

Technical note:

Application of the NLT and Farmscoper models to Newbald Becksies

1. Introduction

This note describes the application of two models of nitrate leaching (or the risk of nitrate leaching) from agricultural land. The Environment Agency Nitrate Leaching Tool (NLT) and the ADAS Farmscoper models have been applied to estimate nitrate leaching from the catchment to the Newbald Becksies SSSI in East Yorkshire.

Section 2 of the note provides a very brief overview of the two models. Section 3 describes the input data requirement of the two models, and Section 4 the application of the two models to the Newbald Becksies catchment.

2. Overview of the NLT and Farmscoper

This note compares the application of two models of nitrate leaching from agricultural land.

Nitrate Leaching Tool

The Nitrate Leaching Tool (NLT) has been developed by the Environment Agency to enable predictions of the risk of nitrate leaching from agricultural land, at field scale and, by aggregation, at catchment scale. The tool is built of a geodatabase which includes Base Data for every RPA-registered field in England. The user is required to enter information on cropping and livestock.

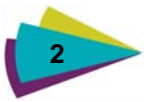
The NLT distinguishes between three land use types and applies a separate algorithm for each of them to calculate residual N.

- ▶ Arable and Vegetable Crops: Simple balance approach, $\text{Residual N} = \text{Input N} - \text{Output N}$
- ▶ Grassland: N-Cycle model
- ▶ Outdoor Pigs and Lowland Sheep: Arable based algorithm using coefficients derived from Farmscoper

The residual N, once calculated with the above algorithms, can then be modified by:

- ▶ Allowance for any uncultivated headland in the field;
- ▶ Application of mitigation options;
- ▶ Minimum Residual N = 20kgN/ha (not applicable to N-Cycle).

The proportion of residual N lost by leaching is then calculated via a formula derived from the NEAP-N model (not applicable to N-Cycle)



Farmscoper

The ADAS Farmscoper 3 model is a decision support tool that can be used to assess diffuse agricultural pollutant loads on a farm and quantify the impacts of farm mitigation methods on these pollutants. It requires data on the management of the farm's land and livestock, and generates predictions of nutrient loadings by sector and pathway. It can also be used to assess the impact of the application of multiple mitigation measures on pollutant losses (although that functionality has not been utilised here). The algorithm in Farmscoper which is used to estimate nitrate leaching is based on the existing national-scale NEAP-N model, which has been applied to each combination of soil series and climate that occurs in England and Wales. Area-weighted average nutrient losses were then calculated for each of 18 soil-climate combinations (3 soil types and 6 climate zones). No further quantitative details of the numerical algorithms used in the Farmscoper model are available.

3. Input Data Requirement – for N leaching calculations

3.1 Overview

This section discusses the minimum data requirement of the NLT and Farmscoper models to enable predictions of nitrate leaching, which is the basic function of both the models. Additional data will be required in order to use additional model functionality such as assessment and optimisation of mitigation measures, farm economics and so on. However, this functionality differs significantly between the models (and not all such functionality is available in the NLT) so cannot easily be compared.

Both models aim to simplify the process of data entry, either by providing multiple choice data entry options (for example, Farmscoper offers a choice of rainfall bands, rather than requiring the user to enter a value for annual rainfall) or by providing default, typical values for variables (the NLT crop templates, for example, offer a complete model description of each major crop).

The key difference between the NLT and Farmscoper is one of scale. The NLT is a field scale tool, and all data input apply to an individual field. Of course, many data will not vary between fields on a farm (eg soil type, HER), but values can be varied individually as required. In contrast, Farmscoper operates at farm scale. Individual crops and land uses are modelled rather than individual fields. Results are output for land use categories (arable; grassland etc) rather than individual fields.

3.2 Farmscoper

Table 3.1 provides a summary of farm scale information required by the Farmscoper model. Table 3.2 provides a summary of additional information required for each livestock type or crop type.

Table 3.1 Farm scale input data

| Input data | Comment |
|--|--|
| Rainfall | Multiple choice from 6 bands |
| Soil type | Multiple choice from 2 options: "free draining" or "other" |
| Drainage status | If soil type is not "free draining". Multiple choice from drained or not drained, for arable and grassland. |
| Farm type | Select a model farm type from a drop-down list, or "blank farm". This provides a template farm structure (areas of various crops and livestock numbers), which can then be customised |
| Field operations (optional) | Each model farm type has a default set of field operations associated with it (e.g. rolling, disking, ploughing). These can be changed if required. |
| Landscape data (optional) | Proportion of fields next to watercourses, or with organic soils, and information on field boundary types (walls, hedges etc). Default values are provided which can be changed if required. |
| Manure management and animal husbandry data (optional) | Multiple choice options for management of dirty water, extensive or intensive grazing, whether livestock have access to watercourses, or cross watercourses. Default values are provided which can be changed if required. |

Table 3.2 Crop and Livestock input data

| Input data | Comment |
|--|--|
| Crop data (data entered for each crop present) | |
| Area of crop grown (ha) | A fixed list of crop types are supported |
| Inorganic fertiliser applied (kg-N/ha/yr) | |
| Organic fertiliser applied | The proportion of manure that is generated on the farm that is spread to the crop. Individual figures for each of 6 manure types. |
| Livestock data (data entered for each livestock type present) | |
| Number of livestock | Detailed sub-categories are included. For example, for beef cattle the user must enter information for 7 sub-categories. |
| Manure management | Proportion of livestock manure that is managed as slurry (for each sub-category of livestock type). |
| Details of grazing and manure management (optional) | Detailed information on, for example, manure nutrient content, livestock grazing period etc. Default values are provided which can be changed if required. |

3.3 Nitrate Leaching Tool

Table 3.3 provides an overview of the NLT Basedata. These data can be exported from the GIS geodatabase and do not need to be entered directly the user. The database values can be over-riden by the user if required. Data are required for each field.



