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East House Cottage

Nutrient Budget and Management

D L A Crossman Will Trust

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Contents

1 Introduction

1.1 Report Objectives

This report has been prepared by ByrneLooby (BLA) on behalf of the D L A Crossman Will Trust, under an instruction from Savills (UK) Ltd. The report presents a nutrient budget for the conversion of a farm building to residential as part of a wider scheme of improvements to the farmyard, which includes the upgrading of all of the wider estate's residential sewage management from an "off-grid" septic tank type system to Package Treatment Plant.

The existing East House has provided accommodation for centuries in its current form prior to nutrient neutrality policies were introduced. This report is therefore specific to the East House Cottage component, a second building, which is to be the new residential development with overnight accommodation.

East House Cottage is located at Cheswick, Berwick upon Tweed, Northumberland, TD12 2RL (Figure 1, Figure 2 and Savill's Drawing 5340/13).

The site is within the catchment area for the Lindisfarne Special Protection Area and Ramsar which is designated by Natural England as requiring "nutrient mitigation" for any new developments[1].

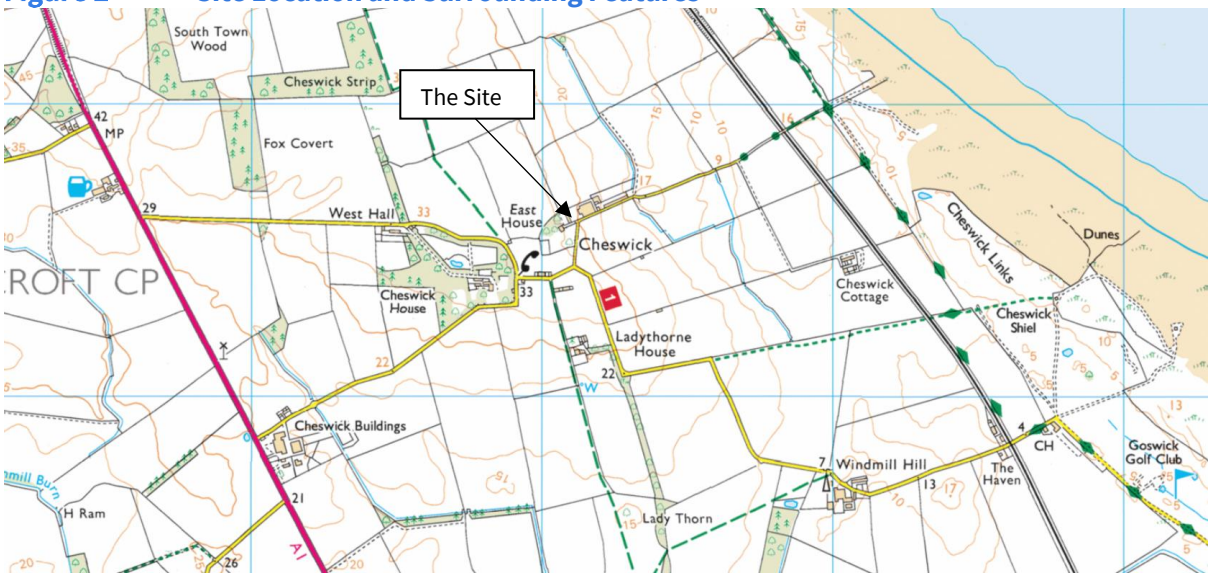
This requirement follows a position statement made by Natural England on 16th March 2022, for which Northumberland County Council have released a position statement[2] as to the reasoning for the requirement to mitigate nutrient releases and the mechanisms to calculate nutrient production using Natural England's calculator[3].

This report has been prepared to quantify the nutrient budget for the proposed increase in capacity and discusses the mitigation approach.

Figure 1 Site Location

[1] https://www.northumberland.gov.uk/Planning/Planning-News.aspx
[2] https://www.northumberland.gov.uk/Guidance For Applicants
[3] https://www.northumberland.gov.uk/CalculatorGuidanceDocument.pdf

Figure 2 Site Location and Surrounding Features



1.2 Nutrient Neutrality

Nutrient neutrality is a core principle and the basis for Natural England's standing objection to all development planning applications in the nutrient sensitive areas identified by Natural England. The policy was initially implemented in the southern counties where surface water catchments discharged into the Solent, Southampton Water and other nearby partially enclosed coastal bays. The areas of concern have now been expanded across a larger number of counties and a Policy Paper has been published by DEFRA[4].

