New Jersey Highlands Council

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New Jersey Highlands Council **Letter 86**

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The application of the Trela-Douglas nitrate dilution model is one of the keystones of the Regional Master Plan (RMP). The adoption of the model's approach and specific inputs by both the NJDEP and the Highlands Council are in response to the requirements of the Highlands Water Quality Planning and Protection Act (the Act). With the passage of the Highlands Water Protection and Planning Act in 2004, the legislature specified a new more protective approach to land use planning in the Highlands region. It is important to note that the act passed the legislature by large margins: 34-2 in the Senate and 69-10 in the Assembly. Several of those legislators voting against the bill have continued their political opposition the Act until the present. Specifically the Act stipulates that the RMP should focus on the protection, restoration and enhancement and quality and quantity of surface and ground waters in both the Preservation and Planning Areas (C13:20-10.b(1) and c13:20-11.1(a). What exactly is meant by the three words, "restore", "protect", and "enhance" in the context of water resources and land use planning in New Jersey? In Its RMP Technical Resource paper, "Water Resources Vol. 1" the Council carefully examined the three terms, protect, enhance, and restore as follows: "Restore" is the simplest – where waters violate water quality standards, their quality must be improved to the point where they at least meet the water quality criteria established to protect designated water uses such as drinking water, fishing, swimming and ecosystems. The Highlands Region includes areas of both localized and wider scale contamination where restoration would be appropriate, ranging from the effects of intensive agriculture, to the impacts of communities with many septic systems on small lots, to areas of industrial contamination. "Enhance" is also fairly clear but less used for regulatory purposes – it means improving water quality even where the waters currently meet all standards. The laws do not provide a direct mechanism for doing so, but some regulatory programs (e.g., uniform requirements for secondary treatment of sanitary sewage, industrial treatment standards, municipal stormwater permits) enhance water quality. Voluntary efforts (e.g., agricultural improvement cost-share programs, public education) or indirect efforts (e.g., where efforts to control one contaminant achieve improvements for a non-targeted contaminant) also enhance water quality. "Protect" is the most variable in meaning, but is a critical focus of water pollution control programs. Existing regulations, case law and legislative history at both the state and federal level make clear that "protect" covers a wide range of policies, from natural quality (no non-natural pollutant loadings of any type) to non-degradation (no reduction in water quality from a baseline condition) to various levels of anti-degradation (allowing some level of reduction in water quality but never beyond the water quality criteria and always controlled to protect public interests). What becomes clear from historic use is that "protect" refers to the protection of water uses ranging from highly sensitive ecosystems that tolerate no degradation, to other water uses that will tolerate some limited degradation under some situations. Additionally, the Act specifies that a carrying "capacity approach" should be used in the Regional Master Plan: "The regional master plan shall include, but not be limited to: (1) A resource assessment which determines the amount and type of human development and activity which the ecosystem of the Highlands Region can sustain while still maintaining the overall values thereof with special reference to surface and ground water quality and supply (emphasis added)." These requirements, the use of a non-degradation approach to surface and groundwater quality and the use of a carrying capacity approach, have been met by the RMP which employs the Trela-Douglas nitrate dilution model along with other planning techniques. A brief introduction to the nitrate dilution model as used in New Jersey is contained in the N.J. D.E.P.'s "Nitrate Dilution Model, Frequently Asked Questions" (http://www.state.nj.us/dep/njgs/enviroed/infocirc/nitratedilutionFAQ.pdf). The Trela-Douglas nitrate dilution model was developed in New Jersey and is capable of meeting important statutory objectives mandated by the Act. Perhaps the first clearly articulated explanation of the model appeared in 1988 in "Document 32: Development of the Nitrate Dilution Model for Land Use Planning in the State of New Jersey", a technical document prepared by the Office of State Planning (http://www.nj.gov/state/planning/docs/nitratemodel120788.pdf). The model was specifically reviewed to determine its ability to provide carrying capacity guidance to land use planning in non-sewered areas: "Traditional tools for evaluating the suitability of a development site for onsite wastewater disposal from conventional septic systems focus on the ability of the surface soils and underlying geologic formations to absorb and transmit septic effluent. These evaluations (e.g., percolation tests) are frequently accurate in determining the ability of the land to support individual septic systems with respect to the filtering and drainage ability of surface and subsurface soils. However, such tests do nothing to evaluate the ability of the environment to dilute and transport contaminants safely out of the watershed. Thus, groundwater degradation may occur in areas having a high density of approved, properly functioning septic tank systems; this may be compounded by additional contaminants introduced by intensive agricultural use of the land. (Doc. 32, p.1). The model was applied