Table 3.3 NLT Basedata

| Input data | Comment |
|---|--|
| Field area | Agreed area (ha) |
| Soil depth (mm) | Based on soil series data (NSRI) |
| Soil stored water (field capacity) (mm) | Based on soil series data (NSRI) |
| HER (mm) | Derived from NEAP-N |
| SPR (%) | Based on soil series data (NSRI) |
| RPA land use | A broad categorisation, not a crop type. |

In addition, the user is required to enter crop or livestock and management data for each field, as shown in Table 3.4.

Complete crop templates are provided which include default values for all input data, so the user only has to enter a crop type for each field. Alternatively, any or all of the default values may be overwritten as necessary. The minimum data requirement for each field is therefore simply a crop type or livestock type, with everything else only required if default values are not to be used.

Table 3.4 NLT Field data

| Input data | Comment |
|---|---|
| Crop type | Selected from a list in a user form |
| Uncultivated margin (m) | |
| Inorganic fertiliser applied (kg/ha) | |
| SNS Index | |
| Manure application type and rate | Selected from a list in a user form Up to 2 applications may be specified. The NLT also requires manure application timing information, although this is not actually used by the NLT. |
| Crop data (for arable fields only) | |
| Crop yield (t/ha) | Tables of literature values are provided in the NLT. |
| Crop N content (%) | Tables of literature values are provided in the NLT. |
| Livestock data (for grazed fields only) | |
| Livestock type | Selected from a list in a user form |
| Stocking rate (Low/medium/high) | Selected from a list in a user form |
| Grazing period (months) | |

4. Application to Newbald Becksies wetland site

4.1 Introduction

The NLT and Farmscoper models have been applied to estimate nitrate source apportionment to Newbald Becksies SSSI in East Yorkshire. The purpose of this section is to compare the results from the two models,

for input data which are as near as possible identical. The remainder of this section describes the assumed catchment to the site, land use and potential sources of nitrate within the catchment, model setup and results, and a brief discussion of the differences and similarities between the models.

4.2 Catchment and land use

There is some uncertainty as to the catchment area draining to the site, and this is discussed in a separate note (ref 38884D013, March 2017). For the purposes of modelling, the catchment to the site has been divided into four areas: north-east, north-west, south-east and south-west.

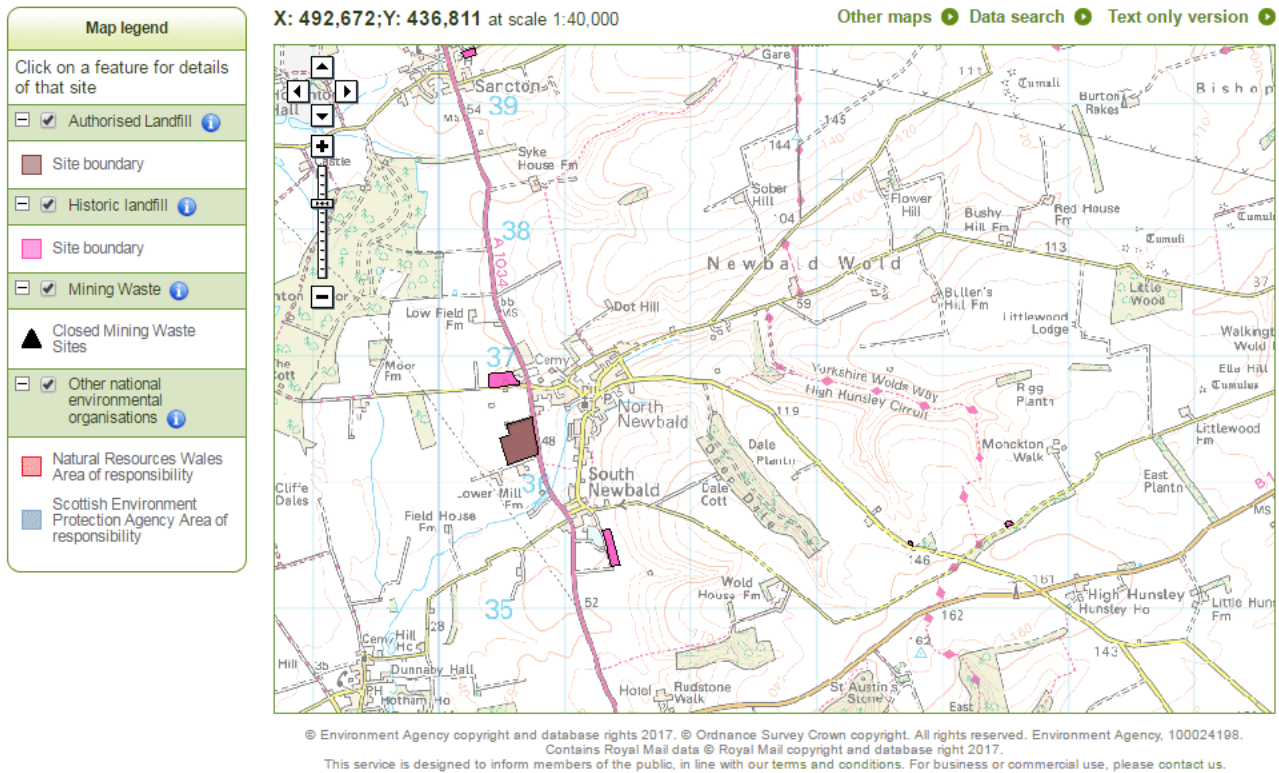
The following potential sources of nitrate to groundwater have been identified:

- ▶ Leaching of nitrate from agricultural soils;
- ▶ Leaching of nitrate from soils on the site itself (atmospheric deposition and mineralisation);
- ▶ Leaching of nitrate from manure heaps in the catchment (there are unlikely to be many given the low numbers of livestock within the catchment. However, there is a horse paddock on the opposite side of Beverley Road to Newbald Becksies where there may be a small manure heap);
- ▶ Leakage from septic tanks at dwellings within the catchment not connected to mains sewers;
- ▶ Sewer leakage from mains sewers serving the dwellings within the catchment; and
- ▶ Mains water leakage from water mains serving the dwellings within the catchment.

