

**Appendix J - NJEP Overview Of Build-Out Model To Estimate  
New Sewer Flows And Septic Yields**

**NJ Department of Environmental Protection**



**Water Quality Management Planning  
N.J.A.C. 7:15**

**Wastewater Management Plans  
Wastewater Estimation & Sustainable Environmental Planning**

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**Overview and Guidance for a Model Builder Application  
to Estimate New Sewer Wastewater Flows and Septic Yields**

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## **I. Introduction**

This document is designed to provide Wastewater Management Planning Authorities with guidance on the use of the Wastewater Estimation model builder application, and sustainable environmental planning beyond the requirements of a Wastewater Management Plan. The Wastewater Estimation model builder application is an optional tool that has been designed to assist with the preparation of a county-wide Wastewater Management Plan consistent with the Water Quality Management Planning rule (N.J.A.C. 7:15). Questions regarding sustainable environmental planning or the use of the Wastewater Estimation model builder application may be referred to the Office of Planning & Sustainable Communities.

### **A. Water Quality Management Planning Rule**

The Water Quality Management Planning Rule, N.J.A.C. 7:15 (Rule), primarily implements the New Jersey Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., whose purpose is to maintain, and where attainable, restore the chemical, physical and biological integrity of the surface and ground water resources of the State. Accordingly, the rules prescribe water quality management policies, procedures and standards which protect public health; safeguard fish, aquatic life, and scenic and ecological values; and enhance domestic, municipal, recreational, industrial and other uses of water.

The Department administers the Water Quality Management Planning Rule as part of the “continuing planning process” required by the Federal Clean Water Act, 33 U.S.C. §§ 1251 et seq., and the New Jersey Water Quality Planning Act. These rules serve two basic functions. They establish the Department’s general regulatory framework for water quality/water resource planning and supplement other Department rules pertaining to wastewater management.

The Department’s adopted Rules, among other things, ensures better protection of water quality and improves predictability in implementation of the rules. The adopted Rule includes reassignment of wastewater management planning responsibility to the County Boards of Chosen Freeholders; withdrawal and re-designation of wastewater service areas where the applicable wastewater management plan (WMP) is not in compliance with the mandatory update schedule contained in the rules; a requirement that municipalities pass ordinances designed to assure water quality maintenance (riparian corridor protection, steep slope protection, stormwater management, septic maintenance, TMDL); and a requirement that updated WMPs address septic density in a manner that demonstrates compliance with a 2 mg/L (ppm) nitrate planning standard.

The Rule also establishes clear standards for delineating sewer service areas to protect environmentally sensitive areas as well as clear, environmentally protective standards for the review of WQM plan amendments. The latter include standards to address wastewater, water supply, nonpoint source pollution (including controls related to stormwater, riparian zones and steep slopes), and habitat of threatened and endangered species.

### **B. Build-out Analysis Model**

The *Wastewater Estimation model builder* application is provided as an “Optional Development Tool” for Counties/Municipalities to utilize in the preparation for Water Quality Management Plan (WQMP) updates. It is provided to start the process of developing a semi-automated GIS tool based in the ESRI ArcMap Version 9.2, Arc Info Model Builder extension. The application is specific to the estimation of new Wastewater Flows within Sewer Service Areas and to compare existing zoning to HUC 11 Nitrate Dilution Septic Densities.

Wastewater estimations generated with this tool are specific to wastewater applications and may not meet the requirements of other buildout calculations required by other NJ Department of Environmental Protection programs. Further, these estimations may not recognize all regulated land uses or consider additional environmental resources, most notably those located outside of sewer service area. Nitrate dilution capacity is only one aspect of land use limitations. The wastewater build out information

generated by this model should supplement county- or municipal-wide comprehensive planning that takes additional environmental and capacity considerations into account.

## II. Sustainable Environmental Planning

The Wastewater Estimation model builder application included with this guidance document will assist counties and municipalities estimate new wastewater flows within delineated sewer service areas and compare those estimated flows to treatment works capacity. It also compares new development potential, based on local zoning, to regional septic density standards for those areas outside of sewer service area. However, the model itself does not represent sustainable environmental planning. To that end, the Department [Office of Planning and Sustainable Communities](#) (OPSC) offers various tools and technical assistance to counties and municipalities toward development of plans that meet both the requirements of the Water Quality Management Planning rule, as well result in sustainable environmental planning.

