About Buildouts

A Brief Guide to Buildout Analysis, and Why and How to do Them

A technical report of the CT NEMO Program, a part of the Center for Land Use Education and Research
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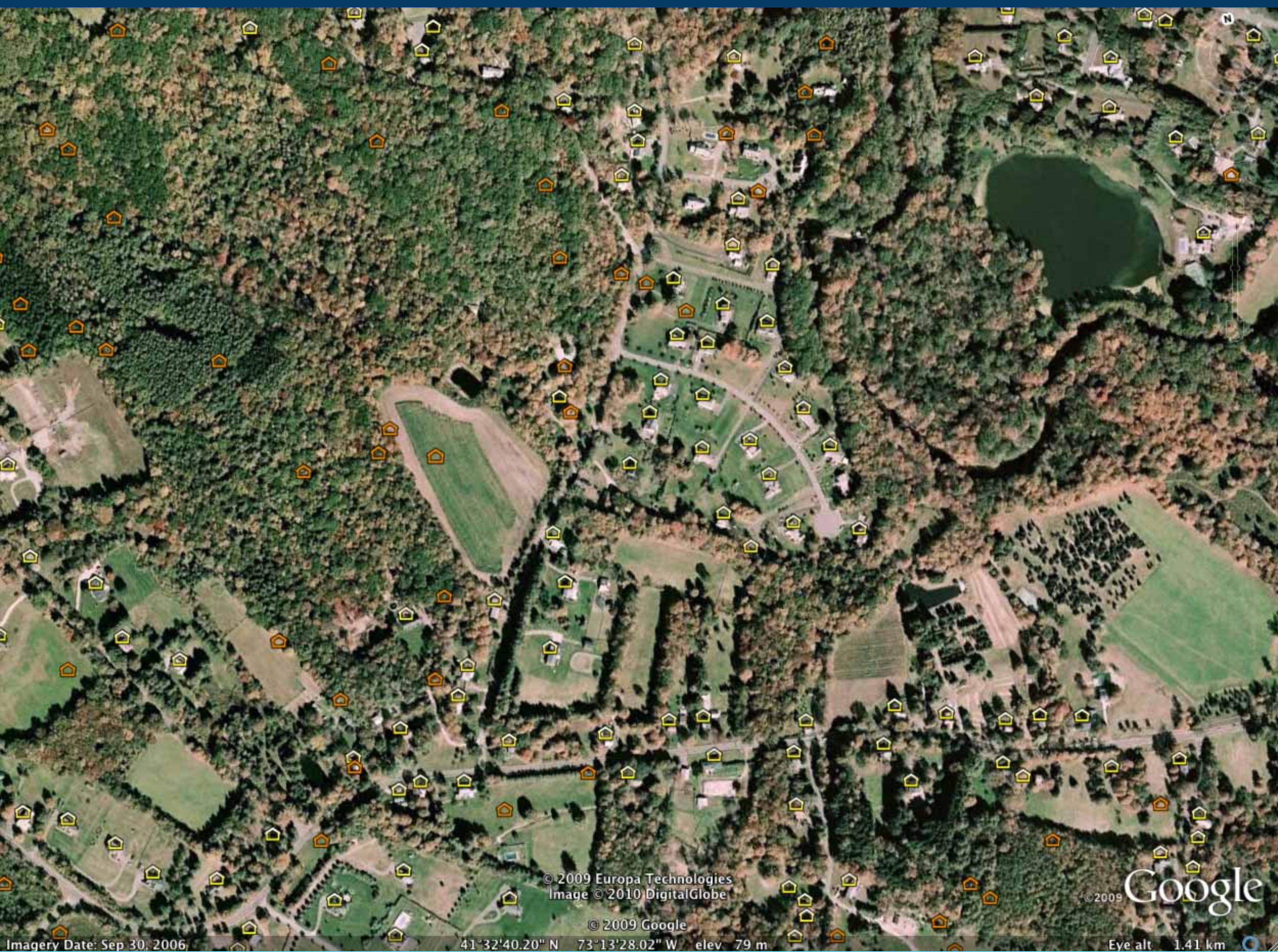

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1. Introduction

Purpose

In recent years in Connecticut, there has been considerable concern and debate about “sprawl,” “smart growth,” and the impacts of growth on the state’s communities. This has led to a discussion of tools available to municipal and other land use decision makers that might help them to better plan the growth of their communities. Buildout analyses have been mentioned frequently in this debate.