The following, while potentially sources of nitrate, have been discounted as not present within the catchment:

- ▶ Graveyards or cemeteries (there are no cemeteries within the catchment as it is currently defined but it is noted there is a cemetery located close to the western boundary of the catchment in North Newbald);
- ▶ Landfills (there are no landfill sites within the catchment as it is currently defined but it is noted that there are four located close to the western boundary of the catchment, refer to Figure 4.1);
- ▶ Animal burial sites; and
- ▶ Farm slurry stores.

Figure 4.1 Authorised and Historic Landfill Sites (Environment Agency, What's in your backyard?)



4.3 Land management scenarios

The degree of nitrate leaching from managed agricultural land in the catchment is a function of land management (fertiliser applications and livestock stocking rates). The details of this management within the catchment of Newbald Becksies are not known, and assumptions have been made in order to construct a number of feasible scenarios.

The general assumptions for the nitrate modelling are:

- ▶ Arable crop rotation is winter OSR, winter wheat, spring barley and vining peas (this is considered to be a plausible rotation given the observed area of OSR. Whilst we do not know the local agricultural practices, feedback received to date from the project steering group suggests our assumptions are appropriate);
- ▶ Soil is free draining with low organic matter (<http://www.landis.org.uk/soilscapes/>);
- ▶ No manure is applied to arable land due to low livestock numbers – all fertiliser is inorganic; and
- ▶ Soil Nitrogen Supply (SNS) is low (Index 1).

Average rainfall in the area is 660 mm¹, and so average summer rainfall will be around 330 mm (half of the annual total). For shallow soils over Chalk this results in an RB209 grass growth class of “average”.

The assumptions behind the definitions of the scenarios are summarised in Table 4.1, and the proposed model scenarios are described in Table 4.2. Once the detail of the land use and management has been agreed, further scenarios can be defined using a feasible range of fertiliser and stocking rates.

¹ Average rainfall 2004-2016 at Newbald Becksies according to data provided by Environment Agency

Table 4.1 Summary of catchment data and assumptions

| Variable | Total | North East | North West | South East | South West |
|----------------------------|--|------------|------------|------------|------------|
| Soil type | Loamy, shallow, free draining | | | | |
| Annual rainfall | 660 mm/yr | | | | |
| Summer rainfall | 330 mm (half of the annual total rainfall) | | | | |
| RB209 grass growth class | Average | | | | |
| Area of arable fields (ha) | 886.7 | 146.8 | 214.4 | 234.5 | 291.1 |
| Area of grazed grass (ha) | 101.5 | 1.7 | 8.2 | 60.8 | 30.8 |
| Area of rough grazing (ha) | 14.2 | 0 | 0 | 14.2 | 0 |
| Area of woodland (ha) | 48.4 | 0 | 2.5 | 12.4 | 33.5 |
| Urban area (ha) | 8.0 | 0 | 8.0 | 0 | 0 |

Table 4.2 Land Management Scenarios

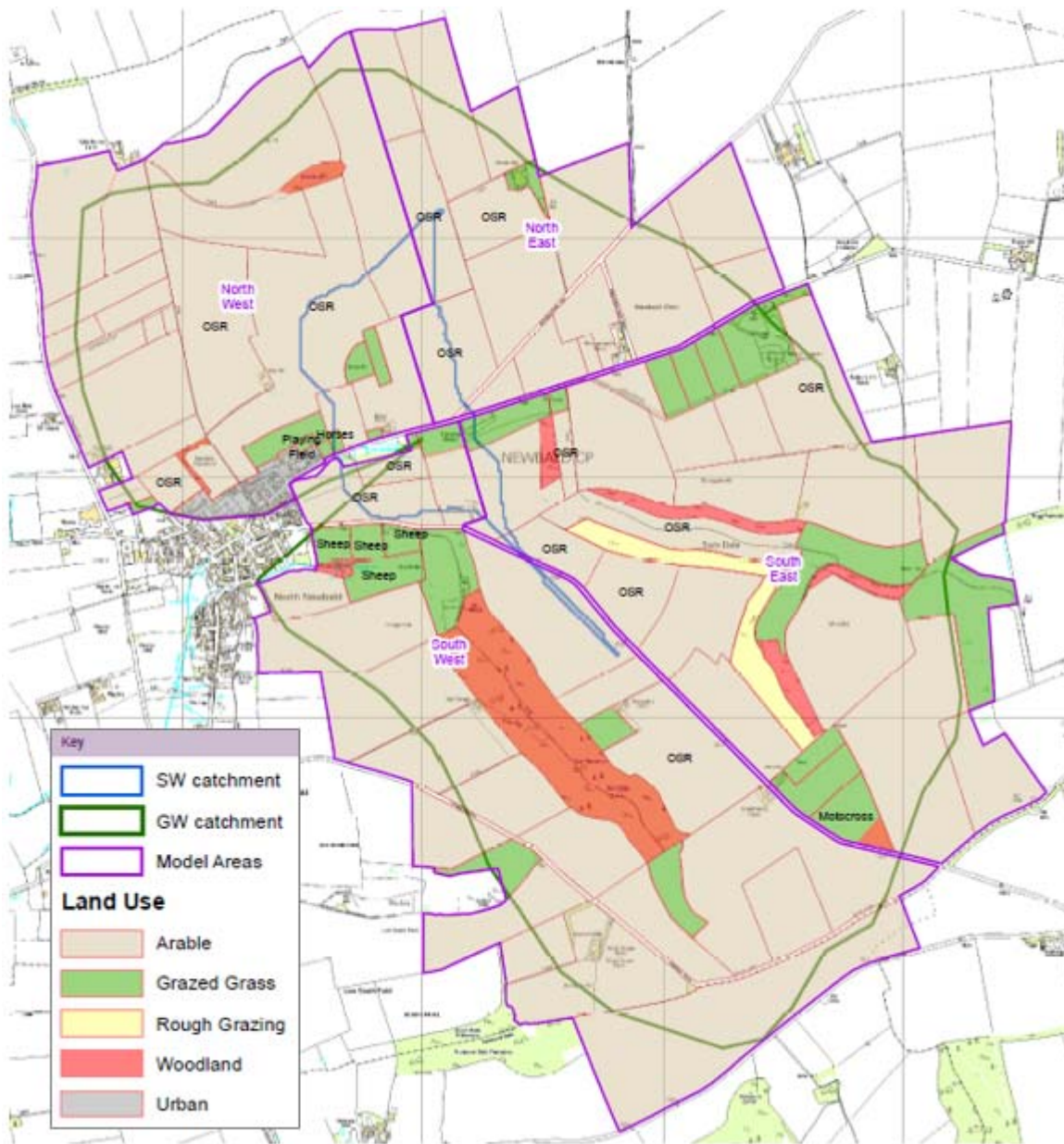
| Land Use / Scenario No. | Nitrogen Fertiliser Rate | Stocking Rate (LU/ha) | Comments |
|-------------------------|--------------------------|---|---|
| Winter oil seed rape | 220 kg/ha inorganic | N/A | The RB209 fertiliser rate for a SNS index of 1. |
| Winter wheat | 240 kg/ha inorganic | N/A | The RB209 fertiliser rate for a SNS index of 1. |
| Spring Barley (malting) | 120 kg/ha inorganic | N/A | The RB209 fertiliser rate for a SNS index of 1. |
| Vining Peas | 0 kg/ha | N/A | The RB209 fertiliser rate for a SNS index of 1. |
| Grazed Grass | 170 kg/ha | 1.5 LU/ha (9 ewes plus lambs per hectare) | Assumed no manure spread to grazed grass. |
| Rough Grazing | Zero inorganic | 0 LU/ha | Assumed no manure spread to rough grazing. |
| Woodland | Zero inorganic | N/A | |

