Nutrient Management Plan (NMP)

Proposed Anaerobic Digestion Facility at Spring Grove Farm, Withersfield, Northwest of Haverhill, CB9 7SW

On behalf of: Acorn Bioenergy Limited, 58 Marylebone High Street, London W1U 5HT

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Abbreviations

AD	Anaerobic digestion/Anaerobic digester
BAT	Best available techniques
Defra	Department for the Environment, Food and Rural Affairs
EA	Environment Agency
ETL	Earthcare Technical Ltd
FRfW	Farming Rules for Water
K	Potassium
N	Nitrogen
NVZ	Nitrate Vulnerable Zone
Mg	Magnesium
P	Phosphorus
RAN	Readily Available Nitrogen
S	Sulphur
SSAFO	Silage Slurry and Fuel Oil Regulations
SCC	Suffolk County Council

1 Introduction

This Nutrient Management Plan (NMP) has been prepared by Earthcare Technical Ltd (ETL) on behalf of Acorn Bioenergy Limited, hereafter referred to as 'the Client,' in support of a planning application at Spring Grove Farm, Withersfield, Northwest of Haverhill, CB9 7SW, hereafter referred to as 'the Site,' to Suffolk County Council (SCC) (application reference SCC/0045/23SE). The application is for a proposed Anaerobic Digestion (AD) facility, hereafter referred to as the 'Proposed AD plant.'

In their response to the application 23 October 2023 Natural England recommended that:

".. your Authority should be confident that the proposal has an up-to-date nutrient management plan (Following RB209 Guidance) and will meet the following:

- *The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010*
- *The Nitrate Pollution Prevention (Amendment) Regulations 2016*
- *The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018*
- *The Environmental Permitting (England and Wales) Regulations 2016*
- *Farming Rules for Water (FRFW) – which includes, The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018*

SCC requested further information be provided in support of the application. Appendix A of the Regulation 25 request letter requests a nutrient management plan.

This NMP report is produced by A Becvar BSc (Hons), MI Soil Sci, C Sci, MBPR FACTS RFE/414. Anna is a Chartered Scientist and Member of the British Society of Soil Science. She has had 30 years of experience across the agricultural, waste, and environmental sectors and has worked on government-funded projects on behalf of WRAP and Natural England during her career. She maintains continued professional development activities to meet the requirements of the Fertiliser Advisory Certification Training Scheme (FACTS) and Chartered Scientist status and is a BASIS-approved trainer for certain advanced modules. She is also past Chair of the Professional Practice Committee and Board Trustee for the British Society of Soil Science, and a current member of the Green Gas Steering Group within the Renewable Energy Association.

1.1 Site description

The Proposed AD Plant would accept around 92,000 tonnes of feedstock materials for anaerobic digestion (AD) which will comprise of:

- Energy crops such as maize, rye and grass silage
- Residue straw; and
- Poultry litter and farmyard manure.

The AD process produces biogas which will be upgraded to biomethane to be injected into the National Gas Grid, and digestate, a nutrient rich biofertiliser which can be used to supply major nutrients such as nitrogen (N), phosphorus (P) and potassium (K) as well as a range of beneficial minor nutrients and trace elements.

Digestate can be used to replace up to 50% of a crop's N requirement, otherwise supplied from a manufactured fossil fuel-derived fertiliser. In addition, fibre digestate is a good source of organic matter and acts as a soil improver.

The whole digestate produced within the process will be separated into a liquid fraction (liquid digestate) and a solid fibre fraction (fibre digestate). The fibre digestate will be removed daily from the Proposed AD plant and stored in preparation for use within temporary destination field heaps.

The Proposed AD plant site has been designed to have ample liquid digestate storage, such that it may be stored to ensure it is applied at the correct time to meet crop need and when soil and weather conditions are appropriate.

The planning application includes in total five digestate lagoons, capable of storing c.a. 50,000m^3 of digestate. There are 3 No. digestate lagoons each of 10,000 m^3 storage capacity at the site of production which are connected via a pipeline to 2 No. offsite lagoons central to most of the receiving land. This design optimises the transfer of liquid digestate from the site to land managed by the principal end user and keeps vehicle movement transfers on the road network to a minimum.

