COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER DIVISION

Subject: **Guidance Memo No. 22-2013 – Nutrient Management Plans for Irrigation Reuse of Reclaimed Water and Land Treatment of Wastewater**

To: Office of Land Application Programs Staff and Regional Water Permit Managers

From: A. Scott Morris, Director, Water Division

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Summary:

The purpose of this guidance is to provide information and instructions to DEQ water permitting staff on existing nutrient management plan (NMP) requirements for irrigation reuse of reclaimed water and land treatment of wastewater authorized by VPDES or VPA permits. The guidance further clarifies the requirements and processes for review and, as applicable, approval of such NMPs, which may additionally involve Nutrient Management Program staff in the Department of Conservation and Recreation, Division of Soil and Water Conservation.

Electronic Copy:

Once effective, an electronic copy of this guidance will be available on Virginia Regulatory Town Hall at https://townhall.virginia.gov/L/gdocs.cfm?agencynumber=440.

Contact Information:

Contact Neil Zahradka, Office of Land Application Programs, (804) 698-4102, Neil.Zahradka@deq.virginia.gov, with any questions regarding the application of this guidance.

Certification:

As required by Subsection B of § 2.2-4002.1 of the Administrative Process Act, the agency certifies that this guidance document conforms to the definition of a guidance document in § 2.2-4101 of the Code of Virginia.

Disclaimer:

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does no mandate or prohibit any particular action no otherwise required or prohibited by law or regulation. If alternative proposals are made, such proposals will be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

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List of Acronyms

BNR	Biological Nutrient Removal
DCR	Department of Conservation and Recreation
DCR-DSWC	DCR, Division of Soil and Water Conservation
DEQ	Department of Environmental Quality
N	Nitrogen
NMP	Nutrient Management Plan
P	Phosphorus
PAN	Plant Available Nitrogen
SCAT Regulations	Sewage Collection and Treatment Regulations
TKN	Total Kjeldahl Nitrogen
VPA	Virginia Pollution Abatement
VPDES	Virginia Pollutant Discharge Elimination System

I. Introduction

The purpose of this guidance is to provide information and instructions to DEQ water permitting staff on existing nutrient management plan (NMP) requirements for irrigation reuse of reclaimed water and land treatment of wastewater authorized by Virginia Pollutant Discharge Elimination System (VPDES) or Virginia Pollution Abatement (VPA) permits. The guidance also builds upon existing guidance to authorize these activities through the VPDES and VPA permit programs. Therefore, regional water permit staff should always refer to the most current guidance and manuals posted for these programs on the DEQnet.

II. Authority

Sewage Collection and Treatment (SCAT) Regulation 9VAC25-790-880

9VAC25-790-880.H.5 states that the "growing and maintaining of a vegetative cover on application sites is a very integral part of the system", the "plants prevent soil erosion and utilize nutrients and water", and design of the land treatment system "shall address crop and nutrient management." Other provision of the regulation address pretreatment of the wastewater prior to land application, criteria for application site evaluation and selection, wastewater application rates, and operation and maintenance.

Water Reclamation and Reuse Regulation 9VAC25-740-10 et seq.

9VAC25-740-100.C specifies nutrient management requirements for irrigation reuses of reclaimed water. The nutrient management options available for irrigation reuse are based, in most cases, on the nutrient content of the reclaimed water and the size of the sites to be irrigated. Other provisions of the regulation address access restrictions, advisory signs, setbacks, irrigation rates, and design and operational restrictions for irrigation reuse sites.

Virginia Nutrient Management Standards and Criteria, Revised July 2014

The Virginia Nutrient Management Standards and Criteria, Revised July 2014 provide nutrient recommendations for a variety of crops and turf, and management practices for the land application of wastewater to prevent runoff and soil erosion of application sites. These standards and criteria are used to develop the nutrients management plans that may be required for irrigation reuse of reclaimed water and land treatment of wastewater.

