REDUCING WATER TREATMENT COSTS FOR SCOTTISH WATER BY USING SATELLITE DATA TO ASSESS AND MONITOR PEATLANDS

THE PROBLEM

With over 230 water treatment works supplied with water from over 400 catchments, Scottish Water have an ongoing challenge to improve water quality upstream in order to reduce the rising operational cost of treatment downstream. 12,000km^2, approximately 50% of the catchments are peatland or consist of soils with a high organic matter content.

Healthy and intact peatlands act as a huge store and sink of atmospheric carbon, as well as a source of drinking water, and an important habitat for many plants and animals. The quality of peatlands has been degraded over many years from drainage, landscape conversion and other anthropogenic disturbances, which has affected levels of dissolved organic carbon (DOC) in water running off peatlands.

Almost all of the 58 peatlands tested for Scottish Water showed signs of degradation and high DOC in the waters. This water requires expensive treatment to achieve the required drinking water standards. Therefore, to reduce treatment costs, improve water quality and maximise the effectiveness of its limited resources, SW needed a cost-effective, non-disruptive and time-efficient method of monitoring the condition of its large area of peatland assets.

Rezatec presented its innovative method to improve water quality thus reducing treatment costs using satellite-derived intelligence to identify peatland degradation hotspots and prioritise restoration activities.
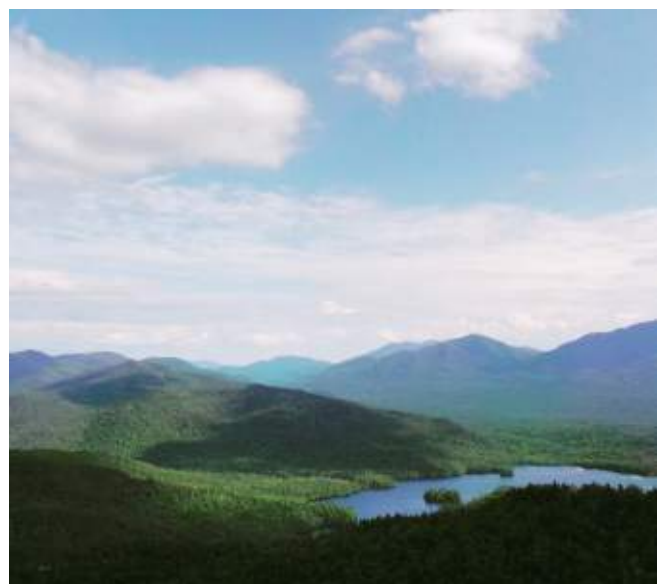
THE SOLUTION

Following extensive mapping and assessment of peatland data covering 10,200km^2 of Scottish Water catchments, Rezatec derived a peatland integrity index and water quality risk information layer from multiple sources of aggregated data. To enable more pro-active peatland and catchment management in general, the data sets were enhanced with unique algorithmic predictive modelling. Then an interactive data visualisation and interrogation service was developed containing a comprehensive set of satellite-derived data products depicting ecosystem integrity, land use and environmental risk for the entire set of Scottish Water's catchments across all peat soils.

The data product, visualised and interrogated through an online portal, has been developed using a variety of satellite imagery, e.g. Sentinel-1 SAR and Sentinel-2 optical, in combination with ground data. The components of the data product depict different features of c. 6,000km^2 of Scottish Water's organic-rich water catchments, and are displayed as independant data layers.

+ DATA LAYERS

- Catchment features for use in contextualising the landscape, e.g. contours and woodlands

- The location of anthropogenic landscape disturbances, i.e. Anthropogenic Channels, Peat Cuttings and Upland Vegetation Management

- Aspects of peatland soils, i.e. the distribution and depth of organic soil and Relative Soil Moisture

- The distribution of positive and negative floristic indicators of typical peatland hydrology, i.e. the Combined Vegetation Indicator

- Layers to aid management decisions, i.e. Water Quality Risk and Peatland Integrity Index

THE SOLUTION

+ BUSINESS PLANNING TOOL

Rezatec's application is being used as a business planning tool by Scottish Water, and integrated into their Strategic Research Plan for DOC. The Portal and its data layers assist Scottish Water in locating landscapes with a higher risk of contributing to DOC at present and into the future.

