Nitrate Vulnerable Zone (NVZ) designation, 2017 Eutrophication (lakes)

Publication Date: June 2016

NVZ Name: Thurstonfield Lough
NVZ ID: EL137
This document provides a summary of the evidence used in proposing an area of land as one which should be, or should continue to be, designated as a Nitrate Vulnerable Zone (NVZ) for the purposes of the Nitrate Pollution Prevention Regulations 2015.

A full description of the methods used in developing the NVZ proposals is set out in the detailed methodology for eutrophication-related NVZs, available via http://apps.environment-agency.gov.uk/wiyby/141443.aspx. These methods were developed under the guidance of a review group convened by the Defra for the last NVZ review (2011-2013), which included representatives from the farming and water industries as well as independent academic experts. Minor refinements to the methods have been made for the current review.

NVZs are areas of land that drain to polluted waters and which contribute to the pollution of those waters. Polluted waters include those which are eutrophic or may in the near future become so if the Regulations were not to apply there.

Eutrophication is defined as “the enrichment of water by nitrogen compounds, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned”.

For both freshwaters and saline waters, a weight-of-evidence based approach to assessing the risks and impacts of eutrophication was employed. The evidence for individual water bodies was assessed against a national suite of criteria for eutrophication in the different categories/types of water for review. The criteria are both quantitative and qualitative and reflect scientific understanding of the process and effects of eutrophication. They are broken down in the same way for each water category as follows:-

- Nutrients
- Plants/algae
- Secondary and other effects

For each designated or candidate water body which might meet the criteria for eutrophication, a datasheet such as this one was completed, bringing together information about the water body, its catchment, its uses, evidence of eutrophication and the sources of nitrogen input.

This document is a record of the evidence used in the designation process, including results from national monitoring and assessment programmes, and further information supplied by Area staff. The proposals for NVZ designation are made as a result of close working between Area and national Environment Agency teams, with further quality assurance for the eutrophication designations through the use of a national expert panel.

An accompanying guide to these datasheets is available, which provides an explanation of the contents, acronyms and technical terms.

Some features of the maps within this report are based on digital spatial data licensed from the Centre for Ecology and Hydrology, ©.

Please note that any maps shown here have not used detailed field boundaries and therefore represent the indicative 'soft' boundary only. The definitive NVZ area can be seen on the “What’s in Your Backyard” (WIYBY) website (http://apps.environment-agency.gov.uk/wiyby/141443.aspx).
Section 1. Lake and catchment characteristics

WB ID: 28429  
2013 NVZ status: Not Designated

Lake attributes

<table>
<thead>
<tr>
<th>EA Area</th>
<th>Cumbria and Lancashire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake grid co-ordinates (Easting/Northing)</td>
<td>331951 / 556260</td>
</tr>
<tr>
<td>Lake waterbody area (ha)</td>
<td>8.4</td>
</tr>
<tr>
<td>WFD Lake Typology</td>
<td>Organic, very shallow, very small, lowland</td>
</tr>
<tr>
<td>Lake Alkalinity (ueq/L)</td>
<td>1750</td>
</tr>
<tr>
<td>Mean lake depth (m)</td>
<td>2</td>
</tr>
<tr>
<td>Is the lake heavily modified according to WFD?</td>
<td>Yes</td>
</tr>
<tr>
<td>Does stratification occur?</td>
<td>Well mixed</td>
</tr>
<tr>
<td>Is this waterbody a reservoir?</td>
<td>No</td>
</tr>
</tbody>
</table>

Natural or artificial lake:
Natural

Type of artificial lake:
n/a

Lake perimeter (% artificial)
Natural

Significant changes in lake level due to seasonal drawdown:
N

Pumped storage or other reservoir:
n/a --- Water transferred from a natural stream via an aqueduct to the reservoir

