

Methodology to calculate the nitrogen budget for development in the Solent and achieve nitrogen neutrality

Introduction

- 1 There are high levels of nitrogen and phosphorus input to the water environment in the Solent with evidence that these nutrients are causing eutrophication at internationally designated sites. An Integrated Water Management Study for South Hampshire was commissioned by the Partnership for Urban South Hampshire (PUSH) Authorities to examine the delivery of development growth in relation to legislative and government policy requirements for designated sites and wider biodiversity.
- 2 This work has identified that there is uncertainty in some locations as to whether there will be sufficient capacity to accommodate new housing growth. There is uncertainty about the efficacy of catchment measures to deliver the required reductions in nitrogen levels, and/or whether the upgrades to waste water treatment works will be sufficient to accommodate the quantity of new housing proposed. The IWMS recommended that new housing developments could be brought forward albeit in a phased manner up to 2020; targeted to those areas with sufficient capacity. Beyond 2020; we are not yet able to demonstrate with certainty that there will be no adverse impact on European nature conservation designations
- 3 In light of this uncertainty, Natural England advises that a nitrogen budget – the principal nutrient that tends to drive eutrophication in the marine environment - is calculated for larger developments. This will show that development either avoids harm to European protected sites or provides the level of mitigation required to ensure that there is no adverse effect. For confidence that the development will be deliverable, Natural England recommends that the proposals achieve nitrogen neutrality by securing the required mitigation.
- 4 Mitigation can be 'direct' through upgrading sewage treatment works and through alternative measures, e.g. wetlands (see for example <http://www.balticdeal.eu/measures/wetlands-drainage-and-irrigation/>); or 'indirect' by offsetting the nitrogen generated from new development by taking land out of nitrogen intensive uses, e.g. where fertiliser is applied to crops. Mitigation measures will need to be secured for the duration over which the development is causing the effects, generally 80-125 years.
- 5 Natural England would be happy to provide further advice on the methodology and mitigation options through our [Discretionary Advice Service](#) (DAS).

Type of development

- 6 The methodology is for all types of development that would result in a net increase in population served by a wastewater system, including new homes, student accommodation, tourism attractions and tourist accommodation.
- 7 Other commercial development not involving overnight accommodation will generally not be included. It is assumed that anyone living in the catchment also

works and uses facilities in the catchment, and therefore wastewater generated by that person can be calculated using the population increase from new homes and other accommodation. This removes the potential for double counting of human waste water arising from different planning uses. Tourism attractions and tourism accommodation are exceptions as these land uses attract people into the catchment and generate additional wastewater and consequential nitrogen loading on the Solent. Serviced, tourist accommodation includes hotels, guest houses, bed and breakfasts and self-catering holiday chalets and static caravan sites.

- 8 There may be cases where planning applications for new industrial development or changes in agricultural practices could result in the release of additional nitrogen into the system. In these situations, a case by case approach will be adopted. Early discussions with Natural England via DAS are recommended.

Methodology

Stage 1 Calculate Total Nitrogen (TN) in kilograms per annum derived from the development that would exit the WWTW after treatment

Step 1 Calculate additional population

- 9 Determine the additional population that would use the proposed development based on well evidenced occupancy rates.

Step 2 Confirm water use

- 10 Determine the water use / efficiency standard for the proposed development to be defined in the planning application and, where relevant, the Environmental Statement. The nitrogen load is calculated from the scale of water use and thus the highest water efficiency standards under the building regulations will minimise the increase in nitrogen from the development. Each Local Planning Authority will impose a planning condition on all planning permissions for one or more net additional new dwellings requiring construction to the optional requirement¹ under G2 of the Building Regulations 2010. A model condition is set out below:

“The dwellings shall not be occupied until the Building Regulations Optional requirement of a maximum water use of 110 litres per day has been complied with.”

- 11 A different standard of water efficiency can be used in the calculation, provided this is secured by planning condition.

¹ The optional requirement referred to in G2 requires installation and fittings and fixed appliances for the consumption of water at 110 litres per person per day.