OPSC can provide guidance on the development or update of general planning documents such as Master Plans, natural resource inventories, and zoning ordinances. OPSC, with cooperation from several Department programs, can also provide additional [tools](#) such as model ordinances, model planning documents, guidance on sustainable and “green” development, data and guidance on both water supply and wastewater capacity issues, and technical assistance in putting all of these pieces together to produce a sustainable environmental plan.

**Information can be found on the following:**

Wellhead Protection Ordinance  
Septic Management Plan and Ordinance  
Open Space Guidelines  
Habitat Conservation  
Natural Resource Inventories  
Water Conservation  
Stream Corridor Protection and Ordinance  
Clustering  
Energy and Green Buildings  
Environmental Assessment Ordinance and Checklist

Areas outside of sewer service areas are a primary area of concern. The nitrate dilution standards of the Water Quality Management Planning rule result in a "septic density" for each watershed in the State. This septic density identifies the maximum *comparable residential zoning density* that meets the groundwater quality goal. The Department does not recommend uniformly zoning at these densities across the watershed. DEP intends this comparable residential zoning density to represent the total number of units that, if built, would not result in a degradation of groundwater quality by exceeding the 2 mg/L nitrate limit. Instead, the Department advocates center-based development, clustering, and protection of environmental features and agriculture land. To protect environmental features in the areas outside of sewer service area, the Department advocates a combination of tools that, together, provide fairly comprehensive protections. For example, the Department believes that adoption of a habitat protection program – which may include specific performance standards, environmental assessments, site plan and subdivision standards, clustering resource-specific ordinances, open space prioritization, habitat management, and implementation measures that would protect, create, enhance, and restore critical habitat areas.

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<sup>1</sup> This is not intended to be an exhaustive list. Municipalities should consider additional plans, strategies or ordinances that would reach their sustainability goals and further protect water quality and other natural resources within the municipality.

The Department also advocates sustainable development practices. Executive Order #54 (2/13/07) and the NJ Global Warming Response Act (7/6/07) set aggressive Green House Gas (GHG) reduction goals for NJ and outline a number of state actions to begin to address the state's energy consumption patterns and reduce its GHG emissions. While all sectors of the State are contributors to GHG emissions and thus all must be part of the solution, this responsibility also presents opportunities to communities. A number of state programs exist to help defray the cost of municipal actions, including measurement, planning, and implementation. It is recommended that municipalities begin to plan for the low-energy future since it is only a matter of time before regulation and market forces will require it. Voluntary actions give communities greater flexibility to develop programs best meeting their particular needs and priorities. A number of sources of assistance exist and the OPSC can provide guidance as you initiate your planning process. For example, OPSC has developed the [\*Creating Sustainable Communities: A Guide for Developers and Communities\*](#). This guide provides a series of fact sheets on a wide array of sustainable practices and technologies. Each fact sheet includes: the benefits from implementing the practice, how it relates to and helps us address a state goal or policy, a description of the practice or technology, sources of State government assistance, and sources of additional information.

The Department has also developed the [\*Permit Readiness Checklist\*](#). The Readiness Checklist (formerly "scorecard") initiative is a business practice improvement to help applicants and Department program staff/managers to better understand project readiness. Use of the readiness checklist will help identify, before the start of the regulatory process, if a planned project is ready for detailed review by the Department and to identify regulatory issues that may need to be addressed. In addition to framing the project site (lot and block information, acreage, topographic mapping), the checklist will address project ownership, local zoning consistency, water supply, wastewater capacity, the need for additional internal and external governmental approvals, and proposed environmental enhancements. The checklist is organized into a series of questions that help to identify project readiness. A "score" is not actually tabulated, but the identification of regulatory consistency issues will help the applicant and the Department to determine, before a proposed project is submitted to DEP for review, whether the project will easily meet DEP technical and policy requirements, or if it will require a more complicated review and/or project modifications. Upon successful completion and Departmental review of the readiness checklist, the applicant is ready to request a full permit coordination team and a pre-application meeting with the submittal of a permit identification form, site maps, and development plan.

