DATASHEET: Nitrate Vulnerable Zone (NVZ) designation
2017 - Surface Water

NVZ ID: S477  NVZ Name: Northfield Brook (Source to Thames) at Sandford NVZ

Publication Date: June 2016
This document contains a summary of the evidence used to designate NVZ S477 - Northfield Brook (Source to Thames) at Sandford. It was produced in June 2016 by the Environment Agency on behalf of the Secretary of State for Environment, Food and Rural Affairs.

Northfield Brook (Source to Thames) at Sandford is an existing catchment designation. There is currently one polluted sample point in the waterbody that designates this NVZ, and, in total, one polluted sample point in the entire NVZ including the designating waterbody and any area upstream of the designating waterbody. Our assessment of monitoring data shows that water quality in this NVZ has remained stable in the 2017 NVZ review period compared to the previous NVZ review. Based on our assessment of monitoring data we have high confidence that the water is polluted. We did not use modelling evidence in proposing this designation, because the proposed NVZ is smaller than the minimum size that we can apply the land use model with confidence. Water quality has neither improved nor deteriorated sufficiently to require a change in NVZ status, therefore it is proposed that the existing designation is retained.

The contribution of agriculture to the observed nitrate pollution in this NVZ has been assessed and we are confident that agriculture is an important contributor to nitrate pollution.
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1 Introduction

NVZ name: Northfield Brook (Source to Thames) at Sandford
NVZ ID: S477

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 surface water NVZs, available via apps.environment-agency.gov.uk/wiyby/141443.aspx. These methods were developed under the guidance of a review group convened by the Department for Environment, Food & Rural Affairs 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.

Under the surface water method an NVZ is designated if the water is affected by pollution or could be affected by pollution.

Please note that the area of NVZ designation may change during the appeals process. The definitive NVZ area can be seen on the What's in Your Backyard (WIYBY) website apps.environment-agency.gov.uk/wiyby/141443.aspx.

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1.1 Core principles

1. Each NVZ review takes the previous designations as its starting point and most designations are continuations of those designations.
2. Evidence of pollution is based on a combination of monitoring data, recent and longer term trends, and modelled data.
3. A water is affected by pollution if our monitoring or modelling evidence, or a combination of the two, confidently calculates that the 95th percentile\(^1\) concentration of nitrate exceeds 50 mg l\(^{-1}\) (as nitrate (NO\(_3\))).
4. A water could be affected by pollution if our monitoring evidence indicates 95th percentile concentrations will exceed 50 mg l\(^{-1}\) nitrate in the near future (2020).
5. We include all inorganic nitrogen (N) compounds in our assessment, not just nitrate. 50 mg l\(^{-1}\) nitrate (as NO\(_3\)) is equivalent to 11.3 mg l\(^{-1}\) nitrogen (as N). As nitrogen can readily transform we include all commonly monitored forms of inorganic nitrogen; nitrate, nitrite and ammonium (referred to as Total Inorganic Nitrogen (TIN) when summed). All water quality data presented here is TIN and is compared to 11.3 mg l\(^{-1}\) to determine if the water is affected by pollution or could be affected by pollution.
6. If a sample point is downstream of a sewage treatment works or other point source consented discharge\(^2\) we assess whether the sample point is representative of the wider water quality of the catchment, in terms of TIN. We do not automatically discount such sample points as a comprehensive screening procedure is used to determine if a sample point should be removed from our analysis.
7. We use the Water Framework Directive river waterbodies as our units of assessment. If one part of that waterbody is affected by pollution or could be affected by pollution then the entire waterbody is designated. This is the case even if the sole monitoring point that shows evidence of pollution is in the upper (upstream) section of the waterbody and downstream monitoring points show no evidence of pollution. For ‘catchment’ designations the designated NVZ is all land that drains to the designating waterbody. For ‘waterbody’ designations the designated NVZ covers only the designating waterbody.
8. All existing designations are continued unless we can be confident that the water is no longer affected by pollution and will not become affected by pollution. We have already considered whether existing designations are eligible for removal.
9. The development of proposed designations involves close working between national and area office Environment Agency staff with quality assurance through discussions at workshops.