Information on abstraction (if available)
Lake catchment attributes

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake catchment area (ha)</td>
<td>425</td>
</tr>
<tr>
<td>If pumped, pumped catchment area (ha)</td>
<td></td>
</tr>
</tbody>
</table>

Hydrological character
Primarily surface water

Please note that the map above has not used the detailed field boundaries and is the indicative ‘soft’ boundary. The definitive NVZ area can be seen on the Environment Agency website (www.environment-agency.gov.uk)

Comments on accuracy of lake catchment:

Is the map representative of the natural catchment?
Yes

Is the map representative of the artificial catchment?
n/a
Section II - Waterbody uses

Water Supply:
Controlled water (Section 104 of Water Resources Act):
Yes

Public Water Supply:
No

Drinking Water Protected Area:
No

UWWTD designation
No --- The lake is eutrophic but not under UWWTD

Used for hydropower or flow regulation:
n/a

Recreational use:
Accessiblity to public:
Easily accessible, many visits

Recreational fishing:
Moderate benefit --- Local private fishery with lodges

Contact watersports
No activity

Nature of watersports (if applicable):
---

Other public benefit visits:
Moderate benefit- Walking

Conservation status:
Conservation value of lake:
National

Habitats Directive site:
Not SPA or SAC --- SSSI

SPA or SAC for aquatic interest features
--- The submerged aquatic flora is of considerable note with populations of three rare or scarce species: six-stamened waterwort Elatine hexandra, autumnal water-starwort Callitriche hermaphroditica and needle spike-rush Eleocharis acicularis.

SSSI or local conservation designation:
SSSI --- This water body is a SSSI and Local Nature Reserve, specifically for the benefit of aquatic vegetation

Description of Aquatic interest features:
--- Thurstonfield Lough is the largest, species-rich area of open water in the lowlands of north and east Cumbria. Within this area it supports some of the best examples of a range of vegetation types: from the submerged aquatics through an extensive fringing marsh to good wet sallow and alder woodland. The Lough lies in the Solway Plain of north Cumbria, 5 km west of the city of Carlisle. It is formed in boulder clay and is thought to be a natural feature although the water levels are now controlled by sluice. In addition to its vegetation interest the Lough is relatively undisturbed and supports a notable invertebrate fauna and a good range of waterfowl. The submerged aquatic flora is of considerable note with populations of three rare or scarce species: six-stamened waterwort Elatine hexandra, autumnal water-starwort Callitriche hermaphroditica and needle spike-rush Eleocharis acicularis. Canadian waterweed Elodea canadensis now appears to be the dominant species but a range of other submerged plants also occur. The

NVZ Name:  Thurstonfield Lough
NVZ ID:  EL137
marsh or Emergent vegetation fringing much of the Lough includes areas dominated by water horsetail, common clubrush, bulrush and, back from the waters edge, bottle sedge. Small areas of a more fen-like vegetation contain species such as water plantain and marsh cinquefoil.
### Total oxidised nitrogen (TON) data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean summer TON (mg/l)</td>
<td>0.1</td>
</tr>
<tr>
<td>Total number of summer TON samples</td>
<td>9</td>
</tr>
<tr>
<td>75th percentile annual TON (mg/l)</td>
<td>0.4</td>
</tr>
<tr>
<td>Total number of TON samples</td>
<td>18</td>
</tr>
<tr>
<td>Confidence of annual 75th %ile TON exceeding 1 mg/l</td>
<td>Not confident</td>
</tr>
<tr>
<td>Confidence of annual 75th %ile TON exceeding 2 mg/l</td>
<td>Not confident</td>
</tr>
<tr>
<td>Date range of TON samples</td>
<td>2010 - 2014</td>
</tr>
</tbody>
</table>

### TON monitoring data

![TON monitoring data graph]