The Department also recognizes that counties/municipalities may wish areas identified by the Wastewater Management Planning process as environmentally sensitive included in a sewer service area. In that instance, the Water Quality Management Planning rule provides the municipality with the option of utilizing the State [\*Plan Endorsement\*](#) process to address the issue. Through the Plan Endorsement process, sewer service area may be extended into environmentally sensitive areas as necessary to accommodate center-based development provided that appropriate environs protections are enacted. Such environs protections include those discussed above. The Plan Endorsement process also offers an opportunity for municipalities to connect their resource capacity opportunities and constraints with local land-use plans and goals.

The Department has developed a guidance document (Guide) for municipalities seeking Plan Endorsement that provides information on the key Plan Endorsement requirements established by the State Planning Commission and how these requirements relate to the Department's regulatory programs, resource management and natural systems protection efforts. The guide is intended to provide an overview of the types of information generally considered by the Department to be necessary in the community's Plan Endorsement Petition and how the information should be used to develop and support improved local protection and management of New Jersey's environmental resources. The Guide will be available June 2008 on the OPSC website: <http://www.nj.gov/dep/opsc/>.

### **III. Overview of Model Builder Application**

#### **A. Establishing Sewer Service Areas and Determining Estimated Flows**

The Department at N.J.A.C. 7:15-5.24 has identified the conditions where extension of sewer service is not appropriate. N.J.A.C. 7:15-5.24(a) sets forth the general policy that large contiguous areas of environmentally sensitive resources, coastal planning areas where the extension of sewers would be inconsistent with New Jersey's Coastal Zone Management program, and special restricted areas that are prone to natural hazards such as flooding, wave action and erosion should not be included in sewer service areas. The limitations on the extension of sewer service in these areas are consistent with the Department's mandate to protect the ecological integrity and natural resources of New Jersey, including water, threatened and endangered species, wetlands and unique and rare assemblages of plants. Once the extent of sewer service area mapping has been updated, future wastewater flows can be estimated using the Wastewater Estimation model builder application.

#### **B. Establishing Allowable Septic Densities**

The Wastewater Estimation model builder application uses results from a separate nitrate dilution model designed by New Jersey Geological Survey to estimate septic densities. This separate model is titled: *A Recharge-Based HUC 11-Scale Nitrate-Carrying-Capacity Planning Tool for New Jersey, v1.0 (MS Excel Workbook)*. The abstract of this model states, "Nitrate (NO<sub>3</sub>) is a constituent found in the effluent from individual on-site wastewater disposal systems (septic tanks.) Ensuring that nitrate concentrations in ground water do not exceed targets should be one goal when planning or reviewing proposed developments that will use septic tanks. The method presented here combines a model of nitrate dilution (based on Trela and Douglas, 1978) with one of ground-water recharge on a HUC11 basis (based on Charles and others, 2003). The goal is a HUC11-scale planning exercise to estimate region-average lot sizes needed to provide enough recharge to dilute nitrate to a specified target. This method is intended to be a guide for estimating the impact of nitrate from septic tanks on HUC11-scale ground-water quality." This analysis scale is at a regional watershed level. Another more specific method is available if a more detail analysis is required. These can be acquired and reviewed at: <http://www.nj.gov/dep/watershedmgt/rules.htm>.

#### **C. Local/Regional Data Needs**

To further develop this tool, Counties/Municipalities need to provide additional customization to the application by adding local digital data. If digital municipal level data does not exist, hard copy records could be utilized to adjust the application for developed areas after the year 2002, local preserved open space, or other local constraints currently not recognized. The most current digital zoning with Minimum Lot size, Residential densities (Unit/Acre) and Non-residential Floor Area Ratios is needed to run the model. The following are examples of local data that would improve the model accuracy if available: 1) The most current digital parcel layer; 2) Digital sub-division (after LULC Urban 2002) and approved sub-division polygons; 3) Digital redevelopment area polygons; 4) The most current local Preserved Open Space and Preserved Farms; 5) Local regulated environmental features; 6) Other Local spatial digital data and database records. In addition, Counties may need to adjust the application to "Gross" or "Net" minimum lot selection based on each specific municipality's zoning requirements. This application was designed to utilize current municipal parcel and zoning digital layers.

