British Poultry Council/British Egg Industry Council

Poultry Washwater Study – Composition and Legislative Aspects

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Summary

Poultry washwaters so far studied are on average in line with their reported RB209 'standard' values, however, there is significant variation in their composition. Whilst in general, the level of nutrients co-vary (i.e., have a similar ratio of nutrients respective to their dry matter) , many of samples returned are below the expected values, but some are disproportionately higher. There is no strong evidence that there is any bias towards certain systems, but that sites should undertake their own sampling to establish a baseline.

The majority of poultry washwaters would be considered to be high readily available nitrogen content manures (RAN>30%) as defined by Nitrate Vulnerable Zone (NVZ) legislation and as presented in the guidance for Farming Rules for Water (FRfW). Given that poultry manures themselves are most probably high RAN, this result is not unexpected. However, there is no strong evidence that RAN % changes across the range of dry matter strengths of washwater encountered. Therefore, there is no reason to suspect that RAN of high or low strength washwaters are any more or less subject to NVZ and FRfW regulations. The default position would appear to be to treat poultry washwaters as high RAN regardless. Technically, these should be treated the same as high RAN slurries and poultry manures with regard to the above legislation.

Given that the absolute risk of nitrate leaching is subject to more factors than simply RAN content, it is inappropriate to use this single factor when determining the ultimate risk of leaching when applying these as a manure, particularly in closed periods. Within NVZ regulations, high RAN closed periods are set out in the statutory instrument. With FRfW, high RAN periods are set in the guidance, not the primary legislation. The current guidance allows for discretionary applications during the closed period, and therefore is not as such a fully strict rule. We believe that there may be scope to relax the high RAN related regulations via either a better definition of high RAN (one that takes into account the total, absolute amount of RAN) and/or a more risk based approach to assessing the risk of significant environmental pollution from applications of this material.

Inevitably, poultry washwaters are organic manures classed as or equivalent to slurries. It is important that other parts of the legislation are complied with and that accurate records of volumes and applications are maintained, demonstrating that the nutrients within these materials are properly recovered.

Introduction

This is a report of a study into the nutrient status of poultry washwaters. Poultry washwaters have been sampled from a range of units, reflecting different sites, organisations and systems. In general, at the end of each cycle, units are cleaned prior to the next cycle. This typically involves the physical removal of any litter followed by a wash down. Whilst sites may operate slightly differently, the washwaters are collected in an collection tank/interceptor and removed off site, generally for application to agricultural land in the local vicinity. By the very nature of the activity, the washwaters produced are dilute, but there is little empirical evidence as to their exact composition.

From the perspective of legislation, the principle of landspreading of the washwater is the recovery of the nutrient content of the material for agricultural benefit

There are a number of pieces of legislation and codes of practice which control this landspreading activity. In England, the Farming Rules for Water (FRfW; The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018), were introduced to further protect the environment from the effects of diffuse pollution. It is generally now accepted that any liquid that contains any trace of manure is considered a slurry, regardless of its nutrient or dry matter content.

The purpose of this report is to further understand the characteristics of poultry washwaters, particularly in light of the regulatory regime that controls their final recovery.

Materials and Methods

Samples were collected during or shortly (no more than a few days) after a washdown. A number of sites were sampled by ADAS personnel and a number of sites were self sampled. The sampling methodology chosen was relatively straightforward. Single samples (a current total of 33) were taken from either collection tank/interceptors/storage tanks or in some instances the tanks of spreading units if these were available at the time. Poultry washwaters are generally low in solids (typically reported at 0.5 % w/v) when compared with, for example, cattle and pig slurries (generally >2% w/v). The typical operation for cleaning is to remove as much solid material in the first instance (to be removed for landspreading or incineration) and then clean the residue. In this respect any solids in the washwaters will tend to settle only slowly over time and are not expected to form discontinuous layers such as crusts. Therefore, it is expected that the samples are relatively homogenous when collected.

The configuration of drainage and collection systems vary highly from installation to installation. For example, some sites had divertors in place to direct discharge clean rainwater, in other sites this was not possible or implemented. In this respect, our aim was to sample a large number of individual farms to assess the range of possible values encountered. Various different systems were targeted e.g., broilers, breeders, egg layers and turkeys.

A single sample of washwater was collected from each site in a 250 ml plastic screw top vessel provided by and sent to an NRM laboratory for a standard manure analysis. This analysis included oven dry solids (dry matter), pH, total nitrogen, ammonium-nitrogen, nitrate-nitrogen, total phosphorus, total potassium, total calcium, total sulphur, total zinc and total copper in compliance with their certified procedures.

The results from the samples were aggregated to calculate the mean, median and range (minimum and maximum) for each parameter measured on a wet weight basis. The readily available ammonium was calculated as the ammonium divided by the total nitrogen (expressed as a percentage).

MANNER-NPK (MANure Nutrient Evaluation Routine) is a decision support tool for quantifying manure crop available nutrient supply. This enhanced version of MANNER (first launched in August 2000) retains the user-friendly characteristics of the earlier version, but includes additional factors to drive new and revised nitrogen (N) transformation/loss modules (estimating ammonia volatilisation, nitrate leaching and nitrous oxide emissions, and organic N mineralisation) and estimates manure phosphate (P_2O_5), potash (K_2O), sulphur (SO_3) and magnesium (MgO) supply. Notably, MANNER-NPK provides N availability estimates for following crops through the mineralisation of organic N. Using MANNER-NPK (freely available from https://www.planet4farmers.co.uk), poultry washwater applications using a conservatively high strength washwater (1% dry solids; Total N 0.8 kg/T; 60% RAN

– defined based on the average results obtained in this study) were modelled on winter cereal/grass, various soil types (reflecting light and heavy soils), at various dates in and around the closed period (as defined by either NVZ regulations and/or FRfW). Whilst there is considerable overlap between the periods, these do vary slightly and are dependent on other factors, e.g., soil type and arable/grass cultivation. A number of models were used with comparator materials including cattle FYM, lime stabilised biosolids, and layer manure to provide context to the results.

Just to note, due to the general low solids content of poultry washwaters 1m^3 (1000L) is regarded to be 1T and therefore when referring to poultry washwater these terms can be used interchangeably.

Results

Oven Dry Solids

The mean Oven Dry Solids equals 0.47 %, with a minimum value of 0.04 %, with a maximum value of 1.53 %. The median value is 0.33 %. The mean is 30% greater than the median as a percentage of the mean.

The typical value from RB209 is 0.5%.

This equates to a mean dry solids content of 4.7 kg/T, with a minimum value of 0.4 kg/T, and a maximum value of 15.3 kg/T. The median value is 3.3 kg/T.

Total Kjeldahl Nitrogen

The mean Total Kjeldahl Nitrogen equals 0.03 % w/w, with a minimum value of 0.01 % w/w, and a maximum value of 0.25 % w/w. The median value is 0.02 % w/w. The mean is 43 % greater than the median as a percentage of the mean.

The mean Total Nitrogen equals 0.3 kg/T, with a minimum value of 0.1 kg/T, and a maximum value of 2.5 kg/T. The median value is 0.2 kg/T.

The typical value from RB209 is 0.5 kg/T.

Using the Total Nitrogen and the NVZ Nitrogen field limit of 250kg/ha, the mean annual NVZ limit for washwaters (expressed T/ha/annum) was calculated. The mean NVZ limit equals 1994 T/ha, with a minimum value of 100 T/ha, and a maximum value of 2500 T/ha. The median value is 1250 T/ha. The mean is 10% greater than the median as a percentage of the mean.

The mean Total Nitrogen per 30T application equals 10.45 kg, with a minimum value of 3.0 kg, and a maximum value of 75.0 kg. The median value is 6.0 kg. Note, that the percentage crop available N varies between 10-50% depending on time of year, crop and soil type as reported in RB209. Although, only a typically a small amount for most crop nitrogen requirements, this should be calculated for each specific instance.