Step 3 Confirm WWTW and permit level

- 12 Identify the Waste Water Treatment Works (WWTW) that the development will use and identify the permit concentration limit for Total Nitrogen at the WWTW. If the WWTW will have a tightened permit concentration limit for Total Nitrogen under the company's Water Industry Asset Management Plan then use this tightened value. If a new WWTW is proposed, obtain a determination from the Environment Agency on the permit limit for Total Nitrogen that would apply to the works. Where the WWTW has no consent limit on Total Nitrogen derive a value for nitrogen in the wastewater stream based on the type of wastewater treatment at the works.
- 13 Where there is a permit limit for Total Nitrogen, the load calculation will use a worst case scenario that the WWTW operates at 90% of its permitted limit. A water company has the option of operating the works as close to the consent limit as practicable without breaching the consent limit. Natural England and the Environment Agency have agreed to take 90% of the consent value as the closest the water company can reasonably operate works without breaching the consent limit.

Step 4 Calculate Total Nitrogen (TN) in Kg per annum that would exit the WWTW after treatment derived from the proposed development

- 14 The Total Nitrogen load is calculated by multiplying the water use of the proposed development by the appropriate concentration of Total Nitrogen after treatment at the WWTW.
- 15 The following worked example calculates the Total Nitrogen load of a development of 1000 dwellings based on a WWTW with a consent limit for Total Nitrogen of 9 mg/l.
- 16 Where residential developments also include other overnight accommodation such as tourist accommodation and attractions, the associated water use from these additional land uses will need to be included in the calculation. This should be based on the water use associated with these facilities.

STAGE 1 - WORKED EXAMPLE TO CALCULATE TOTAL NITROGEN (TN) LOAD FROM DEVELOPMENT WASTEWATER				
Step	Measurement	Value	Unit	Explanation
Development proposal	Development types that would increase the population served by a wastewater system	1000	Residential dwellings	
Step 1	Additional population	2300	Persons	Uses an average household size of 2.3 x 1000 dwgs (greenfield site).
Step 2	Wastewater volume generated by development	253,000	litres/day	2300 persons x 110 litres Where relevant, deduct wastewater volume of population displaced by the proposed development
Step 3	Receiving WWTW environmental permit limit for TN	9.0	mg/l TN	
Step 4	TN discharged after WWTW treatment	2,049,300	mg/TN/day	90% of the consent limit = 8.1 mg/l TN. 253000×8.1
	Convert mg/TN to kg/TN per day	2.0493	Kg/TN/day	Divide by 1,000,000

	Convert kg/TN per day to kg/TN per year	748	Kg/TN/yr	X 365 days
Wastewater total nitrogen load	748 kg/TN/yr			

Table 1 – Calculating wastewater Total Nitrogen load from proposed development

Stage 2 ***Adjust Total Nitrogen load to offset existing nitrogen from current land use***

- 17 This next stage is to calculate the existing nitrogen from the current land use. The nitrogen loss from the current land use will be removed and replaced by that from the proposed development land use. The net change will need to be subtracted from or added to the wastewater Total Nitrogen load.
- 18 Nitrogen–nitrate loss from agricultural land can be modelled using the Farmscoper model. A study commissioned by Natural England from ADAS modelled this loss for different farm types across the river catchments that drain to the Solent (ADAS UK Ltd. 2015. Solent Harbours Nitrogen Management Investigation).
- 19 If the development area covers agricultural land that clearly falls within a particular farm type used by the Farmscoper model then the modelled average nitrate-nitrogen loss from this farm type should be used. The farm types used in the ADAS model are set out in Table 2, with the nitrate-nitrogen loss. Further details on farm classification are included in Appendix 1.