Digestate may also be supplied to other farms, or indeed transported to fields close to the Proposed AD Plant via tankers. Therefore 15,000 m^3 of liquid digestate vehicle movements have been included within SLR Consulting Transport Statement[1] for when digestate is removed directly from the Site.

Digestate storage has been conservatively planned given the proposed c.a.50,000 m^3 combined lagoon capacity would allow for a minimum of 7.2 months of storage if the 92,000 t of feedstock were converted solely to liquid digestate.

1.2 About this report

This report describes: relevant legislation and guidance to be followed when applying digestate to land (section 2); nutrient management planning (section 3); and example scenarios (section 4) before the report concludes in section 5.

[1] Transport Statement – Spring Grove Green Power, SLR Consulting, August 2023

2 Relevant Legislation and Guidance

The legislation and guidance relevant to digestate storage and use are summarised below.

2.1 The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010

The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010[2] are referred to as the Silage Slurry and Fuel Oil (SSAFO) Regulations. The Environment Agency (EA) enforces SSAFO. Guidance[3] is provided on how to follow the rules. There are general rules which apply if any of the three substances are stored and then rules specific to each substance.

Given the Proposed AD site is to receive poultry litter and farmyard manure it will be regulated under Environmental Permitting Regulations (Section 2.4 below) and therefore digestate storage lagoons will in fact be required to be constructed in accordance with the Containment systems for the prevention of pollution CIRIA 736[4] and not SSAFO.

2.2 Nitrate Vulnerable Zone Regulations

The Action Programme for Nitrate Vulnerable Zones (England and Wales) Regulations 1998[5] covers areas designated as being at risk from agricultural nitrate pollution. The Nitrate Pollution Prevention (Amendment) (No. 2) Regulations 2016 came into force 31st December 2016. The designated Nitrate Vulnerable (NVZ) areas include about 55% of land in England. The Proposed AD Plant and land to which digestate will be applied are within an NVZ.

Farmers must follow NVZ rules if their farm is within an NVZ. The EA enforces the NVZ Regulations.

NVZ rules govern the storage and use of fertiliser and organic manures (such as digestate) within the catchment. Key relevant points are described here.

There must be sufficient storage capacity available to store slurry. The storage period runs from:

- 1 October to 1 April inclusive (6 months) for pigs and poultry
- 1 October to 1 March inclusive (5 months) for cattle, sheep, goats, deer and horses

Manure such as fibre digestate may be stored within a manure bunker or destination field heap. When locating and constructing a temporary field heap the following should be considered:

- the field heap must be at least 10 metres from any surface water (such as a river, pond, or ditch) or land drain, or 30 metres if the land slopes at 12 degrees or more.

[2] The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010, No.639 https://www.legislation.gov.uk/uksi/2010/639/regulation/3/made

[3] https://www.gov.uk/guidance/storing-silage-slurry-and-agricultural-fuel-oil

[4] Containment systems for the prevention of pollution (C736F), June 2014 https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C736F

[5] Using nitrogen fertilisers in nitrate vulnerable zones (Published 10 August 2015, Last updated 15 August 2022) (https://www.gov.uk/guidance/using-nitrogen-fertilisers-in-nitrate-vulnerable-zones) Accessed October 2022.

- the field heap must be on land that is not liable to being waterlogged or flooded.
- field heaps must be at least 50 metres from a spring well or borehole.
- the position of the field heap must be moved at least every 12 months.
- a 2-year gap should be left before returning to the same site.
- a record of the sites used for field heaps should be kept and the dates of use.

No more than 250 kg of total N from all organic manures may be applied in any 12-month period to any single hectare (ha) of land. This limit (the field limit) ensures that total organic N is not over-applied.

All applications of fertiliser and organic manures must be planned before they are carried out. The plan comprises four steps to calculate:

1. The amount of N in the soil (soil N supply) that is likely to be available for the crop to use during the growing season.
2. The optimum amount of N that should be applied to the crop, considering the amount of N that is likely to be available from the soil.
3. The amount of N from any planned applications of organic manure, (such as digestate), likely to be available to the crop in the growing season in which it is to be spread.
4. The remaining amount of manufactured N fertiliser required.

The quantity of crop-available N supplied from digestate will be calculated based on analysis of the digestate to be spread, the crop type, timing of application, soil type and rainfall within the catchment.