Ammonium Nitrogen

The mean Ammonium Nitrogen equals 194 mg/kg, with a minimum value of 25.0 mg/kg, and a maximum value of 1927 mg/kg. The median value is 93 mg/kg. The mean is 52 % greater than the median as a percentage of the mean.

The mean Total Ammonium-N equals 0.19 kg/T, with a minimum value of 0.025 kg/T, and a maximum value of 1.9 kg/T. The median value is 0.093 kg/T. The mean is 52 % greater than the median as a percentage of the mean.

Using the Total Nitrogen for each sample, the mean Readily Available Nitrogen (RAN) equals 47.61 %, with a minimum value of 12.33 %, with a maximum value of 96 %. The median value is 42.33 %. The mean is 11 % greater than the median as a percentage of the mean.

Total Phosphorus (P)

The mean Total Phosphorus (P) equals 60 mg/kg, with a minimum value of 5 mg/kg, and a maximum value of 265 mg/kg. The median value is 40.6 mg/kg. The mean is 32 % greater than the median as a percentage of the mean.

The mean Total Phosphorus (P) equals 0.06 kg/T, with a minimum value of 0.005 kg/T, and a maximum value of 0.265 kg/T. The median value is 0.04 kg/T. The mean is 32 % greater than the median as a percentage of the mean.

The mean Total Phosphate (P_20_5) equals 0.14 kg/T, with a minimum value of 0.01 kg/T, and a maximum value of 0.61 kg/T. The median value is 0.09 kg/T.

The typical value from RB209 is 0.1 kg/T.

The mean Total Phosphate (P_20_5) per 30T application equals 4.13 kg, with a minimum value of 0.34 kg, with a maximum value of 18.21 kg. The median value is 2.79 kg. Note, the percentage of available Phosphate is 50% of the Total Phosphate. This lower value is used when calculating crop nutrient requirements on fields where the index is below target (Soil P index 2).

Total Potassium (K)

The mean Total Potassium (K) equals 283 mg/kg, with a minimum value of 22.0 mg/kg, and a maximum value of 1089 mg/kg. The median value is 194 mg/kg. The mean is 32 % greater than the median as a percentage of the mean.

The mean Total Potassium (K) equals 0.28 kg/T, with a minimum value of 0.022 kg/T, with a maximum value of 1.09 kg/T. The median value is 0.194 kg/T. The mean is 32 % greater than the median as a percentage of the mean.

The mean Total Potash (K_20) equals 0.34 kg/T, with a minimum value of 0.03 kg/T, with a maximum value of 0.131 kg/T. The median value is 0.23 kg/T.

The typical value from RB209 is 1.0 kg/T.

The mean Total Potash (K_2O) per 30T application equals 10.3 kg, with a minimum value of 0.80 kg, with a maximum value of 39.4 kg. The median value is 7.0 kg. Note, all the Potash is considered available for the receiving crop.

Total Magnesium (Mg)

The mean Total Magnesium (Mg) equals 39.4 mg/kg, with a minimum value of 10 mg/kg, and a maximum value of 165 mg/kg. The median value is 27.6 mg/kg. The mean is 30 % greater than the median as a percentage of the mean.

Total Copper (Cu)

The mean Total Copper (Cu) equals 13.0 mg/kg, with a minimum value of 0.0 mg/kg, and a maximum value of 320.0 mg/kg. The median value is 0.30 mg/kg. The mean is 98 % greater than the median as a percentage of the mean.

Total Zinc (Zn)

The mean Total Zinc (Zn) equals 5.25 mg/kg, with a minimum value of 0.0 mg/kg, and a maximum value of 42.5 mg/kg. The median value is 2.6 mg/kg. The mean is 51 % greater than the median as a percentage of the mean.

Total Sulphur (S)

The mean Total Sulphur (S) equals 86.4 mg/kg, with a minimum value of 2.37 mg/kg, with a maximum value of 307.0 mg/kg. The median value is 67.8 mg/kg. The mean is 22 % greater than the median as a percentage of the mean.

Total Calcium (Ca)

The mean Total Calcium (Ca) equals 192.8 mg/kg, with a minimum value of 37.7 mg/kg, and a maximum value of 913 mg/kg. The median value is 141 mg/kg. The mean is 27 % greater than the median as a percentage of the mean.

Total Sodium (Na)

The mean Total Sodium (Na) equals 128 mg/kg, with a minimum value of 15.9 mg/kg, and a maximum value of 328 mg/kg. The median value is 95.1 mg/kg. The mean is 26 % greater than the median as a percentage of the mean.

pH 1:6 [Fresh]

The mean pH 1:6 [Fresh] equals 7.42, with a minimum value of 6.57, and a maximum value of 8.98 . The median value is 7.35. The mean is 0.9 % greater than the median as a percentage of the mean.

Correlation Matrix

We have performed a correlation matrix for all the measured parameters to investigate any potential interactions between the parameters. Of particular interest is the positive correlation (r in brackets) between oven dry solids and total nitrogen (0.84), ammonium N (0.9), Total Phosphorus (0.65), Potassium (0,61), Magnesium (0.64), and Calcium (0.75). This is not unsurprising. This means the higher the solids, the more nutrient value, which makes perfect sense. Whilst unsurprising, it does mean that measuring a limited number of parameters (e.g., dry matter or total N) is sufficient to extrapolate the remaining parameters.

MANNER NPK

Results of the Manner NPK analysis are shown in Appendix 2. Whilst MANNER-NPK is a very useful tool for planning nutrient applications on an individual basis, it is not ideal for modelling purposes since it cannot run large numbers of different permutations simultaneously. Given the large amount of parameter space to be investigated and the slightly laborious nature of recording each permutation, the results are more illustrative. Using a conservative high poultry washwater, applied at 30 m^3/ha, it can be seen that significant (>5kg ha Nitrate-N) leaching of nitrate can result. However, this requires a specific set of circumstances (e.g., application to winter cereals on light/medium soil, in early winter). However, as shown in the results significant leaching using an application of Cattle FYM (20T/ha) and biosolids (20T/ha) can occur using similar conditions. These applications appear to be the exception rather than the rule for applications of poultry washwater made during the effective “closed” season. When compared with poultry manure, the risk is very much reduced.

Discussion

The dataset collected currently includes results from 33 individual units of which 10 were sampled by ADAS. The dataset is biased towards broilers (being the easiest to sample due to their short crop cycle length). Sampling was affected by an outbreak of avian influenza which clearly restricted resources and movement between holdings.

The mean values of all constituents are consistently higher than the median values. This is consistent with a non-normal (i.e., skewed) distribution of the data. Simply put, there are some sites that are producing disproportionately higher levels of more fouled water. This is slightly pronounced in the dry solids and major nutrients, and therefore for the purposes of nutrient planning is not a major concern. For copper the difference is quite considerable and would require some further investigation. Effectively, as the difference between the median and the mean increases, then the median value as a representative measure of the average becomes the better parameter to use.

The cause of this skewed distribution is not completely clear at present. Even under a normal distribution we would expect to see some noise in the data as effectively random variation from sites, site conditions, sampling and experimental error occur. We are not convinced that the type of system has a major effect, when considering other site factors. For example, the photo below shows 2 samples collected within hours from 2 sites of close geographic origin from the same producer and the same system. It can be clearly seen that one sample has a stronger colour than the other, indicating a more fouled water. This was attributed to differences in the site design and the collection of rainwater. This is consistent with the dataset of one producer who has completed their sampling. Of the 4 samples that currently show high (>1%) solids, 2 are broiler units from the same producer whose other broiler units show standard (0.5%) solids or below. Whilst the results are within reasonable bounds for most samples with no clear distinction between different groups, we are cautious to put any confidence of statistical approach to analysing the data (which given the non-normal distribution of the data would require either a non-parametric approach or log transformation) given the relatively small sample size. In order for the data to be considered "biologically" as opposed to statistically significant we would expect to see clear trends in the data, with a relevant hypothesis to drive any such observations. Note, none of the outlying high values were collected by ADAS personnel and were self-sampled. This could be a result of inappropriate sampling techniques. However, this only stresses the importance of understanding the "typical" nature of washwaters produced by each individual site.