The recent interest in buildout analysis as a tool for community planning is encouraging. However, there remains a disconnect between the perception and reality of this analysis. The common perception seems to suggest a monolithic, “one size fits all” tool with automatic benefits for municipal officials, while the reality is that the term “buildout” encompasses a wide range of techniques, goals, and uses, depending on the data available, the technology used, and the questions that the analysis is designed to answer.

This publication is intended to help close the gap between perception and reality, serving as a brief guide reviewing basic information about buildout analyses, including:

- what they are;
- why they’re done;
- what type of data is needed;
- how to do a buildout, and, everybody’s favorite;
- *so we’ve done one…now what?*

Although the booklet gives a number of examples of buildouts and details on the data that went into them, it is not a step-by-step “cookbook” on how to conduct these types of analyses. Rather, it’s intended as a general guide that might help you to decide if a buildout might be a good tool to use in your town, and if so, what the major considerations are before you start.

Background

This booklet grew out of a 2007 project conducted by the NEMO Program for the Office of Policy and Management (OPM) on the feasibility of a statewide buildout analysis. The project evaluated the technical and data requirements needed to do a statewide analysis and, working with the Council of Governments of the Central Naugatuck Valley (COGCNV), performed a series of analyses on both regional and local scales. Many of the case studies used in this publication came from this project. Others were taken from the NEMO archives.

2. Buildouts: The Basics

What is a Buildout Analysis?

A buildout analysis ("buildout") is simply a projection of how much development would occur in a community if it were to build on every available acre of land allowed by certain constraints. In most cases, the major governing constraint would be what is allowed under zoning regulations; other constraints can include environmental and fiscal factors.

A buildout generally is not tied to a specific timeframe, but is rather an "end point" scenario that might occur in some indefinite future, whether it is in ten years or a hundred. The analysis is most often used to estimate future population or number of housing units, and the secondary fiscal, environmental or other impacts of this growth. However, buildout analyses can be done in many ways using many different types of data and technology, and for a variety of purposes. Depending on the type of buildout you pursue, your "take home" results can be in the form of a single number, a table, a graph, a map, or all of the above.

Why do a Buildout?

An understanding of the potential pattern of future growth can have wide ranging effects on local government decisions. Policies from housing to economic development to transportation are all influenced by the quantity and quality of future growth, so the ability to "see into the future" can help local decision makers make more informed decisions.

Of course, nobody can actually see into the future and buildouts are not some sort of black magic that suspends the laws of nature. A buildout is just a tool to help you evaluate a specific planning question you might have about the consequences of current conditions. For example, it can help show how many houses would be allowed on a particular 10 acre parcel under the current town regulations; or, what would be the projected town population if we build on every possible acre of town. The buildout analysis can help with the types of "what if" questions that can help guide discussions of common local issues like open space planning and future capital improvement needs.

What Data and Technical Wizardry Do I Need to Do a Buildout?

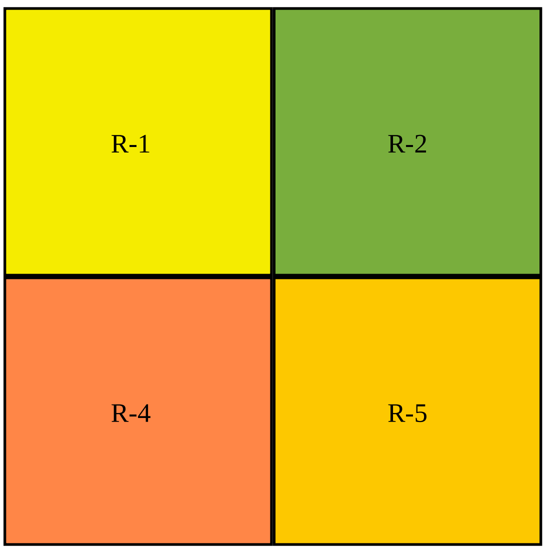
A buildout analysis does require some level of technical ability and some prior information in order to get to a meaningful result. The amount of each is directly related to the type of analysis you want to perform (see Table 1). At the minimum, you will need a good spreadsheet program and some information about your town's zoning requirements and codes. More likely, it will be helpful to have a good knowledge of the amount of buildable land in your town. This type of geographic analyses will require the use of a geographic information system (GIS) and is best left to those who have the training and ability to perform them. Numerous classes in GIS are offered statewide.

