The Identification of Root Causes Behind Water Quality Incidents and Events

RESEARCH SUMMARY

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Independent Analysis of Water Quality Events and Incidents Reported by Scottish Water to the Drinking Water Quality Regulator

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1. ISSUE

1.1.1. Water quality compliance and the number of event notifications show a year-on-year improving trend (Figure 1). However, while the number of events reported is falling, the overall number remains considerable which the Drinking Water Quality Regulator (DWQR) would like to see reduced significantly.

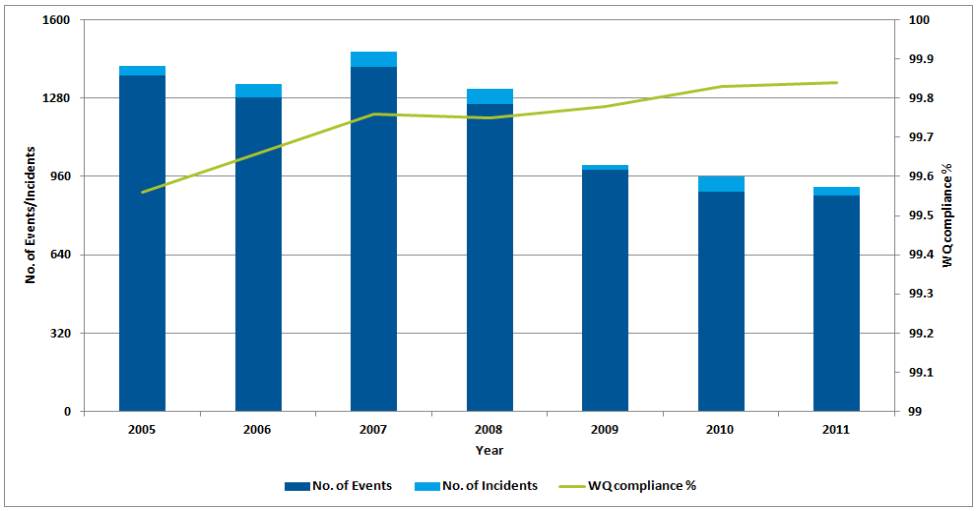

Figure 1: The number of Scottish Water event notifications, incidents and percentage water quality compliance for the period 2005-2011 [Drinking Water Quality Regulator Annual Reports]

1.1.2. Comparison between Scottish Water and the privatised water companies in England & Wales suggests a significantly higher number of water quality events were reported to DWQR than to the Drinking Water Inspectorate (DWI) for the period 2010-2011.

1.1.3. Data mining analysis revealed that 'Other' or 'Unknown at this time' was used to describe the 'cause' of 63% of all Scottish Water events. Water Quality events that occurred at Water Treatment Works (WTW), Distribution Service Reservoirs (DSRs) and within Water Quality Zones (WQZs) showed similar trends with 55%, 86% and 62% respectively being assigned 'Other' or 'Unknown at this time' as causes.

1.1.4. DWQR commissioned Black & Veatch Ltd to complete an independent analysis of water quality events reported by Scottish Water (SW) between 2010 and 2012 to identify root causes and contributing factors.

1.1.5. The project further supports and informs DWQR's approach to targeting scrutiny resources effectively, ensuring the adoption of proactive, risk-based approaches that align with the Scottish Government's 'Better Regulation' initiative.

2. SUMMARY OF KEY FINDINGS AND CONCLUSIONS

2.1 Water Treatment Works

2.1.1. Five key common causal factors were identified:

- Failure or malfunction of water treatment process control and monitoring systems.

- Multiple asset and component failure of key treatment process units and chemical dosing systems.
- Loss of mains power and failure of redundancy power systems.
- Treatment optimisation due to raw water changes.
- Inadequate treatment provision and catchment mitigation.

2.2 Distribution Service Reservoirs and Water Quality Zones

2.2.1. Analysis of event reports found that a significant percentage either did not (a) establish a cause or (b) the information documented was not comprehensive enough to infer key causal factors with confidence.

2.3 Conclusions

2.3.1. Problems relating to the adequacy, quality and comprehensiveness of a large proportion of event reports meant that the interpretation and interrogation of the data to establish and identify root causes was compromised.

2.3.2. For many events, the absence of evidenced-based root causes and conclusions or comprehensive narratives with supporting evidence, appears on the surface to stem from the lack of a structured, holistic and continuous learning and improvement-based approach to the investigation of events. We also note that this matter is not isolated to just one or two operational regions, but applies across all of the different water quality reporting elements of SW.

2.3.3. The apparent lack of conclusions with regards to the fundamental or underlying cause(s) of events within the distribution system is likely to impact adversely on SW's ability to identify and implement corrective action: thereby preventing the recurrence of water quality failures across assets, sites, regions or the company. This may provide some degree of explanation as to why, compared to England & Wales, SW has proportionally many more events.