Recommendation. It is recommended that each site undertakes periodic monitoring of washwaters to identify the typical level (e.g., RB209 for dry matter and/or total nitrogen) of each site. We would suggest an annual monitoring in the first instance. Sites with elevated levels (e.g., >0.5% solids should be investigated further.

Photo 1. Two samples (A and B) of Poultry Washwater. Samples collected same day from 2 different sites on the same system.

Results of Samples A and B.

Sample	A	B	Expected (RB209)	Units
Oven Dry Solids	0.500	0.04	0.5	%
Total Nitrogen	0.4	<0.1	0.5	kg N/T fresh weight
Ammonium	0.24	0.02	N/A	kg N/T fresh weight
RAN	60%	>20%	N/A	%
Total Phosphorus	0.11	<0.1	0.1	kg P_2O_5 /T fresh weight
Total Potassium	0.69	0.06	1	kg K_2O/T fresh weight

Interestingly, sample A this appears to match almost exactly the expected RB209 values for washwater. Sample B, which is clearly more dilute is almost exactly 10x more dilute in each parameter assessed above. Whilst we would not agree that dilution is the solution to achieving any legislative compliance there is a clear need to understand the base level of poultry washwaters on a site specific basis. It should be noted that a lower than expected oven dry solids may indicate an inefficient use of water, and it may be possible to reduce and/or re-use water.

The average (bearing in mind the difference between the median and mean) values for the dry solids and major nutrients correspond well to the RB209 values for dirty water (Section 2 Organic materials; Tables 2.8-2.10, p. 16-18). The slight exception to this is potash which is lower in our washwaters than reported in RB209. This is most probably due to the RB209 dirty water corresponding to cattle as opposed to generic washwaters and there typically being a higher requirement (and therefore uptake) for potash in grassland systems. Simply put there is more potash being moved around in predominately grass-fed systems.

Average results of poultry washwater compared with RB209.

Sample	Mean	Median	Expected (RB209)	Units
Oven dry solids	0.49	0.39	0.5	%
Total Nitrogen	0.35	0.2	0.5	kg N/T fresh weight
Ammonium	0.19	0.093	N/A	kg N/T fresh weight
RAN	48%	42%	N/A	%
Total Phosphate	0.13	0.09	0.1	kg P_20_5 /T fresh weight
Total Potash	0.34	0.23	1	kg K_20/T fresh weight

Recommendation. In the absence of analytical results, standard RB209 values for dirty water can be used for nutrient planning when applying poultry washwater. Given that some sites may underestimate (as well as over-estimate) nutrient values, testing to establish site specific values may be more appropriate for these sites.

Legislation – England

The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010 (SAFFO) regulations defines;

"slurry" means liquid or semi-liquid matter composed of—

(a) excreta produced by livestock while in a yard or building (including that held in wood chip corrals); or
(b) a mixture wholly or mainly consisting of livestock excreta, livestock bedding, rainwater and washings from a building or yard used by livestock, of a consistency that allows it to be pumped or discharged by gravity at any stage in the handling process.

On the basis of the definition above, poultry washwater would be classified as a slurry. The requirements of SAFFO are that;

6. (1) Subject to sub-paragraph (2), the slurry storage tank must have adequate storage capacity for the likely quantities of slurry produced from time to time on the premises in question, taking into account—

(a) the proposed method of utilising the slurry, and the likely rates and times of utilisation; and

(b) the matters mentioned in sub-paragraph (3).

(2) If it is proposed to utilise the slurry on the premises by spreading it on the land, the tank need not have a greater storage capacity than is adequate, taking into account the matters mentioned in sub-paragraph (3), to hold the maximum quantity of slurry likely to be produced in any four month period.

(3) The matters to be taken into account for sub-paragraphs (1) and (2) are—

(a) the storage capacity of any other slurry storage tank on the premises;

(b) the likely quantities of rainfall (including snow, hail or sleet) that may fall or drain into the slurry storage tank during the likely maximum storage period; and

(c) the need to provide at least 750 millimetres of freeboard in the case of a tank with walls made of earth and 300 millimetres of freeboard in all other cases.

Recommendation. Under SAFFO, poultry washwaters are classed as slurry Sites should therefore provide sufficient storage for four month's production of washwaters, if they are to be spread to land. (Storage requirements for washwater removed for treatment and off-site disposal are not specified under SSAFO)

When applying organic manures (including slurries), in England spreading is covered by Farming Rules for Water (FRfW; The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018). Under this legislation all applications should be planned (see Regulation 4; or rule 1 of FRfW).

4. (1) A land manager must ensure that, for each application of organic manure or manufactured fertiliser to agricultural land, the application—

(a) is planned so that it does not—

(i) exceed the needs of the soil and crop on that land, or

(ii) give rise to a significant risk of agricultural diffuse pollution, and

(b) takes into account the weather conditions and forecasts for that land at the time of the application.

For the purposes of this regulation an "organic manure" means fertiliser derived from one or more animal, plant or human source, including a) anaerobic digestates and liquors, (b) ash from meat, poultry litter or biomass, (c) bone meal, (d) livestock manure, (e) paper crumble, (f) silage effluent, (g) sludge, (h) slurry.

FRfW defines slurry as:

"liquid or semi-liquid matter with a consistency enabling it to be pumped or to be discharged by gravity, which is composed of—

1. excreta produced by livestock while in a yard or building (including that held in wood chip corrals), or

2. a mixture of livestock excreta, livestock bedding, rainwater and washings from a yard or building used by livestock"

Based on the definitions above, poultry washwater is classified as slurry regardless of any physio-chemical characteristics it may have.

Recommendation. Under FRfW, poultry washwaters are classed as slurry.

Therefore, in order to comply with FRfW, all applications should be planned taking into account the nutrient status of the soil (as shown by soil testing), the nutrient content of the manure and the crop demand. In particular, land managers should avoid, where reasonably practicable, raising the soil P index to above target levels.

Based on a single 30T/ha application, which is generally regarded as a normal to high application rate (over 50T/ha is regarded not compliant with good agricultural practice) the amount of nutrient supplied as N, P, and K is low. Typical values of total nutrients would be 6-8, 3-4 and 6-8 kg/ha of the respective nutrients in their relevant oxide form for phosphorus and potassium. Whilst under FRfW, application of organic manures should be planned, these nutrient applications are unlikely to meet crop need where soil nutrient indexes are at target or below and unlikely on a single application raise soil indexes of the major nutrients.

Recommendation. In all instances, the legislative requirements, particularly around spreading and nutrient planning, of FRfW should be adhered to when poultry washwaters are spread to land.

Additionally, in designated areas, the spreading of poultry washwaters will be subject to Nitrate Pollution Prevention Regulations 2015 (Nitrate Vulnerable Zone (NVZ) regulations). However, Nitrate Pollution Prevention Regulations 2015 (NVZ regs), defines "slurry" as: "excreta produced by livestock (**other than poultry**) while in a yard or building (including any bedding, rainwater or washings mixed with it) that has a consistency that allows it to be pumped or discharged by gravity (and in the case of excreta separated into its liquid and solid fractions, the slurry is the liquid fraction);"

On this basis, under NVZ regulations, the poultry washwaters are strictly not classified as slurries. However, this does not mean that they are not organic manures since "organic manure" means a nitrogen fertiliser or phosphate fertiliser derived from animal, plant or human sources (and includes livestock manure – livestock being defined as including poultry (chicken, duck, turkey or ostrich). Our interpretation of this is that poultry washwaters are exempt from NVZ storage requirements as slurries (see Storage capacity - Regulation 25(1)(a) and following items specific to slurries or restriction on spreading slurry (Regulation 18).

