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Report to Environment Committee
from Gary Stephenson, Surface Water Quality Scientist

Effects of Urban Stormwater in the Wellington Region: a Synthesis of Existing Information

1. Purpose

To report on the first phase of Council's investigation into the effects of urban stormwater discharges on the Region's receiving environments.

2. Background

The current Wellington Regional Plans allow stormwater discharges as Permitted Activities. However, the rules outlined within the Plans require compliance with the conditions listed in Section 70 of the Resource Management Act 1991, namely:

> *"That none of the following effects are likely to arise in the receiving waters, after reasonable mixing, as a result of the discharge of the contaminant (either by itself or in combination with the same, similar, or other contaminants):*
> *(c) The production of conspicuous oil or grease films, scums or foams, or floatables or suspended materials:*
> *(d) Any conspicuous change in the colour or visual clarity:*
> *(e) Any emission of objectionable odour:*
> *(f) The rendering of fresh waters unsuitable for consumption by farm animals:*
> *(g) Any significant adverse effects on aquatic life."*

At least one of these conditions – that the discharge shall not cause any significant adverse effects on aquatic life – is probably being breached by discharges of urban stormwater in some parts of the Region. For the Wellington Regional Council to establish effective policies for avoiding the adverse environmental effects of such discharges, the quality and effects of stormwater must first be determined. The Council therefore commissioned the preparation of a report synthesising existing

information on the effects of urban stormwater discharges on the Region's receiving environments. This work was carried out by the National Institute of Water and Atmospheric Research Limited (NIWA) in conjunction with two sub-consultants, Diffuse Sources Limited and GeoEnvironmental Consultants.

3. Methods

The project was a purely desk-top review. No site inspections were carried out, although one of the authors was familiar with most of the sites discussed. For the purposes of the report, stormwater was regarded as the rainfall runoff from impervious surfaces (roads, paths, roofs, etc.), plus diffuse (i.e., non-point source) discharges of contaminants to that rainfall runoff, which is collected and conveyed through a stormwater reticulation system to be discharged into receiving waters. Discharges of sewage, landfill leachate, industrial/commercial wastewater and spills were considered point-source discharges to the stormwater conduits. Stormwater conduits were generally defined as man-made conduits, usually pipes. Streams, even when re-aligned and/or highly modified (thus effectively acting as part of the stormwater system), were regarded as the receiving environment.

4. Results

Urban Stormwater Effects

The main potential effects of stormwater discharges from urbanised catchments on surface water quality and aquatic environments are considered to be:

- Changes in the flow regime (i.e., increase in peak flow and reduction in base flow)
- Increases in suspended solids
- Channelisation of streams
- Changes to riparian vegetation
- Increases in toxic substances in the water column and sediments
- Increases in nutrients
- Contamination by human pathogens
- Accumulation of litter in waterways
- Effects on the biota

Stormwater Effects on Freshwater Ecosystems in the Wellington Region

There is relatively sketchy information on the impact of urban stormwater on freshwater quality in the Wellington Region, and the information that is available is restricted to the larger urban centres of Wellington, Hutt and Porirua cities.

Microbiological Impacts

High levels of faecal coliforms are found in all monitored urban streams in the Wellington Region, which suggests that they may possibly be contaminated with disease-causing micro-organisms. They share this characteristic with other urban streams around the country. The extent to which this is due to diffuse runoff compared with leaking sewage systems or illegal connections to the stormwater system is impossible to say, because faecal coliforms can originate from both human sewage and animal excreta.

Suspended Sediments

While not yet investigated in the Wellington Region, suspended sediment impacts downstream from urban development have been identified as important in other studies of stormwater impacts around New Zealand.

Water Quality

Zinc, cadmium, and copper levels in the water column of several urban streams in the Wellington Region occasionally exceed water quality guidelines. However, the amount of data is too small to assert that this is representative of the Wellington Region as a whole. There is also a need to establish the bio-availability of these metals to stream biota to enable more robust comparisons with the guidelines. Almost no data is available on the concentrations of toxic organic compounds in the waters of the Region's streams.

Sediment Quality

Concentrations of copper, lead, and zinc in the fine fraction of stream sediments from some fully urbanised catchments in the Wellington Region are extremely high, often exceeding the Probable Effects Level (PEL). Almost no data is available on the levels of contamination of the Region's stream sediments by persistent organic compounds.