**NVZ Name:** Thurstonfield Lough  
**NVZ ID:** EL137
Total nitrogen (TN) data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean annual TN (mg/l)</td>
<td>1.3</td>
</tr>
<tr>
<td>Total number of TN samples</td>
<td>18</td>
</tr>
<tr>
<td>Confidence of annual mean TN exceeding 1 mg/l</td>
<td>High</td>
</tr>
<tr>
<td>Confidence of annual mean TN exceeding 2 mg/l</td>
<td>Not confident</td>
</tr>
<tr>
<td>Date range of TN samples</td>
<td>2010 - 2014</td>
</tr>
</tbody>
</table>

TN monitoring data

Does any other (e.g. EA non-WFD, or third party) monitoring data for the lake provide improved evidence of significantly elevated nutrient nitrogen?

n/a
Total phosphorus (TP) data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual geometric mean TP (ug/l)</td>
<td>50</td>
</tr>
<tr>
<td>WFD face value TP class</td>
<td>Moderate</td>
</tr>
<tr>
<td>Confidence of moderate or worse TP status</td>
<td>100%</td>
</tr>
<tr>
<td>Date range of TP samples</td>
<td>2010 - 2014</td>
</tr>
</tbody>
</table>

TP monitoring data

Does any other(e.g. EA non-WFD, or third party) monitoring data for the lake provide improved evidence of significantly elevated nutrient phosphorus?

n/a
Nitrogen loading estimates based on catchment map area

<table>
<thead>
<tr>
<th>Source</th>
<th>Leached N (kgN/yr)</th>
<th>Conc. (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From all agricultural sources</td>
<td>14204</td>
<td>8</td>
</tr>
<tr>
<td>From agricultural sources minus atmospheric deposition</td>
<td>14027</td>
<td>No data</td>
</tr>
<tr>
<td>From urban sources</td>
<td>62</td>
<td>0</td>
</tr>
<tr>
<td>From all sources</td>
<td>14266</td>
<td>8</td>
</tr>
<tr>
<td>From all sources (minus atmospheric deposition)</td>
<td>14089</td>
<td>7.9</td>
</tr>
<tr>
<td>Ranking based on nitrogen loading from agricultural sources</td>
<td></td>
<td>120</td>
</tr>
</tbody>
</table>

Local assessment 2015

**Significance of loading from agricultural sources to the catchment of the lake**

Principal source --- Catchment is nearly entirely agricultural. Natural England & EA have a Diffuse Water Pollution Plan in place to reduce the impact from diffuse agricultural pollution, in particular phosphate & sediment.

**Significance of loading from human habitation to the catchment of the lake**

Minor source --- Some non-mains sewage drainage, bird populations and internal lake sediments.

**Significance of any other sources of nutrient loading to the lake or its catchment**

--- Some non-mains sewage drainage, bird populations and internal lake sediments. Please refer to the WFD investigation report (2013).
Chlorophyll data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual mean Chlorophyll (ug/l)</td>
<td>16</td>
</tr>
<tr>
<td>total number of Chlorophyll samples</td>
<td>18</td>
</tr>
<tr>
<td>WFD face value Chlorophyll class</td>
<td>Moderate</td>
</tr>
<tr>
<td>Confidence of moderate or worse status</td>
<td>51%</td>
</tr>
<tr>
<td>Chlorophyll Good/Moderate boundary value</td>
<td>19</td>
</tr>
<tr>
<td>Date range of Chlorophyll samples</td>
<td>2010-2014</td>
</tr>
</tbody>
</table>

Chlorophyll monitoring data

- NVZ Name: Thurstonfield Lough
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Other responses

<table>
<thead>
<tr>
<th></th>
<th>Phytoplankton (Pluto EQR)</th>
<th>Macrophytes (EQR)</th>
<th>Diatoms (EQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQR</td>
<td>0.3</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Total number of samples/surveys</td>
<td>12</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>WFD face value class</td>
<td>Moderate</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Confidence of moderate or worse status</td>
<td>98%</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Date range of samples</td>
<td>2011 - 2013</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Number of years when algal blooms were observed based on reactive monitoring 2010-2015: 0