However, NVZ regulations apply to regulations related to livestock manures and organic manures. For example, when spreading any organic manure the occupier of the holding must record the area, quantity, month, type of manure, its total N content and the amount of nitrogen likely available (Records of spreading nitrogen fertilizer regulation 31(1)(a-g)).

Recommendation. Poultry washwaters are not classed as slurries, when considered under NVZ regulation, but are considered as organic manures. We recommend that nutrient management planning activities required under this legislation be considered in full when this material is spread to land.

NVZ regs define high Readily Available Nitrogen (RAN) manures as organic manures with more than 30% of the total N available to crop at the time of spreading (Closed periods for organic manure – Regulation 20(8)). RAN is therefore defined irrespective of the total nitrogen content or the absolute concentration of the available nitrogen forms. The guidance on complying with the rules for Nitrate Vulnerable Zones in England for 2013 to 2016, (published June 2013) defines dirty water as "lightly contaminated run-off from lightly fouled concrete yards. It also states that the "closed period does not apply to organic manures with a low readily available N content, which may (emphasis added) include the following; dirty water." Therefore, although the guidance implies that dirty water is low RAN, this is not definitive. Dirty waters from yard runoff from manures that have low RAN e.g., cattle FYM, may be low RAN and thus not subject to closed periods. Note, this is no longer current guidance.

The definition of high RAN does not appear in the legislative act for FRfW. However, under the guidance issued by the Secretary of State;

A high RAN organic manure has a RAN content above 30 percent. For applications of high RAN organic manure the potential nitrate leaching risk linked to the application rate will not be considered significant if one of the following 3 criteria are met.

The application is made:

outside the time periods set out in Table 1, in which case no application rate limit would need to be enforced because of nitrate leaching risk.

during the time periods set out in Table 1 with a single application rate limit of 30m^3/ha for high RAN organic manures in general and 8t/ha for high RAN poultry organic manures — there must also be no repeat applications for at least 21 days during the restricted time periods.

during the time periods set out in Table 1 at an application rate to meet the soil and crop need of an autumn/winter commercial crop, not including conventional cover crops or green manure.

Table 1. Closed period for FRfW

Soil type	Grassland	Tillage land
Sandy or shallow soil	1 Sep to 28th Feb	1 Aug to 28th Feb
All other soils	15 Oct to 28th Feb	1 Oct to 28th Feb

Over 75% of the samples so far investigated have RAN>30%. We are not surprised by this result. If solid poultry manures are high RAN, that simply diluting the solid fraction into water (i.e., the process of making a slurry) would not necessarily change the species of nitrogen compounds.

Recommendation. It is acknowledged that poultry washwaters met the definition of high RAN and are technically subject to closed periods either both NVZ and FRfW.

Note, that the FRfW guidance refers to poultry organic manures. Given that the definition of organic manures also covers slurry, then effectively the guidance does not distinguish between solid poultry manures and poultry washwater since both are technically organic manures. It is conceivable that a slurry (typically >2% dry solids) can be applied at a higher rate ($30m^3$) than any poultry washwater (majority of which are at 0.5% dry solids or below), that strictly to the guidance is limited to $8m^3$ merely because of a (presumed) loose definition used. However, this acts in contrary to FRfW (specifically regulation 4(a)(ii)) which only requires that the spreading activity is planned so that it does not give rise to a significant risk of agricultural diffuse pollution. We would be surprised if this could be strictly enforced however.

For applications of low RAN organic manure the potential nitrate leaching risk linked to application rate will not be considered significant if all appropriate reasonable precautions are taken to help mitigate against the risk of diffuse pollution. In this situation an application rate limit would not need to be enforced because of nitrate leaching risk. No more nitrogen should be applied over an annual crop cycle than the soil and crop need on that land.

It defines the closed period for organic manures with high RAN, (defined as organic manures with more than 30% of the total N available to crop at the time of spreading) which may include lightly fouled and dirty water.

Furthermore, under FRfW, an assessment of significant risk of agricultural diffuse pollution when planning should be made. As part of this the RAN of the material should be taken into consideration. In particular, the spreading of high RAN material is subject to closed periods. However, the risk of RAN in washwater contributing to diffuse pollution is low since, as shown above, the Total Nitrogen is very low. Clearly the direct risk of nitrate pollution is initially low, since the nitrate is rarely at detectable levels in the washwaters.

For example, a 20T/ha application of cattle manure (6 kg N/T) would apply 120 kg of Total N/ha onto winter wheat (assume late drilled) on a light soil and creates the same nitrate leaching risk as 30T/ha of poultry washwater (at 0.8 kg N/T; 60% RAN) applied under the same conditions. The cattle manure, being a low RAN material, would not be subject to FRfW rules regarding closed periods. Given that the nitrate leaching risk is the same for each material, this appear to run contrary to FRfW as laid down in the Statutory Instrument. Note, that FRfW, *under present guidance*, do not strictly ban the spreading of high RAN materials in the closed period as single applications of high RAN materials can be made every 21 days.

RAN is not the single predictor of nitrate leaching risk. It is also necessary to consider the Total Nitrogen content of the material alongside the readily available nitrogen (in effect consider the total readily available nitrogen). It appears that the traditional approach of NVZ regulations was to consider washwater as low RAN and thus permissible to spread during closed periods (subject to other restrictions). It is not clear that FRfW will take the same approach. It should be noted that unlike NVZ regulations, which apply to designated areas only, FRfW apply across England. Other rules for devolved administrations may apply. Where spreading is practicably unavoidable, there is guidance issued with regard to spreading in closed periods. However, this guidance will be reviewed in the near future.

Bearing in mind that the maximum application at any one time is 50T/ha under GOCAP, it is unlikely that the field rule for nitrogen (250 kg/ha) under NVZ would be breached via one application per poultry crop cycle (assuming that the minimum poultry crop cycle is approximately 40 days). If multiple applications are being made to the same land, phosphate is more likely to be the limiting factor for the total amount of washwater applied. In drier areas of the country water could also be a benefit to the application. Each tonne of washwater / ha is equivalent to 0.1 mm of rain.

Recommendation. Since high RAN is only part of the risk associated with nitrate leaching, the EA should be encouraged to consider a low risk position statement for washwaters (poultry or otherwise) that permit spreading during the closed period.

Exactly what a low risk position statement would contain is subject to some debate. However, we would make the following suggestions;

A maximum dry matter content (e.g., 0.5% solids).

A maximum total nitrogen content (e.g., 0.5 kg N/T).

A maximum spreading rate (e.g., 30 T/ha).

A maximum leaching value (as calculated using NPK MANNER using the relevant parameters) (e.g., 5 kg N/ha).

Alternatively, a re-definition of high RAN as a percentage of RAN (e.g., >30%) in organic manures where the Total N is below a certain level (e.g., <0.5 kg N/T) could be made to ensure that, in fact, high RAN materials where high in RAN not just proportionally but also quantitatively.

Using either of the approaches above as a low risk position statement would not require significant change in the current legislation. The former suggestion would be in line with RPS252, which although now expired, provides an initial benchmark as to suitability for some of the parameters used.

