

Smart Growth Survival Kit

Practical approaches to managing growth



Planning:

Build-Out and Capacity Analysis

ANJEC's Smart Growth Survival Kit

- **Introduction**
- **The Environmental Resource Inventory: ERI** (ANJEC Resource Paper)
- **A Vision Statement: A Must for All Communities**
- **Planning: Build-Out and Capacity Analysis**
- **Affordable Housing: Meeting a Town's Affordable Housing Obligation while Protecting Natural Resources**
- **Open Space Plan** (ANJEC Resource Paper)
- **The Master Plan: Smart Growth, the Master Plan & Environmental Protection**
- **Ordinances: Using Ordinances to Protect Local Natural Resources**

New sections may be added in the future



Association of New Jersey Environmental Commissions

PO Box 157, Mendham, NJ 07945

Tel: 973-539-7547 • Fax: 973-539-7713 • Email: info@anjec.org • Web: www.anjec.org

I. Build-Out

What Is Build-Out?

What will your community look like when all the vacant land has been built on? Recent studies predict that New Jersey may reach this situation as soon as 2030. We will be the first state in the nation to do so.

A build-out analysis can help residents understand what their municipality, or a section of it such as a highway corridor, will look like if built to the capacity allowed in current zoning. The analysis can also include environmental, social and economic impacts of full development and evaluate whether the current zoning will achieve the goals of the master plan. An economic analysis can forecast future tax revenues and liabilities to finance new infrastructure for the expanded community, including schools, water and wastewater treatment plants, recreational facilities, roadways and services.

A build-out can help identify changes needed in local master plans, zoning ordinances and development regulations. A build-out will not address the capacity of the natural or infrastructure systems, because it is based on zoning that may not recognize the capacity of these systems. (For example, the zoning may allow half-acre lots around lakes without consideration of the potential for eutrophication of the lake from non-point source pollution.) Once the build-out is completed, planners can use Capacity Analysis to assess whether existing resources are sufficient to serve the potential new development. The second half of this article will cover capacity analysis.

While build-out studies are useful, they generally cannot predict when full development will occur. This depends on many pressures, such as the economy, which are generally outside the municipality's control.

Starting a Build-Out

1. Determine the study area.

Defining the boundary of the study area is a critical first step. It can be all or part of the municipality, for

example, the commercial zone, areas with large undeveloped tracts or a number of brownfields.

2. Gather data

The necessary information is probably at your fingertips. The Environmental or Natural Resource Inventory (ERI or NRI) has baseline natural resource information and local planning and engineering departments have planning and zoning information. The county and state are also valuable sources of information.

From the municipality

1. Tax Map showing property sizes and vacant lands
2. Current Zoning Map
3. Existing Land Use Map
4. ERI showing environmentally sensitive areas
5. Open Space Plan showing publicly owned lands, conservation easements, planned greenways, and planned open space
6. Development and subdivision approvals not yet built

From most counties

1. Tax lots in GIS (Geographical Information System) format
2. Open Space Plan showing publicly owned lands

From the State GIS

1. Land use, land cover by watershed
2. Wetlands
3. Streams, lakes, and floodprone areas
4. Aquifers and recharge areas
5. Critical wildlife habitat
6. State Planning Areas
7. Known contaminated sites

All maps should be the same scale to facilitate transfer of data between maps. The computerized mapping program, GIS, can change the scale of the maps and can print multiple copies. If your community does not have access to GIS, manual mapping techniques can still be effective. The key is to adapt to local skills and budgets. The most important task is to complete the build-out sooner than later.

Having high quality data is imperative. The build-out will be only as good as the information collected. Good data are critical to build confidence in the results of the study.

Preparing a Build-Out

1. **Gross Land Surface.** Locate and calculate Gross Land Surface – all the land in the region to be studied. Review the existing land use map to identify zones. Focus on areas most likely to attract development – vacant lands and developed areas with a potential for infill or increased densities. Tax maps can help determine a property’s acreage and any existing easements.
2. **Constrained Lands.** Locate and calculate acreage on the lands with development constraints like
 - Public ownership,
 - Historic sites,
 - Conservation and utility easements,
 - Approved development not yet built, and
 - Environmentally important lands like wetlands, flood plains, steep slopes, stream corridors, water bodies, soils with limitations (limited percolation or bearing strength), and contaminated sites that are regulated by the state or municipality.