Notes: Soils are shallow and free draining and rainfall is "moderate" at 660 mm/yr. For fields previously in cereals, RB209 guidance suggests a low SNS index of 1 would be expected. For fields previously in OSR or peas an index of 2 might be expected.

Farmscoper Input data

For the Farmscoper model, it was necessary to estimate land use in each of the model sub-catchments from satellite imagery, and then, within a GIS, estimate the area of arable land, grassland, forestry etc. The resulting estimated land use is shown in Figure 4.3.

Figure 4.2 Land Use in the groundwater catchment of Newbald Beckies. The purple boundaries indicate the four sub-catchments used for modelling.



Fields where there is evidence (satellite imagery) that oil seed rape (OSR) has been grown have been labelled with 'OSR' on Figure 4.3. In practice the OSR will be within an arable rotation and we have assumed a plausible crop rotation, which is further described in Section 4.3.

NLT Input data

The NLT includes a GIS database of field boundaries and land use classifications, and the fields within each of the four sub-catchments were selected from this geodatabase within a GIS. The basedata for each of the fields were then exported for direct input to the NLT. These data are as described in

Table 3.3. The cropping within each arable field is not specified in the NLT geodatabase, and this was estimated from satellite imagery and local knowledge, as described in Section 4.3. Arable fields were randomly allocated to each of the four assumed arable crops, such that an approximately equal number of fields were assumed under each crop in the rotation.

For arable land, the NLT estimates the residual nitrate at risk of leaching post-harvest. In practice, in an arable rotation, not all of this nitrate will leach, and some will be taken up by the following crop. In order to simulate this effect, the NLT was set up with **cover crops applied to all arable land**. Of course, it is not suggested that all arable fields in the catchment actually have cover crops in place, but this assumption is considered more realistic than assuming that all arable fields are left fallow post-harvest, which is clearly unlikely on a commercial farm. The effect of this is to reduce the simulated leaching from arable land by approximately 50%, relative to the baseline simulation which assumes no autumn uptake of nitrogen by a following crop.

The selected fields are shown in Figure 4.2 and the BaseData summarised in Tables 4.1 and 4.2. Note that there are some differences between the areas of each land use estimated from satellite imagery (Table 4.1) and from the NLT Basedata (Table 4.4).