It is an offence to allow fertiliser or any type of organic manure to enter surface waters such as ponds and rivers. Fields must be inspected to assess the risk of N runoff or leaching prior to an application taking place. The farm must keep a 'spread risk map' identifying risks associated with fields that may be spread. The spread risk map must include "no spread areas" to the field to mitigate a risk where present e.g., the creation of 6-10 m wide '"no spread' buffer strips" alongside streams to protect them from potential runoff. Fields receiving digestate must have a spread risk map in place to assist with digestate management planning.

Within NVZs, there are periods of the year in late autumn and winter which are closed for spreading of high readily available nitrogen (RAN) organic manures and fertilisers to reduce the risk of runoff and leaching and to ensure applications are made when crops have a need for the N applied and will actively take it up. Liquid digestates are typically high in RAN, as are certain fibre digestates: they are therefore subject to NVZ 'closed' periods.

2.3 The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018 and Farming Rules for Water

The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018[6] are referred to as the Farming Rules for Water (FRfW). The EA enforces the FRfW. The FRfW were introduced to reduce and prevent diffuse water pollution from agricultural sources, within England and Wales. They cover the application and storage of fertilisers and organic manures and the

[6] https://www.legislation.gov.uk/uksi/2018/151/contents/made

management of soil and livestock. The rules consider both N and P. The most pertinent requirements are described below.

Applications of fertilisers and organic manures must be planned. A Nutrient Management Plan (NMP) must be in place prior to an application being carried out. The plan must:

- Show a crop nutrient requirement for each field, informed by Agriculture and Horticulture Development Board's (AHDB's) nutrient management guide (RB209),[7] suitable farm software, and/or a suitably qualified adviser.
- Take into account the results of up-to-date soil sampling and analysis (to include P, K, Mg (magnesium) and pH).
- Consider the nutrients provided by organic manures and fertilisers when they are to be applied.
- Farmers should avoid applying organic manures that raise the Soil P Index above target levels for soil and crop on land over a crop rotation.

To reduce the risk of nitrate leaching and surface runoff, there are certain time periods when high RAN organic manure applications are restricted in terms of the timing and quantity that may be spread to land. Farmers must not apply more N than any crop needs over the annual crop cycle. These restrictions are similar to those of NVZs, but time periods of application are more restricted for certain crops.

2.4 The Environmental Permitting (England and Wales) Regulations 2016

The Proposed AD plant requires an Installations environmental permit to operate under the Environmental Permitting (England and Wales) Regulations 2016[8] . The EA is the competent authority which will regulate the facility. The Site operations must comply with best available techniques (BAT) conclusions and BAT Associated Emissions Limits (AEL). These are laid out in the Best Available Techniques Reference Document (BREF) for Waste Treatment: Industrial Emission Directive 2010/75/EU) Integrated pollution Prevention and control) 2018[9]. Chapter 6 stipulates the BAT conclusions for waste operations in general, and specifically for biological treatment of waste.

The Proposed AD plant will require an environmental permit as a Part A Installation under Environmental Permitting since poultry litter and farmyard manure are considered a waste when fed as a fuel to an AD plant. An application will be made to the EA for an Installation environmental permit to treat over 100 tonnes of waste, or a combination of waste and non-waste, each day and for accepting no more than 100,000 tonnes each year.

With regards to the storage of digestate environmental permit requirements stipulate that:

- at least two months of storage of digestate on site and any digestate storage must be covered.

[7] AHDB Nutrient Management Guide (RB209) (https://ahdb.org.uk/nutrient-management-guide-rb209)
[8] The Environmental Permitting (England and Wales) Regulations 2016 (legislation.gov.uk)

[9] Biological waste treatment: appropriate measures for permitted facilities, Environment Agency 21 September 2022, https://www.gov.uk/guidance/biological-waste-treatment-appropriate-measures-for-permitted-facilities

- All lagoons must be constructed in accordance with the Containment systems for the prevention of pollution CIRIA 736 report or an equivalent approved design standard; and
- a freeboard of 750mm must always be maintained on lagoons.

CIRIA 736[10] Containment systems for the prevention of pollution: secondary, tertiary, and other measures for industrial and commercial premises guidance was developed to assist operators of industrial and commercial facilities storing substances (inventories) that may be hazardous to the environment. It provides guidance on identifying the hazards, assessing the risks, and mitigating the potential consequences of a failure of the primary storage facility and/or the combustion of its contents.