Recommendations

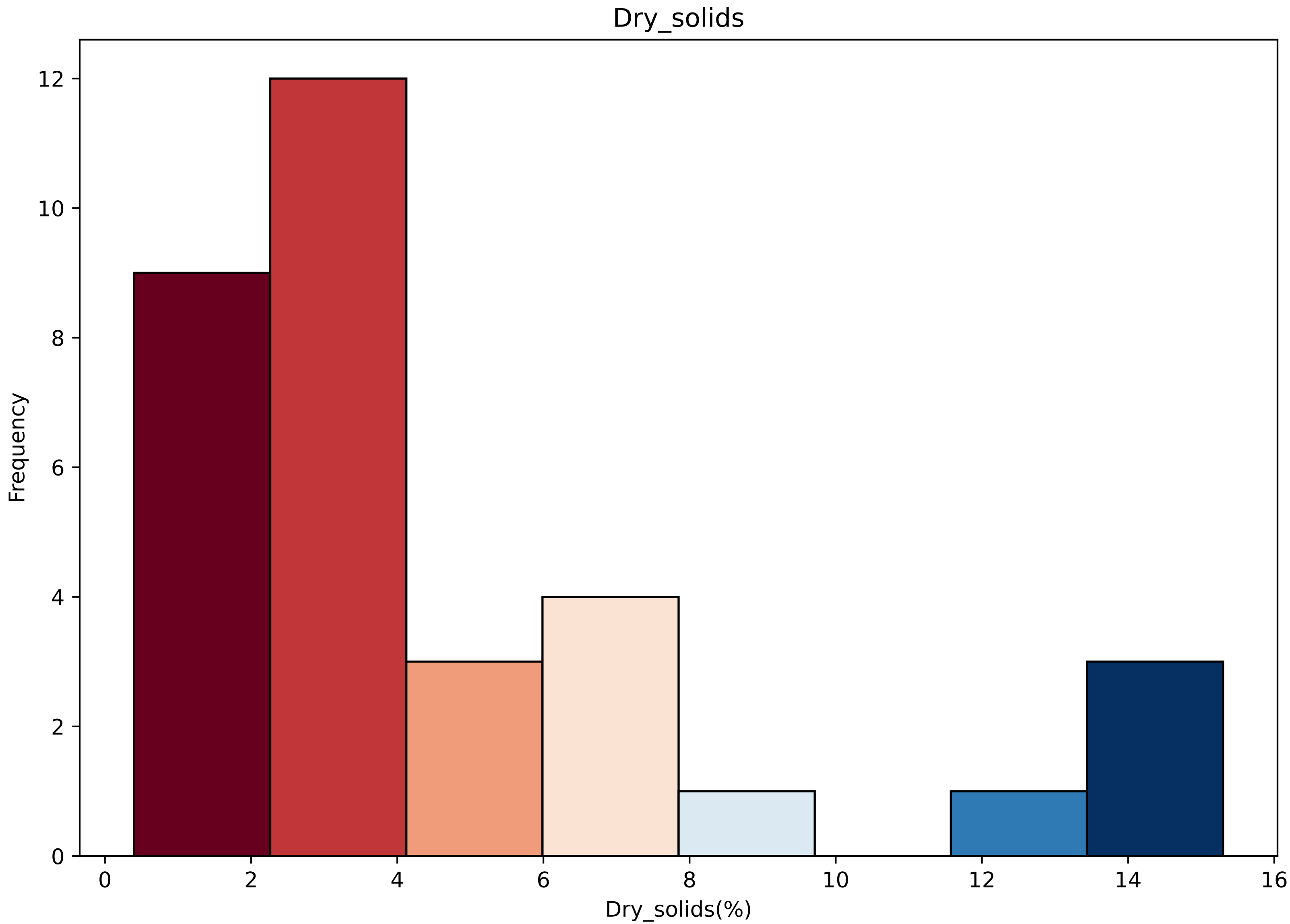
1. **Since high RAN content is only part of the risk associated with nitrate leaching, the EA should be encouraged to consider a low risk position statement for washwaters (poultry or otherwise) that permit spreading during the closed period.**
2. **It is recommended that for each site there is periodic monitoring of washwater production to identify the typical nature and volume at each site. We would suggest an annual monitoring in the first instance. Sites with elevated levels (e.g., >0.5% solids should be investigated further.**
3. **In the absence of analytical results, standard RB209 values for dirty water can be used for nutrient planning when applying poultry washwater. Given that some sites may under or overestimate nutrient values, testing may be more appropriate for these sites.**
4. **Under SAFFO, poultry washwaters are classed as slurry. Where washwater is to be spread to land sufficient storage for the volume produced over a four month period must be provided.**
5. **Under FRfW, poultry washwaters are classed as slurry.**
6. **In all instances, the legislative requirements of FRfW, particularly around spreading and nutrient planning, should be adhered to when poultry washwaters are spread to land.**
7. **Poultry washwaters are classed as organic manures equivalent to slurries, under NVZ regulation, Nutrient management planning activities required under this legislation must be considered in full when this material is spread to land.**
8. **It is acknowledged that poultry washwaters met the definition of high RAN and are therefore technically subject to closed periods under both NVZ and FRfW.**

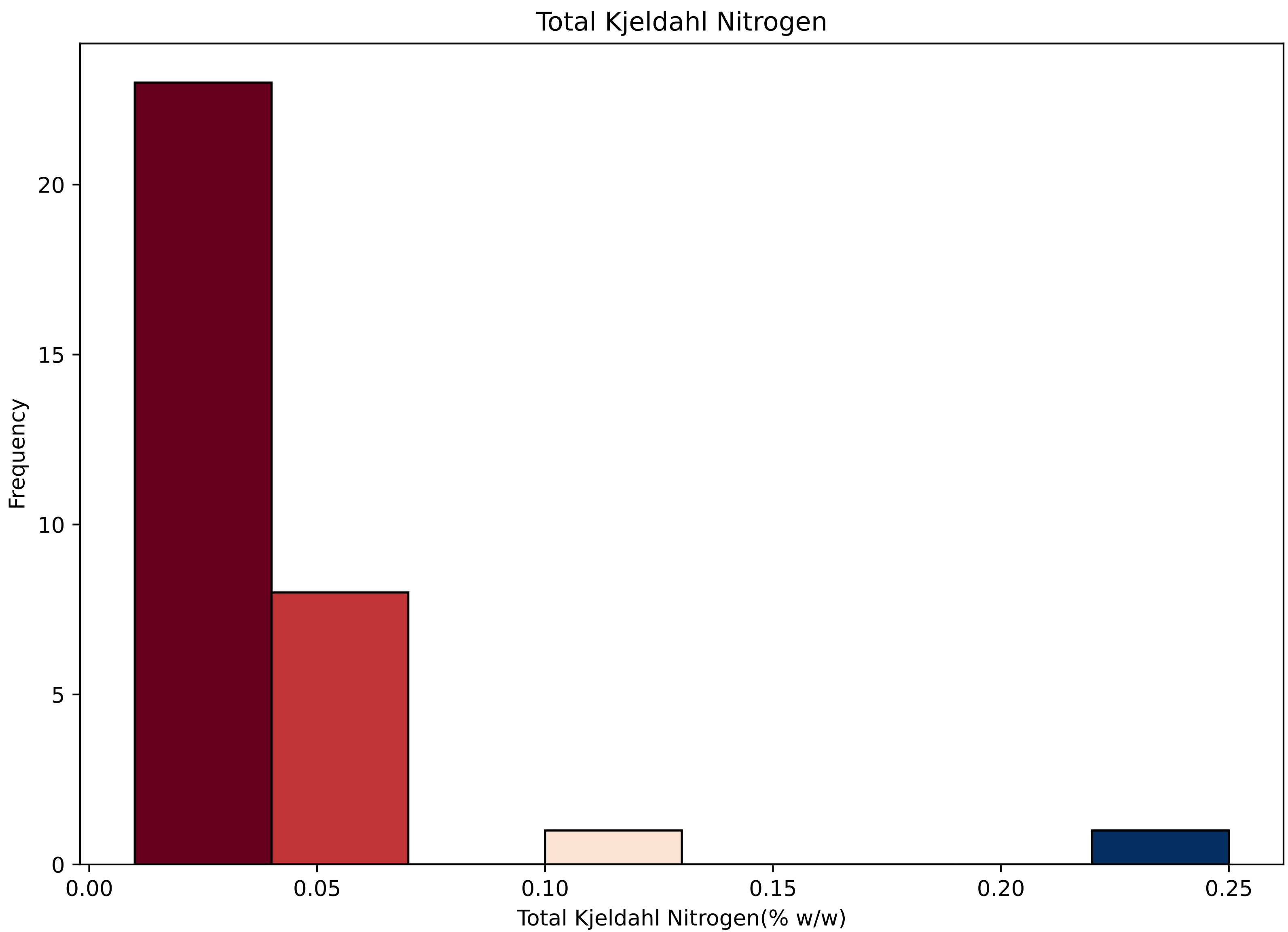
Summary Table of results.