We review the evidence every four years, and we believe that NVZ designation is justified in the area that is described in this data sheet.

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\(^1\)A 95th percentile is the value exceeded by 5% of samples. It is used instead of a maximum value as it is more stable and less sensitive to extreme events.

\(^2\)Consented discharge means all point source discharges that are consented to discharge to controlled waters by the Environment Agency. This includes sewage treatment works (sometimes also referred to as waste water treatment works), industrial discharges, private sewage discharges, intermittent sewage discharges, landfills & all other discharge types.
2 Basic information

Table 1: Designation summary

<table>
<thead>
<tr>
<th>NVZ ID</th>
<th>NVZ Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>S477</td>
<td>Northfield Brook (Source to Thames) at Sandford</td>
</tr>
</tbody>
</table>

Area (km²) 17.96
NVZ status Existing
NVZ type (catchment/waterbody) catchment
Designating WFD waterbody GB106039030180
% of this NVZ previously designated as surface water NVZ 100
% of this NVZ previously designated as any NVZ 100

Designations under the surface water method use a combination of monitored and modelled information. Water quality data from our monitoring and modelling assessments are put into one of six classes, where enough data is available, that reflects how confident we are that the 95th percentile will exceed 11.3 mg/l. We combine the monitoring and modelled data using the matrix shown in figure 1 to identify those waters that are affected by pollution or could be affected by pollution. The combinations marked in red indicate a new designation should be recommended where there is not an existing NVZ designation (an ‘X’ indicates that extra checks should be undertaken before a designation is proposed). Where there is already an NVZ designation, the designation is continued unless there is sufficient evidence for de-designation.

Figure 1: Evidence matrix used to determine if waterbody is subject to nitrate pollution

The 1 to 6 classes used in the matrix are explained in table 2. A class of zero is given where there are no suitable sample points within the waterbody, so a monitoring class can’t be given, or where the waterbody was not large enough to be used in the modelling assessment.
Table 2: Matrix class descriptions

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High confidence 95th percentile concentration is below 11.3 mg/l^-1</td>
</tr>
<tr>
<td>2</td>
<td>Moderate confidence 95th percentile concentration is below 11.3 mg/l^-1</td>
</tr>
<tr>
<td>3</td>
<td>Low confidence 95th percentile concentration is below 11.3 mg/l^-1</td>
</tr>
<tr>
<td>4</td>
<td>Low confidence 95th percentile concentration is above 11.3 mg/l^-1</td>
</tr>
<tr>
<td>5</td>
<td>Moderate confidence 95th percentile concentration is above 11.3 mg/l^-1</td>
</tr>
<tr>
<td>6</td>
<td>High confidence 95th percentile concentration is above 11.3 mg/l^-1</td>
</tr>
<tr>
<td>0</td>
<td>Monitoring or modelling classification not available</td>
</tr>
</tbody>
</table>

The designating waterbody has had the following catchment scores in the last three NVZ reviews (table 3);

<table>
<thead>
<tr>
<th>Monitoring scores</th>
<th>Modelling scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 6</td>
<td>2013 0</td>
</tr>
<tr>
<td>2017 6</td>
<td></td>
</tr>
</tbody>
</table>

Northfield Brook (Source to Thames) at Sandford is an existing catchment designation. Our assessment of monitoring data shows that water quality in this NVZ has remained stable in the 2017 NVZ review period compared to the previous NVZ review. Based on our assessment of monitoring data we have high confidence that the water is polluted. We did not use modelling evidence in proposing this designation, because the proposed NVZ is smaller than the minimum size that we can apply the land use model with confidence. Water quality has neither improved nor deteriorated sufficiently to require a change in NVZ status, therefore it is proposed that the existing designation is retained.

Figure 2 shows the area covered by this NVZ.