All land should be considered developable unless State laws (e.g. wetlands, flood-plains) or municipal ordinances (e.g. steep slopes, stream corridors) restrict their use.

3. **Net Useable Land.** Subtract the **constrained lands** from the **gross land surface** to obtain the **net useable land** area for future growth. This should include remaining farmlands, forest and open space not currently deed-restricted and developed parcels that could accommodate more intense uses.

Transfer the **net useable land** area to the base map.

4. **Total Developable Acreage.** Use the zoning map and applicable ordinances to determine the requirements and limits for each vacant parcel or zone, for example road rights-of-way, septic field requirements, minimum frontage, open space set-asides, and building coverage or floor area ratio requirements (FAR). A community may zone for clustered residential zones with a mandatory open space set-aside of 25 percent or place additional limits on number of units or acreage of development. Subtract these zoning controls from the **net useable land area** to obtain the **total developable acreage**.
5. **Full Build-Out.** For residential zones, divide the **total developable acres** by the underlying lot-size requirement for each zone to obtain an estimate of potential new units. For commercial zones, if FAR is applicable, multiply the **total developable area** by the FAR ratio to determine how much commercial floor space is permitted by the zone.

Use a figure or tables and bar charts to show the study’s results. A phased build-out approach also may show several points in the future, such as 50 percent or 75 percent building coverage.

Build-Out Example		
Total Study Area		2000 acres
Current Zoning	Agriculture, 1-acre	1500 acres
	Commercial	500 acres
Development Approvals	Agriculture	250 acres (210 units)
	Commercial	0
State and Local Regulations	Agriculture	Wetlands and buffers — 150 acres
		Steep Slopes — 25 acres
	Commercial	Wetlands and buffers — 25 acres
		Historic sites — 25 acres Easements — 50 acres
Net Usable Land	Agriculture	1075 acres
	Commercial	400 acres
Zoning Controls	Agriculture	1 dwelling unit/1 acre
	Commercial	Road/Infrastructure ROWs 15% FAR of 25%
Total Developable Land	Agriculture	914 acres (1075*(1-0.15))
	Commercial	400 acres
Full Build-Out	Agriculture	1124 units (914+210)
	Commercial	4.36 million sq. ft. (400*0.25)

Current zoning allows for 1,124 dwelling units and 4.4 million square feet of commercial space on 2,000 acres of fields. Eye opening indeed.

Education and Outreach

To make sure the build-out study's recommendations become reality, it is very important to present the results and offer a written summary at a public forum for local officials and interested citizens, place articles in the local newspaper, public service announcements on cable TV, postings on the community web page.

The support of public officials is key to accomplishing the build-out study's recommendations since they have the power to make the necessary zoning and infrastructure planning decisions. The town may need to adopt more creative development and design techniques to protect natural resources, retain a stable tax base, and avoid wall-to-wall subdivisions. The town can also use the study to calculate what additional services the community will need like education, recreation, municipal fire, police, and maintenance services, and infrastructure for drinking, waste, and stormwater systems. A build-out analysis also offers the opportunity to insure that the master plan goals are consistent with the current zoning.

A build-out provides valuable insight of future development potential based on current zoning. Large-lot zoning, mandatory clustering, an open space plan, transfer of development rights, and reductions in building lot coverage can change the outcome. Economic analysis can be a good technique for convincing local officials and citizens that over-development may not pay for itself in the long run. Tables and figures can effectively summarize the results.

Capacity analysis can provide the underlying factual data needed to put large lot zoning or reductions in lot coverage in place.

Stafford (Ocean) Build-Out Case Study

Stafford Township (Ocean) has completed several build-out analyses to address concerns about encroachment of development on environmentally sensitive lands like the Barnegat Bay Estuary. Using the results of two studies since 1990 to put creative conservation zoning and land preservation initiatives in place, Stafford has reduced its estimated build-out population from 66,000 to 49,000 with 14,000 fewer housing units.

