Technical Inspection of Scottish Water's Water Treatment Works

Tighnabruaich Water Supply System – Manganese Management Inspection

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Summary of Inspection

Overall Summary

An inspection was undertaken by DWQR to assess the management of manganese at the site. The raw water is sourced from Craignafeich Reservoir. There are two draw off points at the reservoir; only one is in use, the upper draw off point, the other has not been operational for a number of years. Water is drawn off at a high point from the reservoir, and there is reportedly not a history of algal blooms at the reservoir. The raw water main is an undulating pipeline, 4.8km in length, and insoluble Mn deposits accumulate in the pipeline. Events have been caused by negative pressure on the main scouring the pipeline of these deposits, increasing manganese levels in the raw water and drawing air into the system. The air agitates Mn deposits in the limestone contactor, releasing them into the distribution system.

To manage these raw water pipeline deposits, eight new scour points have been installed along the length of the raw water main. Twice a year, Operators connect a pump to the raw water main, open the first scour, and increase the pump pressure to scour the first part of the system to the nearby watercourse, watching as the water gradually runs clear. The first scour point is then closed, the second opened, and the next part of the main is scoured. This continues down the line until the entire raw water main has been scoured.There is no dedicated manganese removal treatment stage at Tighnabruaich WTW. It is likely that suspended particulate or colloidal Mn will be removed in the nano filtration membrane process, and this should be monitored regularly by Scottish Water.

The limestone contactor, designed for final water pH correction, provides ideal conditions for the oxidation and precipitation of soluble Mn to insoluble Mn, and it is clear that Tighnabruaich WTW uses this process as a manganese removal stage, a major cause of manganese events has been manganese precipitate being sloughed off the surface of limestone media. To minimise this, as well as reducing the risk from air entry into the system by scouring the raw water main, Operations staff have increased the frequency of cleaning of the manganese oxide deposits on the limestone media, and have increased the physical agitation of the media. The Operators visually check the limestone contactor for evidence of Mn precipitate, and then use an air pump to agitate the limestone media and flush the manganese deposits to waste. This is a scheduled task, but the Operators know from experience when to carry out more regular checks on the limestone contactor and record this in task scheduling. The operational interventions to date appear to have been successful at reducing concentrations of manganese released into the distribution system. Operators reported that they routinely analyse for manganese at Loch Eck WTW using a Hach DR3900 portable spectrophotometer, which measures total manganese.Data gathered by Scottish Water shows that there has been a reduction in the amount of manganese entering the network from the treatment works, and the operational tasks appear to be responsible for this. The experience, skill and understanding of the supply system by the Operators and the Team Leader are evident. Enhanced monitoring of the supply shows that all manganese is oxidised at the treatment works, and as a result, all manganese in the network is likely to be precipitate which has been flushed into the system. The use of the limestone contactor as a manganese oxidation treatment stage is clearly very effective, but it is a crude method and potentially difficult to manage effectively, particularly when Operators are entirely reliant on visual inspections and experience of the supply. The regular discharge of tankered water into the supply exacerbates the situation by disturbing Mn deposits.