- The pink outline indicates the extent of this NVZ.
- The yellow area shows any surrounding area covered by other surface water NVZs.
- The black hatched area shows the designating waterbody that is either affected by pollution or could be affected by pollution.
Figure 2: Overview of designated catchment

NVZ ID: S477 - NVZ Name: Northfield Brook (Source to Thames) at Sandford NVZ
3 Monitoring Evidence

Table 4: Summary of monitoring evidence

<table>
<thead>
<tr>
<th>NVZ</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sample points in the designating waterbody</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Number of sample points in the entire designated NVZ</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Number of sample points with 95\textsuperscript{th} percentile TIN greater than 11.3 mg\textsuperscript{-1} in the designating waterbody</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Number of sample points with 95\textsuperscript{th} percentile TIN greater than 11.3 mg\textsuperscript{-1} in the entire designated NVZ</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Most polluted sample point in the designating waterbody</td>
<td>PTHR0048</td>
<td></td>
</tr>
<tr>
<td>Current monitored 95\textsuperscript{th} percentile concentration (class)</td>
<td>20.4 mg\textsuperscript{-1} (6)</td>
<td></td>
</tr>
<tr>
<td>High confidence lower and upper bounds for current monitored 95\textsuperscript{th} percentile concentration</td>
<td>17.97 mg\textsuperscript{-1} - 23 mg\textsuperscript{-1}</td>
<td></td>
</tr>
<tr>
<td>Moderate confidence lower and upper bounds for current monitored 95\textsuperscript{th} percentile concentration</td>
<td>19.7 mg\textsuperscript{-1} - 21.77 mg\textsuperscript{-1}</td>
<td></td>
</tr>
<tr>
<td>Trend (future) 95\textsuperscript{th} percentile concentration (class)</td>
<td>20.18 mg\textsuperscript{-1} (5)</td>
<td></td>
</tr>
<tr>
<td>High confidence lower and upper bounds for trend 95\textsuperscript{th} percentile concentration</td>
<td>9.78 mg\textsuperscript{-1} - 30.6 mg\textsuperscript{-1}</td>
<td></td>
</tr>
<tr>
<td>Moderate confidence lower and upper bounds for trend 95\textsuperscript{th} percentile concentration</td>
<td>16.08 mg\textsuperscript{-1} - 24.5 mg\textsuperscript{-1}</td>
<td></td>
</tr>
</tbody>
</table>

There is currently one polluted sample point in the waterbody that designates this NVZ, and, in total, one polluted sample point in the entire NVZ including the designating waterbody and any area upstream of the designating waterbody. This is a catchment designation, only monitoring points relevant to a catchment designation are used in table 4, although all monitoring points are used in the counts at the top of table 4.

Figure 3 shows the time series of concentrations for the most polluted sample point in the designating waterbody. In figure 3 the circles represent each sample taken since 1990. The dark blue line represents the 95\textsuperscript{th} percentile over time. The green bar shows the current 95\textsuperscript{th} percentile. The green shaded areas show the uncertainty in the current 95\textsuperscript{th} percentile, we have high confidence that the current 95\textsuperscript{th} percentile lies within the light green shaded area and moderate confidence that the current 95\textsuperscript{th} percentile lies within the dark green shaded area. The right most dashed blue line represents mid-2020, where it crosses the dark blue line is the future (2020) 95\textsuperscript{th} percentile. The blue shaded areas from 2015 onward represent the uncertainty in the future 95\textsuperscript{th} percentile, we have high confidence that the future 95\textsuperscript{th} percentile lies within the light blue shaded area and moderate confidence that the future 95\textsuperscript{th} percentile lies within the dark blue shaded area.

Graphs for all monitoring points in this NVZ designation are included in appendix 1.

Figure 4 shows the location of the monitoring points in the designating waterbody. The monitoring points are shown as coloured points, the colours show the monitoring class (1-6) of each point. The monitoring score per sample point is based on the highest of the current and future 95\textsuperscript{th} percentiles. The monitoring score is taken from the most polluted sample point in the designating waterbody.