#### **D. Model Limitations**

The information depicted within this application is provided as a resource in the development of a GIS Model Builder Application tool for Counties/Municipalities. The information depicts regional overlays which are not site specific. No representation is explicitly or implicitly implied by the New Jersey Department of Environmental Protection (NJDEP) as to the site-specific accuracy of the information presented. The condition of any area appearing suitable for an intended use must be assessed by a comprehensive, due diligence investigation of several factors, including but not limited to a Natural Resource Inventory, physical on-site conditions, local, State and Federal requirements, approvals, status of any outstanding violation, the past uses and possible residual contamination of a site. NJDEP Land Use/

Land Cover and 2002 aerial photographs were utilized as the base layers. Refer to each digital layer's metadata for detailed descriptions of the attribute and spatial extent limitations.

Please be advised that the following represents specific method/digital data limitations within the application, including but not limited to:

- 1) Allowable uses and development standards not considered in this application include:
  - a) Minimum width and depth per lot
  - b) Front yard set backs, depending on subdivisions
  - c) Side and rear yard set backs
  - d) Allowable building stories
  - e) Road access issues defining building densities and lock parcel not removed
  - f) Road right of ways not removed
  - g) Percolation limits
- 2) Urban 2002 is used, missing 6 years of development, not measuring re-development areas or existing development expansions. Also, buildings on septic within sewer service areas are not identified by this analysis.
- 3) Urban foot print removed does not remove the associated Minimum Lot Area creating the potential, in some areas, to over estimate new units in oversized lots.
- 4) Population estimates not included, application represents all time or absolute build out (No time steps analyzed).
- 5) 100% of selected environmental constraints (Wetlands, Stream Corridors & Open Space) are removed from sewer area, some flexibility related to buffer permitting requirements are not recognized.
- 6) Water purveyor future allocation agreements, stressed ecological flows, water purveyor interconnections and water purveyor distribution blending are not measured by this analysis.
- 7) Does not measure other specific regional zone requirements; 1) Highlands, 2) Pinelands, 3) Delaware River, 4) Meadowlands, 5) CAFRA, etc.
- 8) HUC 11 Nitrate Dilution Analysis does not recognize other land use regulated features (i.e. stream corridor buffers) which may further restrict land use within specific Septic locations.
- 9) HUC 11 Nitrate Dilution Analysis measures only densities for future septic systems. Additional areas potentially providing dilution not recognized in the sewer areas.
- 10) Contaminated sites are not recognized by this application.
- 11) Grandfathered, non – conforming (under Minimum Lot Size) lots are currently not recognized by this application.
- 12) Overlays zones are not recognized by the application.
- 13) Lot ownership current and future plans are not recognized by this application including but not limited to proper owners' and homeowners' association common areas, right of ways, easements, lot consolidation, etc.
- 14) Specific municipal land use variances are not recognized by this application.

As a result of these limitations, the current output of this GIS tool can only be qualified as an initial screen of current field conditions per County/ Municipality. Any other representation of generated results from this tool is not an accurate depiction of development potential and will be deemed to be a misrepresentation. The application in the current configuration does not generate a “Vacant Land Analysis” and should not be represented as a “FINAL PRODUCT” in any form or secondary product. At the municipal level, additional GIS steps are needed to further complete the analysis. These include but are not limited to the integration of digital municipal data updates, the customization of the application relating the municipal zoning requirements and quality control reviews of municipal records and field checks.