The Proposed AD Site will be designed in accordance with CIRIA 736 and will be operated in accordance with the environmental permit.

2.5 Codes of Good Agricultural Practice

Protecting our Water, Soil and Air: A Code of Good Agricultural Practice for farmers, growers, and land managers[11] (the 'CoGAP') provides a practical interpretation of legislation and provides advice on best practice. "Good agricultural practice", in this context, means a practice that minimises the risk of causing pollution while protecting natural resources and allowing economic agriculture to continue. It was written by technical specialists from Defra and Natural England (NE), published 2011 and last updated in 2018.

The additional guidance *Nitrates and phosphates: plan organic fertiliser and manufactured fertiliser use*[12] was published in 2016 which specifically applies to land managers with an Environmental or Countryside Stewardship agri-environmental agreement on land that is outside of an NVZ.

The Code of Good Agricultural Practice for reducing ammonia emissions[13] provides best practice guidance for reducing ammonia emissions from farms in England. It is referenced here given that digestate is typically high in ammonium which is at risk of volatilisation and gaseous losses of ammonia. By following Good Agricultural Practice in using precision application methods such as dribble bar, trailing shoe and injection as well as considering soil and weather conditions ammonia emissions can be abated to mitigate their potential impacts.

3 Nutrient Management Planning

Farmers are navigating the effects of Climate Change and exceptional challenges as they try to secure sufficient supplies of manufactured and mined fertilisers to sustain crop yields amid potential

[10] Containment systems for the prevention of pollution (C736F) (2014) https://www.ciria.org/ItemDetail?iProductCode=C736F&Category=FREEPUBS

[11] Defra Guidance: Protecting our water, soil and air: A Code of Good Agricultural Practice for farmers, growers and land managers (2009) (https://www.gov.uk/government/publications/protecting-our-water-soil-and-air)

[12] Defra (Published 22 December 2016) Use organic manures and manufactured fertilisers on farmland (https://www.gov.uk/government/publications/nitrates-and-phosphates-plan-organic-fertiliser-and-manufactured-fertiliser-use) accessed January 2023.

[13] Defra (2018) Code of Good Agricultural Practice (COGAP) for Reducing Ammonia Emissions (https://www.gov.uk/government/publications/code-of-good-agricultural-practice-for-reducing-ammonia-emissions)

shortages of grain production across the world. Digestate is seen as a viable and now sought-after alternative nutrient source to directly replace these fertilisers. The Proposed AD plant is situated amidst a large available land bank on which the digestate can be used effectively.

The N supplied from digestate is the most critical major nutrient to sustain crop growth, alongside a balance of additionally valuable P, K, Mg, sulphur (S), and trace elements. Digestate should be used at the optimum times when crops are able to take up the supplied nutrients most effectively, thus realising the maximum nutrient and financial value, particularly with regards to N use efficiency.

The FRfW guidance and NVZ rules for England require farmers to demonstrate that they have a written NMP in place prior to an application taking place. The NMP needs to demonstrate how significant risks of agricultural diffuse pollution from nitrate leaching and phosphorus runoff are avoided, taking account of the RAN content of the digestate. Recent representative laboratory analysis of the digestate will be supplied to all farmers planning to use it. The digestate liquor will be high in RAN and potential pollution risk must be considered, given the timing of each application. Single applications must not exceed 30m^3/ha unless they are to be made at an appropriate time of year when the digestate can be soil-incorporated ahead of drilling a crop which has a need for N at the time for establishment. In that case, there must be no repeat application within 21 days.

Crops such as oilseed rape have a small croprequirement to take up N to get well established in the autumn, followed by a rigorous spring requirement. Most cereal crops, such as winter wheat will establish effectively from the N held within the soil (soil N supply) in autumn and only additional N in the spring to sustain rapid growth and attain yield.

Fibre digestate, in addition to its fertiliser nutrient content, has the added advantage of being a soil improver, supplying good quantities of organic matter. It is typically applied to soils around the time crops are sown, both for practical reasons and as it is typically low in RAN and therefore the N is less likely to be lost through nitrate leaching. High RAN fibre digestate is best applied to crops with a need for N in the autumn or ahead of drilling spring crops, when the RAN will be rapidly taken up by crops, rather than lost.