The Buildout Process: A Ridiculously Simple Example

To help illustrate how buildouts work, let's look at a very simple example. Let's say the hypothetical town of Squaretown is interested in seeing how their recent zoning regulation update will impact the number of future housing units in town. The first thing they decide to do is look at a map of the town's zoning districts and figure out how much of the town is in each district (Figure 1). Since they have divided the 20,000 acre town into four equally sized districts, each district is 5,000 acres.

Next they need to know is what the zoning regulations allow in terms of density. This requires a perusal of the regulations to see how many housing units are allowed per zoning district. In Squaretown, all the land is zoned for residential uses, with the R-1 zone allowing 1 housing unit per acre, the R-2 zone allowing 1 house per 2 acres, the R-4 zone 1 house per 4 acres and the R-5 allowing a house every 5 acres. By knowing how much of the town is in each zone, we can do some simple arithmetic to determine how many housing units you can get in each (arrow, Figure 1).

What this buildout analysis tells us is that when every acre of available land is built upon using the current zoning regulations, there will be 9,750 housing units in town. Of course as you have been reading this, you have probably already started to identify problems with this analysis. First, it assumes that every square



Total Acreage: 20,000 acres

Zoning Districts
R-1 zone: 1 Unit/acre
R-2 zone: 1 Unit/2 acres
R-4 zone: 1 Unit/4 acres
R-5 zone: 1 Unit/5 acres

Buildout Calculation
R-1: (5,000 acres) X (1 Unit/acre) = 5,000 Units
R-2: (5,000 acres) X (1 Unit/2 acre) = 2,500 Units
R-4: (5,000 acres) X (1 Unit/4 acre) = 1,250 Units
R-5: (5,000 acres) X (1 Unit/5 acre) = 1,000 Units
→ Total # of Units At Buildout = **9,750 Units**

Figure 1. A buildout calculation for Squaretown

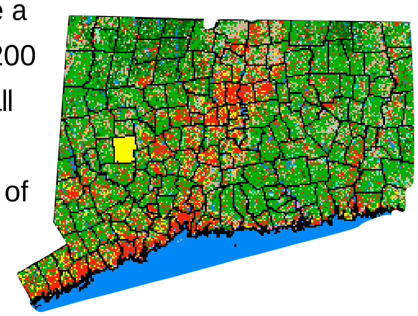
acre of the town can be built upon. How about wetlands, water bodies, or other natural constraints to development? Won't they have a significant impact on the ability to build? Second, this analysis assumes that the division and development of land is 100-percent efficient. But in reality, the location of streets and utilities, as well as the topography of the land, means that land division has some inherent inefficiencies (See *More on Efficiency Factors*, pg 7). Third, there are no perfectly square towns in Connecticut. All these are valid criticisms, and the science and art of buildout analysis is to try to accommodate the reality of on-the-ground conditions to achieve some level of verisimilitude. The case studies that follow are examples of different buildout techniques used in real Connecticut towns that attempt to get a picture of future conditions through an understanding of current conditions.

3. Case Studies

The best way to get a feel for the issues involved in carrying out a buildout analysis is to look at examples. So, here are a few examples of these analyses, taken from the files of the NEMO Program. Before we dive in, a couple of considerations.

First, many of the case studies presented here were part of a study done by the Council of Governments of the Central Naugatuck Valley (COGCNV), in partnership with the NEMO Program of UConn CLEAR. The project was conducted in 2006 – 2007, funded by the Connecticut Office of Policy and Management (CT OPM) for the purpose of investigating the feasibility of a statewide buildout analysis.