statewide and found appropriate septic unit densities ranging from 3.1 ac/unit to 31.1 ac/unit based on a 3mg/l output concentration. The model was adopted for use in New Jersey by the State Planning Commission, the N.J. D.E.P., the Pinelands Commission and numerous municipalities. An excellent guide to the model at a watershed scale and its use was published by Somerset County in 2010: (WQMP Rule N.J.A.C. 7:15: Development of the NJGS HUC11-Scale Nitrate-Dilution Model to Determine Regional Septic Densities 03-09-10)(https://www.co.somerset.nj.us/planweb/wastewater/maps/NJDEPNO3-Models.pdf). This document addresses the use of the model to meet the requirements of the N.J. D.E.P.'s Water Quality Management Planning Rule that by then had incorporated the use of the model. The extensive bibliographic references, numerous reviews and applications of the model in New Jersey indicate that the model has a strong scientific basis and has been reviewed and used by a wide variety of scientific and non-scientific land use practitioners. Overall, the model is, at present, the best available and understood mechanism for establishing appropriate septic densities in non-sewered areas. Like other models, the inputs used have an effect on the results. In the case of the nitrate dilution model, several factors must be carefully considered. The Council's entire approach and application of the nitrate dilution model is described in the Water Resources Technical Report, Vol 1 on pages 114-173. The document recognizes that there is a clear association between land use intensity and the concentrations of nitrates present in groundwater. It also recognizes that nitrate concentrations are not only a potential health problem but that they can be used as an indicator to predict the presence of other contaminants in groundwater. While health concerns are of crucial importance it is also necessary to consider the impacts of nitrate concentrations on ecological systems. Since many of the Highlands stream systems are, or should be, low nutrient streams, the threshold for ecological protection is generally lower than the human health threshold. Median nitrate concentrations were evaluated using 352 direct well measurements and a logistic regression process implemented by the U.S. Geological Survey. "Of the 183 subwatersheds, the median concentration for the Highlands Region as a whole was determined to be 0.83 mg/L, slightly lower than the 1.1 mg/L value calculated directly from well sampling analytical results. The model-derived median is considered more accurate as it addresses limitations in the well monitoring network, related to the overall distribution of wells with a disproportionately small number located in undeveloped areas. The modeling analysis also provides an indication of general trends in water quality and magnitude of contamination in terms of both areal extent and actual concentrations that are related to nitrate loadings. Estimated median nitrate concentrations for each of the 183 subwatersheds range from 0.17 to 3.6 mg/L; just nine subwatersheds have an estimated median concentration greater than 2.0 mg/L. The median nitrate concentration in undeveloped areas was estimated to be 0.1 mg/L, with concentrations in subwatersheds with very limited development typically less than 1.0 mg/L. Highly urbanized areas are likely to have somewhat elevated concentrations, with intensely agricultural areas most likely to have the highest concentrations of nitrate. The results of the median nitrate concentration analysis, aggregated into representative values for the HUC14-specific results are illustrated in the map figure entitled Median Nitrate Concentrations by HUC14". Water Resources Technical Report (Vol.1,p. 116). Median results from the Protection Zone were .72 mg/l, Conservation Zone, 1.87 mg/l and for the ECZ, 1.17 mg/l. The median concentrations for the Protection Zone and the Conservation Zone were adopted as targets while 2.0 mg/l was adopted as the target in the ECZ Zone corresponding to the NJ DEP statewide level. The Council did not analyze the Preservation Area of the N.J. D.E.P. While there may be some distrust of the modeled results it is important to note that in 2014 a report prepared by the N.J.'s New Jersey Geologic and Water Survey found N.J. G &WS: Technical Memorandum 14-1, 2014 Nitrate Concentrations of New Jersey's Highlands Region, using 19,369 sample results generated through the Private Well Testing Act found similar figures: for the Protection Zone the median was .2 mg/l, for the Conservation Zone 2.55 mg/l and for the ECZ 3.55 mg/l. The overall range was similar ranging from .1mg/l in the Protection Zone of the Preservation Area to 3.55 mg/l in the ECZ in the Planning Area. Based on a comparison of these two studies it is clear that median concentration have been accurately determined. Another variable in the model is the recharge volume. The Council and the N.J. D.E.P. both used the 1961-1966 drought of record to inform the model. This was done to assure a conservative analysis and is the proper choice for long term water resources planning. Home occupancy was also considered at 4 persons per household, despite the fact that census figures indicate an average home occupancy of 2.73 people per unit in the region. This is explained in the Technical Report as a compensation for other potential sources of nitrate such as lawn fertilizer and to account for occupancy above the average. The model was then applied to all 183 subwatersheds to determine the average density to be permitted so as not to break the target number. Each municipality was assigned a percentage of the available septic capacity based on its land area in the watershed. Controversy about NJDEP's Septic Density Standard for the Highlands Preservation Area, characterizing it as junk science, etc. comes from the equally valid input variables used by NJDEP in the nitrate model.