Effects on Aquatic Organisms

Macroinvertebrate Community Index (MCI) values indicate that many of the Region's small urban streams have degraded habitat quality, but the evidence that stormwater is responsible is equivocal, because stormwater is only one of several possible stressors acting in these streams. The causative agents are not known with certainty. Higher peak flows, lower baseflows, excessive light, higher temperatures, heavy metal concentrations in the water column and in the stream sediments, industrial spills of smothering and toxic materials, and habitat modification, can all be causative agents in the Wellington Region.

Stormwater Effects on Marine Ecosystems in the Wellington Region

Microbiological Impacts

The suitability of Wellington Region's coastal waters for contact recreation downstream of urban areas is generally good, although six out of 37 sites downstream

from stormwater discharges exceeded contact recreation guidelines in 1999/2000. These sites are not generally designated bathing beaches. Only two out of 45 bathing beaches monitored in 1999/2000 did not comply with contact recreation guidelines. Both of these sites (Taupo Stream mouth and Riversdale Lagoon) are strongly influenced by streams, and not urban stormwater.

In general terms, urban stormwater probably reduces the microbiological quality of the Region's marine receiving waters. However, the effects cannot be distinguished from other contamination sources using the current data. Sewage contamination (of stormwater) and diffuse-sourced run-off from rural land are probably the major factors influencing microbiological levels in the Wellington Region's coastal waters.

Water Quality

No studies were found investigating the effects of stormwater discharges on marine water quality in the Wellington Region. However, concentrations of toxic substances in marine waters receiving stormwater discharges are probably too low after dilution to exceed water quality guidelines. This is because urban outfall discharge volumes are relatively small compared with their marine receiving waters.

Sediment Quality

There is compelling evidence of stormwater impacts on the sediments of Wellington Harbour and Porirua Inlet, which have experienced large increases in heavy metal concentrations, specifically:

- High concentrations near the Evans Bay outfalls in Wellington
- High concentrations near the Semple Street drain in Porirua
- High concentrations in stormwater drains in inner Wellington City and Miramar
- A modest increase in Porirua Inlet (in line with urbanisation history)
- A very small impact in Pauatahanui Inlet (in line with the low extent of urbanisation)

The evidence is consistent with a much larger body of evidence from Auckland estuaries, which has demonstrated that urban stormwater is causing an increase in the concentration of zinc, lead, copper, and polycyclic aromatic hydrocarbons, in the sediments of sheltered waters.

Effects on Aquatic Organisms

There is insufficient information to conclusively demonstrate adverse effects on marine animals from stormwater discharges in the Wellington Region. However, extensive studies in the Auckland region have provided *circumstantial* evidence linking adverse effects on marine fauna to stormwater discharges.

5. Discussion

The report has highlighted gaps in the information available on the effects of urban stormwater discharges on the Region's receiving environments. Specifically, there is a lack of information on:

- The nature and concentrations of the contaminants (particularly organic compounds) present in urban stormwater discharges in many parts of the Region.
- The relationship of the contaminants present in urban stormwater discharges to catchment characteristics.
- The relative importance of the different phases of urban stormwater (liquid, coarse sediment, fine sediment) in transporting contaminants to the receiving environments.
- The levels of contamination of receiving environments where adverse effects are *likely* due to the degree of urbanisation of the catchment and the characteristics of the receiving environment, but for which there is currently no information.

6. Further Action

Further studies into the effects of urban stormwater will be commissioned in the 2001/02 financial year. These will focus on improving the level of information available to Council on the nature and concentrations of contaminants present in the different phases of urban stormwater *at the point of discharge to the receiving environments*. This approach has the advantage of also providing information which can be used to trace the possible sources of some contaminants within stormwater catchments and visit these premises to ensure that any discharges to the stormwater system are curtailed.

The Council will continue its State of Environment monitoring programme relating to the accumulation of toxic compounds in marine food chains. Most of these compounds derive from urban stormwater and sewage discharges. Shellfish (cockles, mussels, tuatua, and paua), representing the primary consumers level of the trophic pyramid, are currently being analysed for heavy metals and a broad suite of organic compounds. Other trophic levels of the marine ecosystem may be targeted in future.

7. Communications

Copies of the consultant's report will be made available to all territorial authorities in the Wellington Region.

8. **Recommendation**

That the report be received and the Committee endorse the future action.

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