AVERAGE NITRATE-NITROGEN LOSS PER FARM TYPE IN THE SOLENT CATCHMENT AREA (kg/ha)	
Cereals	31.2
Dairy	36.2
General Cropping	25.4
Horticulture	29.2
Pig	70.4
Lowland Grazing	13.0
Mixed	28.3
Poultry	70.7
Average for catchment area	26.9

Table 2 Farm types and average nitrogen-nitrate loss

- 20 If the proposed development area covers several or indeterminate farm types then the average nitrate-nitrogen loss across all farmland may be more appropriate to use. The average figure is also included in Table 2.
- 21 The figures in the ADAS report are based on 2010 land use data and may be updated from time to time as land use and agricultural practice to control nitrate loss changes.
- 22 A worked example to calculate the Total Nitrogen load from existing land use is set out in Table 3.

STAGE 2 - WORKED EXAMPLE TO CALCULATE TOTAL NITROGEN LOAD FROM CURRENT LAND USE				
Step	Measurement	Value	Unit	Explanation
1	Total area of existing agricultural land	40	Hectares	This is the area of agricultural land that will be lost due to development
2	Identify farm type and confirm nitrate loss.	26.9	Kg/ha/yr	The developable area covers several farm types therefore an average has been used. Reference Appendix 1 and Table 2
3	Multiply area by nitrate loss	1,076	Kg/TN/yr	40 ha x 26.9 kg/TN/yr
Total nitrogen load - current land use	1,076 Kg/TN/yr			

Table 3 Calculating Total Nitrogen load from current land use

Stage 3 Adjust Total Nitrogen Load to account for land uses with the proposed development

- 23 The last stage is to add in the nitrogen load that will result from the new development that is not received by a WWTW. This includes the nitrogen load from the new urban development and from the new open space including any Suitable Alternative Natural Greenspace (SANG), Nature Reserves or Bird Refuge Areas.
- 24 The calculation only includes the areas of the site where there will be a change in land use, for example from agricultural land to new urban development or agricultural land to Suitable Alternative Natural Greenspace (SANG) / open space. Where there is no proposed change to land use, this land should be excluded from the nitrogen budget as there will be no change to the nitrogen load from this area.
- 25 The nitrogen load from the new urban development results from sewer overflows and from drainage that picks up nitrogen sources on the urban land. These nitrogen sources include atmospheric deposition, pet waste, fertilisation of lawns

and gardens and inputs to surface water sewers. The nitrogen leaching from urban land equates to 14.3 kg/ha/yr².

- 26 Nitrogen loss draining from new SANG or open space should also be included. The nitrogen leaching from this land is likely to approximate the average nitrate-nitrogen loss from low intensity grazing land – 13.0 kg/ha/yr. This figure can also be used where new nature reserves or bird refuge areas are created.
- 27 A worked example is shown in the table below. This is based on a developable area of 30 hectares covering land in a mix of farm types with the removal of 10 hectares of agricultural land to create SANG.

STAGE 3 - WORKED EXAMPLE TO CALCULATE TOTAL NITROGEN LOAD FROM FUTURE LAND USES				
Step	Measurement	Value	Unit	Explanation
1	New urban area	30	Hectares	Area of development that will change from agricultural land to urban land use
2	Total Nitrogen Load from future urban area	429	Kg/TN/yr	30 ha x 14.3 Kg/TN/yr
3	New SANG / open space	10	Hectares	Area of development that will change from agricultural land to SANG / open space
4	Total Nitrogen load from SANG / open space	130	Kg/TN/yr	10 ha x 13.0 Kg/TN/yr
5	Combine Total Nitrogen load from future land uses	559	Kg/TN/yr	429 Kg/TN/yr + 130 Kg/TN/yr
Total Nitrogen Load - future land uses		559 Kg/TN/yr		

Table 4 – Adjust Nitrogen Load to account for future land uses

Stage 4 ***Calculate the net change in the Total Nitrogen load that would result from the development***

- 28 The last stage is to calculate the net change in the Total Nitrogen load to the Solent catchment with the proposed development. This is derived by calculating the difference between the Total Nitrogen load calculated for the proposed

² Supplementary Planning Document – Achieving Nitrogen Neutrality in Poole Harbour

development (wastewater, urban area, open space etc) and that for the existing land uses. Table 5 sets out a worked example.