In Natural England's guidance to the Lindisfarne Nutrient Budget Calculator[3], the requirement for Nutrient Neutrality is justified as a potential future issue as:

> *There is uncertainty as to whether new growth will further deteriorate designated sites, and/or make them appreciably more difficult to restore. The potential for future housing developments to exacerbate these impacts creates a risk to their potential future conservation status.*
>
> *One way to address this uncertainty is for new development to achieve nutrient neutrality. Nutrient neutrality is a means of ensuring that development does not add to existing nutrient burdens and this provides certainty that the whole of the scheme is deliverable in line with the requirements of the Habitats Regulations.*

In essence, this future potential to depreciate habits is because nutrients have been entering the surface water system since industrialisation from a combination of fertilisers, other agricultural nutrients and sewage effluents (untreated and treated) to the extent that there is a perceived eutrophication problem in restricted flow waters. Natural England's objective is to prevent developments from exacerbating these eutrophic regimes by removing an equivalent quantity of

[4] https://www.gov.uk/government/publications/nutrient-pollution-reducing-the-impact-on-protected-sites/nutrient-pollution-reducing-the-impact-on-protected-sites

nutrients which are already in the environment and contributing to the surface water systems by either, or a combination of:

1) treating all additional nutrients that could be produced by the development at source;
2) reducing an agricultural nutrient contribution by permanently removing farmland from production; or
3) intercepting and treating the nutrient content of groundwater or surface waters which are already in the environment.

Potential mitigation measures are informed by a nutrient budget which quantifies the amount of mitigation required. Northumberland County Council, acting as the planning authority, have provided links to Natural England's online guidance relevant to their area[2]. This guidance includes direct links to a "Nutrient Budget Calculator" which will form the basis for determining the quantity of nutrient to be managed.

The quantity of nutrients to be managed is the balance between the current and future land use as well as the residual load released after wastewater treatment to the river system. However, this is tempered by the quality and quantity of the treated sewage effluent released to the environment, and other post development contributions.

Recent Government Policy has however modified this position, whereby the UK government through the Chief Planner has released an updated position statement.[5]

The ethos of this July 2022 is that nutrient neutrality obligations in future are to be addressed by three elements, namely:

1) obligating the upgrade of Wastewater Treatment Works in nutrient neutrality areas by 2030;
2) a strategic mitigation scheme; and
3) clarifying the application of Habitats Regulations Assessments for post permission approvals

Mitigation for schemes that are not in themselves nutrient neutral are therefore in the first instance time limited to the period that will be required for the upgrade to the Municipal Wastewater Treatment Works (WwTW) at some point between 2023 and the governmental imposed WwTW upgrade time limit of 2030.

This report presents a nutrient balance following the guidance and then identifies the extent of mitigation required in order to meet these obligations in the short and longer term.

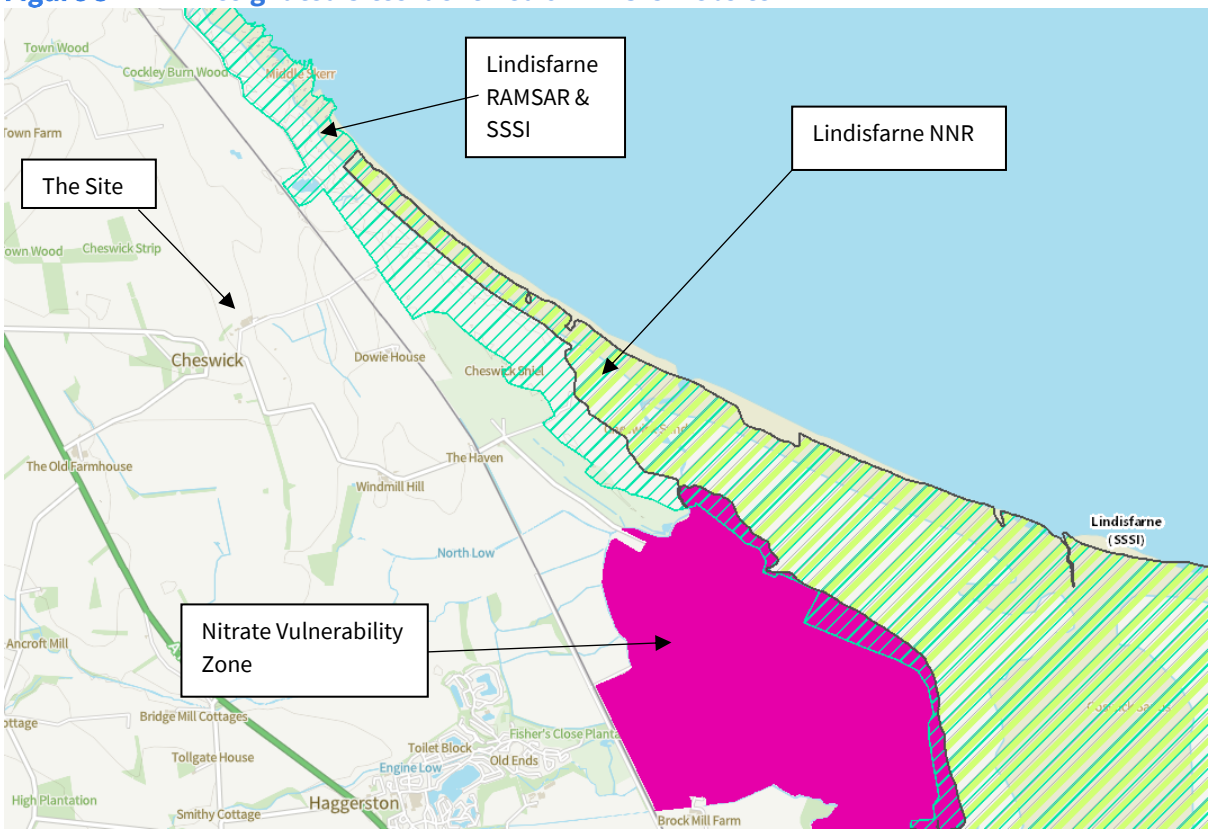
[5] Chief Planner Letter Nutrient Neutrality and HRA Update - July 2022

