Appendix 5.0-A

Nutrient Credit Evaluation Letter

March 30, 2000

Mr. George S. Garrett
Director of Marine Resources
Department of Marine Resources
2798 Overseas Highway Suite 420
Marathon, Florida 33050

Subject: Stormwater Master Plan – Nutrient Reduction Credits for Stormwater Systems (Subtask I-H)

Dear Mr. Garrett:

This letter presents an analysis of the reduction of stormwater nutrient loads through the use of Best Management Practices (BMPs), and the potential conversion of these reductions into "credits" that could be "redeemed" to obtain regulatory agency approval for new residential construction. It is envisioned that the general concept for this credits program for stormwater BMPs would be similar to the current credits program that involves the replacement of wastewater cesspits with new types of onsite wastewater facilities (discussed below). However, as we discussed at meetings of February 15 and March 29, 2000, the stormwater nutrient credits program would be more complex because it involves more variables (as will be discussed later). A summary of our findings is provided at the end of this letter.

Based upon our meetings, CDM understands that, in the particular case of the Monroe County program, when a cesspit is removed and replaced by a new type of onsite treatment system, a credit is generated that allows the construction of a new residence with its new type of onsite system. The credit is held by the Department of Health, which keeps track of the geographic region of the credit (Upper, Middle or Lower Keys). The credit may only be applied to new construction within the same geographic region. Every quarter the County develops separately a priority list of new construction permits to be issued (maximum of about 20 per region). Permits are issued only to the extent that the same number of credits is available. That is, for example, if only 10 credits are available for a given region, only 10 permits out of the maximum of 20 may be issued.

For stormwater nutrient credits, the application of stormwater BMPs will reduce nutrient loads, such that additional development could be accommodated without a net increase in load. Initially, we considered two possible scenarios for applying nutrient reduction credits: (1) retrofits of BMPs in existing developments and (2) installation of BMPs for new development. However, in the new development scenario (No. 2), BMPs would be needed anyway to meet existing regulations of the South Florida Water Management District (SFWMD) and Monroe County. Thus, we recommend award of credits only for the first scenario, i.e., the retrofit of areas currently lacking BMPs.

Calculation of the nutrient credits for stormwater is more complex because the benefit

depends upon the total area to be retrofit, its land use type, the type(s) of BMP, etc. Therefore, a simple equivalency system (such as an acre of new development for an acre of retrofit area) is not possible. Instead, it is necessary to first express the benefit of retrofit in terms of calculated reduction of nutrient load.

The reduction in nutrient load (expressed on an average annual basis) can be calculated using the information developed as part our use of the Watershed Management Model (WMM) for Monroe County. For each type of land use and for each BMP application, the loading rates used in WMM can be used to calculate the applicable nutrient load reduction attributable to each BMP, on a per acre basis. Thus, for any given drainage basin being retrofit with BMPs, the nutrient load reduction can be calculated by applying the various unit reduction rates to the various land use areas. Sample calculations are presented in Appendix A. The nutrient constituent chosen is nitrogen, which is considered to be the limiting nutrient for biological growth in near shore waters.

The resulting nutrient load reduction amount can be made available to offset the load from a new residential development, which would be designed to meet County and SFWMD regulations. The allowable area of this development can be calculated by dividing the total load reduction resulting from the retrofit by the unit incremental load typical of the proposed density (dwelling units per acre) and meeting the above regulations. Incremental load is defined as the difference between the pre-development (vacant) condition load and the post-development condition load. Both loads would be estimated using the WMM loading rates. The number of allowable dwelling units can then be calculated by dividing the allowable new area by the proper density from the County's development regulations. For simplicity, it would be desirable to limit the spectrum of densities to three: low, medium and high, each with its pre-defined density definition (units/acre).

Summary

In summary, there are two fundamental issues addressed in this letter.

Is it feasible to have a nutrient credit for new stormwater facilities?
Yes. When a site is redeveloped or retrofit with new stormwater facilities, there is a measurable reduction in nutrient loading when proper stormwater facilities are constructed (and maintained). However, if a retrofit reduces nutrient loading to the near shore waters and a new development is allowed to increase loading to match the reduction, no net benefit is achieved.

