stoffers, P.; Glasby, G.P.; Wilson, C.J.; Davis, K.R.; Walter, P. 1986. Heavy metal pollution in Wellington Harbour. *New Zealand Journal of Marine and Freshwater Research* 20(3): 495–512.

Of the 22 organochlorine pesticides analysed, only the insecticide DDT and its derivatives were consistently detected. Total DDT is present above sediment quality guidelines over much of the harbour, indicating that although its use in agriculture effectively ceased in the 1970s, and its use in urban areas was banned in the late 1980s, substantial sources remain in the environment.

Recent studies of urban stormwater and streams in several subcatchments draining into Wellington Harbour confirm that inputs of heavy metals, PAHs and DDT to the harbour are on-going. On-going organotin inputs are unlikely given that the use of butyltins as an antifoulant on small boats was banned in 1989 and is being phased out on large overseas commercial vessels.

4.2 Benthic ecology

A total of 101 species were found in the benthic fauna samples collected in November 2006, predominantly polychaete worms, crustaceans, bivalve molluscs and nemertean worms. The fauna present at the investigation sites can be considered as being variants of an inner harbour subtidal fine sediment community occurring in water depths >10 m. The principal species in this community were Sipunculida sp.#1, Tanaidacea sp.#1, *Theora lubrica*, *Labiosthenolepis laevis*, *Cossura consimilis*, Paraonidae sp.#1, Phoxocephalidae sp.#1, Cirratulidae sp.#1, *Arthritica* sp.#1, *Maldane theodori*, *Aglaophamus macroura* and *Amphiura rosea*. The heart urchin *Echinocardium cordatum*, the bivalve *Dosina zelandica*, the rag-worm *Onuphis aucklandensis*, the bamboo worm *Asychis trifilosa*, or a combination of these species, most often dominated the biomass.

4.3 Relationship between the benthic community and chemical variables

Analysis shows that variation in benthic community structure across the 17 sites is not strongly correlated with the concentrations of the chemical contaminants that exceed sediment quality guidelines. Therefore, there is no clear evidence of significant adverse effects on the benthic fauna at the *community level* of organisation. While the absence of obvious effects at this level is encouraging, the thresholds for such effects are still not known for this environment, indicating periodic reassessments of both sediment quality and benthic ecology will be needed. Five-yearly monitoring of a subset of the 17 investigation sites is desirable.

4.4 Synthesis

The marine sediments in Wellington Harbour have been contaminated with toxic compounds derived from the surrounding catchments. Some of these compounds, including several metals, PAHs and Total DDT, are present at concentrations above sediment quality guidelines.

The strong offshore gradients in contaminant concentrations and the chemical nature of some of the contaminants in the sediments of Wellington Harbour provide a clear indication of their land-based origin. A review of the available stormwater quality and stream monitoring data from the harbour's catchment

indicates that urban stormwater is the principal agent in the transport of the majority of these contaminants to the harbour seabed, either directly or by way of urban streams. While the stormwater discharges continue in their present form it is highly likely that the level of contaminants in the harbour sediments will increase.

An examination of the benthic fauna present at each site did not provide any clear evidence of the elevated contaminants measured in the sediments having resulted in significant adverse effects on benthic community structure as at November 2006. However, this may not be the case at some sites in the future if contaminants continue to accumulate. This may also not be the case closer to shore where available data indicate sediment contaminant concentrations are higher.

5. Management implications

The results of this investigation, the presence of higher sediment contaminant concentrations nearer to shore and the continued input of contaminants strongly indicate that stormwater discharges into Wellington Harbour have the potential to cause significant adverse effects on the benthic ecology of the harbour. This, together with the findings from other stormwater-related investigations, highlights the need for a review of Greater Wellington's permitted activity standards for stormwater discharges as recommended in the evaluation of the Regional Freshwater Plan (see report 06.86) and the Regional Coastal Plan (report in preparation). Regional rules cannot allow any discharge as a permitted activity if the discharge may cause "significant adverse effects on aquatic life". The same restriction applies to consented activities although the discharge permit can specify a timeframe for compliance. Stormwater discharges into sensitive receiving environments such as Wellington and Porirua harbours are therefore better controlled through the resource consent process.

Greater Wellington will need to continue to work with the territorial authorities and the wider public to improve stormwater management in the Wellington region. The Stormwater Action Plan is a key tool to progress this work.

6. Communications

Copies of this report and the technical report² documenting the 2006/07 Wellington Harbour sediment quality investigation will be sent to Wellington City Council, Hutt City Council, Upper Hutt City Council, Transit, and the Department of Conservation. The technical report will be available on Greater Wellington's website and a media release will be issued summarising the key findings.

² Stephenson, G.; Milne, J.R.; Sorensen, P. 2008. *Wellington Harbour marine sediment quality investigation*. Greater Wellington Regional Council, Publication No. GW/EMI-T-08/83.

7. Recommendations

It is recommended that the Committee:

1. **Receive the report; and**
2. **Note the contents.**

Report prepared by:

Report approved by:

Report approved by:

Juliet Milne
Team Leader Environmental
Science, Environmental
Monitoring & Investigations

Ted Taylor
Manager,
Environmental
Monitoring &
Investigations

Nigel Corry
Divisional Manager,
Environment Management