2 Site Conditions

2.1 Site Setting

The site is located at an elevation of 25mAOD within an agricultural area, some 970m to the west of the Lindisfarne RAMSAR / SSSI and 1,300m from the Lindisfarne National Nature Reserve (NNR). The RAMSAR and SSSI includes the NNR (Figure 3). The site is however outside of and of no continuity with a mapped Nitrate Vulnerability Zone (NVZ).

Figure 3 Designated Sites Identified on MAGIC Website[6]



Ground Conditions

The site is located on a glacial clay surface, which overlies the Stainmore Formation, a sequence of interbedded cyclic sandstone, siltstones, mudstones and thin limestones and coal horizons (Figure 4). This formation is part of the Upper Carboniferous Great Limestone Member (formerly the Upper Limestone Group).

The site's drainage status on the Soilscapes map[7] of "Impeded Drainage" (Figure 5) correlates to the mapped distribution of the Boulder Clay. As noted above the is not within the Nitrate Vulnerability Zone (NVZ)[8] (Figure 6) which forms the basis of the characterisation of the Lindisfarne RAMSAR site's nutrient neutrality obligations.

[6] https://magic.defra.gov.uk/MagicMap.aspx
[7] http://www.landis.org.uk/soilscapes/#.
[8] https://mapapps2.bgs.ac.uk/ukso/home.html?layers=NVZEng

Figure 4 Geological Setting (Extract from BGS Sheet 2 – Berwick upon Tweed)

