May 22, 2017

TO:
Clean Water Consultation 2017
Ministry for the Environment (MfE)
PO Box 10362
Wellington 6143

**Clean Water 2017: MfE Submission for Consultation**

I write in response to the call from the Ministry for the Environment for further submissions from persons interested in swimmability and issues related to the gradings outlined in the proposed national swimming standards.

1. **Criteria are required for short-term actions**

Ideally, revisions to swimmability standards need to be compatible with options for short-term actions, such as public notification at beaches (Boehm et al 2009). The proposed guidelines were informed by robust statistical analysis. However, an important further consideration is the need for additional single-sample standards in the form of maximum values. This may be particularly important in instances when regional councils need to make immediate beach notification and closure decisions.

While the statistical approach currently suggested in the proposed guidelines is relevant for ensuring that appropriate long-term actions are taken to protect and improve water quality, single-sample maximums to underpin immediate actioning are not included in the revision (Table 1).

**Table 1 The newly proposed *E. coli* swimming categories (attribute states) in detail (Source: MfE 2017).**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage of exceedances over 540: <em>E. coli</em> per 100 ml</th>
<th>Median: <em>E. coli</em> per 100 ml</th>
<th>95th percentile: <em>E. coli</em> per 100 ml</th>
<th>Percentage of samples above 260: <em>E. coli</em> per 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>&lt; 5 per cent</td>
<td>≤ 130</td>
<td>≤ 540</td>
<td>&lt; 20 per cent</td>
</tr>
<tr>
<td>Green</td>
<td>5-10 per cent</td>
<td>≤ 130</td>
<td>≤ 1000</td>
<td>20-30 per cent</td>
</tr>
<tr>
<td>Yellow</td>
<td>10-20 per cent</td>
<td>≤ 130</td>
<td>≤ 1200</td>
<td>20-34 per cent</td>
</tr>
<tr>
<td>Orange</td>
<td>20-30 per cent</td>
<td>&gt;130</td>
<td>&gt;1200</td>
<td>&gt;34 per cent</td>
</tr>
<tr>
<td>Red</td>
<td>&gt; 30 per cent</td>
<td>&gt;260</td>
<td>&gt;1200</td>
<td>&gt;50 per cent</td>
</tr>
</tbody>
</table>
There may be instances when it could be difficult, due to logistical reasons, to collect the number of samples over a single recreation season required to apply the proposed standards. In this case, an additional single-sample maximum on which to base shorter term decisions on beach notifications and closures may be warranted (EPA, 2015).

2. **Epidemiological work is needed to underpin the proposed guidelines**

There are some important considerations which could be included in the scope of efforts geared at protecting health of recreational swimmers. The former national swimmability targets were based on a very robust freshwater microbiology research program (FMRP) completed 15 years ago. The FMRP focused on prevalence of water pathogens as well as human health risk assessment (McBride et al 2002). It appears, however, that the current amendments to the national swimmability targets are not based on any epidemiological study, as is normally recommended when the aim is to protect human health (Lévesque and Gauvin 2007, Boehm et al 2009).

I suggest, therefore, that epidemiological studies be conducted. Such studies should include improvements upon the previous FMRP that heralded the current water quality targets. These opportunities for improvement could be carefully incorporated into future studies that are intended to guide water quality standard setting.

I suggest that any future microbiological research program or epidemiological study established for the purpose of informing water quality standards will need to be wide in scope. For instance, the previous FMRP focused essentially on pathogens associated with gastroenteritis. Making a case for gastroenteritis alone is understandable because of the non-specific character of health problems associated with bathing in polluted waters, but this fails to capture ear and skin problems or respiratory illnesses which have been shown to be associated with polluted waterbodies (WHO, 2003; Lévesque and Gauvin 2007). Notwithstanding the difficulty of detection, a number of epidemiological studies have demonstrated a relationship between polluted bathing waters and gastroenteritis (Kay et al, 1994, Cabeli et al 1982), as well as with febrile respiratory illnesses, skin, ear and eye ailments (Fleisher et al 1996). Previous studies have also illustrated increased risk of respiratory illness in waters with elevated faecal indicator bacteria levels (Fleisher et al. 1996; Haile et al. 1999, Boehm et al 2009).