III. Guidance

A. General

DEQ regulates the irrigation reuse of reclaimed water and the land treatment of wastewater. Irrigation reuse is often confused with land treatment as both use water derived from wastewater (municipal or industrial). However, irrigation reuse and land treatment will, in most cases, differ from each other based on the following characteristics:

Irrigation Reuse:

- Utilizes only reclaimed water meeting the standards of the Water Reclamation and Reuse Regulation (9VAC25-740-10 et seq.);

- Is primarily intended to meet the water demands (not the nutrient demands) of the irrigated vegetation, which conserves potable water and may provide some nutrients;
- Is not intended to provide any additional treatment of the reclaimed water applied to irrigation reuse sites; and
- Does not require groundwater monitoring at the sites.

Land treatment via slow rate irrigation:

- Is to be designed and operated in accordance with the SCAT Regulations (9VAC25-790-880) for land treatment of municipal wastewater. The wastewater must receive a minimum of secondary treatment or better determined by site conditions, and may, in some cases, be equivalent in quality to reclaimed water;
- Is first and foremost a method of treating and disposing of wastewater;
- Establishes the rate of wastewater application based, in most cases, on the nutrient demands of the irrigated vegetation, which under specific conditions can cause the water demands of the vegetation to be exceeded and the applied wastewater to move to groundwater;
- Is intended to provide additional treatment of the wastewater applied to the land treatment sites; and
- Requires groundwater monitoring to verify that any discharge to groundwater from the sites complies with applicable Ground Water Standards (9VAC25-280-10 et seq.).

For irrigation with reclaimed water produced from municipal wastewater, the reclaimed water must meet a minimum of Level 1 or Level 2 treatment and standards contained in 9VAC25-740-70.A. Level 2 reclaimed water requires a minimum of secondary treatment and standard disinfection, and is generally considered suitable for reuses where there is no or minimal potential for public contact. Level 1 reclaimed water requires more advanced treatment than secondary alone and higher level disinfection than Level 2 reclaimed water. As a result, Level 1 reclaimed water is generally considered suitable for reuses where there is potential for public contact.

Acceptable irrigation reuses of Level 1 and Level 2 reclaimed water are listed in 9VAC25-740-90.A. Irrigation reuses requiring a minimum of Level 2 reclaimed water include irrigation of food crops commercially processed, and irrigation of nonfood crops and turf, such as pasture for foraging livestock, sod farms, nurseries, silviculture, and fodder, fiber and seed crops. Irrigation reuses requiring a minimum of Level 1 reclaimed water include all types of landscape irrigation in public access areas (i.e., golf courses, cemeteries, public parks, school yards and athletic fields), and irrigation of any food crops not commercially processed with some restrictions on crops eaten raw. Note that Level 1 reclaimed water is suitable for all irrigation reuses that require a minimum of Level 2 reclaimed water. However, Level 2 reclaimed water can only be used for irrigation reuses requiring a minimum of Level 2 reclaimed water.

In accordance with 9VAC25-740-90.B, irrigation reuses must be evaluated and approved on a case-by-case basis if they are not listed in 9VAC25-740-90.A, or they will reuse reclaimed water derived from industrial wastewater. Treatment requirements and standards for Level 1 and Level 2 reclaimed water may be applied on a case-by-case basis to industrial wastewater reclaimed for irrigation reuse.

Although this guidance focuses on NMP requirements, in part, for irrigation reuse of reclaimed water, DEQ water permitting staff may need to consider and address the following other requirements contained in the Water Reclamation and Reuse Regulation when preparing a permit to authorize irrigation reuse:

- Additional access restrictions for spray irrigation with Level 2 reclaimed water (9VAC25-740-90.A, footnotes)
- No direct contact of reclaimed water (Level 1 or 2) with edible portions of crops eaten raw

(9VAC25-740-90.A, footnotes)
- Waiting periods following irrigation with Level 2 reclaimed water for livestock or general public access (9VAC25-740-90.A, footnotes)
- Irrigation reuse to establish vegetative cover at construction sites (9VAC25-740-90.A, footnotes)
- Supplemental irrigation requirement for all irrigation with reclaimed water (9VAC25-740-100.C)
- Access control and advisory signs for areas irrigated with reclaimed water (9VAC25-740-160)
- Use area restrictions for all irrigation reuse (9VAC25-740-170)
- Design and operational restrictions for bulk irrigation reuse (9VAC25-740-170)
- Setbacks distances for irrigation reuse of Level 1 and Level 2 reclaimed water (9VAC25-740-170)

See also GM 10-20001, Rev.1 for further information regarding these regulatory requirements.