In figure 4, the small crosses represent the outlets of consented discharges. Any monitoring point that is too close (within the mixing zone) to a consented discharge of nitrogen compounds and therefore not representative of the water quality of the waterbody or is otherwise not representative of the water quality within the waterbody is excluded from the analysis.
Figure 3: TIN as N time series for worst sample point in designating waterbody
Figure 4: Overview of monitoring locations and classes with point source locations
4 Modelling Evidence

Our modelling (referred to as the land use model) predicts the underlying risk of pollution from the land use within the proposed NVZ designation. It allows us to assess whether a waterbody is affected by pollution even if we have no monitoring data or where the monitoring data is not suitable for use in this assessment.

The land use model uses information on:

- Agricultural N losses
- Consented discharges
- Diffuse urban N losses
- Residential properties not connected to sewer networks

The water quality data used in the monitoring evidence chapter is also used in the development of the land use model.

Outputs from the land use model were not used in this designation. The land use model summary table (table 5) will contain NA (Not Available) values.

Table 5: Summary of catchment modelling evidence

<table>
<thead>
<tr>
<th>NVZ</th>
<th>Land use model 95th percentile concentration (class)</th>
<th>NA (0)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High confidence lower and upper bounds for land use model 95th percentile concentration estimate</td>
<td>NA - NA</td>
</tr>
<tr>
<td></td>
<td>Moderate confidence lower and upper bounds for land use model 95th percentile concentration estimate</td>
<td>NA - NA</td>
</tr>
</tbody>
</table>

Figure 5 shows how the model predictions vary across the designated area. If any waterbodies are not coloured on figure 5 this is because that the waterbody or the upstream area of the waterbody has an area less than 20 km². Figure 5 is included even if the land use model was not used in this designation.
Figure 5: Landuse modelling predictions
5 Supporting Evidence

5.1 Contribution of agriculture to nitrogen losses

5.1.1 Sectoral load apportionment from land use analysis inputs

We consider a range of the most important nitrogen sources in an NVZ designation in our land use analysis. Based on the data that is input to that analysis, we can estimate the contribution of each source to the total losses of nitrogen within the designated area.

Load apportionment estimates are not available for this NVZ designation.

Regardless of whether load apportionment estimates are available for this NVZ, a full list of discharges is included in appendix 2.
5.1.2 Sectoral load apportionment from SEPARATE\textsuperscript{3} framework

SEPARATE (SEctor Pollutant AppoRtionment for the AquaTic Environment) is a national scale multiple pollutant source apportionment framework developed by ADAS, Rothamsted Research, Centre for Ecology and Hydrology and the Environment Agency. SEPARATE uses data on sources of total nitrogen including agricultural practice, sewage treatment works, combined sewer overflows, storm tanks & septic tanks to apportion the load input to the aquatic environment into individual sectors.

Outputs from the SEPARATE model are not available for this NVZ designation.

5.1 Contribution of agriculture to nitrogen losses

5.1.3 Sectoral load apportionment from SIMCAT-SAGIS

SIMCAT (SIMulated CATchment) is a well-established river water quality model with a long history of use in the UK. It has recently been incorporated into a source apportionment framework, SAGIS (Source Apportionment Geographical Information System), to allow apportionment of a range of pollutants to various sectors, including agriculture. For catchment designations we provide the annual mean nitrate as N concentration SIMCAT predicts at the farthest downstream point of the proposed NVZ designation and the proportion of that concentration from diffuse sources\(^4\).

SIMCAT-SAGIS predictions are not available for this designation.

\(^4\)In SIMCAT-SAGIS diffuse sources include agriculture, but not solely agriculture. We provide the proportion from diffuse source figure to give context, and hopefully, corroboration to the other load apportionment methods presented above.
5.2 Land cover & livestock

We have used land cover and livestock information as part of the method to derive this designation. It is used to drive the NEAP N model\(^5\) and the estimate of urban N load\(^6\) which are both input to the land use model. We take our land cover and livestock data from the 2014 Defra June agricultural survey\(^7\). We have included the data below for this designation.

![Diagram showing land cover by area: Urban 667.96 (Ha), Arable 484.63 (Ha), Permanent grassland 264.32 (Ha), Rough grazing 191.38 (Ha), Woodland 177.25 (Ha).]