How would the nutrient credit work?
Since the nutrient reduction benefits of stormwater treatment facilities depend on the type of best management practice, the land use of the drainage area, and the acreage of land draining to the facility, a nutrient credit for stormwater facilities must be site specific. Once the loading benefit of the retrofit is calculated, the credit is applied to new developments depending on acreage, type of development and type of best management practice used by the new development. While there is some simplification possible, the credits must be

offered on a case-by-case basis and the calculation and use of credits must be monitored.

This letter is being provided to you as a summary of our work for your review. If you have any questions or comments, please do not hesitate to contact us.

Very truly yours,

CAMP DRESSER & McKEE INC.

Armando I. Perez, P.E., Ph.D, DEE
Vice President

AIP/pd

File: 16582-27291-RT.DAC.IH

Monroe County Stormwater Management Master Plan
BMP Load Reduction Calculations

The CDM Watershed Management Model is a simple, spreadsheet-based loading model that calculates the pollutant loading for twelve constituents that are characteristic of stormwater runoff. Average runoff is calculated based upon the imperviousness of various land uses and average annual rainfall. Loading for each constituent is calculated based upon pollutant- and land use-specific event mean concentrations (EMCs) adjusted with the effects of best management practices (BMPs). The model equations are provided below.

The total runoff from a particular land use is:

$$Q_L = [c_p + (c_i - c_p)P_I]\frac{RA_L}{12}$$

where:

Q_L = Runoff for land use L (ac-ft/yr);
c_p = pervious runoff coefficient;
c_i = impervious runoff coefficient;
P_I = percent imperviousness;
R = annual average rainfall (inches/year); and,
A_L = area of land use L (acres).

The total loading for a particular land use with associated BMP is:

$$L_L = kQ_L C_{EMC}(1 - E_{BMP})$$

where:

L_L = annual loading for land use L (lb/year);
k = 0.2266, a conversion factor;
C_{EMC} = event mean concentration for specific pollutant for specific land use l (mg/l); and,
E_{BMP} = the pollutant removal efficiency for the specific BMP.

Combining these equations and converting to a per-acre loading, the amount of loading per acre for a specific pollutant, land use and BMP is:

$$\Delta L_L = [c_p + (c_i - c_p)P_I]\frac{R}{12}kC_{EMC}(1 - E_{BMP})$$

where ΔL_L = total load with the BMP per acre.

For the Monroe County Stormwater Management Master Plan, the following parameters are used for the WMM simulations for each island.

$c_p = 0.10$
$c_i = 0.95$
R = 36 inches/year = 3 feet/year

Using these parameters, the equation for the calculation of the total load is:

$$\Delta L_L = [0.06798 + 0.57783P_I]C_{EMC}(1 - E_{BMP})$$

For the purposes of the Monroe County Stormwater Management Master Plan, this equation was applied to total nitrogen reductions for residential and commercial land uses to calculate the nitrogen reduction credits based upon the type of land use and BMP. Nitrogen has been shown to be a limiting nutrient for eutrophic impacts to near shore water quality and coral reefs. Nitrogen is present in stormwater runoff and discharges from septic tanks as well. Therefore, nitrogen species were evaluated for comparable reductions to estimate the benefit of capital improvements for the reduction of nitrogen from stormwater versus wastewater sources.

Total nitrogen is the sum of total Kjeldahl nitrogen (TKN) and nitrate plus nitrite nitrogen. Table 1 provides event mean concentrations for residential and commercial land uses as well as the nitrogen reduction efficiencies of various BMPs.

For the following examples, a medium density residential property of 10 acres that, through retrofit, applies wet detention as the BMP will reduce total nitrogen loading by 3.7 pounds per year (see Table 1A). The credit is therefore 3.7 pounds per year.

Example 1:
A new 2-acre commercial development with wet detention built on urban open land use would consume some of this credit. Using Table 1B:

2-acre commercial development with wet detention	= 1.102 x 2 = 2.204 pounds/year
2-Acre Urban Open Land Use	= 0.123 x 2 = 0.246 pounds/year
Nutrient Load Increment	= 1.958 pounds/year

Credits Left = 3.7 pounds/year credit - 1.958 pounds/year for Development
= 1.742 pounds/year still available

Example 2:
A new 7-acre high-density residential development with swales built on urban open land use would consume some of this credit.

7-acre high-density residential development with swales	= 0.705 x 7 = 4.935 pounds/year
7-Acre Urban Open Land Use	= 0.123 x 7 = 0.861 pounds/year
Nutrient Load Increment	= 4.074 pounds/year

Nutrient load increment exceeds credit so development not allowed.