STAGE 4 - WORKED EXAMPLE TO CALCULATE THE NET CHANGE IN TOTAL NITROGEN LOAD FROM THE DEVELOPMENT				
Step	Measurement	Value	Unit	Explanation
1	Identify Total Nitrogen load from wastewater (stage 1)	748	Kg/TN/yr	See Table 1
2	Calculate Total Nitrogen from land use - subtract Total Nitrogen load from future land uses (stage 3) from existing land uses (stage 2)	517	Kg/TN/yr	1076 Kg/TN/yr-559 Kg/TN/yr
3	Determine Nitrogen Budget – the difference between the Total Nitrogen load for the proposed development and the existing uses	231	Kg/TN/yr	748 Kg/TN/yr (step 1) – 517 Kg/TN/yr (step 2)
Total Nitrogen Budget	231 Kg/TN/yr			

Table 5 Total Nitrogen Load Budget

- 29 If there is a Total Nitrogen surplus (positive figure), then mitigation is required to achieve nitrogen neutrality. If the calculation identifies a deficit (negative figure), no mitigation is required.
- 30 In the worked example below, mitigation is required for the additional 231 Kg/TN/yr. The options for mitigation include a combination of the following:
- (i) Agreement with the wastewater treatment provider that will maintain an increase in nitrogen removal at the WWTW.
 - (ii) Agreement with the wastewater treatment provider or others to provide and maintain an increase in nitrogen offsetting from catchment management measures (this may include mini-farm wetland).
 - (iii) Provide measures that will remove nitrogen draining from the development site or discharged by the WWTW (such as wetland or reedbed).
 - (iv) Increase the size of the SANGs and Open Space provision for the development on agricultural land that removes more nitrogen loss from this source.

- (v) Establish changes to agricultural land in the wider landholding in perpetuity that removes more nitrogen loss from this source.
- (vi) Acquire, or support others in acquiring, agricultural land elsewhere within the river catchment area containing the development site, changing the land use in perpetuity (e.g. to woodland, heathland or conservation grassland) to remove more nitrogen loss from this source and/or, if conditions are suitable, provide measures that will remove nitrogen on drainage pathways from land higher up the catchment (e.g. interception wetland).

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Appendix 1 – Farm Types

The UK system is based on weighting the contributions of each enterprise in terms of their associated outputs. The weights used (known as ‘Standard Outputs’ or SOs) are calculated per hectare of crops and per head of livestock and used to calculate the total standard output associated with each part of the Farm Business.

Cereals

Holdings on which cereals, combinable crops and set-aside account for more than two thirds of the total SO and (pre-2007) where set-aside alone did not account for more than two thirds of the total SO. (Holdings where set-aside accounted for more than two thirds of total SO were classified as specialist set aside and were included in “other” below.)

General cropping

Holdings on which arable crops (including field scale vegetables) account for more than two thirds of the total SO, excluding holdings classified as *cereals*; holdings on which a mixture of arable and horticultural crops account for more than two thirds of their total SO excluding holdings classified as *horticulture* and holdings on which arable crops account for more than one third of their total SO and no other grouping accounts for more than one third.

Horticulture

Holdings on which fruit (including vineyards), hardy nursery stock, glasshouse flowers and vegetables, market garden scale vegetables, outdoor bulbs and flowers, and mushrooms account for more than two thirds of their total SO.

Specialist Pigs

Holdings on which pigs account for more than two thirds of their total SO.

Specialist Poultry

Holdings on which Poultry account for more than two thirds of their total SO.

Dairy

Holdings on which dairy cows account for more than two thirds of their total SO.

Lowland Grazing Livestock

Holdings on which cattle, sheep and other grazing livestock account for more than two thirds of their total SO except holdings classified as *dairy*. A holding is classified as lowland if less than 50 per cent of its total area is in the Less Favoured Area (LFA).

Mixed

Holdings for which none of the above categories accounts for more than 2/3 of total SO. This category includes mixed pigs and poultry farms as well as farms with a mixture of crops and livestock (where neither accounts for more than 2/3 of SOs).

http://farmbusinesssurvey.co.uk/DataBuilder/UK_Farm_Classification_2014_Final.pdf