During this project, members of the following organisations were consulted and provided feedback on the work: Scottish Natural Heritage (SNH), RSPB, the James Hutton Institute (JHI), the IUCN UK Peatlands Programme and CEH Edinburgh. JHI, SNH, the Botanical Society of Britain and Ireland (BSBI) and the British Bryological Society (BBS) all provided invaluable ground data to support the project.

The portal provides a tool that reduces the time and cost needed to monitor the condition of large and remote catchments from which they extract drinking water. Scottish Water can now identify areas of degraded peat within a specific catchment and make preliminary decisions on where to target restoration activities – all without needing to visit the area.

Water Quality Risk and Upslope Risk Analysis layers for one boxed catchment within Scottish Water's peatland asset base.

THE OUTCOME

Rezatec's web-based portal and customised peatland data product allows Scottish Water to view problematic areas of peatland degradation or areas at risk of water pollution from DOC using a number of different data layers. Detection of risk areas means that ground teams can now be deployed more efficiently to cover vast and difficult terrain and to carry out restoration efforts more effectively. In turn, this will help improve peatland integrity and reduce DOC pollution. Overall the operational cost of mapping, assessing and monitoring peatlands is also reduced.

Another benefit is that, by moving to a more proactive catchment management approach, Scottish Water can mitigate against potential impacts more precisely allowing greater resources to be invested in peatland management and restoration.

Accessible data product layers that empower decision-making include:

+ ANTHROPOGENIC:
- Drains
- Peat Cuttings
- Upland Vegetation Management

+ HYDROLOGY MAPS:
- Flow Direction
- Flow Accumulation
- Water Quality Risk
- Upslope Risk Analysis
- Relative Soil Moisture

+ PEATLAND MAPS:
- Peat Depth
- Combined Vegetation Indicator
- Peatland Integrity Index

"This tool can be used to assess the current condition of peat within drinking water catchments, which can have a large impact on source water quality. Using the tool, we should be able to identify specific areas to focus ground based activities; this may include more detailed surveys as well as potential peat restoration. This will save on unnecessary surveys, which can often involve considerable man power due to the location and nature of the terrain. The tool will also provide a baseline from which we can evaluate any change. Scottish Water is committed to providing wholesome water to our customers. To help achieve this it is important that our source water quality is protected both now and for the future. Using this tool will help us towards this goal."

Dr Zoë Frogbrook, Technical Lead: Catchment Management, Sustainable Land Management

THE OUTCOME

The key achievements of this project are as follows:

1) A peat extent and depth map covering the organic rich soils across c. 12,000km^2 of Scottish Water catchments

2) A Combined Vegetation Indicator layer, modelled using an extended set of location data for vegetation types indicative of peatland condition, in combination with Sentinel imagery

3) A set of layers depicting anthropogenic features across c.6000km^2, including anthropogenic linear channels, peat cuttings and upland vegetation management

4) A time series of Relative Soil Moisture maps, including May, August, September 2015, and Summer and Winter 2016, modelled using newly available Sentinel-1 imagery

5) Two key indices of ecosystem condition, i.e. Peatland Integrity and Water Quality Risk, which can be visualised, interrogated and used by Scottish Water to understand and more effectively manage their organic rich catchments.

Scottish Water can now:

+ IDENTIFY RISK AREAS

+ DETECT AND RESTORE DEGRADED PEATLANDS

+ TARGET SPECIFIC CATCHMENTS FOR MORE EFFICIENT USE OF GROUND RESOURCES

+ REDUCE THE AMOUNT OF ORGANIC MATTER ENTERING THE WATER

+ REDUCE THE COST OF WATER TREATMENT