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Review of existing faecal indicator organism (FIO) models and future integration opportunities

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Background and aim

This project looked at how modelling can help better understand where *E. coli* and other **faecal indicator organisms (FIOs)** in rivers, coastal waters and shellfish areas in Scotland are coming from. These pollutants can originate from many places – livestock, wildlife, septic tanks, wastewater systems and runoff during wet weather – and it is often difficult to tell which sources matter most. The aim of the work was to review the modelling tools that already exist, understand what they can and cannot do, and identify what type of approach would be most useful for Scotland.

What we set out to do

- Identify the main models used to predict or understand FIO pollution.
- Compare how these models work, what data they need and what they are best suited for.
- Explore whether different approaches could be combined to give a clearer picture of catchment scale contamination.
- Consider whether a simple, practical screening tool could be developed to help identify the most important sources in Scottish catchments.

Key findings

What we found

- There are many models available, but **none** can cover all sources and pathways across a whole catchment in a way that is practical for routine regulatory use.
- **Process based models** can represent hydrology and diffuse pollution well, but they need a lot of data and are difficult to maintain.

- **Screening and risk based tools** are more realistic for Scotland's data limited catchments and can help identify likely problem areas.
- Rainfall and flow conditions are the biggest drivers of FIO pollution, and the dominant sources can change between dry weather and storms.
- Many models struggle to represent short lived events such as storm runoff, combined sewer overflows and sediment resuspension – even though these events often cause compliance failures.
- Fully integrated “source to sea” models are technically possible but not sustainable for long term operational use.
- The greatest benefit would come from a **simple national screening tool**, supported by more detailed modelling where it adds clear value.

Recommendations

What we recommend

- 1. Match modelling ambition to the data available.**
A national audit of data should guide what type of modelling is realistic and sustainable by identifying (i) data that are currently available; (ii) could be strengthened through investment; or (iii) are unlikely to be available.
- 2. Develop a simple national screening tool.** This should help identify likely FIO sources under key conditions (especially rainfall events) and support practical decision making.
- 3. Build a long term, sustainable modelling framework.** This should be modular, transparent, easy to maintain and designed around routine operational needs.

Please reference this project summary as follows: Avery, L., Tomczyk, T., Quinn, P and Oliver D. (2026). *Review of existing faecal indicator organism (FIO) models and future integration opportunities to support catchment-scale source apportionment in Scotland*. Project Summary. CD2025_02. Centre of Expertise for Waters (CREW).

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