Does any other (e.g. EA non - WFD, or third party monitoring data for the lake provide improved evidence of eutrophication? (local judgement)
No change --- Continues to fail for multiple elements linked to eutrophication - strong evidence of this. 2015 WFD classification : Overall WB status: Moderate Phytoplankton blooms: Moderate Total phosphorus: Moderate

To which biological element(s) does it relate?
More than one (describe) ---

**Palaeolimnology**

<table>
<thead>
<tr>
<th></th>
<th>Change as Square Chord Distance</th>
<th>Change in Diatom community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No data</td>
<td>No data</td>
</tr>
</tbody>
</table>

Evidence that designated aquatic interest features associated with the lake show evidence of eutrophic disturbance? (local judgement)

Likely to be affected

**Strength of evidence** (local judgement)

Strong evidence ---

Local judgement on the evidence of eutrophic disturbance

Y, definitely
**Comments and decisions**

**WFD Weight of evidence for eutrophication:**

Certainty of eutrophication problem based on core WFD tools: 
- Quite certain eutrophication problem

Certainty of eutrophication problem based on overall weight of evidence:
- Very certain eutrophication problem

WFD overall ecological status: Moderate

Confidence in WFD status: Very Certain

---

**Current assessment of weight of evidence supporting designation in 2017**

**First national panel**

Recommended action: Needs further investigation

Comments from first panel:

TN is elevated but TON is <1 mg/l. Limited evidence of impact - need to check if any further evidence available, any use-related impacts?

**Second national panel**

Comments from second national panel:

Natural England survey reported extensive filamentous algal growth after Elodea removal was carried out. Continues to be in unfavourable condition. Check any local in-lake management activities for impact on results. Panel support designation.

Recommendation: Designate

Local summary and recommendation:

This water body continues to fail for multiple elements linked to eutrophication. 2015 WFD classification: Overall WB status: Moderate Phytoplankton blooms: Moderate Total phosphorus: Moderate A WFD investigation in 2013 and Eutrophication WoE assessment both confirm that this lake is certainly eutrophic, but not necessarily under the Nitrates Directive. The principle cause of eutrophication is certainly diffuse agricultural pollution with well documented problems of siltation and phosphate. There is a Diffuse Water Pollution Plan in place to reduce the impact from agriculture. There may be some minor impact from non-mains drainage, internal lake sediments and bird populations. The primary issues are with sediment and phosphate - the question is whether there is enough of a problem with nitrate to justify designating the catchment of Thurstonfield Lough as an NVZ - it would certainly help reduce the contribution of agriculture to the eutrophication issues in this water body.
Final summary (2017)

2017 Recommendation: Designate
2013 Decision: Not Designated
2008 Decision: Not Designated

Lake Description:
Thurstonfield Lough was used as a supply for three mills, it is a very small shallow lake.

Why the lake should be designated as a Polluted Water (eutrophic):
Thurstonfield Lough is outside any current NVZ designation. There are no discharge consents within the proposed NVZ, the catchment is predominantly agricultural. Nitrogen concentrations are slightly elevated - total nitrogen is within the 1-2 mg/l threshold range. Reducing nitrogen input from agriculture should have a direct effect on nitrogen availability in the lake.

Nitrogen:
The 75th percentile TON concentration is 0.4 mg/l and mean annual TN is 1.3 mg/l, so TN is within the 1-2 mg/l threshold range. Mean summer TON declines to low levels, it is likely that phytoplankton growth was limited by the availability of nitrogen, and further reduction in nitrogen would extend this limitation.

Phosphorus:
The WFD classification for total phosphorus is Moderate status.

Ecological response:
Chlorophyll and overall phytoplankton status for WFD are both Moderate status, indicating a eutrophic impact.

Supplementary evidence:
Natural England reported extensive filamentous algal growth in the lake after Canadian pondweed had been removed.
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