

1 SUMMARY

- A series of analytical methods and associated standard operating procedures were developed to facilitate the isolation of norovirus (NV) and adenovirus (AdV) from raw and partially treated water samples. The identified concentration procedure utilised a conventional adsorption/elution approach using membrane filters and acidified beef extract and, in its present form, appeared to favour recovery of AdV, although NV was consistently concentrated from spiked samples. The enumeration of the two viruses was effected using quantitative polymerase chain reaction (qPCR) and reverse-transcription qPCR (RT-qPCR) to quantify AdV and NV respectively in water sample concentrates. All of the methods are considered robust and reliable and could reasonably be transferred to competent water utility laboratories for routine use.
- The documented analytical methodologies were used to analyse raw and partially-treated water samples generated from a works monitoring programme undertaken over a nine month period (June 2011- March 2012 inclusive) at 4 water treatment works across the UK.
- 74% of raw water samples were AdV- positive. AdV was present in raw waters throughout the year and, whilst the water treatment process reduced the level of AdV by between 2 and 4 orders of magnitude, the virus was apparently able to persist through to the pre-chlorination stages. Around 20% of all pre-chlorination (final stage) samples were AdV positive although none of the isolates proved to be infective when assessed by ICC-PCR.
- Removal of AdV occurred mainly at the first stage of treatment (post clarification), thereafter removal was negligible.
- NV was generally not detected in raw waters except during the winter months, December-March, when 94% of the raw water samples were positive. In contrast to AdV, there was apparently no significant effect of treatment on the level of NV. The levels of NV in raw waters were often so low that the demonstration of a significant reduction in numbers was impossible. However, in one instance where NV levels in raw waters were considered significant (Asset M; 14.02.2012: Appendix C), the virus was undetected in post-GAC (pre-chlorination) samples.
- There was strong evidence that, in raw waters where NV was detected, AdV was also detected. However, AdV was frequently detected in the absence of NV. Thus, on the basis of the data presented here, AdV may potentially be considered as a conservative indicator for the presence of NV in raw waters.
- In raw or pre-chlorinated water, there was no evidence to support the use of a chemical or bacteriological parameter to indicate the removal of the target viruses. However, changes in levels of bacteriological and chemical parameters did indicate that water treatment had taken place, with an associated decrease in AdV levels. For example, where there were reductions in levels of overall organic particulate matter (as measured by turbidity, there was also a general reduction in virus numbers)