Phosphorus contributions from the digestate should be carefully considered. FRfW require that farmers should avoid applying organic manures that raise the Soil P Index above target levels for soil and crop over a crop rotation. Up-to-date, (less than five years old), soil analysis results will be assessed for existing concentrations of crop-available P. The results will inform the strategy for phosphate and potash use. This will either involve building up concentrations which are low, maintaining levels to maintain crop productivity or running down the concentrations by applying less P and/or K than will be removed within the rotation. The Nutrient Management Guide (RB209)[14] or suitable farming software such as Gatekeeper will be used to calculate appropriate digestate application rates to achieve the chosen strategy.

The area of available land and the crop rotation within the vicinity of the Proposed AD Plant presents great opportunity to use the digestate produced effectively and for agricultural benefit. Table 1 below provides a summary of areas of different crop types grown on local estates and farms which may

[14] Nutrient Management Guide (RB209), AHDB 2023 https://ahdb.org.uk/nutrient-management-guide-rb209

receive digestate applications as part of an integrated nutrient management plan, taken from 2024 cropping season data.

Table 1 Example crops grown on land within the vicinity of the AD Plant

Crop Type	Area Grown (ha)
Spring barley	29.68
Winter barley	654.90
Winter oilseed rape	615.82
Spring wheat	733.28
Winter wheat	1398.47
Maize	250.00
Total example land bank available	**3,682.15**

Soil analysis data has been provided which demonstrates soil P index levels ranging from 0 to 4 but largely at or below P Index 2 with some fields below optimum levels at P Index 0 and 1 and some at higher index levels of P Index 3 and 4. Excessively high P Index levels were not seen.

The detailed analysis of the digestate to be spread is unknown at this time but example application rates might be 25 t/ha for fibre digestate and 30m^3/ha for liquid digestate. The planning application states production levels of 27,800 m^3 of liquid digestate and 55,000 t of solid digestate. These levels would require 2,200 ha of land to receive fibre digestate and 927 ha of land for liquid digestate. As a worst-case scenario if all digestate were produced as a liquid, 82,800 m^3 of whole digestate would be spread to around 2,760 ha of land.

Avalailble example soil analysis, crop and land data indicate there is sufficient landbank available to ensure effective nutrient management planning and compliant use of digestate can be carried out. The volume of proposed digestate storage within the planning application will allow for storage of digestate during inclement weather conditions to allow applications to be carried out at appropriate times.

4 Conclusion

The fields to which digestate will be applied will be selected based on soil analysis, crop need, soil type and growth conditions. Nutrient management planning is dynamic. Applications must be planned but may be subject to change given weather and soil conditions. For example, the period autumn 2023 and spring 2024 has been the wettest on record in many areas of the country and whilst applications of liquid digestate to winter wheat may have been planned, some crops were not planted, and soils were too wet to spread before the crop became too advanced to travel through with spreading equipment. Therefore, plans were changed and digestate was stored to be spread later in the year to meet crop need. Contingency storage has been planned for the Proposed AD plant which also allows for the effects of Climate Change.

The rules and regulations controlling the quality and safety of digestate use are well established. They have been outlined in Section 2 of this report. When these rules and regulations are followed, along with the correct adopted strategy for each individual field, the risk of nutrient losses to the wider environment will be effectively mitigated and digestate will be applied for agricultural benefit.

Logistics must be optimised when using digestate. This means getting the material applied to the right crop, at the right time to meet crop demand to attain economic yields of crops of a suitably high quality. The Proposed AD Site will have up to 30,000 m^3 of digestate liquid storage onsite connected via a pipeline to a further 20,000m^3 centrally placed within the available landbank. This volume of storage considerably exceeds the required 6 months of storage.

This will allow digestate to be stored ready to apply during the short application windows when crops are actively growing and able to take up applied nutrients effectively.

A spreading team will complete spreading operations, using precision application equipment to reduce the potential for nutrient losses to the wider environment. All applications will be recorded such that the land manager can effectively calculate the balance of fertiliser required to meet crop need.

Digestate provides a sustainable source of nutrients which, when used on farms surrounding the Proposed AD plant, will have a lower carbon footprint than manufactured or mined fertilisers. Adherence to effective nutrient management plans and adherence to good agricultural practices should result in beneficial use of digestate as a Biofertiliser and soil improver. The nutrients supplied by the digestate will replace those from fertilisers rather than increase overall nutrient use.