	mean	min	25% Quartile	50% Quartile (median)	75% Quartile	max	Expected RB209	Units
Oven Dry Solids	0.47	0.04	0.2	0.33	0.6	1.53	0.5	% w/w
Total Kjeldahl Nitrogen	0.03	0.01	0.01	0.02	0.04	0.25	0.05	% w/w
Ammonium Nitrogen	194.12	25	45	93	214	1927		mg/kg
Total Phosphorus (P)	60.13	5	16.5	40.6	79.4	265		mg/kg
Total Potassium (K)	283.74	22	129	194	431	1089		mg/kg
Total Magnesium (Mg)	39.42	10	20.7	27.6	42.9	165		mg/kg
Total Copper (Cu)	13.04	0	0.2	0.3	0.83	320		mg/kg
Total Zinc (Zn)	5.25	0	0.8	2.59	5.29	42.5		mg/kg
Total Sulphur (S)	86.43	2.37	42.8	67.8	107	307		mg/kg
Total Calcium (Ca)	192.84	37.7	98.5	141	227	913		mg/kg
Total Sodium (Na)	128.17	15.9	56.9	95.1	183	328		mg/kg
pH 1:6 [Fresh]	7.42	6.57	7.1	7.35	7.59	8.98		
RAN	47.61	12.33	34	42.33	59.75	96		%
Total Nitrogen	0.35	0.1	0.1	0.2	0.4	2.5	0.5	kg/T

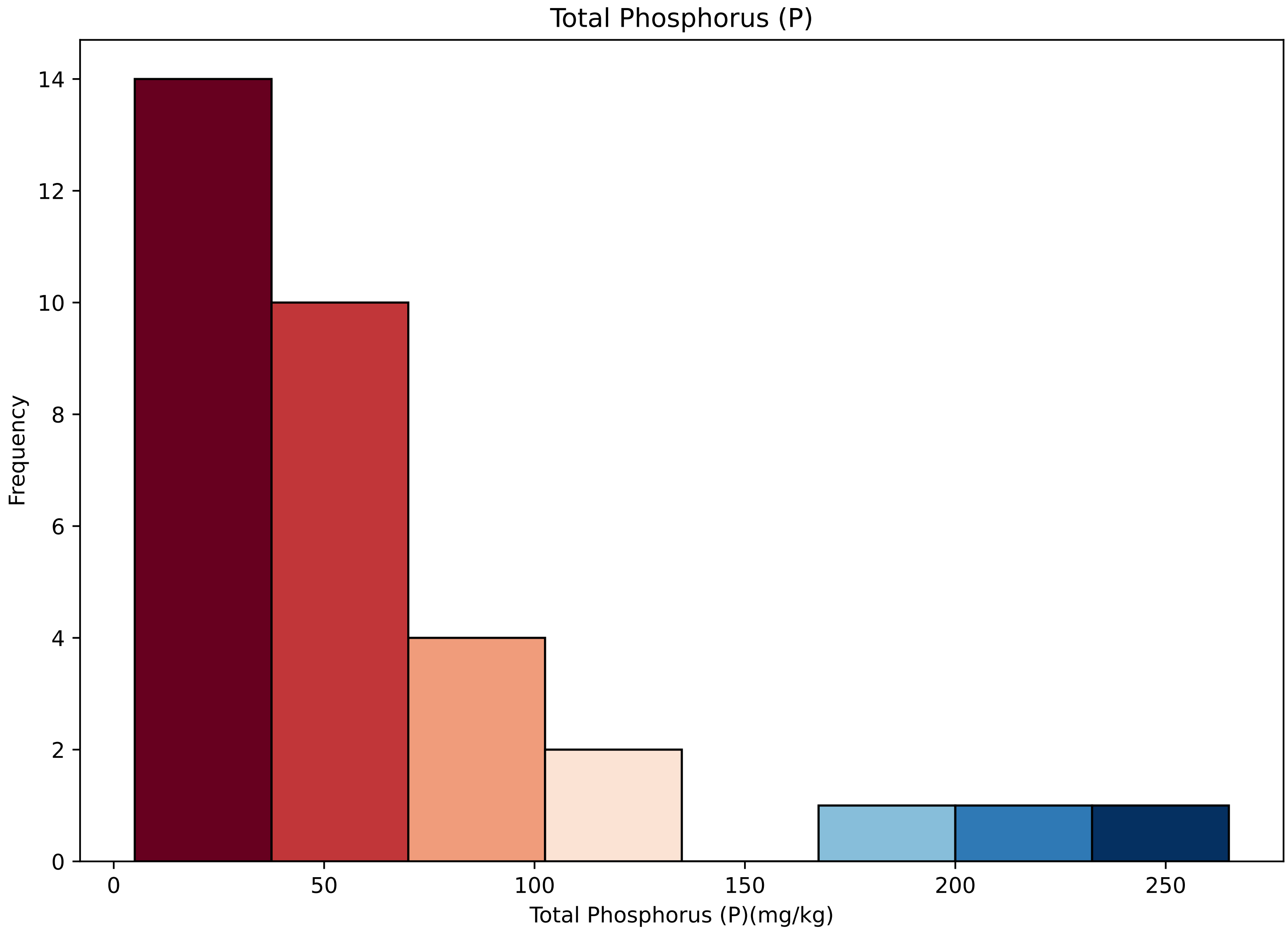
Total Ammonium-N	0.19	0.025	0.045	0.093	0.214	1.927		kg/T
NVZ limit	1394	100	625	1250	2500	2500		T/ha
Total Phosphate	0.14	0.01	0.04	0.09	0.18	0.61	0.1	Kg P_20_5/T
Total Potash	0.34	0.03	0.16	0.23	0.52	1.31	1	Kg K_20/T
30T N	10.45	3.00	3.00	6.00	12.00	75.00	15	Kg per 30T application
30T P	4.13	0.34	1.13	2.79	5.46	18.21	3	Kg per 30T application
30T K	10.26	0.80	4.66	7.01	15.58	39.37	30	Kg per 30T application