Second, the Town of Woodbury (highlighted at right) was chosen to demonstrate a comparison of three buildout methods. Woodbury is a town of approximately 9,200 people located in the center of Connecticut. This town was chosen because of all the 13 towns in the COGCNV region, it had the most up-to-date land use and property ownership data (parcels), which are necessary in order to run the range of buildout techniques. Woodbury served as a relative control to allow the project principals a way to assess the best approach for towns with less local GIS data.



Finally, this project focused on analysis of residential growth, as the most prevalent type of growth in this region and the state overall, and the issue driving the debates on sprawl and smart growth. These techniques can be applied to commercial and industrial land uses as well.

Table 1. Generalized data requirements for different builldout methods. As the technical sophistication of the method increases, the data requirements also increase.

Simplicity of Method

Type of Buildout	Data Requirements	Data Availability
Mathematical	• Local Zoning	Local
Basic GIS	• Local Zoning • Natural Constraints (Wetlands, floodplains, etc) • Committed Open Space • Developed lands	Local Statewide Local/Statewide Regional/Statewide
Spatially Specific GIS	• Local Zoning • Natural Constraints (Wetlands, floodplains, etc) • Committed Open Space • Developed lands • Parcels	Local Statewide Local/Statewide Regionally/Statewide Local - Not generally available

Increased Data Requirements

Again, these are not detailed procedures, but for each example we've channeled our Journalism 101 training and included information on who did it, what data they used, when it was done, where it was applied, and why they did it. Table 1 lists the different buildout methods used in this study and the data requirements for each. These methods go from the least data intensive method, the mathematical buildout, to the spatially specific technique that requires the most data. In what follows we will look at how these different techniques are applied and look at how the results of these different methods compare.

With the fine print over with, lets move on to the examples.

Method 1 - A (Slightly) More Realistic Buildout: A Mathematical Method

The simplest approach to a buildout analysis, and the one with the least data requirements, is the mathematical population estimate. This approach, which requires only the use of a spreadsheet, uses the estimated areas of each zoning district along with the allowed "as-of-right" densities within those districts. As-of-right uses and densities are typically used in most of the buildout methods, since they are the uses that require no special permit or review.

Step 1: Estimate the Total Number of Dwelling Units at Buildout

In order to determine the total number of dwelling units the town would have when built out, you first need to estimate the total area of town and the area of each zoning district. Areas of each zoning district can be determined by using GIS software; however, it is possible to estimate areas for these districts using traditional approaches such as a planimeter or a grid overlay. The town's zoning regulations are used to determine the lot density for each zoning district and the number of dwelling units for each lot. Zoning districts which allow only single family homes have only one dwelling unit per lot, whereas multifamily districts may have 40 or more dwelling units per lot. The last factor used in this calculation is a so-called "efficiency factor" (See *More on Efficiency Factors*, pg 7). The efficiency factor is used to estimate the effect that land constraints, infrastructure such as roads, and lot layout inefficiencies have on the final disposition of development on the landscape. This factor is a number between 0 and 1, and was chosen using literature values and best professional judgment. Multiplying these factors together gives you the number of possible dwelling units that can be built in the town under current zoning (Figure 2).

Area of Zoning District *(acres)* **X** **Lot Density** *(lot/acres)* **X** **Dwelling Units per Lot** *(du/lot)* **X** **Efficiency Factor** **=** **# of Possible Units** *(Dwelling Units)*

Figure 2. Equation for the mathematical buildout process. Units are in acres and dwelling units (du).

Step 2: Estimate the Total Number of New Dwelling Units

New dwelling units were determined by subtracting the number of existing dwelling units from the estimated total number of dwelling units in Step 1.

Step 3: Estimate Population at Buildout

Population at buildout is estimated by multiplying the current number of persons/dwelling unit by the number of new dwelling units. This number was obtained from the Connecticut Department of Economic and Community Development's 2005 Housing Stock estimate (see Resource list at the back of this publication). This estimate of population increase was then added to the current population of the town in order to give a total population at buildout.