In accordance with 9VAC25-790-880 of the SCAT Regulations, the land treatment of municipal wastewater is to consist of biological pretreatment followed by the application of the pretreated wastewater to sites that will provide further treatment through a combination of naturally occurring physical, chemical and biological processes. The required biological pretreatment must "produce an effluent either with a maximum BOD_5 of 60 mg/l or less, or be of such a quality that can be adequately disinfected, if necessary," and can include "the use of conventional unit operations prior to the land application of treated effluent and advanced treatment prior to reuse." Because the pretreatment required for municipal wastewater land treatment is comparable to the minimum treatment required for Level 2 reclaimed water, treatment and monitoring requirements for Level 2 reclaimed water are now recommended in the VPA Permit Manual for use in permits that will authorize land treatment of municipal wastewater (slow rate irrigation). Public access control, setbacks, and use area design, operation and management requirements for irrigation reuse with Level 2 reclaimed water may also be applied to land treatment of municipal wastewater. However, the rate at which pretreated wastewater may be applied to land treatment sites will, in most cases, be greater than supplemental irrigation rates required for irrigation reuse sites. Exceptions are discussed in the VPA Permit Manual.

For the land treatment of industrial wastewater, limits, monitoring requirements and permit conditions will be established on a case-by-case basis as described in the VPA Permit Manual.

B. NMPs for Irrigation Reuse of Reclaimed Water

The Water Reclamation and Reuse Regulation does not have reclaimed water standards for nutrients. However, to avoid unaccounted for and unmanaged transfers of nutrient loads to state waters from point sources to non-point sources via irrigation reuse, the regulation requires some form of nutrient management and tracking for this reuse. This is determined, in most cases, by two primary factors:

(i) the nutrient content (i.e., nitrogen and phosphorus) of the reclaimed water relative to a nutrient threshold established in the regulation, and

(ii) the size of the sites irrigated with reclaimed water.

There is an exception for certain irrigation reuse where independent of the reclaimed water nutrient content, an NMP will be required.

Biological Nutrient Removal (or BNR) is a threshold that is used to determine how nutrients, if present in a reclaimed water, will be managed. BNR is defined in the regulation (9VAC25-740-10) as treatment that achieves annual average concentrations less than or equal to 8.0 mg/l total nitrogen (N) and 1.0 mg/l total

phosphorus (P) (hereafter referred to in this guidance as the "BNR thresholds). The term "BNR reclaimed water" refers to reclaimed water with total N and total P content less than or equal to the BNR thresholds. The term "non-BNR reclaimed water" refers to reclaimed water with total N or total P content greater than the BNR thresholds.

Measures to be implemented to manage nutrients at an irrigation reuse site will also be determined by the size of the site relative to the following thresholds:

- Bulk irrigation reuse, defined in the regulation as reuse of reclaimed water for irrigation of an area greater than five acres on one contiguous property; and

- Nonbulk irrigation, reuse defined in the regulation as reuse of reclaimed water for irrigation of individual areas less than or equal to five acres.