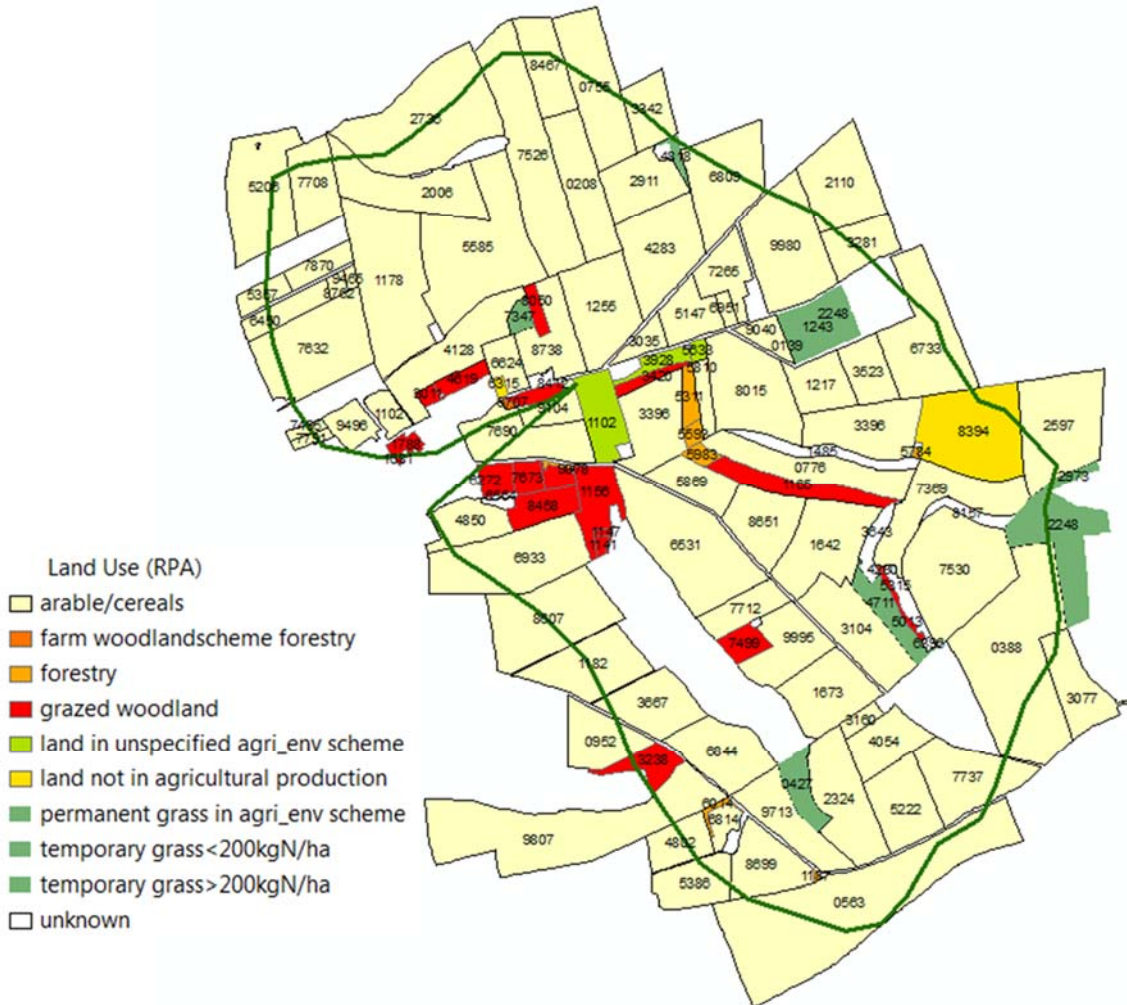
Table 4.3 Field areas, soils data and effective rainfall

| | Min | Mean | Max |
|-------------------|-------|-------|-------|
| Field area (ha) | 0.0 | 7.9 | 44.1 |
| Soil depth (cm) | 30 | 60.4 | 150 |
| Stored water (mm) | 125 | 198.6 | 270 |
| HER (mm) | 217.3 | 239.6 | 268.6 |

Table 4.4 Distribution of land use within Newbald Becksies catchment (NLT BaseData)

| Variable | Total | North East | North West | South East | South West |
|----------------------------|-------|------------|------------|------------|------------|
| Area of arable fields (ha) | 872.1 | 147.2 | 199.0 | 224.1 | 301.8 |
| Area of grazed grass (ha) | 73.6 | 1.0 | 6.8 | 36.0 | 29.8 |
| Area of rough grazing (ha) | 33.8 | 0.0 | 3.1 | 23.7 | 7.0 |
| Area of woodland (ha) | 14.2 | 0.0 | 0.0 | 12.7 | 1.5 |

Figure 4.3 Fields within the Newbald Becksies catchment selected from the NLT geodatabase. Fields are labelled with field numbers. Gaps in the field map represent areas of non-agricultural land (mainly woodland and urban areas).



4.4 Non-agricultural sources and agricultural point sources of nitrate

Input data relevant to the calculation of other potential sources of nitrate are as shown in Table 4.5. These values have been estimated from OS mapping data.

Table 4.5 Groundwater catchment input data: Non-agricultural sources and agricultural point sources

| Parameter | North West | North East | South West | South East | Comment |
|---|------------|------------|------------|------------|--|
| Sewered Population | 115 | 0 | 0 | 0 | Approx. 50 dwellings, average 2.3 people per household. |
| Population served by septic tanks / Package Treatment Plants | 3 | 7 | 9 | 5 | Approx. 10 dwellings, average 2.3 people per household. |
| Area of gardens | 1 ha | 0 | 0 | 0 | Assumed associated 50 houses in 8 ha urban area. |
| Area of manure heaps | 0.1 ha | 0 | 0 | 0 | Horse paddock on north side of Beverley Road, opposite North Newbald SSSI. |
| Area of paved and road surfaces | 0.4 ha | 0.4 ha | 0.9 ha | 0.9 ha | Approximately 6.4 km of road estimated at 4 m wide. |

4.5 Observed nitrate concentrations at Newbald Beckies

Observations of nitrate concentrations across the Newbald Beckies site have been collated by the Environment Agency and made available to the project. The observation sites are shown in Figure 6.4 and comprise two springs, three boreholes and a rain gauge. The discharge from the pipe that crosses the site (origin unknown) has also been monitored.

The monitoring data comprise observations taken at irregular intervals over the periods 2009-2010 and 2015-2016. Readings of nitrate concentrations are summarised in Tables 4.6 (2009-2010) and 4.7 (2015-2016). The observation sites are labelled in Figure 4.4 with the average concentration for the period 2015-2016.