The town also used the build-out data to perform an economic analysis to evaluate the breakeven point where additional development will be a tax burden on the community.

For Further Information

- ANJEC Resource Center, resourcecenter@anjec.org, www.anjec.org, 973-539-7547
- *The Environmental Resource Inventory: ERI*, 2003, Association of New Jersey Environmental Commissions
- *Open Space Plan*, 2003, Association of NJ Environmental Commissions
- GIS Data, NJDEP, www.state.nj.us/dep/gis, 609-984-2243; NJ Geological Survey, www.state.nj.us/dep/njgs; NJ Landscape Project, www.njfishandwildlife.com; NJ Geographic Information Network, <https://njgin.state.nj.us> (use no www)

Note: Environmental commissions and non-profit organizations can apply for GIS software from the NJ Office of GIS by applying on-line at the Resources section of <https://njgin.state.nj.us>. (use no www)

II. Next Steps – Carrying Capacity of Natural Systems

Capacity analysis takes the build-out study a step further by analyzing the capacity of the environmental and the infrastructure systems. It looks at questions like these.

- Is there enough water to supply the projected development?
- How will nonpoint source pollution generated by the new development affect local streams and lakes?
- Can existing roads and transit systems handle the increased traffic?

Projected growth should be sustainable; otherwise over-development will destroy existing stable communities. Engineered systems can modify the capacity of a system, but usually result in continued operating costs and/or negative ecological impacts. For example, channelization of urban streams increases flow but reduces water purification. Good planning should include some aspect of capacity analysis so the natural and built systems are not overloaded and a balance is achieved between the developed and natural systems. This section will focus on the capacity of natural systems, although a similar analysis can be performed for infrastructure, such as water and wastewater systems.

In the 1980s the Pinelands Commission used capacity analysis to determine where within the Pinelands it would allow development and what intensity it should be. The Commission used a nitrate dilution model to limit the impact of nitrates, from residential septic systems on groundwater quality. The model assumed no treatment of nitrates in the sandy soils and established an ambient ground water quality of 2 ppm (parts per million) nitrate-nitrogen at the property line as the sustainable limit. Lot sizes could be adjusted to be bigger or smaller than the modeled density number, as long as the overall density within each sub-watershed achieved the 2 ppm nitrate-nitrogen standard. The Commission used the nitrate

dilution study to develop residential zoning. For example, it set zoning in the forested area at one unit per 30 acres.

The State Planning Commission recommends municipalities use capacity analysis as a basis for exploring alternate growth patterns and addressing sustainability. Because GIS and mathematical models have made working with data easier and relatively inexpensive, municipal and regional planners will be using capacity analysis studies more frequently.

Limitations of Mathematical Models

Environmental Commissioners are not expected to be experts in the field of capacity analysis so don't hesitate to ask the professionals about the details of the mathematical model used for the analysis.

1. What are the model's assumptions?
2. What is the boundary of the model (e.g. municipal borders, physiographic region)?
3. Has NJDEP approved the model?
4. What determined the sustainable goal (e.g. non-degradation limits such as background water quality or health-based limits such as drinking water standards)?

General Approach for Natural Resource Capacity Analysis

Generally, a municipality hires a professional consultant to complete the analysis. Municipal officials, the environmental commission, and interested citizens should work with the professional to tailor the study to local resources.

1. Determine extent of the study area.

Natural resources may encompass different study areas depending on their basic characteristics. For instance, water supply may be limited to a local aquifer of 30 square miles, while air quality issues may encompass the entire state or beyond its borders.

Regional and site-specific capacity analysis studies are feasible. The bottom line is that the community must decide whether to limit the study to municipal borders or specific tracts of land within the town. West Windsor (Mercer) used capacity analysis to determine whether to downzone several tracts of developable land. Another approach is to work with neighboring communities to study the capacity of a regional system.

GIS is an excellent tool for defining the boundaries of the study area because it can display or hide map layers depending on the area of focus.

2. Determine which resources to evaluate.

Capacity analysis can cover a wide range of natural systems, but probably time and money will limit the study's scope.