An NMP will not be required for most bulk irrigation reuse with BNR reclaimed water and for all nonbulk irrigation reuse (independent of the reclaimed water nutrient content). However, for nonbulk irrigation with non-BNR reclaimed water, the reclaimed water management (RWM) plan to be submitted and implemented by the reclaimed water provider, must describe other measures that will be used to manage nutrients from within the provider's service area. These measures must include, at a minimum:

- Language in the service agreements or contracts between the provider and end users explaining the proper use of reclaimed water by the end user,
- Distribution of literature by the provider annually or more often to individual nonbulk irrigation end users, again explaining proper use of reclaimed water (this applies only for distribution of Level 1 reclaimed water), and
- Monthly monitoring of N and P loads from nonbulk irrigation reuse to the service area.

Refer to 9VAC25-740-100.C and GM 10-2001, Rev. 1 for more information regarding the RWM plan and required content related to nutrient management for irrigation reuse.

An NMP will be required for:

1. Bulk irrigation reuse with non-BNR reclaimed water, and
2. Bulk irrigation reuse independent of the reclaimed water nutrient content where:
    a. The bulk irrigation site is under common ownership or management with facilities that generate or distribute reclaimed water applied to the site, *and*
    b. In addition to reuse, there is no option to dispose of the reclaimed water via a VPDES permitted discharge, or there is such an option but the VPDES permit does not allow discharge of the full nutrient load under design flow.

In the case of items 2.a and 2.b above, the NMP must be prepared by a nutrient management planner certified by the Department of Conservation and Recreation (DCR), and DCR must approve the plan.

Independent of NMP requirements for irrigation reuse specified in the Water Reclamation and Reuse Regulation, DCR requires the following in accordance with §10.1-104.5:

1. An NMP for land operated as a golf course and upon which fertilize, manure, sewage sludge or other compounds containing N or P are applied to support turf, plant growth, or other uses; and
2. All sources of nutrients are to be accounted for in the NMP. This may include reclaimed water

applied to a golf course, if the reclaimed water contains nutrients.

These requirements also apply to irrigation reuses regulated by the Water Reclamation and Reuse Regulation, but do not change the requirement for DCR approval of specific NMPs prepared for bulk irrigation reuses discussed above.

C. NMPs for Land Treatment of Wastewater

NMP requirements for wastewater land treatment are much less complicated than those for irrigation reuse. Like irrigation reuse, however, land treatment can use wastewater from municipal or industrial sources.

Municipal wastewater typically contains nutrients (i.e., N and P). Therefore, an NMP is to be required for all projects involving land treatment of municipal wastewater.

Due to the variable composition and character of each industrial wastewater, NMP requirements for the land treatment of such wastewaters are to be determined on a case-by-case basis. In general, an NMP should be required for the land treatment of an industrial wastewater with high N and/or P concentrations, but not required for an industrial wastewater with no nitrogen and phosphorus.

Where the nutrient concentrations of an industrial wastewater will be low, but the wastewater will be applied at higher rates, and/or the application sites to which the wastewater will be applied will have limitations (e.g., shallow depth to bedrock, shallow depth to water table, etc.), an NMP may be required.

D. NMP Equations for Irrigation Reuse and Land Treatment

1. Plant Available Nitrogen

For the management of nitrogen in municipal wastewater that will be used to produce reclaimed water for irrigation reuse or pretreated wastewater for land treatment, the concentration of Plant Available Nitrogen (or PAN) must be determined using the most current nitrogen analyses of these waters and the following equation:

$$PAN\ mg/l = TKN\ mg/l + (NO_3^-mg/l + NO_2^-mg/l)$$

Where:

TKN = Total Kjeldahl Nitrogen
NO_3^- + NO_2^- = Nitrate-Nitrogen + Nitrite-Nitrogen

This equation does *not* break down TKN into organic-N and ammonia-N and subsequently, does not include a mineralization factor for organic-N and a volatilization factor for ammonia-N.

Some assumptions about the above PAN equation are that:

- Both ammonia-N and more easily mineralized organic-N fractions will be reduced by aerobic treatment processes common to secondary treatment of municipal wastewater, required, at a minimum, to produce reclaimed water for irrigation reuse and pretreated wastewater for land treatment;
- The amount of the more easily mineralized organic-N remaining in the reclaimed water or pretreated wastewater will be negligible; therefore, the mineralization of organic-N is not

calculated; and

- Lastly, the reclaimed water or pretreated wastewater applied to a site will generally move below the soil surface soon after application under operating conditions allowed by the permit; therefore the volatilization of ammonia-N is not calculated.