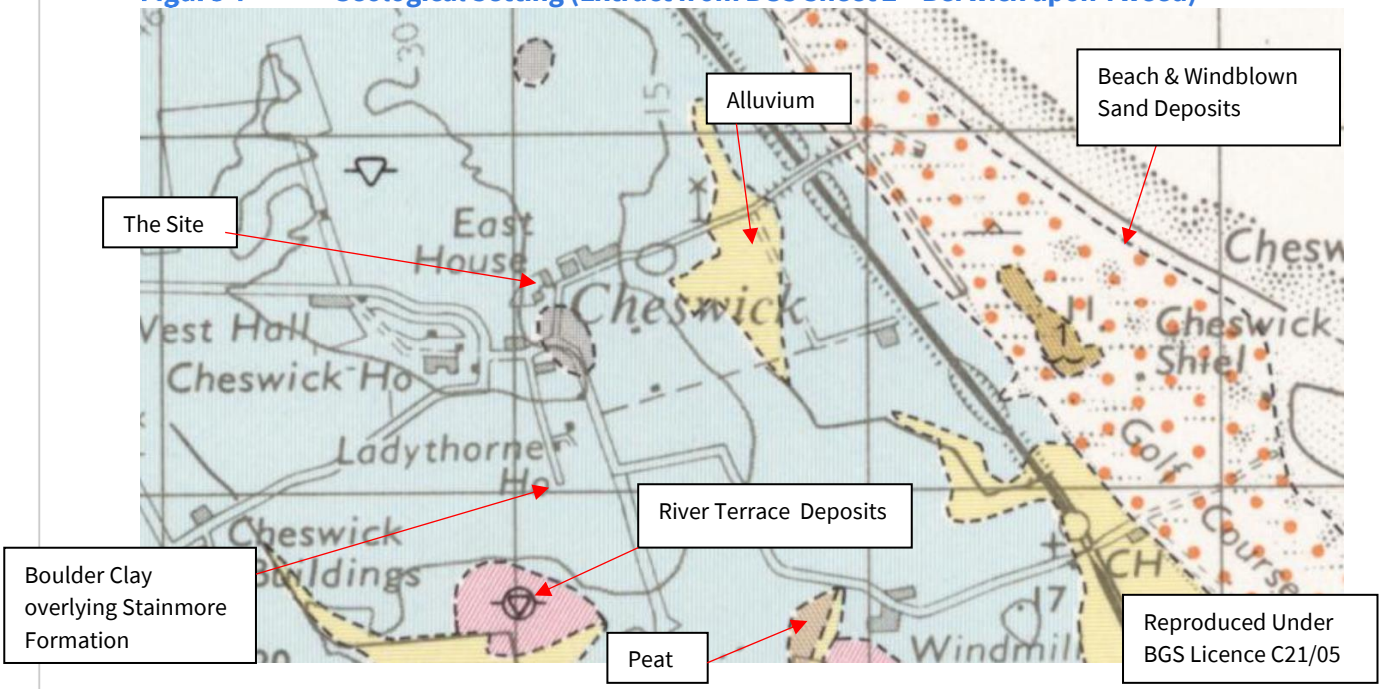


Figure 5 Drainage Type Extracted from Soilscapes

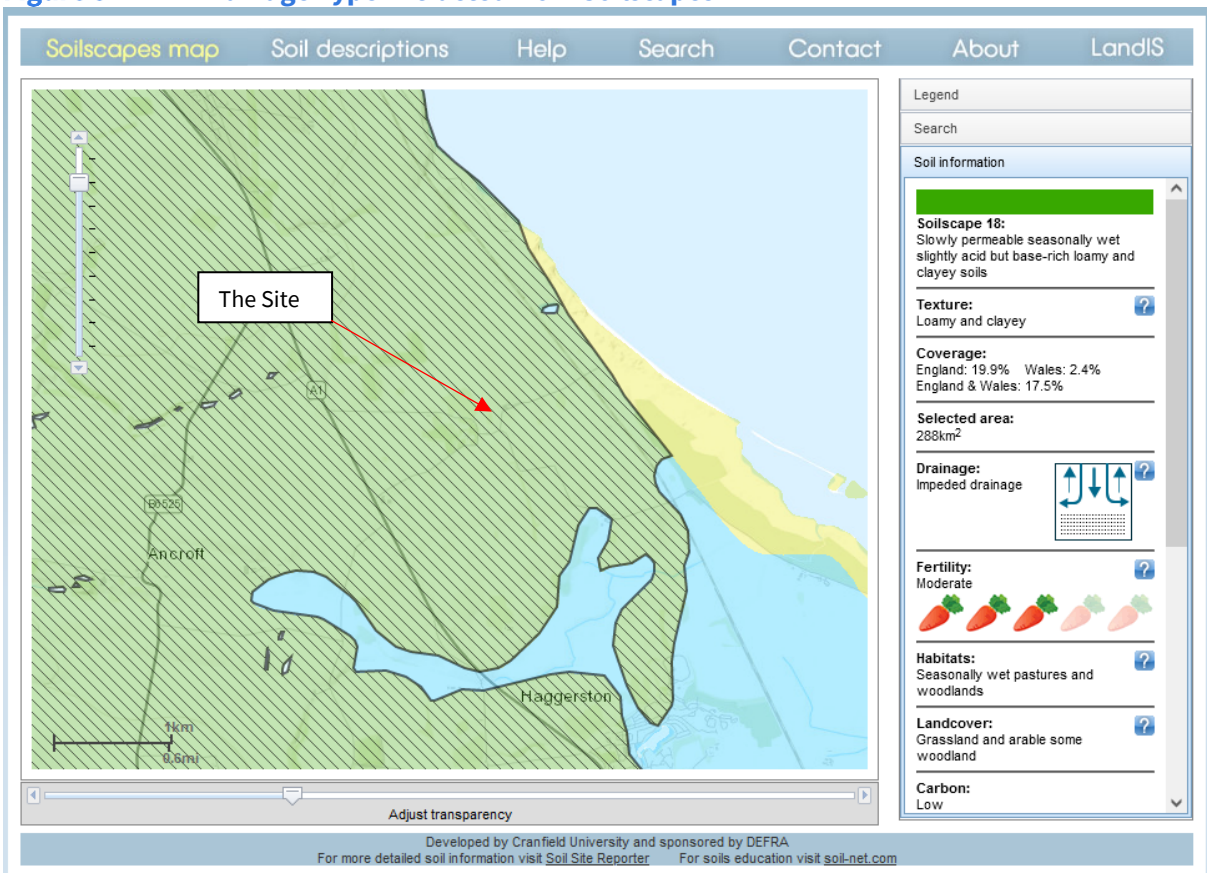
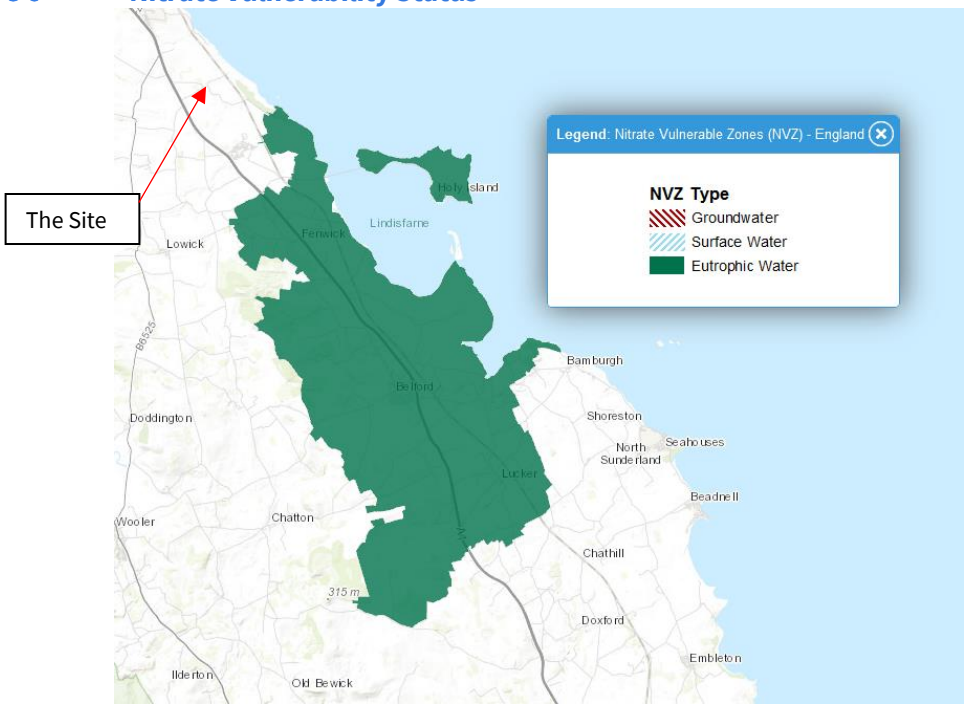