## **Model Builder User Guide**

### **C. Bring Application into Tool Bar and Connect Specific Data Layers**

- 1) Within ESRI Arc – Map Version 9.2 - Open Toolbox - right click within toolbox and click on Add Toolbox
- 2) With provided DEP Land Use / Land Cover 2002 (in Statewide\_Data File), re-select the attribute “TYPE02” in LU/LC shapefile and select Water; Urban and Wetlands and save as individual shapefiles. Respectively add the three (3) individual shapefiles to the specific module where the data input connections are located (i.e. Urban to 1<sup>st</sup> Module – Parcel\_Selct.).
- 3) With Watersheds\_HUC11 shapefile and Septic\_Dens Excel table (in Statewide\_Data File), join using attributes “link” and “HUC11” respectively and export as a new shapefile. This will integrate the septic densities to the shapefile. Add new HUC 11 septic densities shapefile into the 2<sup>nd</sup> Module – Base\_info.
- 4) Union Preserved Farms and Total Preserved Open Space (in Statewide\_Data File), create a common attribute field to select on in the Geo-database. Example attribute is OS\_ADA with specific records tag either OS and ADA respectively.
- 5) Go to file where the “Wastewater\_Estimator” (.tbx) is located, add and open.
- 6) Right click on the 1<sup>st</sup> module (Parcel\_ Selct) and chose EDIT, connect county specific data to process functions and repeat with other 4 modules. Specific County/ Municipal digital data includes: a) Parcel; b) Zoning; c) Updated Sewer service area; d) Preserved Open space and Farms; e) Specific environmental features.
- 7) In Arc Catalog, go to Wastewater\_estimation\_052008\ Output\_data\ Final\_calculations.mdb. Right click on Final\_calculations.mdb and import sewer and septic final shapefiles into feature classes. Create SQL queries and pivot tables within the Final\_calculations.mdb (Access) to output data results (see SQL and Pivot Tables in Example Geo-database SQL pivot table.mdb).

Please be advised that application is set to the pilot example of Bernards Twp. A majority of the data and data connections need to be modified from this setting and adjusted to each County and Municipality specific data inputs and final output. If needed, the Department will provide assistance to the counties in regards to adjusting the application and any data development. In the State\_Data File, data provide is current public downloads to be utilized in the application. Periodically, these files need to be checked for updates at <http://www.nj.gov/dep/gis/stateshp.html>.

**D. GIS Steps per Selected Method – (“GROSS” and “NET” Minimum lot selection variations)**

**(GROSS - Single lot) Select greater or equal to minimum lot size after subtracting only LULC Urban 2002 from lot areas**

**OR**

**(NET – Single lot) Select greater or equal minimum lot size after subtracting LULC Urban 2002 and Environmental Constraints from lot areas (optional based on Municipalities allowance).**

***(Please be advised for lots with Minor/ Major subdivision potential the selection criteria within this application needs further development)***

**Environmental Constraints set in the application as Examples** = a) C2 waters - 50' Buffer; b) C1 waters - 300' Buffer; c) Wetlands; d) Preserved Farms; e) Preserved Open Space; f) Surface water

**Other Environmental Constraints not currently set in the application** = a) Flood zones; b) Wetland Buffers; c) Local Open Space; d) Environmental Features Regulated by Municipal Ordinances; e) Other Stream Corridor buffers; f) Hydric soils; g) Other.

**Gross Method**

- 1) *ERASE* - LULC Urban 2002 from Parcel Layer
- 2) *IDENTIFY* - Township zoning into Parcel Layer
- 3) *RE-SELECT* - Remaining Parcel area < zoning minimum lot size - remove parcel
- 4) *IDENTIFY* - Update Sewer and Septic Area
- 5) *IDENTIFY* - Open Space and Preserved Farms
- 6) *IDENTIFY* - HUC 11 joined with NO3 dilution target densities
- 7) *IDENTIFY* - Water Purveyor Areas
- 8) *ERASE* - Environmental constraints in remaining sewer lots.
- 9) *ERASE* – Wetlands and surface water in remaining septic lots (erase hydric soils if digital coverage available).
- 10) *OPTIONAL*: Clean irregular polygons created by removing features by re-selecting perimeter / area ratio limit per individual polygons.
- 11) Calculate potential new flows and septic yields compare to capacity and existing zoning
- 12) Quality Control/ field verification of results by County/ Municipality
- 13) *OPTIONAL*: Overlay generated environmental constraint module over septic area as a reference for other potential land use restrictions (overlay not in calculation)