The natural resources considered will depend on the community's needs. The study may include development impacts on environmentally sensitive lands like critical slopes, forested areas, plant and animal habitat, wetlands, water supply in recharge areas, water quality impacts due to impervious coverage. Each area will have its own issues of concern. In general, understanding the water capacity of a community is critical since the availability of clean drinking water can limit most future development. Although engineered systems can divert water from one watershed to another, in the long run, over-development will deplete regional resources, increase operating costs and probably reduce water quality.

3. Prepare a literature review.

Review recent research to understand different approaches. The Internet provides access to academic institutes and non-profit organizations working on natural resource protection and global sustainability issues. Also consider plans developed by State agencies. For comprehensive planning, it is critical that municipal, regional and state plans are linked. Most State and regional plans can be downloaded from the

Internet, obtained at minimum cost from the agency or consulted at a depository library. State agency plans that may be of interest include the following.

Regional Plans

- *Delaware River Basin Commission Comprehensive Plan*, www.state.nj.us/drbc; 609-883-9500
- *Hackensack Meadowlands Master Plan* www.hmdc.state.nj.us; 201-460-1700
- *Pinelands Comprehensive Management Plan*, www.state.nj.us/pinelands/cmp.htm; 609-894-7300
- *Regional Strategic Transportation Plans*
 - North Jersey Transportation Planning Organization, www.NJTPA.org for 13 northern counties; 973-639-8400
 - Delaware River Valley Planning Commission for Burlington, Camden, Gloucester, Mercer, www.dvrpc.org; 215-592-1800
 - South Jersey Transportation Planning Organization 4 southern counties, www.sjtpo.org; 856-794-1941

Statewide Plans

- *NJ State Development and Redevelopment Plan*, www.nj.gov/dca/osg
- *NJ Statewide Water Supply Plan*, www.state.nj.us/dep/watershedmgt/water_supply_planning.htm
- *NJ Statewide Water Quality Management Plan*, with amendments — incorporates some 13 regional plans — www.state.nj.us/dep/watershedmgt/water_quality_management_planning.htm
- *Long Range Schools Facilities Master Plans*, www.state.nj.us/njded/facilities and from local school districts
- 2003 SCORP (*Statewide Comprehensive Outdoor Recreation Plan*), www.state.nj.us/dep/greenacres
- *NJ Transportation Capital Program*, www.state.nj.us/transportation/capital_improvements.html

4. Take it from the drawing board to a full-scale system.

Once you have defined the boundaries of the study area and obtained literature values on capacity and related factors, you need to extrapolate the values from the micro- to the macro-system. To develop these numbers you may need to make assumptions, which should be documented in writing. The extrapolated values can be used in mathematical models to determine the capacity of the system. A professional can select the appropriate mathematical models appropriate. You can look at various scenarios once the mathematical model is set up. For instance, water withdrawal rates can be changed to understand better the water supply needs during peak withdrawal periods, or the impact of conservation techniques. One benefit of a mathematical model is that once the computer program is calibrated you can easily change the variables to study several scenarios.

5. Compare projected capacity versus projected level of growth.

At this point, compare the results of the build-out study with the results of the capacity analysis results. Tables and figures can help link the two studies. Can the capacity of the natural systems and infrastructure sustain the projected level of growth at full build-out?

If the projected development exceeds the capacity of the natural system then the town should amend the existing zoning code to achieve a reasonable density. For example, Bedminster Township (Somerset) recently downzoned a large area from 3 to 10 acres based on the results of a nitrate dilution model study that showed negative impacts to groundwater at higher densities. Courts have upheld the rezoning based on the merits of the capacity analysis and master plan goals. As part of a master plan re-examination, a number of municipalities are using water demand and nitrate dilution models to re-evaluate the impact of current zoning on the community's hydrogeologic capacity.

Word of Warning

While capacity analysis can quantify a system's remaining resources, it has limits. Outside forces like global warming will impact the hydrological cycle. Also once a system's capacity is known, a natural tendency is to fill the capacity rather than manage the resource wisely. Natural systems do not observe political boundaries (for example, aquifers stretch for miles and cross municipal boundaries), so cooperation by municipalities on regional capacity analysis is essential.