Figure 6: Landcover by area within proposed NVZ designation from 2014 Defra agricultural survey

<table>
<thead>
<tr>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle 299</td>
</tr>
<tr>
<td>Sheep 431</td>
</tr>
<tr>
<td>Pigs 102</td>
</tr>
<tr>
<td>Poultry 11260</td>
</tr>
<tr>
<td>Other livestock 54</td>
</tr>
</tbody>
</table>

Table 6: Count of livestock within proposed NVZ designation from 2014 Defra agricultural survey

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\(^7\) Defra, 2015. Agriculture in the United Kingdom 2014. HMSO.

NVZ ID; S477 - NVZ Name; Northfield Brook (Source to Thames) at Sandford NVZ
5.3 Agricultural load over time

Figure 7 shows how the nitrate available for leaching from agricultural sources, as predicted by the ADAS NEAP N model\textsuperscript{8}, varies over time for this NVZ designation. The data is presented relative to a baseline (the year 2000). The NEAP N model uses long term average climate data, so changes in nitrate available for leaching is due primarily\textsuperscript{9} to changes in cropping and livestock within the NVZ.


\textsuperscript{9}NEAP N has been developed over time so a portion of any temporal variation may be due to changes to the model or model parameters.

Figure 7: Nitrate available for leaching across NVZ S477 relative to 2000 baseline due to cropping and livestock
5.4 Workshop discussion

As part of the designation process the Environment Agency held a series of workshops with EA area office staff and invited partners, including representatives from the farming industry.

The purpose of the workshops was to discuss any proposed NVZ designations where the evidence supporting designation was uncertain or contradictory, or where there were new or modified designations. We were not able to discuss every designation, but where discussion did take place abridged notes are provided below.

This designation was not considered a priority for workshop discussions.
6 Appendices

6.1 Appendix 1 - Sample point time series graphs

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Figure A1: PTHR0048 - NORTHFIELD BROOK AT SANDFORD
6.2 Appendix 2 - Discharge consent conditions

We present two figures for load from consented discharges (points sources). The maximum value is based on discharge consent conditions (the conditions consented discharges may not legally exceed). Therefore the maximum value represents the maximum possible legal load emitted from each discharge. The minimum value is based on information from flow and water quality monitoring and represents the most likely load from each discharge. Where there is not flow and water quality monitoring in place the minimum and maximum loads will be the same.

Table 7: Summary of sources of nitrogen compounds within NVZ S477

<table>
<thead>
<tr>
<th>Source type</th>
<th>Source sub-type</th>
<th>Source name</th>
<th>Lower load (N kg yr(^{-1}))</th>
<th>Upper load (N kg yr(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point source</td>
<td>Sewage Disposal Works - water company</td>
<td>OXFORD STW</td>
<td>375213</td>
<td>375213</td>
</tr>
<tr>
<td>Point source</td>
<td>Sewage Disposal Works - water company</td>
<td>OXFORD STW</td>
<td>375213</td>
<td>375213</td>
</tr>
<tr>
<td>Diffuse - agricultural</td>
<td>Permanent grassland</td>
<td>Losses from permanent grassland</td>
<td>435.1</td>
<td>435.1</td>
</tr>
<tr>
<td>Diffuse - agricultural</td>
<td>Rough grazing land</td>
<td>Losses from rough grazing land</td>
<td>77.14</td>
<td>77.14</td>
</tr>
<tr>
<td>Diffuse - other</td>
<td>Woodland and inland water</td>
<td>Losses from woodland and inland water</td>
<td>83.21</td>
<td>83.21</td>
</tr>
<tr>
<td>Diffuse - urban</td>
<td>Diffuse urban N</td>
<td>Various losses from urban areas</td>
<td>1372</td>
<td>1372</td>
</tr>
<tr>
<td>Diffuse - septic tanks</td>
<td>Septic tanks N</td>
<td>Discharges from septic tanks for residential properties</td>
<td>103.9</td>
<td>103.9</td>
</tr>
<tr>
<td>Diffuse - agricultural</td>
<td>Arable land</td>
<td>Cropping practices, applied fertilisers and atmospheric deposition to arable land</td>
<td>6612</td>
<td>6612</td>
</tr>
</tbody>
</table>
End of document
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