Table 4.6 Observations of nitrate concentration (nitrate-N, mg/l) at Newbald Beckies 2009-2010

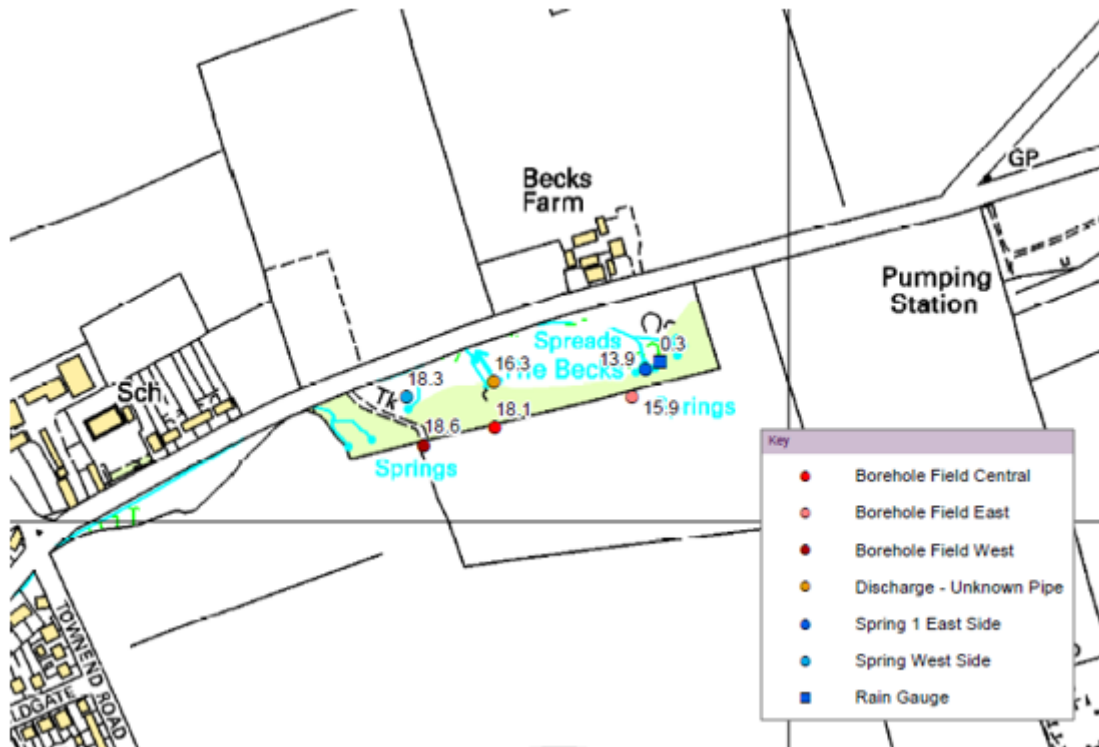
| Sample Point | First Sample | Last Sample | Min (mg-N/l) | Max (mg-N/l) | Average (mg-N/l) | No. of Records |
|-------------------------------------|--------------|-------------|--------------|--------------|------------------|----------------|
| Borehole Field Central | 30/07/2009 | 19/10/2010 | 16.6 | 18.0 | 17.4 | 7 |
| Borehole Field East | 30/07/2009 | 19/10/2010 | 14.8 | 16.8 | 15.8 | 7 |
| Borehole Field West | 30/07/2009 | 19/10/2010 | 17.5 | 19.8 | 18.5 | 7 |
| Spring 1 - East Side of Site | 30/07/2009 | 19/10/2010 | 12.3 | 15.0 | 13.5 | 6 |
| Discharge From Unknown Pipe | 30/07/2009 | 19/10/2010 | 15.5 | 17.2 | 16.3 | 7 |

Table 4.7 Observations of nitrate concentration (nitrate-N, mg/l) at Newbald Becksies 2015-2016

| Sample Point | First Sample | Last Sample | Min (mg-N/l) | Max (mg-N/l) | Average (mg-N/l) | No. of Records |
|------------------------------|--------------|-------------|--------------|--------------|------------------|----------------|
| Borehole Field Central | 05/11/2015 | 18/08/2016 | 18.0 | 18.3 | 18.1 | 3 |
| Borehole Field East | 05/11/2015 | 18/08/2016 | 14.9 | 16.5 | 15.9 | 3 |
| Borehole Field West | 05/11/2015 | 18/08/2016 | 18.2 | 19.1 | 18.6 | 3 |
| Spring 1 - East Side of Site | 05/11/2015 | 18/08/2016 | 13.1 | 14.7 | 13.9 | 3 |
| Spring - West Side Of Site | 05/11/2015 | 18/08/2016 | 18.2 | 18.4 | 18.3 | 3 |
| Discharge From Unknown Pipe | 05/11/2015 | 18/08/2016 | 15.5 | 16.7 | 16.3 | 3 |
| Rain Gauge | 08/12/2015 | 24/11/2016 | 0.1 | 0.6 | 0.3 | 10 |

Comparison of the 2009-2010 and 2015-2016 monitoring data suggests nitrate concentrations at Newbald Becksies have remained relatively constant since 2009 i.e. no apparent rising or falling trend. There is, however, some variation across the site. Nitrate concentrations are typically higher at the western end of the site compared to the eastern end. Spring discharges at the western end of the site were observed to be smaller during the site visit undertaken on 25 January 2017.

Figure 4.4 Newbald Becksies nitrate monitoring locations, and average nitrate concentrations (mg-N/l) in the 2015-2016 monitoring campaign.



4.6 Farmscoper modelling results

The ADAS Farmscoper model was used to predict nitrate leaching from each of the land uses and management scenarios described in Tables 4.1 and 4.2. The results are as shown in Table 4.8.

Table 4.8 Farmscoper predictions of nitrate leaching from each land use scenario

| | Nitrate Loss (kg-N/ha) | Soil drainage (mm) | Nitrate Concentration (mg-N/l) |
|---------------|------------------------|--------------------|--------------------------------|
| Grazed Grass | 15.28 | 181.23 | 8.43 |
| OSR | 50.61 | 249.03 | 20.32 |
| Winter Wheat | 31.75 | 249.03 | 12.75 |
| Spring Barley | 27.94 | 223.68 | 12.49 |
| Vining Peas | 52.53 | 223.68 | 23.49 |
| Woodland | 0.04 | - | - |
| Rough grazing | 4.01 | 247.76 | 1.62 |

Combined with the areas of each land use identified in each sub-catchment (as shown in Table 4.1), these predictions of nitrate leaching result in the catchment total figures shown in Table 4.9.