**Net Method**

- 1) *ERASE* - LULC Urban 2002 and Environmental constraints from Parcel Layer
- 2) *IDENTIFY* - Township zoning into Parcel Layer
- 3) *RE-SELECT* - Remaining Parcel area < zoning minimum lot size - remove parcel
- 4) *IDENTIFY* - Update Sewer and Septic Area
- 5) *IDENTIFY* - Open Space and Preserved Farms
- 6) *IDENTIFY* - HUC 11 joined with NO3 dilution target densities
- 7) *IDENTIFY* - Water Purveyor Areas
- 8) *OPTIONAL*: Clean irregular polygons created by removing features by re-selecting perimeter/ area ratio limit per individual polygons.
- 9) Calculate potential new flows and septic yields compare to capacity and existing zoning

10) Quality Control/ field verification of results by County/ Municipality

11) **OPTIONAL**: Overlay generated environmental constraint module over Septic Area as a reference for other potential land use restrictions (overlay not in calculation)

## II. General Calculations

### SEWER SERVICE AREA:

- 1) New Residential Flow = Remaining Area \* Zone Density \* 300 Gallon/ Unit/ Day
- 2) New Non Residential Flow = Remaining Area \* FAR \* 0.1 Gallon/ Sq. Ft. / Day

### SEPTIC AREA:

- 1) HUC 11 Nitrate Dilution Calculate New Units (With/ without Open Space Area)
  - a) New Residential Units
  - b) New Non - Residential (FAR)Both (a) & (b) = Total Area/ HUC 11 Densities
- 2) Existing Zoning Calculate New Units
  - a) New Residential Units = Remaining Area \* Zone Density
  - b) New Non - Residential Eq. Calculation =  $\frac{\text{FAR} * 0.125 \text{ Gal/ Sq. Ft./ Day}}{500 \text{ Gal/ Unit/ Day}}$

## IV. Distribution Agreement

### Wastewater Estimation Model Builder Application and Data Distribution Agreement

Users of the Wastewater Estimation Model Builder Application and Data agree to abide by the terms and conditions of the following:

#### I. Description of Wastewater Estimation Model Builder Application and Data as Provided.

The application and data provided herein are distributed subject to the following conditions and restrictions:

For all Model Builder Applications and data contained herein, (NJDEP) makes no representations of any kind, including, but not limited to, the warranties of merchantability or fitness for a particular use, nor are any such warranties to be implied with respect to the application and digital data layers furnished hereunder. NJDEP assumes no responsibility to maintain them in any manner or form.

#### II. Terms of Agreement

1. Application and digital data received from the NJDEP are to be used solely for internal purposes in the conduct of daily affairs.
2. The application and data are provided, as is, without warranty of any kind and the user is responsible for understanding the accuracy limitations of all digital data layers provided herein, as documented in the accompanying Data Dictionary and Readme files. Any reproduction or manipulation of the above data must ensure that the coordinate reference system remains intact.

3. Application and digital data received from the NJDEP may not be reproduced or redistributed for use by anyone without first obtaining written permission from the NJDEP. This clause is not intended to restrict distribution of printed mapped information produced from the digital data.

4. Any maps, publications, reports, or other documents produced as a result of this project that utilize NJDEP digital data will credit the NJDEP's Geographic Information System (GIS) as the source of the data with the following credit/disclaimer:

"This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized."

5. Users shall require any independent contractor, hired to undertake work that will utilize the application and digital data obtained from the NJDEP, to agree not to use, reproduce, or redistribute NJDEP GIS application and data for any purpose other than the specified contractual work. All copies of NJDEP GIS application and data utilized by an independent contractor will be required to be returned to the original user at the close of such contractual work.

The Wastewater Estimator model builder uses proprietary ESRI software. While ESRI software is required for successful implementation and/ or operation of the application, the department does not endorse, advertise for, provide license or access to, the ESRI proprietary software. Nor does the Department accept or assume any liability for the use of misuse of the ESRI proprietary software.

Users hereby agree to abide by the use and reproduction conditions specified above and agree to hold any independent contractor to the same terms. By using the application and data provided herein, the user acknowledges that terms and conditions have been read and that the user is bound by these criteria.