Table 2. is the working spreadsheet for the Woodbury mathematical buildout. The numbers in red show the number of housing units and total population at buildout using 3 different efficiency factors.

Table 2. Sample spreadsheet showing the mathematical buildout method for the Town of Woodbury. Since this analysis was only interested in residential buildout, only the residential zones were analyzed using three different efficiency factors.

				Potential Buildable Lots (3 efficiencies)				# of Possible Dwelling Units		
Zone	**Total Area (sqft)**	**Acres**	**DU Density (Sqft/DU)**	**50%**	**60%**	**70%**	**# DU/Lot**	**50%**	**60%**	**70%**
EE	14,300,660	328								
GA	3,190,739	73	435,600	3.7	4.4	5.1	40	146	176	205
MQ-A	873,539	20								
MQ-B	935,918	21								
MQ-C	903,860	21								
MQ-D	576,637	13								
MQ-E	1,089,765	25								
MQ-F	1,156,434	27								
MQ-G	798,031	18								
MSD	6,520,206	150								
OS-100	513,081,919	11,779	100,000	2,565	3,078	3,592	1	2565	3078	3592
OS-60	258,342,992	5,931	60,000	2,153	2,583	3,014	1	2153	2583	3014
OS-80	187,191,631	4,297	80,000	1,170	1,404	1,638	1	1170	1404	1638
PI	5,186,503	119								
R-40	29,572,712	679	40,000	370	444	518	1	370	444	518
		23,501				**Total Potential DU:**		**6,404**	**7,685**	**8,966**

Existing DU*	**Potential New DU**			**Potential New Popl.****			**Total B.O. Population**		
	50%	**60%**	**70%**	**50%**	**60%**	**70%**	**50%**	**60%**	**70%**
4,104	2,300	3,581	4,862	5,452	8,488	11,523	**15,186**	**18,222**	**21,257**

*Existing Units from COGCNV 2005 Housing stock est

**COGCNV 2005 est. population = 9,734. Est. 2.37 people/DU in 2005

Method 2 – A More Realistic Buildout: Using Geographic Information System to Determine Constraints

This buildout method requires the ability to analyze GIS data and have access to some key data sets (see Table 1). For this analysis, investigators used ESRI's ArcView® 9.1 software to perform all the necessary analyses coupled with both local and statewide available geographic data. Key data sets include local zoning districts, committed open space, developed lands, and environmental constraints to development, such as wetland soils, floodplains, steep slopes, and water resources.

The investigators chose to use the best regionally available data for this analysis (a complete list of the data used is listed in Appendix 1). Zoning districts and regulations were obtained from the towns, digitized if necessary, and the density attributes of each district were incorporated into the zoning data layer. Environmental constraints are available statewide from the Connecticut Department of Environmental Protection. For this analysis, COGCNV had recently updated both the committed open space and developed lands layers, and they were assessed to be more accurate than the statewide information, so the investigators used these data sets.

Step 1: Establish available buildable lands

The determination of which lands are available for future development starts with the identification of those areas that are not available. The unavailable lands include those lands already developed, those that are in permanently committed open space, and lands that have significant environmental constraints. For this analysis, the environmental constraints chosen included wetland soils, floodplains, water bodies and slopes over 20 percent. These unavailable lands were aggregated and geographically removed from the total land area. The remainder is the area that is currently undeveloped and available for future development (See *The Buildable Lands Anaysis*, pg 9).

Step 2: Apply zoning-based coefficients to buildable lands

The buildable lands data layer from Step 1 was then "intersected" with the zoning layer to determine the current zoning and lot density allowed on these lands. Given that this analysis is only considering residential lands, non-residential zones (i.e. commercial and industrial) were removed

More on Efficiency Factors

Efficiency factors are ways to modify an analysis to reflect the effect the land or various development requirements might have in the final buildout. For example, the parcel depicted in the lower left is 200-acres. Local zoning allows 1-acre lots in this district. If a strict buildout was calculated for this property, this would mean 200 lots could be potentially developed. In reality, given the limitations of the land, the need for public utilities and rights-of-way, and the inefficiency of lot creation, the developer could only get 117 lots. The efficiency factor for this parcel, therefore, is around 60% (117 actual lots/200 potential lots). We can use these kinds of estimates to "tweak" our analyses so they better reflect how development actually manifests in our towns. Looking back at past developments in town is a good way to estimate your town's development efficiency.