Engineered systems can lessen natural resources depletion, but cannot sustain our society. Capacity analysis can help us better understand the limits of natural resources and change the local land use regulations to correct any imbalance.

Case Study on Capacity Analysis: Evaluating Impacts from Impervious Coverage

The Connecticut Extension System in cooperation with the University of Connecticut (UCONN) and EPA developed the NEMO (Nonpoint Education for Municipal Officials) program, which maps impervious cover to indicate the impacts of land use practices on water quality. Impervious coverage can increase flooding, reduce aquifer recharge rates, increase non-point source pollution, and reduce aquatic biodiversity. NEMO's mapping exercise shows the direct link between land use decisions and water quality with just two sets of data – impervious cover for existing land cover and impervious cover at build-out. Existing land cover data is readily available on GIS from NJDEP. NEMO uses estimates for different densities developed by the Natural Resources Conservation Service to calculate impervious cover for build-out. This type of capacity analysis is readily transferable to other regions and states, including New Jersey.

Carrying the Torch

Both build-out and capacity analyses are excellent tools for understanding municipal plans. Municipalities will rely upon these techniques more and more in the future as the entire state reaches full build-out. Communities that complete build-out and capacity analyses will be closer to understanding limiting factors to development and developing creative techniques to address sustainability in their communities. A core group committed to the benefits of comprehensive planning can coordinate the study and organize public forums to discuss the study's results.

For Further Information

Regional Studies

- Barnegat Bay Build-Out, CRSSA, Rutgers University – www.crssa.rutgers.edu/projects/runj/buildout.html for an example of build-out analysis
- NJ Highlands Build-Out, Environmental Defense – Jason Patrick, 212-505-2100 ext. 1209 for an example of a build-out analysis
- NJ Pinelands Commission studies on the Mullica watershed – go to Science Office section of www.state.nj.us/pinelands/ 609-894-7300

Tools and Data

- ANJEC Resource Center – www.anjec.org, email to resourcecenter@anjec.org, 973-539-7547
- Center for Watershed Protection – www.cwp.org,

410-461-8323, for scientific information on watersheds

- NJ DEP, *A Model of Residential Carrying Capacity for New Jersey Based on Water Quality* – www.state.nj.us/dep/watershedmgt/wmp_rule_model.htm, 609-984-0058, for the nitrate model used by NJDEP; other models are also available
- GIS Data – NJDEP, www.state.nj.us/dep/gis/, 609-984-2243; NJ Geological Survey, www.state.nj.us/dep/njgs/; NJ Landscape Project, www.njfishandwildlife.com; NJ Geographic Information Network, <https://njgin.state.nj.us> (use no www)
- NJ Environmental Digital Library – <http://njenv.rutgers.edu/njdlib> (use no www) for an on-line library of environmental literature
- *NJ State Development and Redevelopment Plan* – www.nj.gov/dca/osg, 609-292-7156, statewide land use initiatives, development and redevelopment scenarios
- Nonpoint Education for Municipal Officials (NEMO) – for case studies and local information, contact ANJEC, NEMO's NJ representative, at 973-539-7547, or email resourcecenter@anjec.org. NEMO, <http://nemo.uconn.edu> (use no www), 860-345-4511, offers an approach to capacity analysis
- Regional Planning Partnership, www.planningpartners.org, 609-452-1717, GOZ™ model (goal-oriented zoning) in Tools and Services for “capacity-based” plans

This publication was made possible by grants from The Fund for New Jersey, the Geraldine R. Dodge Foundation, the William Penn Foundation and the Victoria Foundation.

ANJEC is a statewide non-profit organization that informs and assists environmental commissions, local officials and interested citizens in preserving and protecting New Jersey's environment.

For further information, contact ANJEC at
P.O. Box 157, Mendham, NJ 07945 (973-539-7547) FAX (973-539-7713)
or
204 W. State St., Trenton, NJ 08608 (609-278-5088) FAX (609-278-5089)
E-MAIL (info@anjec.org)
WEB (www.anjec.org)