Figure 6 Nitrate Vulnerability Status



The site is located to the east in a "rain shadow" area of the River Till catchment. The site is located to the east of Gauging Station 21035[9] (River Till at Heaton Mill) which identifies a 30-year average rainfall rate of 822mm/yr. This is almost identical to the 827mm/yr rate for the River Till at Etal Archive Station 21031[10], to the south of the Heaton Mill gauging station.

2.2 Hydrochemical Regime

The Cheswick area is not on the mains sewer, and the proposed development as well as surrounding properties have historically been serviced by septic tanks followed by infiltration to ground. Consequently, all nutrients (*i.e.* nitrogen) are released untreated into the groundwater system. As the site and the surrounding land comprises Boulder Clay, this nitrogen is released sub-surface to infiltrate into groundwater.

As Cheswick is located so close to the sea, the hydraulic gradient is generated by recharge from the higher ground to the west, which infiltrates into the bedrock and then flows sub-surface beneath the Boulder Clay to the sea. The point of entry to the RAMSAR area for this hydraulic flux must be either off-shore where marine waters mix with the aquifer at depth, or via a nearer surface flow by upwelling through the tidal muds. These tidal mudflats are described by Natural England[11] as "food rich mudflats". This is a strongly anaerobic environment, whereby it is common to develop strongly

[9] https://nrfa.ceh.ac.uk/data/station/spatial/21035
[10] https://nrfa.ceh.ac.uk/data/station/spatial/21031
[11] https://www.lindisfarne.org.uk/general/pdf/NNRLindisfarneLeaflet.pdf

anaerobic conditions whereby the biological rich regime readily induces both sulphate reduction and nitrate reduction, both of which are biochemical and chemical causes of denitrification.

Such a denitrification route is distinctly different to the general surface run-off route or the sewer discharge route which underlies the need for a nutrient mitigation policy. Nutrient mitigation is a policy implemented to limit eutrophication in surface waters whereby excess nitrogen in a restricted flow regime water column induces and promotes microbial and algal growth which in turn reduces dissolved oxygen contents.

In the case of the Lindisfarne area, this is due to baseflow entering the river system from a combination of treated sewage effluents discharged to surface water as well as agricultural fertiliser or manure contributions to the run-off waters captured by field drains and thereby released to the surface water column surrounding Lindisfarne.

The inclusion of the Cheswick area into the Nutrient Neutrality guidance and nitrogen vulnerability zone therefore presupposes that the route that the nitrogen releases contribute to is this surface route and not a sub-surface route which is inherently a self-denitrification route for a treated sewage effluent. A treated sewage effluent released to ground via a sub-surface infiltration system in the Cheswick area cannot therefore contribute to solubilised nitrogen releases into the marine water column within the downgradient NNR and RAMSAR.

2.3 Sewage Management

East House Cottage is a proposed annex conversion to overnight accommodation of a farm building associated with East House. Historically sewage has been managed via a septic tank for a 5-bedroom property. The occupancy capacity will be increased by a further single bedroom accommodation (*i.e.* East House Cottage) as a separate dwelling.

Although an inter-related set of dwellings, effluent is being managed for treatment purposes separately. For the 5-bedroom East House property a 10 PE (Population Equivalent) treatment system is being installed as a process enhancement replacement to the septic tank. The Package Treatment System (PTP) treats the effluent and discharges to the same infiltration field as the septic tank.

However, as this treatment plant is graded to a 10PE size, there is not sufficient capacity to receive the effluent from the additional East House Cottage. A 4PE plant is intended to be installed as part of the conversion works for the new cottage. The sizing is based on “standardised capacity” PTP design and therefore is reflective of an “over-capacity” in the design, for a property with an expected occupancy of 2people. Actual occupancy rates are however expected to be in line with Natural England’s default 2.4 persons per property for the new residential dwelling.

The treated effluents are to be cojoined at the effluent pipe from the 10PE treatment plant and released to ground.