200-acre parcel in 1-acre residential zone

Parcel after development supports 117 lots

from the buildable lands data layer. Mixed use areas, that is areas that have a combination of commercial and residential uses, were retained, but only the estimated residential densities in these areas were used.

Step 3: Calculate number of new dwelling units

Similar to the process in Method 1, a calculation was made to determine the number of new dwelling units based on the total area of buildable land in a given zoning district. Because of the inefficiency of lot layout during actual subdivision design, as well as the inclusion of infrastructure such as roads and stormwater management areas, an efficiency factor was still applied to these calculations, despite the fact that environmental constraints were already factored in. To make reasoned judgments on the appropriate efficiency factor to use for a town, the local planner was consulted. These factors ranged from 70% in urban areas to 60% or less in more suburban areas. Population at buildout was then estimated as in the equation used for Method 1 (Figure 2).

The Buildable Lands Analysis

The first step in the GIS-based buildout is to determine the amount and location of lands available and suitable for development. This analysis, sometimes called the “buildable lands” analysis, is essentially an exercise in subtraction, beginning with all the land in the town and subtracting each GIS data layer that symbolizes lands that cannot support future development.

You start with all the land within the town boundary.

Remove lands that are currently developed.

Next remove out open space lands that are under permanent protection.

Then remove lands with environmental constraints. Here we used wetlands, water bodies and steep slopes.

What you end up with (in green) are all the lands available and suitable for development. This forms the basis for your buildout.

Method 3 – Spatially-Specific Buildout: Refining the Analysis

The GIS buildout gives you an estimate of *how much* future development might occur, but doesn't give you much of a feel for *where* it will occur on the landscape. In order to perform a more spatially specific buildout analysis, the investigators needed both more geographic data than in the above methods, and a cutting-edge GIS tool that would allow a finer scale evaluation of where future buildings can be placed. Although there are several software packages available, the investigators used *CommunityViz*, which works as an extension to ESRI's ArcGIS® products. *CommunityViz* provides GIS-based analysis and real-world 3D modeling that allow people to envision land use alternatives and understand their potential impacts, explore options and share possibilities, and examine scenarios from all angles — environmental, economic, and social. The program provides a "wizard-based" interface, greatly simplifying the GIS procedures necessary to complete a buildout analysis, while allowing the user significant opportunities to customize a given analysis. *CommunityViz* does require, however, additional data in order to be fully effective and requires some additional training for the GIS technician.

In addition to the geographic data sets used in Method 2, detailed property ownership and building data were needed (See Table 1). These so-called planimetric data were only available in the town of Woodbury.

Step 1: Merge parcel and zoning data layers

The parcel data represents individually owned sections of land. The first step in the analysis was to merge the zoning and the parcel layers together. This allowed the program to calculate what the zoned density was for a given parcel of land. This is important since many parcels are considerably larger than the minimum lot size for the zone; therefore, the parcel could conceivably be split to allow additional lots.

Step 2: Identify constraints

CommunityViz works in a somewhat automated manner, but requires the user to establish and identify several key factors. One of these are the constraints to development. As in Method 2, these include environmental constraints, committed open space and landed not zoned for residential development. See Method 2 and Appendix 1 for a complete list of the data layers used as constraints in this step.

Step 3: Identify currently developed parcels

To identify which parcels were developed, building point data was used to assess the intensity of building on the lot. Building points are point data the shows where buildings are located in a parcel. This determines whether this parcel could be subdivided in the future. For example, under current zoning a single family home on a 4-acre parcel in an area zoned for 2-acre lots could potentially be further subdivided to allow another home. In order to complete this analysis, building points that represented residences had to be separated from points that represented outbuildings, garages or sheds (see Figure 3).

