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North Carolina Department of Environment and Natural Resources

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September 12, 2008

MEMORANDUM

To: Aquifer Protection Section Central Office
Aquifer Protection Section Regional Supervisors
Interested Parties

From: Ted L. Bush, Jr., Chief
Aquifer Protection Section

Subject: Single-Family Residence Wastewater Irrigation System Loading Rate Calculation Policy

For single-family residence wastewater irrigation projects, the loading rate calculation is a critical factor. Traditionally, computation of a water balance has been required to determine loading rates for irrigation. This water balance was based on a simple addition of all the hydraulic inputs such as precipitation and irrigation and subtraction of outputs such as drainage and evapotranspiration.

Historically, under the 15A NCAC 02H .0200 rules, the drainage component of the water balance equation was determined from an estimate of the permeability of the most restrictive soil horizon and a drainage coefficient of 4 to 10 percent, as described in a design manual prepared by the *EPA Process Design Manual: Land Treatment of Municipal Wastewater Effluents (EPA 625/R-06/016)*. The soil permeability value used to calculate the soil drainage rate was not determined by in-situ data collected onsite but rather was based upon a soil scientist's professional judgment and the soil permeability range published in soil survey reports.

The 15A NCAC 02T .0600 rules that went into effect on September 1, 2006 now require annual hydraulic loading rates to be based on in-situ measurement of saturated hydraulic conductivity (K_{sat}) in the most restrictive soil horizon for each map unit. Since the implementation of the rules, it has come to our attention that the use of in-situ K_{sat} data, when inserted into the previously used formula, often results in lower annual hydraulic loading rates than predicted in the past.

The purpose of this document is to define the approved calculation method for determination of annual hydraulic loading rates using measured in-situ K_{sat} data. In addition to this document, the reader should review the applicable rules in Subchapter 02T and the Soil Scientist Evaluation Policy[1]. Please note that this policy is only applicable to permits which fall under 15A NCAC 02T .0600.

[1] The Soil Scientist Evaluation Policy is available on the internet at: http://h2o.enr.state.nc.us/lau/policies.html

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SFR Annual Hydraulic Loading Rate Calculations

Loading rates shall be based on the following information (further defined below): SFR Loading Rate Group; 80th percentile yearly precipitation; potential evapotranspiration (PET) and soil drainage based on actual (measured) saturated hydraulic conductivity. The annual hydraulic loading rate shall be calculated by subtracting outputs from inputs. Over a 12-month period there must be a net positive allowable irrigation. Calculations for annual hydraulic loading rates shall be made by a licensed soil scientist (LSS) with the calculations submitted under that professional's signature and seal. A SFR Loading Rate Workbook[2] is available for assistance in calculating the annual hydraulic loading rate.

A. SFR Loading Rate Group

All new single-family residence wastewater irrigation sites shall be assigned a SFR Loading Rate Group for the purpose of determining an annual hydraulic loading rate (see table below). The determination of the SFR Loading Rate Group shall be based upon K_{sat} data from site-specific measurements from the most restrictive horizon. This K_{sat} data shall be from representative areas within the proposed irrigation field and shall conform to the Soil Scientist Evaluation Policy and Division policies regarding K_{sat} tests. A SFR Loading Rate Workbook has been developed using MS Excel to assist with the calculation of SFR annual hydraulic loading rates.

To determine which SFR Loading Rate Group the wastewater irrigation area should be assigned to, find the geometric mean of K_{sat} data from the most limiting horizon in the following table:

Geometric Mean of K_{sat} from most limiting horizon (in/hr) **Low - High**		**SFR Loading Rate Group**	**Annual Hydraulic Loading Rate** (in/yr) **Low - High**
>0.05	→	**SFR-A**	**26.0 - 50.0**
0.015 - 0.05	→	**SFR-B**	**19.5 - 26.0**
0.003 - 0.015	→	**SFR-C**	**13.0 - 19.5**
0.0 - 0.003	→	**SFR-D**	**0.0 - 13.0**

Each SFR Loading Rate Group shows the allowable range for the annual hydraulic loading rate. System designs that exceed the maximum value for the annual hydraulic loading rate for a particular SFR Loading Rate Group shall require additional documentation. At a minimum this additional documentation shall include a mounding analysis and/or lateral flow analysis, depending upon the slope and landscape position of the wastewater disposal area.

Tables are provided in the SFR Loading Rate Workbook that give a rough estimate of which SFR Loading Rate Group a soil series may belong to[3]. *Please note that these tables are only provided as a helpful tool and shall not be used to assign an irrigation site to a particular SFR loading rate group.*

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[2] The SFR Loading Rate Workbook is available on the internet at: http://h2o.enr.state.nc.us/lau/applications.html

[3] The soil series tables included in the SFR Loading Rate Workbook are not inclusive of all the soils that may be found within North Carolina. At this time, tables have only been developed for the soils in areas where most of the currently permitted SFR systems are located.

B. Precipitation

The 80th percentile yearly precipitation shall be used. This is the expected annual amount of rainfall equaled or exceeded only 2 years out of 10. This annual value shall be prorated over the year based upon factored monthly average precipitation. The source data shall be representative of the area where the facility will be located and shall be based on long-term (minimum of 30 years) data. The data source, location, and dates the data was collected shall be cited.

C. Potential Evapotranspiration

PET losses shall be calculated using the Thornthwaite method, another pre-approved methodology, or representative data that is fully documented. Temperature values used in this calculation shall be from the same data source and time as the precipitation data used. If other PET data is used, it must be from a peer reviewed technical journal for the same area and proposed receiver crop and consistent with other area climatic data. The data source, location, and dates the data was collected shall be cited.

D. Soil Drainage

Soil drainage shall be based on site-specific measurements of the saturated hydraulic conductivity (K_{sat}) of the most limiting soil horizon as detailed in the Soil Scientist Evaluation Policy. The soil drainage value used in the calculation shall be the geometric mean of the K_{sat} from site-specific measurements in the most restrictive horizon multiplied by a drainage coefficient (reduction factor). Values for this drainage coefficient shall not exceed 1.0 (100%). Considerations for the drainage coefficient shall include reliability and consistency of K_{sat} data, depth to seasonal high water table (apparent or perched), depth to the restrictive horizon, slope, landscape position, inclusions of minor amounts of more limiting soils, etc. The soil scientist sealing the report shall provide a discussion of considerations in determining the drainage coefficient selected for the individual system.

All permit applications and other site reports shall be reviewed in accordance with this policy for any applications received on or after November 1, 2008. For any application received prior to that time, staff should review the application for adherence to the policy and discuss with the applicant and/or their consultants to encourage consistency with this policy.