Table 4.9 Farmscoper predictions of nitrate leaching in each sub-catchment

| | North East | North West | South East | South West | Combined catchment |
|--------------------------------------|------------|------------|------------|------------|--------------------|
| Area (ha) | 148.5 | 233.1 | 321.9 | 355.4 | 1058.8 |
| Total nitrate-N loading (kg-N/yr) | 6001.0 | 8852.4 | 10530.6 | 12322.1 | 37706.1 |
| Total nitrate-N loading (kg-N/ha/yr) | 40.4 | 39.3 | 32.7 | 34.7 | 35.9 |
| Total drainage (mm/yr) | 235.7 | 231.7 | 217.3 | 209.3 | 220.3 |
| Average concentration (mg-N/l) | 17.1 | 17.0 | 15.1 | 16.6 | 16.3 |

4.7 NLT predictions of nitrate leaching

The NLT was used to predict nitrate leaching from each of the 126 individual fields in the Newbald Beckiesies catchment. Because there is variability in soil properties and hydrologically effective rainfall (HER) between fields, different fields with the same land use and cropping will not necessarily have the same predicted rate of nitrate leaching. The range of predicted loss rates for each land use is shown in Table 4.10.

Table 4.10 NLT predictions of nitrate leaching from each land use

| | Nitrate Loss (kg-N/ha) | | | Nitrate Concentration (mg-N/l) | | |
|----------------------------|------------------------|------|------|--------------------------------|------|------|
| | Min | Mean | Max | Min | Mean | Max |
| Arable:Spring Barley | 55.8 | 61.2 | 65.2 | 22.6 | 24.9 | 27.2 |
| Arable:Winter Oilseed Rape | 72.4 | 92.1 | 98.6 | 31.6 | 38.7 | 42.9 |
| Arable:Winter Wheat | 62.3 | 72.0 | 77.9 | 27.1 | 30.1 | 32.5 |
| Forestry | 3.9 | 3.9 | 3.9 | 1.5 | 1.6 | 1.7 |
| Lowland Sheep | 9.1 | 10.8 | 11.4 | 4.0 | 4.6 | 5.1 |
| Rough Grazing | 4.3 | 6.1 | 12.3 | 1.7 | 2.6 | 5.5 |
| Veg:Peas | 45.9 | 51.9 | 55.3 | 18.7 | 21.6 | 23.9 |

The field level results have been aggregated to sub-catchment scale, as shown in Table 4.11.

Table 4.11 NLT predictions of nitrate leaching in each sub-catchment

| | North East | North West | South East | South West | Combined catchment |
|--------------------------------|------------|------------|------------|------------|--------------------|
| Area (ha) | 148.1 | 208.9 | 296.6 | 340.0 | 993.7 |
| Total loss (kg-N/yr) | 9795.1 | 15038.1 | 14973.5 | 23028.4 | 62835.1 |
| Total loss (kg-N/ha/yr) | 66.1 | 72.0 | 50.5 | 67.7 | 63.2 |
| Total drainage (mm/yr) | 255.2 | 232.5 | 232.3 | 238.5 | 237.9 |
| Average concentration (mg-N/l) | 25.9 | 31.0 | 21.7 | 28.4 | 26.6 |

4.8 Point sources

Based on the figures shown in Table 4.5, the total nitrate loading from point sources and other non-agricultural sources has been calculated using the NLT. (It is not possible to estimate nitrate loading from point sources using Farmscoper). The results are as shown in Table 4.12. In all four sub-catchments, it is evident that non-agricultural sources are insignificant compared with the estimated leaching from agricultural land.

Table 4.12 Estimated nitrate loading from non-agricultural sources and agricultural point sources

| Source | Nitrate loading (kg-N/yr) | | | |
|-------------------------------------|---------------------------|--------------|-------------|--------------|
| | North East | North West | South East | South West |
| Sewer Leakage | 0 | 8.7 | 0 | 0 |
| Septic tank discharges | 11.5 | 4.9 | 8.2 | 14.8 |
| Mains leakage | 1.1 | 18.5 | 0.8 | 1.4 |
| Leaching from gardens | 0 | 5 | 0 | 0 |
| Leaching from manure heaps | 0 | 1 | 0 | 0 |
| Runoff from paved and road surfaces | 0.01 | 0.01 | 0.06 | 0.06 |
| Total | 12.61 | 38.11 | 9.06 | 16.26 |

4.9 Discussion

Across the catchment, the total predicted nitrate load leached from agricultural land and woodland is 37.7 tonnes N/yr (Farmscopers) compared with 62.8 tonnes N/yr (NLT).

The results for each land use are shown in Figures 4.5 and 4.6. The error bars on the NLT results reflect the highest and lowest values for all fields in the catchment of each land use, recalling that variability in soil properties between fields results in variability in predicted leaching from each land use. In contrast, Farmscopers predicts a single value for leaching from each land use.