The Trela-Douglas Nitrate Model is a peer-reviewed tool that has been in use in New Jersey and elsewhere for more than 30 years. The model is not controversial, but the inputs do not sit well with those unhappy with the results. For example, NJDEP assumed a recharge based on drought rather than annual precipitation averages; for nitrate loading, NJDEP assumed household sizes of four persons instead of a regional average of 2.7 occupants. These very conservative inputs to the formula result in the 88 acre and 25 acre densities. NJDEP's use of these conservative inputs are directly responsive to the mandates of the Highlands Act and justification by the Department can be found on their website at Basis & Background of the Septic Density Standard of the Highlands Water Protection and Planning Act Rule at N.J.A.C. 7:38-3.4. The Highlands Act is unequivocal in stating the goals it intends for the Highlands Preservation Area. Primary among them are the goals: to protect, restore, and enhance the quality of surface and groundwaters (C.13:20-10.b.1 et seq.). Also stated are goals to: preserve extensive and, to the maximum extent possible, contiguous areas of land in its natural state and to: prohibit or limit to the maximum extent possible construction or development incompatible with preservation. Unlike the series of goals stated for the Planning Area, which includes the character, location and types of development that are encouraged, except for brownfield remediation and development, there exists absolutely no provision to accommodate any form of residential or commercial development in the Preservation Area. For the Preservation Area there is no intention that its primary purposes of protection, restoration and enhancement of water resources be mitigated or softened with loopholes in accommodation of development such as, to the maximum extent practical, or practicable, or feasible. Clearly, the legislative intent for the Highlands Preservation Area is to maintain, if not enhance, the landscapes that contribute to the Highlands supply of clean water. Any human disturbances that could damage the existing fragile ecology is not to be limited, but prohibited. Land uses must conform to policies that are not merely anti-degradation, but non-degradation. NJDEP, in developing a septic density standard for the Highlands Preservation Area had to fully incorporate the mandates of the Act into standards for non-degradation. With that in mind, the 88 acre and 25 acre minimum lot sizes for residential development is not jaw-dropping if the goal is to maintain forest ecology, as it surely is. Lot size shock only comes into play when looking at the Highlands Act as a development plan. It is a preservation plan, and one with lines drawn in the sand. It should be noted that the septic density standard for the Highlands Preservation Area is a component of NJDEP's Highlands Rules in response to the Highlands Act. The standard is not subject to the jurisdiction of the Highlands Council, or a component of the Highlands Regional Master Plan, except as adopted by reference into the RMP. In sum, the nitrate dilution model is a proven mechanism to aid in calculating septic densities and to distribute remaining capacity in an equitable basis. Its application by the Highlands Council and the DEP was carefully considered and assumptions were carefully made. Overall, we can see no reason to abandon or modify the approach. We strongly recommend that the Council continue to apply the model during conformance until substantial land area is controlled by appropriate zoning and further direct groundwater and surface water measurement and analyses can be performed.

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