Note that the above equation to determine PAN concentrations applies to reclaimed water or pretreated wastewater derived from municipal wastewater. To determine the PAN concentrations of reclaimed water or pretreated wastewater derived from an industrial wastewater, other equations may be necessary, determined by a case-by-case evaluation of factors, including but not limited to, the sources of nitrogen in the wastewater (e.g., organic or inorganic), unit treatment processes of the wastewater, and the degree to which these treatment processes effect the availability of nitrogen in the wastewater. In such instances, DEQ water permitting staff may coordinate with staff in the Office of Land Application Programs for assistance determining the most appropriate PAN equation to apply.

2. Nutrient Application Rates

Once the concentration of PAN in the reclaimed water or wastewater is determined, it is then possible to determine the loading rate of PAN applied to an irrigation reuse or land treatment site.

$$\text{PAN lbs/acre} = \frac{[\text{PAN mg/l} \times \text{MG} \times 8.345 \text{ lbs/gal}]}{\text{area of site (acres)}}$$

Where:

PAN lbs/acre = pounds of PAN in the reclaimed water or wastewater, applied per acre of a site
PAN mg/l = concentration of PAN in the reclaimed water or wastewater (see equation of PAN above)
MG = Total volume of wastewater (in million gallons) applied to a site

Important to note is that the same equation may be used to determine phosphorus and potassium application rates for irrigation reuse or land treatment. Only P_2O_5 and K_2O concentrations are to be used in the equation. Therefore, any reclaimed water or wastewater analyses for elemental phosphorus (P) and elemental potassium (K) must be converted to P_2O_5 and K_2O, respectively, by the permittees or their contracted laboratories using the following equations:

P_2O_5 mg/l = P mg/l x 2.3

K_2O mg/l = K mg/l x1.2

E. DEQ Review of NMPs for Irrigation Reuse and Land Treatment

An NMP for irrigation reuse or land treatment may be submitted:

(i) With the permit application to authorize the activity, or

(ii) During the term of the permit authorizing the activity and in accordance with a condition of the permit.

Refer to Section V of the VPA Permit Manual for the NMP permit condition applicable to land treatment projects, and GM 10-2001, Rev. 1 for the NMP permit condition applicable to irrigation reuse projects.

Table 1 provides information on NMP requirements and the need for DCR approval of NMPs under different land treatment and irrigation reuse scenarios. All NMPs required for irrigation reuse or land treatment projects must be reviewed by DEQ, including NMPs approved by DCR for specific bulk irrigation reuse projects discussed in Subdivision III.B. As part of this review, DEQ water permitting staff are to verify that:

1. The DCR Special Conditions section of the NMP contains the following:

    a. A statement that "Nitrogen and phosphorus from [**Choose one:** reclaimed water/wastewater] in combination with other sources of nitrogen and phosphorus applied to the site shall not exceed the annual nitrogen application rate and the sum of annual phosphorus application rates specified in the NMP for the site. Where one or both of these rates are met and there remains a need for additional water to irrigate the site for the remainder of the current growing season, an alternate water source that does not contain nitrogen and/or phosphorus shall be used in lieu of [**Choose one:** reclaimed water/wastewater] for irrigation."

    b. A statement that "Nutrient recommendations of the NMP may be affected by conditions of the DEQ permit authorizing the [**Choose one:** irrigation reuse of reclaimed water/land treatment of wastewater] at the site at the site."

    c. A statement advising the holder of the NMP to "Direct any questions to DEQ staff regarding the effect of the permit conditions on the NMP recommendations." This statement may be consolidated with the statement under 1.b above.

    d. Appropriate equations (see Subdivision III.D) to determine:

        - PAN concentration of the reclaimed water or wastewater, and
        - Nutrient application rates for irrigation reuse or wastewater land treatment.