I suggest future studies should involve pathogens additional to those listed in the FMRP (*Clostridium perfringens* spores, FRNA bacteriophage, somatic coliphage, enteroviruses, adenoviruses, Cryptosporidium oocysts, Giardia cysts, Salmonellae and Campylobacter). Important additions could include Norovirus, Hepatitis A, Legionella, Shigella, methicillin resistant *Staphylococcus aureus* (MRSA) and Verotoxin-producing or Shiga toxin-producing *Escherichia coli*. These pathogens tend to cause infections which may prove to be more serious and even potentially fatal (Pond 2007; Zlot et al 2015; MoH 2012; Varson 2017; CDC 2009; ARPHS 2017; Strongman 2016), particularly in immuno-compromised individuals. For example, infections caused by *E.coli*
O157:H7, Leptospira species and Shigella species bacteria have been epidemiologically linked with bathing in polluted waters. This is also the case for certain viral infections, notably Hepatitis A virus (Pond 2007). Norovirus has previously been detected at potentially infectious levels at New Zealand beaches (Coup et al 2012). Potentially pathogenic Staphylococcus species have been associated with recreational waters (Forgarthy et al 2015, Levin-Edens et al 2012). The incidence rate for invasive and non-invasive Staphylococcus aureus infections in New Zealand is among the highest reported in the developed world, with significantly increased incidence of S. aureus skin and soft tissue infections (Williamson et al 2014). Against the background of unreported illnesses, an acute norovirus outbreak in the Cardrona township of New Zealand, responsible for at least 53 cases of diarrhoea, vomiting and nausea was traced to sewage contamination of ingested water (Jack et al 2013). Currently, testing of recreational waters for these pathogens is not common practice across New Zealand, and there seems to be an apparent reliance on the protective nature of E.coli counts to adequately estimate risk of exposure to these pathogens. Given the aforementioned, a case for inclusion of additional pathogens into any future microbiological study that seeks to guide revisions in water quality targets is both obvious and compelling. A critical objective in a future microbiological study should be an assessment of the relationship between presence/absence or preponderance of these pathogens and how the pathogens correlate with E.coli concentrations in the nationally designated sampling sites.

3. Need for a phased monitoring approach that specifies follow-up actions

Provisions need to be clearly made in the revised standards for follow-up investigations in instances when unusual spikes in E.coli concentrations are observed. Without any underpinning science, there is a general tendency to associate unexpected spikes in E.coli concentration with either elevated rainfall (during wet seasons) or proliferation of extra-intestinal E.coli populations in nutrient-rich waterbodies during summer. This assumption often leads to a ‘do-nothing or no mitigation action scenario’. I suggest the incorporation of a phased approach to recreational water quality monitoring. In addition to the current routine monitoring, there should be clear statements on the need for additional investigations when indicators persist at high levels without a clearly identifiable contamination source. Apart from the first phase of routine monitoring, I suggest that provision be made for additional site-specific studies that:

i. screen for a multitude of pathogens of health concern that are not normally considered on a routine basis,

ii. discriminate between sources of microbial contamination (e.g. microbial source tracking) so that health risks can be abated through a variety of engineering and policy solutions.

The above-listed are necessary because indicator bacteria, which are conventionally used to evaluate recreational water quality, can originate from various non-human sources.

4. Conclusion

In conclusion, this submission makes three salient points: (i) inclusion of criteria for immediate actioning required for decisions relating to beach notifications and closures, (ii) the need for the commissioning of a new health risk assessment study, with broadened pathogen scope, to reliably guide the revisions in water quality standard setting, and (iii) inclusion of provisions in the revised standards for follow-up investigations (such as microbial source tracking) in instances when unusual spikes in \textit{E.coli} concentrations are observed.

Achieving these would require both concerted and substantial efforts across the science, policy, management and industry sectors. Hopefully, the time is right for a renewed commitment to the protection of swimmable waters, as we harness the current momentum and knowledge generated in over 15 years of research on water quality since the first FMRP study, to better protect the public health of New Zealand recreational water users.

Yours sincerely

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REFERENCES


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