

# OR/15/002 Appendix 2: Methodology used to create vulnerability dataset

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Ó Dochartaigh B É, Doce D D, Rutter H K and MacDonald A M. 2015. User Guide: Groundwater Vulnerability (Scotland) GIS dataset, Version 2. Revised Report. *British Geological Survey Internal Report*, OR/15/002.

The groundwater vulnerability dataset was produced in ArcGIS by combining a range of environmental datasets (Table 2). A detailed description of the methodology for developing the groundwater vulnerability Version 1 dataset is given in Ball et al. (2004). This new dataset, Version 2, was produced along largely the same lines, with some small methodological changes to simplify the assessment procedure, but using updated input datasets.

The input datasets used to produce Version 2 of the dataset are listed and described briefly in Table 2. More detail on how they have been amended from Version 1 is given in Appendix 1.

A rule-based method for combining the various input datasets to define a vulnerability classification has been used, which has been modified only slightly from that used for Version 1. The method is described by a set of scenarios, and a corresponding set of rules (or criteria), which are implemented on the input datasets in turn, depending on whether a particular scenario is true. As each rule is implemented, parts of the map (i.e., polygons in the GIS file) are selected, and these selected polygons are attributed with the relevant vulnerability classification, as shown in a set of tables, which are shown in Appendix 2. Once each rule has been implemented, the polygons already attributed are excluded, and the next rule is implemented. The scenarios considered, and the rules implemented, in order, with the input datasets used for each, are as follows:

## **1. Superficial deposits at the ground surface are highly permeable, and water table is in the superficial deposits**

Selection:

Polygons where Superficial Deposits Permeability = High or Very High and Superficial Deposits Thickness  $\geq$  Depth to Water in Superficial Deposits

Vulnerability:

Attributed according to the values in Table A5 (using the datasets *Superficial Deposits Permeability* and *Depth to Water in Superficial Deposits*)

## **2. Fractured bedrock - superficial cover**

Selection:

(Remaining polygons with) Bedrock Flow type = Fractured, AND superficial deposits are mapped.

Vulnerability:

If Clay Thickness  $\geq$  5m then Vulnerability = 1 (from Table A4)

If Clay Thickness  $<$  5m then Vulnerability is attributed according to Table A3 (using *Superficial Deposits Permeability* and *Superficial Deposits Thickness*).

### **3. Fractured bedrock - no cover (no superficial deposits mapped and soil is effectively absent)**

Selection:

(Remaining polygons where) HOST Class = 22 OR 27 AND Bedrock Flow type = Fractured

Vulnerability:

Vulnerability = 5 (from Table A1)

### **4. Fractured bedrock - soil cover (no superficial deposits mapped. Subdivided according to soil permeability: low permeability soils reduce vulnerability from 5 to 4a)**

Selection:

(Remaining polygons where) HOST Class IS NOT 22 OR 27, AND Bedrock Flow type = Fractured

Vulnerability:

If HOST Class = Group A (Class = 9, 16, 18, 24, 26, 28, or 29) (low permeability soil) then

Vulnerability = 4a (from Table A2)

Otherwise Vulnerability = 5

### **5. Intergranular bedrock - superficial cover**

Selection:

(Remaining polygons with) Bedrock Flow type = Intergranular or Mixed, AND superficial deposits are mapped.

Vulnerability:

If Clay Thickness  $\geq$  5m then Vulnerability = 1 (Tables A9, A10 and A11)

If Clay Thickness  $<$  5m AND Superficial Deposits Permeability = Very High or High, then Vulnerability is attributed according to Table A9 (using *Depth to Water in Bedrock*, *Bedrock Permeability*, and Superficial Deposits Thickness).

If Clay Thickness  $<$  5m AND superficial permeability = Moderate, then Vulnerability is attributed according to Table A109 (using *Depth to Water in Bedrock*, *Bedrock Permeability*, and Superficial Deposits Thickness).

If Clay Thickness  $<$  5m AND Superficial Deposits Permeability = Low or Very Low, then Vulnerability is attributed according to Table A11 (using *Depth to Water in Bedrock*, *Bedrock Permeability*, and Superficial Deposits Thickness).

### **6. Intergranular bedrock with no cover (no superficial deposits mapped and soil is effectively absent)**

Selection:

(Remaining polygons where) HOST Class = 22 OR 27, AND Bedrock Flow type = Intergranular or Mixed

Vulnerability:

Attributed according to Table A6 (using *Bedrock Permeability* and *Depth to Water in Bedrock*)

## 7. Intergranular bedrock with soil cover; no superficial deposits mapped.

Selection:

(Remaining polygons where) HOST CLASS IS NOT 22 OR 27, AND Bedrock Flow type = Intergranular or Mixed

Vulnerability:

If HOST Class = Group A (Class = 9, 16, 18, 24, 26, 28, or 29) (low permeability soil) then Vulnerability is attributed according to Table A8 (using *Bedrock Permeability* and *Depth to Water in Bedrock*)

Otherwise if HOST Class = Group B (all other HOST classes) (high or moderate permeability soil) then Vulnerability is attributed according to Table A7 (using *Bedrock Permeability* and *Depth to Water in Bedrock*)

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