2. When DCR approval of an NMP is required for a bulk irrigation reuse site, as discussed in Subdivision III.B, DCR's approval letter is to be attached to the corresponding NMP for the site.

If the NMP is missing any of the above items that apply, the NMP is deficient and DEQ water permitting staff are to request additional information from the permittee to address the deficiencies. Upon receiving all required items and information for the NMP, DEQ staff may notify the permittee that the NMP meets the requirements of the applicable permit.

If an NMP is submitted with an application to issue, modify or reissue a permit authorizing irrigation reuse or land treatment and is found to be deficient, DEQ water permitting staff may:

- Consider the NMP a part of the permit application and require additional information to address the deficiencies of the NMP before deeming the application complete, or
- Consider the NMP separate from the permit application, but include a condition in the permit requiring submittal of an NMP that meets the requirements of the condition prior to any application of reclaimed water or pretreated wastewater to sites authorized by the permit.

Table 1 - NMP and DCR Approval Requirements for Land Treatment and Irrigation Reuse

Pollutant Management Activity	NMP Required?	DCR Approval of NMP Required?	Notes
Land treatment of municipal wastewater	Yes	No	---
Land Treatment of industrial wastewater - no nutrients	No	No	---
Land Treatment of industrial wastewater - with nutrients	Case-by-case	No	• If industrial wastewater has moderate to high N and/or P – NMP required • If industrial wastewater has low N and P, but the wastewater will be applied at higher rates, and/or the application sites to which the wastewater will be applied will have limitations (e.g., shallow depth to bedrock, shallow depth to water table, etc.), an NMP may be required.
Irrigation reuse (nonbulk) of BNR municipal reclaimed water	No	No	---
Irrigation reuse (nonbulk) of non-BNR municipal reclaimed water	No	No	Reclaimed water provider must implement measures to manage nutrients in lieu of an NMP, including but not limited to monthly monitoring of N and P loads from nonbulk irrigation reuse to the provider's service area.
Irrigation reuse (bulk) of BNR municipal reclaimed water	No	No	This applies in most cases with an **exception**[1] where an NMP and DCR approval of the NMP will be required.
Irrigation reuse (bulk) of non-BNR municipal reclaimed water	Yes	No	This applies in most cases with an **exception**[1] where an NMP and DCR approval of the NMP will be required.
Irrigation reuse (bulk) of municipal or industrial reclaimed water with nutrients (N and/or P) on golf courses	Yes	Yes	In accordance with §10.1-104.5, all golf courses receiving N and P in various forms are required to have an NMP approved by DCR. This applies to all bulk irrigation reuse of reclaimed water containing N and/or P, whether BNR or non-BNR.

Pollutant Management Activity	NMP Required?	DCR Approval of NMP Required?	Notes
Irrigation reuse (bulk) of industrial reclaimed water – no nutrients	No	No	This applies in most cases with an **exception**[1] where an NMP and DCR approval of the NMP will be required. Where the exception applies, the permittee may request a variance from the requirements of the exception in accordance with 9VAC25-740-55.
Irrigation reuse of industrial reclaimed water – with nutrients	Case-by-case	Case-by-case	• The need for an NMP will be determined individually for each project and will be based on the concentration of N and/or P in the industrial reclaimed water. • If an NMP will be required for *bulk* irrigation reuse of an industrial reclaimed water, DCR approval of the NMP will not be necessary in most cases with an **exception**[1].

[1] An NMP will be required for bulk irrigation reuse independent of the reclaimed water nutrient content where:

a. The bulk irrigation site is under common ownership or management with facilities that generate or distribute reclaimed water applied to the site, *and*

b. In addition to reuse, there is no option to dispose of the reclaimed water via a VPDES permitted discharge, or there is such an option but the VPDES permit does not allow discharge of the full nutrient load under design flow.

In this case, the NMP must be prepared by a DCR-certified nutrient management planner, and DCR must approve the NMP.