2.3.4. We acknowledge that because of the historical nature of the data, improvements during the current 2010-2015 investment period will have already addressed a number of sites on which the findings are based.

3. RECOMMENDATIONS

3.1 Event Reporting

3.1.1. Within the report, a number of detailed suggestions have been made as to additional information that could be requested from SW to support the understanding and interpretation of events by DWQR. These are focussed on:

- The greater provision of evidence of causal factors, corrective actions and the scope and extent of any investigation.
- The integration of wider water quality risk management activities within event reporting.
- Improving company-wide knowledge transfer and learning from events by SW to support the reduction and reoccurrence of events.

- Improving the clarity and consistency of event reporting.

- Improving the depth, breadth and approach to the investigation of events.

- Limiting the use and documentation of words to describe root causes that do not have a clear meaning, for example the use of 'Other' and 'Environmental Contamination'.

3.1.2. From our observations of the structure of event forms and, based on feedback at the project dissemination workshop, we suggest any discussions of 'report formats/templates' are re-focussed on the provision of appropriate and proportionate information in a more structured, holistic, and consistent way.

3.1.3. This may require SW to develop the most appropriate approach to the documentation and communication of events, while ensuring it meets regulatory requirements and maintaining the commendable transparency currently exhibited by the company.

3.1.4. We believe this approach has a number of potential benefits including:

- Assisting DWQR, as well as other external bodies who receive event forms, in understanding and interpreting events.

- Enabling SW to maintain regulatory, public and wider stakeholder confidence in the safety and resilience of the water supply.
- Providing SW with a suitable and adequate evidence-base for the purposes of continuous improvement in operational practices and investment planning.

3.2 Regulatory Policy

3.2.1. The following recommendations have been considered following a wider look at what the findings mean in a wider policy context for DWQR.

3.2.2. Building on the release of Information Letters 03/12 and 04/12, we recommend that DWQR continues to prompt SW on the need for thorough investigations where problems arise. DWQR should also continue to focus on ensuring event reporting and associated documentation is completed in a logical, structured and consistent manner, commensurate to the level of risk presented by the type of event and hazard.

3.2.3. Within its wider strategic aim of improving event reporting, we recommend that DWQR considers:

- Potential benefits that could be derived from the formal feedback to all events as part of a 'sign-off' process with SW.

- Potential improvements that could be obtained from the separation of non-compliance and operational event reporting.

- Development, by SW, of the documentation and communication of events that meets both its own and key stakeholder's needs, as well as maintaining regulatory reporting requirements.

3.2.4. The significant disparity in the number of DSR events compared to England & Wales, combined with the lack of clear root causes for so many events suggest that DSRs form an area for increased focus by DWQR scrutiny resources.

3.2.5. Further recommendations are made in relation to four specific areas of the process for the reporting and assessment of water quality events in Scotland, and include:

Developing a Risk Methodology for Prioritising and Optimising Scrutiny Activities of Scottish Water Assets, Water Supply Systems and Regions

- Improving DWQR's current risk-based approach through development of a formalised risk methodology and supporting IT infrastructure for the risk ranking of SW assets, water supply systems and regions for the purposes of prioritisation and optimisation of scrutiny activities.

- In this regard, we note that the 'Hampton Implementation Review' of the Drinking Water Inspectorate (DWI) in 2010 (which focussed on the assessment of regulatory performance against 'Better Regulation' principles), commended the DWI for the development of its IT infrastructure, and the way it supported its risk-based regulatory approach to targeting its inspections.

Enhanced Event Metadata Collection at Event Assessment Stage

- Collection and recording of improved standardised metadata on events to leverage the full power of a database approach in producing key event performance metrics.

Event Classification Risk Matrix

- A key aspect of ensuring that scrutiny resources are focussed on the highest risk areas is the classification of events at the initial and outcome notification stage. We suggest reviewing the possibility of improving the flexibility and range of options with which DWQR is able to respond to events.

Basic Event Metadata Collection and Reporting Improvements

- We suggest that DWQR reviews the incorporation of basic standard metadata inputs within the CSV file return that could be completed by either SW or incorporated into the DWQR assessment part of the event reporting process.

  The potential benefits include:

  - 'Intelligent' digitisation of event forms, such that a more significant amount of analysis can be completed with a greater confidence in the output.

  - Reducing the analysis time and being able to monitor event performance or risk metrics in 'almost real time'.

  - Reducing the level of manual input and intervention required for the ongoing production of event performance or risk metrics.

- However, a cautionary approach should be considered so as to avoid an impression of a 'tick box exercise'. Therefore, stakeholder engagement with SW is encouraged, especially as part of developing the standardised/acceptable input, and where mandatory fields may be helpful in improving metadata capture.