Figure 4.5 Nitrate loading leached from each land use as predicted by the NLT and Farmscopers

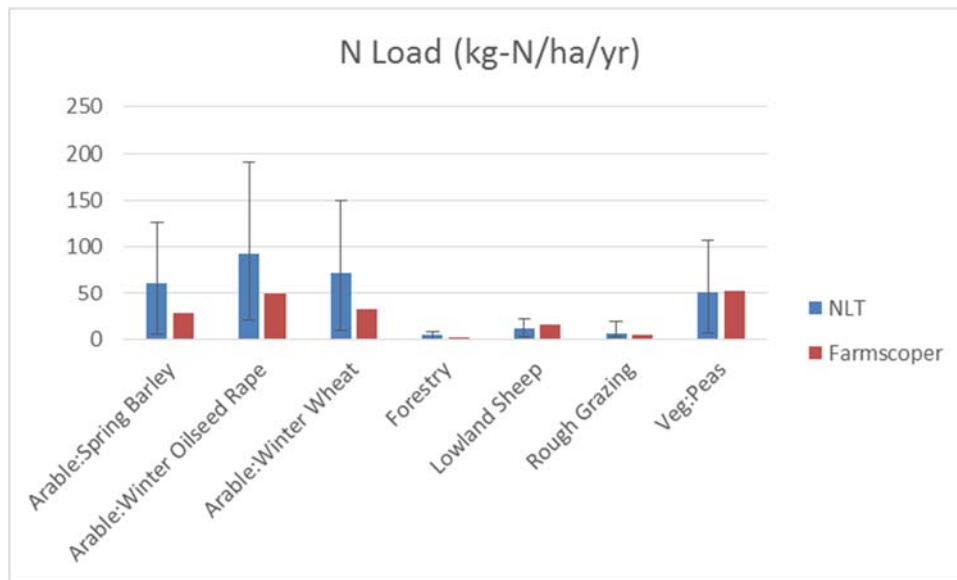
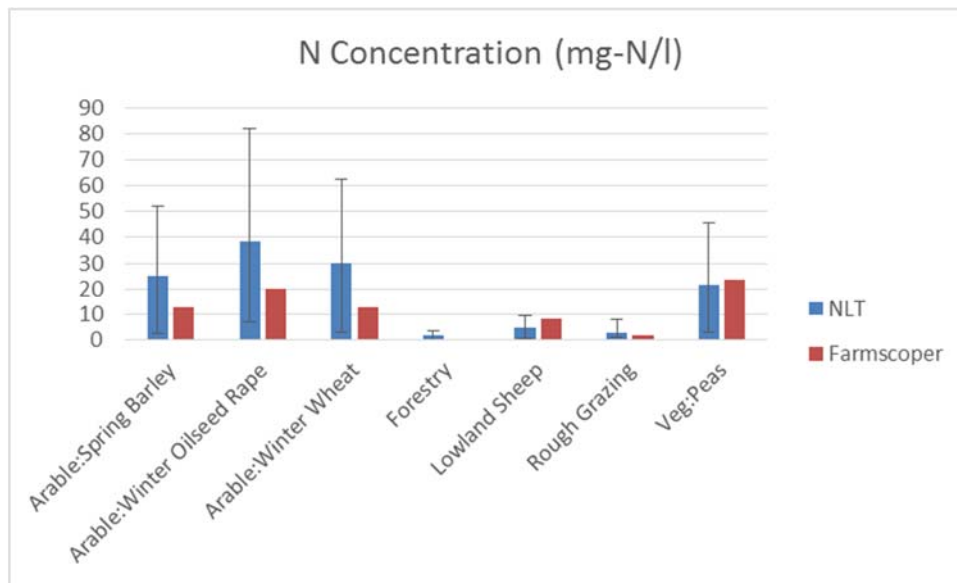


Figure 4.6 Nitrate concentration leached from each land use as predicted by the NLT and Farmscoper



In general, the Nitrate Leaching Tool predicts substantially higher leaching from arable land than Farmscoper, although the results for vining peas are very similar. Farmscoper predicts slightly higher leaching from grazed grassland than the NLT, and the results for rough grazing land and woodland are very similar.

Farmscoper predictions of nitrate concentrations in soil drainage are comparable with, or slightly lower than, observed nitrate concentrations in shallow groundwater at the site, while NLT predictions of nitrate concentrations are somewhat higher than observed.

Qualitatively, both models predict lower nitrate concentrations in the discharge from the southeast part of the catchment than from the other sub-catchments, and this is consistent with observed nitrate concentrations, which are lower in the eastern spring discharge than in the western spring.

It should be recalled that there is significant uncertainty in the modelled scenarios of land management, as well as in the understanding of the detail of how different parts of the catchment might influence the site.

5. Summary and conclusions

The Nitrate Leaching Tool (NLT) and Farmscoper have been applied to predict nitrate leaching from the catchment to the Newbald Becksies wetland site in East Yorkshire. Given incomplete knowledge of the catchment to the site, and land use and management within the catchment, assumptions have been made around nutrient use to enable the specification of input data for the models.

The following approaches to land use and management were applied:

- ▶ The NLT Basedata provide soils data and indicative land use, at field scale, for every field in the catchment;
- ▶ For Farmscoper, it was necessary to estimate land use from satellite imagery and carry out a separate GIS exercise to estimate the area of each land use present in the catchment;
- ▶ Point sources of nitrate were estimated using the parameters included in the NLT, but are not thought to be significant at the catchment scale;

The modelling results indicate:

- ▶ The NLT predicts substantially greater nitrate leaching from arable land (cereals and OSR) than Farmscoper, although the leaching from peas is similar in both models;
- ▶ Predictions of leaching from grassland and forestry are similar for the two models;

- ▶ Farmscoper predictions of nitrate concentrations in soil drainage are slightly lower than observed at Newbald Becksies. NLT predictions of nitrate concentrations in soil drainage are somewhat greater than are observed at the site;

The two models of nitrate leaching give differing estimates of nitrate loadings and concentrations in drainage to the site. There is some uncertainty in the predicted total catchment loading to the site, although compared with available monitoring data the NLT would appear to overestimate nitrate leaching.

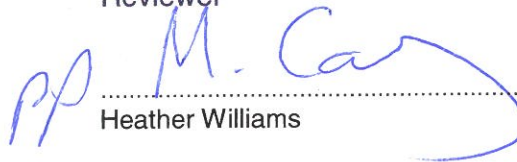
There remains also significant uncertainty in the conceptual model of the hydrology of the site, and further work is required to refine the current conceptual understanding before any targeted programme of measures can be put in place.

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Reviewer



Heather Williams

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