Planned Application Date	Waste	Tonnes	Dry Matter (%)	Total Nitrogen (kg/T)	Ammonium N (Kg/T)	Nitrate_N (Kg/T)	Crop	Topsoil	Subsoil	AAR	Result (Nitrate loss; kg/ha)
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Clay Loam	706	6
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Loamy Sand	706	8
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay Loam	706	5
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay	706	5
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Chalk	706	2
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Clay Loam	706	5
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Loamy Sand	706	5
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay Loam	706	4
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay	706	4
01/11/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Chalk	706	1
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Clay Loam	706	4
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Loamy Sand	706	1
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay Loam	706	4
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay	706	3
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Chalk	706	0
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Clay Loam	706	3
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Loamy Sand	706	0
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay Loam	706	3
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay	706	3
01/01/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Chalk	706	0
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Clay Loam	706	2
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Loamy Sand	706	0
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay Loam	706	2
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay	706	2
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Chalk	706	0
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Clay Loam	706	2
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Loamy Sand	706	0
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay Loam	706	2
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay	706	2
15/02/2024	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Chalk	706	0
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Clay Loam	706	1
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Sandy Loam	Loamy Sand	706	2
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay Loam	706	1
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Clay	706	1
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Winter cereal	Clay Loam	Chalk	706	1
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Clay Loam	706	0
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Sandy Loam	Loamy Sand	706	0
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay Loam	706	0
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Clay	706	0
16/10/2023	Poultry Washwater	30	1	0.8	0.5	0	Grass	Clay Loam	Chalk	706	0
01/11/2023	Cattle FYM	20	25	6	1.2	0	Winter cereal	Sandy Loam	Loamy Sand	706	6
01/11/2023	Cattle FYM	20	25	6	1.2	0	Grass	Sandy Loam	Loamy Sand	706	5
01/11/2023	Food Green waste	20	60	11	0.6	0	Winter cereal	Sandy Loam	Loamy Sand	706	4
01/11/2023	Green Compost	20	60	7.5	0.1	0	Winter cereal	Sandy Loam	Loamy Sand	706	1
01/11/2023	Green Compost	20	60	7.5	0.1	0	Winter cereal	Clay Loam	Clay Loam	706	1
01/11/2023	Food Green waste	20	60	11	0.6	0	Winter cereal	Clay Loam	Clay Loam	706	2
01/11/2023	Biosolids, lime stablised	20	40	8.5	0.9	0	Winter cereal	Clay Loam	Clay Loam	706	5
01/11/2023	Biosolids, lime stablised	20	40	8.5	0.9	0	Winter cereal	Sandy Loam	Loamy Sand	706	10
01/11/2023	Layer Manure	12	35	19	5.6	0.2	Winter cereal	Clay Loam	Clay Loam	706	30
01/11/2023	Cattle FYM	20	25	6	1.2	0	Winter cereal	Clay Loam	Clay Loam	706	4
01/11/2023	Biosolids, lime stablised	20	40	8.5	0.9	0	Winter cereal	Sandy Loam	Loamy Sand	706	8
15/02/2023	Layer Manure	12	35	19	5.6	0.2	Spring Cereal	Sandy Loam	Loamy Sand	706	0
15/02/2023	Layer Manure	12	35	19	5.6	0.2	Spring Cereal	Clay Loam	Clay Loam	706	12
01/11/2023	Layer Manure	12	35	19	5.6	0.2	Winter cereal	Sandy Loam	Loamy Sand	706	54
01/11/2023	Layer Manure	12	35	19	5.6	0.2	Winter cereal	Clay Loam	Clay Loam	706	30
01/11/2023	Poultry Washwater	30	1	0.5	0.3	0	Winter cereal	Sandy Loam	Loamy Sand	706	4

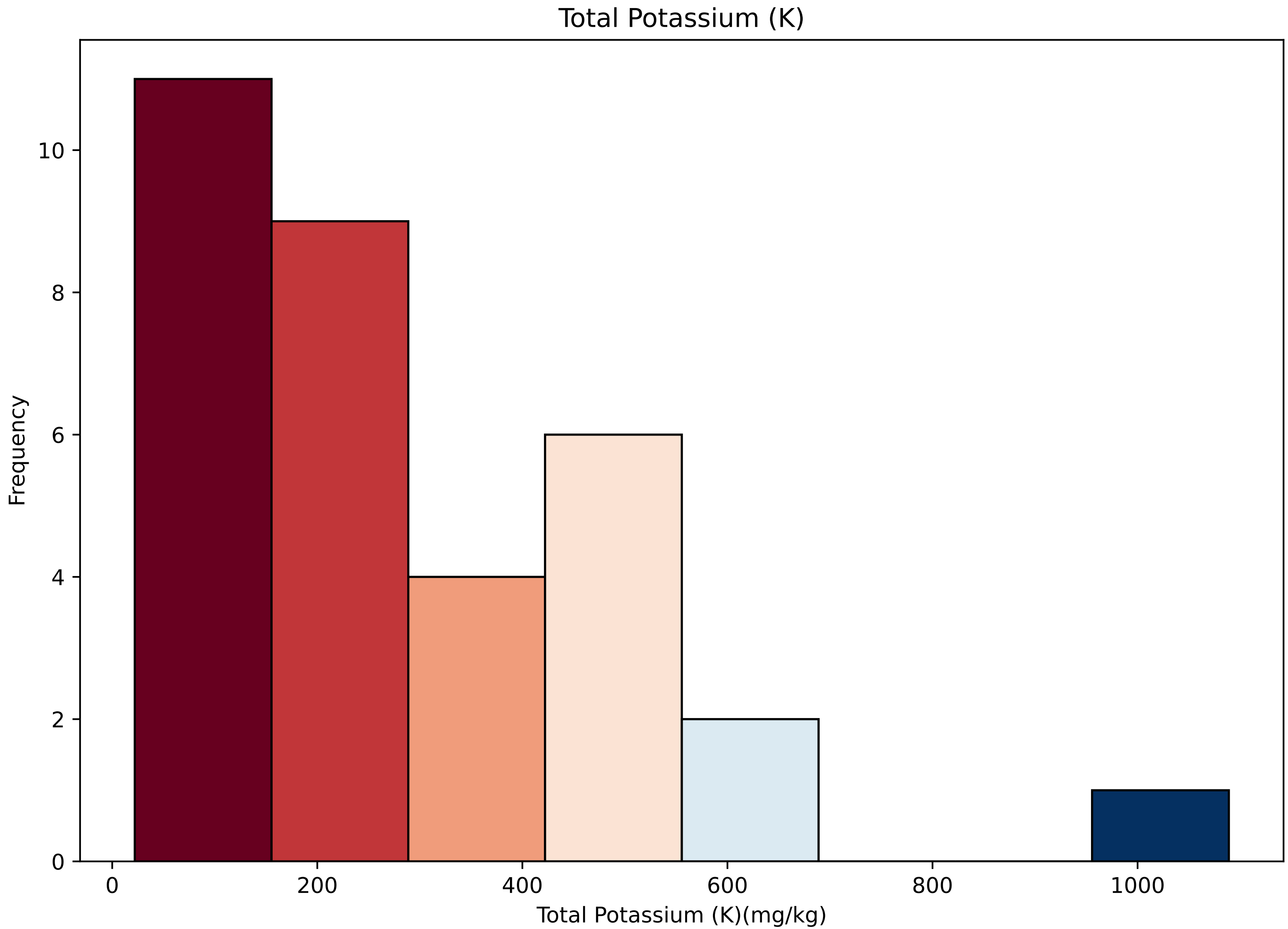

Dry_solids
Frequency
0
2
4
6
8
10
12
0
2
4
6
8
10
12
14
16
Dry_solids(%)



