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Memorandum

Date: **February 19, 2004**

To: **Upper Neuse Task Force**

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Subject: **Translation of SET Loading Estimates to Upper Neuse Performance Targets**

This memorandum discusses the necessary scale translations between the subwatershed scale, used to develop the Upper Neuse Performance Targets, and the site scale that is evaluated in the Site Evaluation Tool (SET).

The Upper Neuse Performance Targets were developed based on modeling using the Generalized Watershed Loading Function (GWLF) program. A number of potential scenarios were tested to evaluate the management measures that would meet the in-lake water quality targets specified by the TAC. As part of these scenarios, a number of assumptions were made regarding nutrient loadings. Based on the Upper Neuse Nutrient Sensitive Waters Rule, agricultural loadings were reduced by 30% from current levels for the future scenarios. Similarly, net effective loading rates for new development in urban areas were required to be less than 3.6 lbs/ac/yr of total nitrogen. Phosphorus loading rates from new urban development were set at 0.6 lb/ac/yr. All available urban land within the ETJ's of the jurisdictions within the Upper Neuse was assumed to be fully developed by 2025.

With the agricultural and urban area contributions defined, an iterative process was used to determine the density of development for the remaining area, within guidelines specified by the TAC, which would allow achievement of the water quality goals for the local drinking water supplies and Falls Lake. It was determined that 3 to 5 acre lots, with associated loading rates of 0.3 lb/ac/yr TP and 1.7 lb/ac/yr TN, would maintain acceptable surface loading rates within the watershed. A summary of the guidelines and performance target loading rates is presented in Table 1.

Table 1. Urban, Rural Residential, and Agricultural Loading Rate Targets

Landuse	Landuse Category	TP Target Rate (lb/ac/yr)	TN Target Rate (lb/ac/yr)
Commercial 50%	Urban	0.6	3.6
Industrial	Urban	0.6	3.6
HDR	Urban	0.6	3.6
MDR	Urban	0.6	3.6

Urban Greenspace	Urban/Conservation[1]	0.6/0.3[1]	3.6/1.7[1]
LDR	Urban/Conservation[1]	0.6/0.3[1]	3.6/1.7[1]
VLDR	Conservation	0.3	1.7

[1] Classification depends on whether parcel is within urban area ETJ.

The Upper Neuse GWLF model estimates loadings of nitrogen and phosphorus on a USGS 12-digit subwatershed scale (with the exception of two watersheds in Orange County which were split to represent drainage areas above and below drinking water reservoirs) and was calibrated to monitoring data at this scale. Current efforts include the development of a site evaluation tool which can be used by planners and developers to determine site scale loading rates which will meet the targets specified by the earlier modeling efforts. However, a number of processes occur on the subwatershed scale which do not allow direct comparison of the GWLF based performance targets and the site-scale loadings estimated by the Site Evaluation Tool (SET).

The SET model uses site-level Event Mean Concentrations (EMCs) to estimate nutrient loadings from different landuses at the site scale. The EMCs used in the SET model have been developed and calibrated based on a number of studies including CH2M Hill (2000), Line et al. (2002), Greensboro (2003) and are consistent with loading estimates at the local site scale in the Jordan Lake Watershed Model (2003). However, the scale at which the SET is applied is significantly different from the Upper Neuse GWLF work, which is calibrated at the watershed scale. Significant attenuation of loads may occur as nutrient loads run off from a land surface and are transported to a receiving water. Recent research shows that a large proportion of nutrient uptake occurs in small headwater streams – these that occur between the site-scale and the watershed scale of the upper Neuse models (McMahon et al., 2002; Alexander et al., 2002). Factors in this attenuation include reattachment/settling of soil bound nutrients and plant uptake at stream margins. Based on our understanding of the attenuation factors and the site-scale loading rates, overall reduction factors of 0.45 and 0.56, for TP and TN respectively, were estimated to translate between site scale loads and the GWLF subwatershed scale at which the performance targets were developed. Table 2 presents the GWLF, original SET, and adjusted SET annual rates.

Table 2. Comparison of GWLF and SET Annual Nutrient Loading Rates

Landuse	SET TP Rate (lb/ac/yr)	GWLF TP Rate (lb/ac/yr)	Translated SET TP Rate (lb/ac/yr)	SET TN Rate (lb/ac/yr)	GWLF TN Rate (lb/ac/yr)	Translated SET TN Rate (lb/ac/yr)
Commercial 50%	2.45	1.20	1.10	16.65	9.29	9.32
Industrial	1.79	0.81	0.81	11.38	6.36	6.37
HDR	1.42	0.69	0.64	8.94	5.49	5.01
MDR	0.95	0.48	0.43	5.77	3.64	3.23
LDR	0.73	0.36	0.33	4.30	2.77	2.41
VLDR	0.38	0.14	0.17	2.12	0.66	1.19
Urban Greenspace	0.59	0.11	0.27	3.32	0.60	1.83
Forest	0.11	0.04	0.05	0.66	0.27	0.37
Agriculture	2.3	1.05	1.04	7.75	4.30	4.34

It should be noted that the translated rates for forest, very low density residential, and urban greenspace are still relatively higher than the GWLF rates. Current research in the Triangle area (Line et al. 2002) indicates that atmospheric deposition is a significant source of nitrogen loading in the Upper Neuse. For this reason, all land uses, including those with limited human influences, show elevated nitrogen levels. In addition, urban greenspace as defined in the SET represent areas such as golf courses and parks that are managed through the use of fertilizer.

Using the current configuration of the SET and translating the results will allow direct comparison of a site plan design and the performance targets developed using the Upper Neuse GWLF model. Table 3 provides a comparison of the watershed and equivalent site based targets. The watershed targets reflect the maximum loading rate from new development that can be exerted to the water supply lakes and still meet in-lake water quality targets. The on-site targets reflect the maximum loading rate allowable from new development sites, again to meet the in-lake targets. As discussed above, the watershed target in smaller than the on-site target because it reflects attenuation of pollutants during transport to the lakes (i.e., the reduction factors .45 and .56, for TP and TN respectively, to translate between the site scale and the watershed scale). It is important to note that the Neuse Nutrient Sensitive Waters Rule model stormwater plan specifies a 3.6 lb/ac/yr nitrogen target for new development but allows a developer to "buy-up" to an annual nitrogen loading rate of 10 lb/ac. Thus, the actual loading rate that will be achieved in compliance with the rule will fall between 3.6 and 10 lb/ac/yr for new urban development. The Upper Neuse Watershed Plan is based on a 3.6 lb/ac/yr watershed target (i.e., exerted to the lake) for new urban development and an annual maximum site-scale loading rate of approximately 8 lb/ac/yr.

Table 3. On-site Targets for Site Evaluation Tool

Landuse	Watershed Target (lb/ac/yr)	On-site Target (lb/ac/yr)
Nitrogen		
Rural/Conservation Area	1.7	3.78
Urban Area	3.6	3.6 to 10 (maximum)
Phosphorus		
Rural/Conservation Area	0.3	0.54
Urban Area	0.6	1.08

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