For nutrient budget purposes the nutrient formation from the post development system incorporates the conversion of a septic tank effluent receiving up to 10 person effluent volume to an up to 12.4 person treated effluent release.

3 Nitrogen Budget Calculator

3.1 Introduction

Natural England have recently published a "Nutrient Neutrality Budget Calculator: a tool for assessing the nutrient loading to a Habitats Designated Site". The Lindisfarne Nutrient Budget Calculator version available on the Northumbria County Council website has been considered in the preparation of this nutrient budget.

The nutrient calculations take a four-stage approach of:

1) Establish net nutrient formation based on increase in residential developments as released to controlled waters
2) Calculate nutrient formation by the site development in its pre-development state
3) Calculate nutrient formation by the site in its as-built state
4) Calculate the difference between the pre-and post-development nutrient releases and multiple the difference by 120% to establish a nutrient budget

In the Lindisfarne catchment, the nutrient of concern is nitrogen.

Stages 1 and 3 determine the post-development nutrient releases to the surface water system and are based on the quantity of residential properties, receiving WwTW performance objectives and future land contributions. The Stage 3 component is influenced by factors such as rainfall rates, nitrate vulnerability status and infiltration potential.

However, there is no explanation in the nutrient budget calculator to explain the usage of the various factors for otherwise the same nutrient loadings. Stage 2 uses the same factors as Stage 3 for the pre-development scenario and are subtracted from the cumulative Stage 1 and Stage 3 calculated nutrient loads.

The four stages and parameters used within the assessment are discussed in more detail below. This format has however been adapted to consider the holistic nutrient releases for the development.

3.2 Stage 1 (Nutrient formation due to increase in dwellings)

The stage 1 calculations are based on a combination of the population and the quality of the effluent to be released to derive a "load" or quantity of effluent nitrogen that will be released to the water system.

In this case two effluent nitrogen loads have been derived using the calculator, the first is via a standard septic tank system, and the second is the increased population size in combination with a PTP (Table 1).

The calculations predict that by reducing the nitrogen content of the effluent from an untreated 96mg/l total nitrogen, to a treated 27mg/l nitrogen concentration (a typical conservative value for effluent treatment), then the effluent nitrogen load will reduce

- from 42.2kg per year; to
- to 14.7kg per year

i.e. a net reduction in nitrogen released from the combined properties of 27.54kg Total Nitrogen (TN) per year.

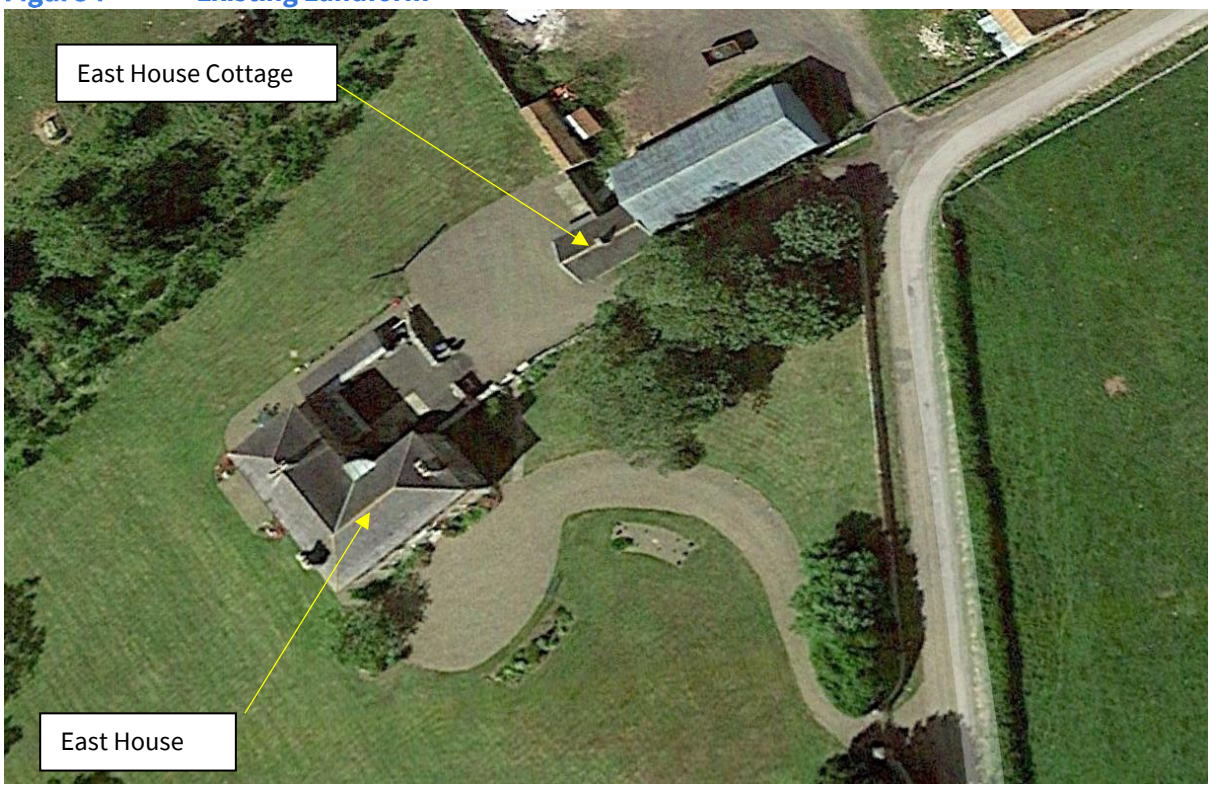
Table 1 Stage 1 Population Nitrogen Formation