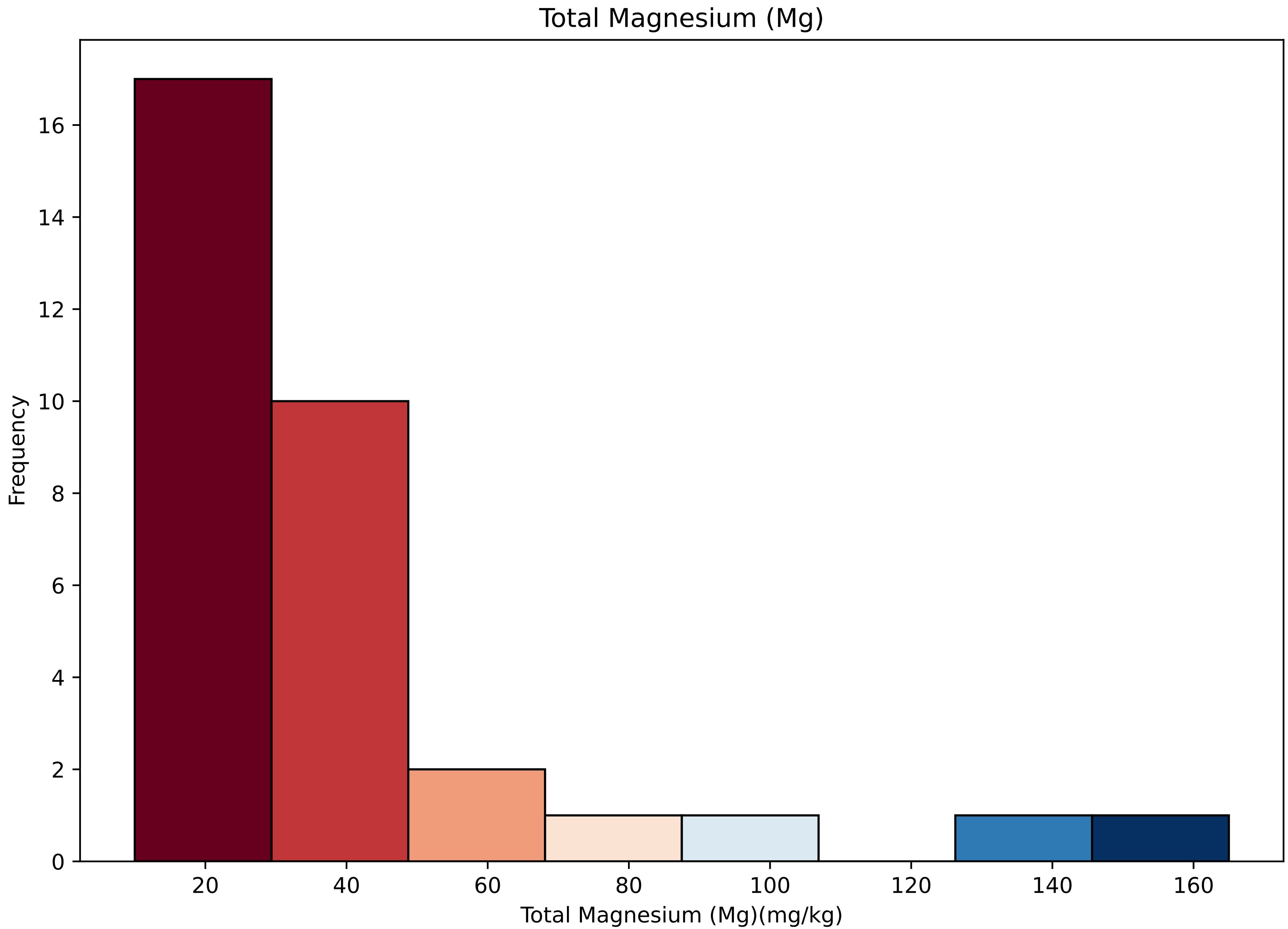
Total Kjeldahl Nitrogen
Frequency
0
5
10
15
20
0.00
0.05
0.10
0.15
0.20
0.25
Total Kjeldahl Nitrogen(% w/w)



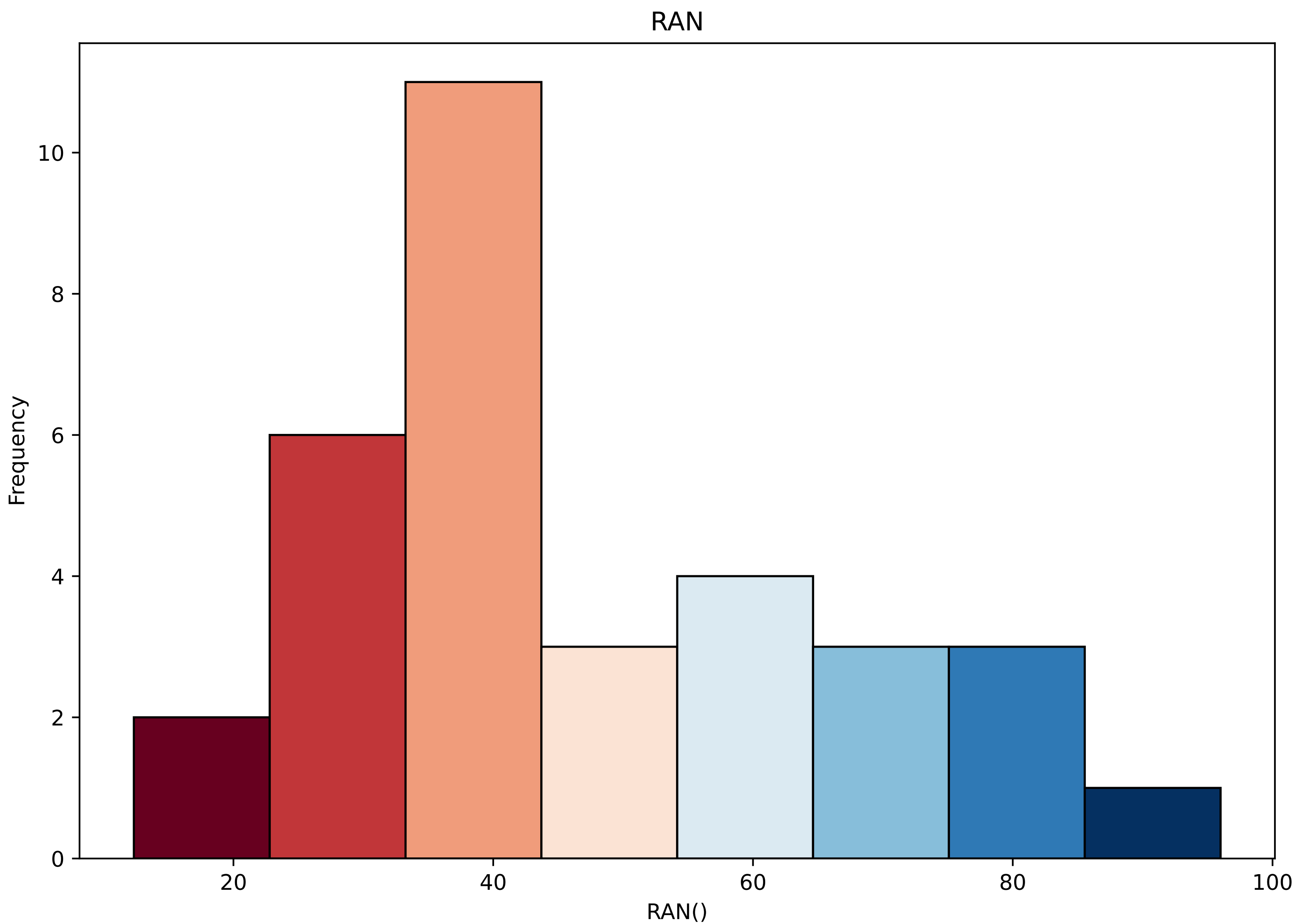
Total Phosphorus (P)
Frequency
0
2
4
6
8
10
12
14
0
50
100
150
200
250
Total Phosphorus (P)(mg/kg)



Total Potassium (K)
Frequency
Total Potassium (K)(mg/kg)
0
2
4
6
8
10
0
200
400
600
800
1000



Total Magnesium (Mg)
Frequency
0
2
4
6
8
10
12
14
16
20
40
60
80
100
120
140
160
Total Magnesium (Mg)(mg/kg)



RAN
Frequency
RAN()
0
2
4
6
8
10
20
40
60
80
100