Parameter	Units	Existing (Septic Tank)	Proposed Development PTP	Comments
Date of First Occupancy		01/01/2021	01/10/2022	Arbitrary date
Average Occupancy Rate		10	12.4	as above
Waste Usage	L/person/day	120	120	(Spreadsheet default parameter)
Development Proposal	Units	1	1	Set as 1 to normalise holistic release
WwTW		Septic Tank	PTP	
WwTW Nitrogen Effluent	mg/l	96.3	27	Spreadsheet Default Belford STW
Stage 1 Calculated Loading from Treated Sewage Effluent Discharge				
Additional Population	Population	10	12.4	Calculations performed by Spreadsheet
Wastewater produced	m^3/day	1.2	1.488	
Annual Total Nitrogen	kg/yr	**42.21**	**14.67**	

3.3 Land Use Nutrient Releases

The site comprises of existing buildings and surfaced driveways within open greenspace (Figure 7).

Figure 7 Existing Landform



The landform will not physically change as part of the proposed building conversion. East House is served by two access routes, of which the northern route is common to both units. The surrounding gardens/greenspace area will remain unchanged.

Technically there is therefore no change in the Step 2 (pre-development) and Step 3 (post development) land use. Consequently, the land use change between the pre- and post-development is zero. Notwithstanding this as part of a sensitivity analysis, if it is considered that the East House Cottage component is considered as a commercial urban area (*i.e.* a farmyard building), then the land and use change component can be considered as illustrated in Table 2.

Table 2 Land Use Change

Stage		**2**	**3**
Land use Type	Type	Commercial Urban Land	Residential Urban Land
Area	ha	0.055	0.055
Nitrogen Export	kg TN	0.45	0.85

The net change in nutrient releases from the development is therefore an increase in 0.4kg TN per year. However, this is itself considered as a conservative increase in nutrient releases.

3.4 Stage 4 (Annual Nutrient Budget)

The annual nutrient budget is the difference between the post and pre-development nutrient formation rates. Therefore the post-development land use, including sewage are aggregated and compared to the pre-development land use nutrient rate to determine if there is a net increase or decrease in nutrient releases.

In this case the actual nutrient budget must be calculated independently from the calculator as there is no capability within the calculator to incorporate the change due to the improvement in effluent release quality.

The actual nutrient budget can however be derived from the loads described above and summarised as Table 3.

Table 3 Nutrient Budget Calculation

Post-development	**kg TN**	**kg TN**
Sewage	14.67	
Land Use	0.85	
Development Releases		**15.52**
Pre-development		
Sewage	42.21	
Land Use	0.45	
Background		**42.66**
Nutrient Budget		**-27.13**

The nutrient budget calculation demonstrates that the proposed development would reduce the nitrogen releases to the environment by 27.13Kg per year.

3.5 Budget Calculation Summary

The nutrient Budget calculation demonstrates that there will be a net reduction in nutrient releases by some 27kg of nitrogen per year.

This reduction in nutrient releases isa direct consequence of the improvement in effluent treatment at East House and East House Cottage such that there is an overall decrease in nutrient released to the hydrogeological system.

Additional mitigation is therefore not required.

4 Conclusion

East House Cottage is a one bedroom conversion of a farm building on the Cheswick Estate to a residential dwelling. The cottage is intended to be used for holiday rental purposes, and for nutrient purposes should be considered as an annex to the adjacent main East House, albeit it is a physically separate dwelling.

Although there will be an increase in sewage type nitrogen releases from the development itself, there will actually be a holistic reduction in the effluent nitrogen (nutrient) released due to improvements in the holistic effluent management at the site. This improvement from septic tank releases as historically implemented at East House is in line with the July 2022 instructions from the Chief Planner[5] that requires that improvements in Municipal Wastewater Treatment Works (WwTW) are implemented by 2030. At East House, this programme is being implemented and therefore the nutrient neutrality obligations are met immediately.

Commentary is also made regarding the hydrogeological system specific to the application site. The site will not discharge via the main surface water system and route within the Nitrate Vulnerability Zone that feeds into the Lindisfarne RAMSAR and is the cause of the Nitrogen Neutrality implemented.

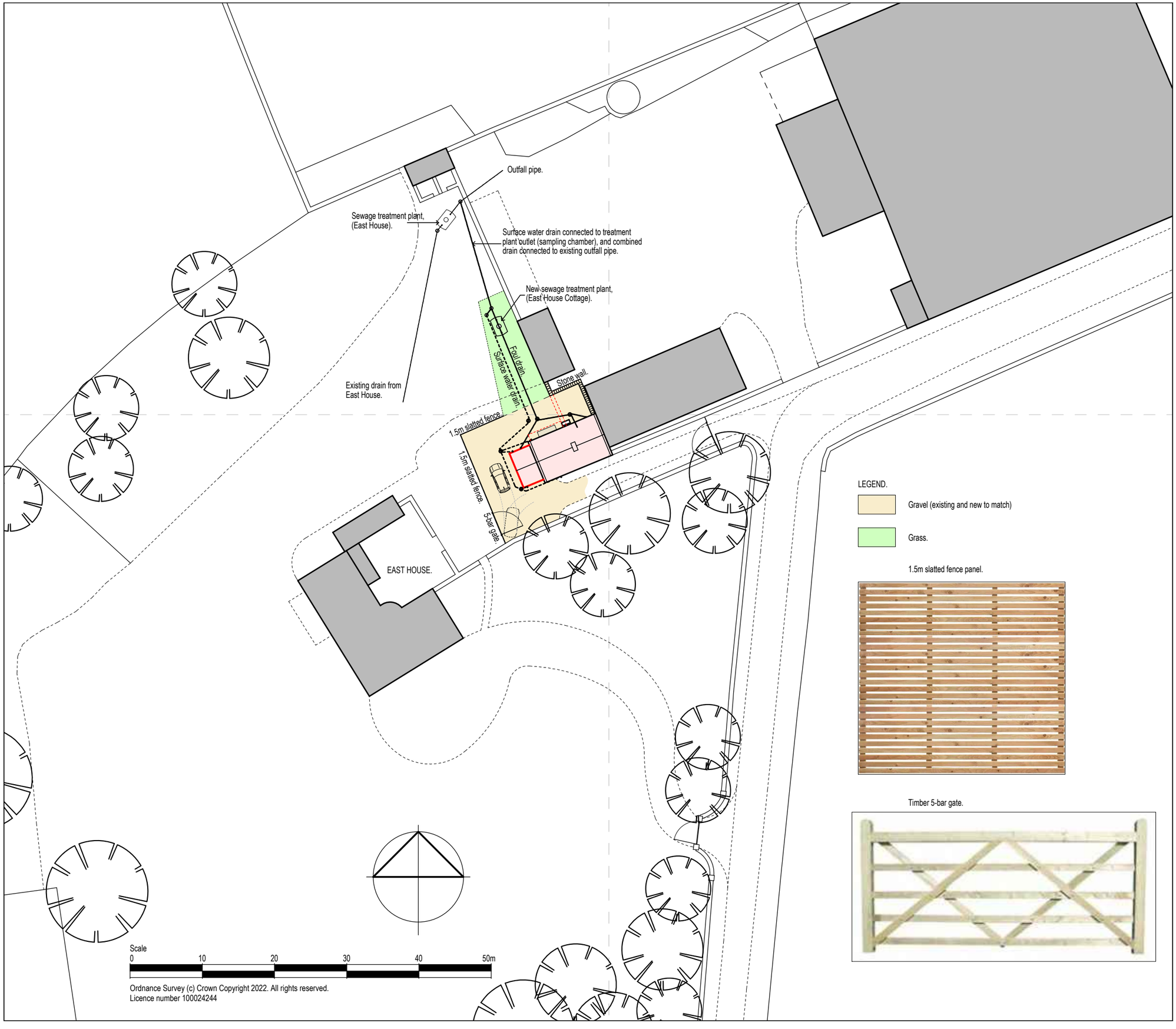
The site will release its effluent to ground and the indirect route to the Lindisfarne RAMSAR area will also be a denitrifying route. Consequently, the nutrient released to the water system will also be achieved by natural biochemical processes. This process is due to the treatment of the effluent into an oxidised form which allows natural denitrification to take place in mudflat systems such as at Lindisfarne. It is therefore considered highly likely that the nutrient calculations contained within this assessment has actually underestimated the amount that nitrogen releases will be reduced at the site.

Specific additional nutrient mitigation measures are not required for the proposed East House Cottage development.

It is however considered that there will be a net reduction in nitrogen released to the environment by a minimum of 27kg per year, and that holistically the quantity of nitrogen that could be released into the RAMSAR area is actually 56kg per year when the holistic treatment and natural processes are taken into account.

This reduction in nitrogen releases could therefore be offered as a mitigation compensation scheme for other developments.

Drawings



LEGEND.

Gravel (existing and new to match)

Grass.

1.5m slatted fence panel.

Timber 5-bar gate.

Notes :

Project :

EAST HOUSE COTTAGE
EAST HOUSE
CHESWICK
BERWICK UPON TWEED
TD12 2RL

Client :

CHESWICK ESTATE

Title :

PROPOSED SITE PLAN

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Scale :
1:500 @ A3

Drawn : I.M.

Date : SEPT. 2022

Drawing Number :

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