Step 4: Configure *CommunityViz* with zoning data

In order to run the analysis, *CommunityViz* needs to be configured with the density and lot specifications for each zoning district. These specifications included units per acre, dwelling units per building, setbacks and minimum separation distance. As with the other buildout methods, an efficiency factor was assigned after consultation with the town planner.

Step 5: Run the buildout wizard

Once *CommunityViz* is configured, the user simply runs the analysis wizard. The output of the analysis includes tabular data of number of units and population at buildout and a map showing where the new homes could conceivably be placed in town (Figure 4).

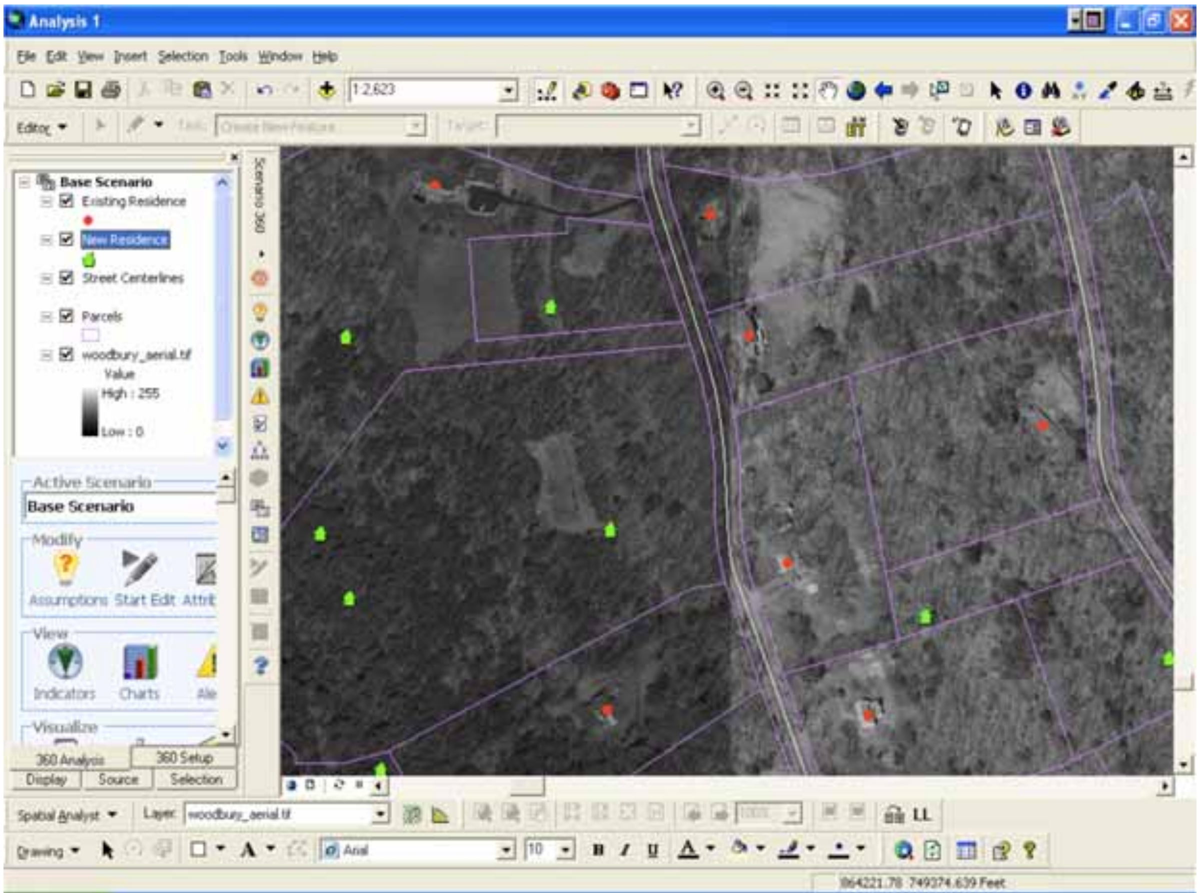


Figure 3. Screen capture of a the CommunityViz buildout program. In the window shown above the purple lines show parcel boundaries, red dots show existing buildings, and green houses potential future building locations. The aerial photo underneath the data layers shows the existing use of the land.

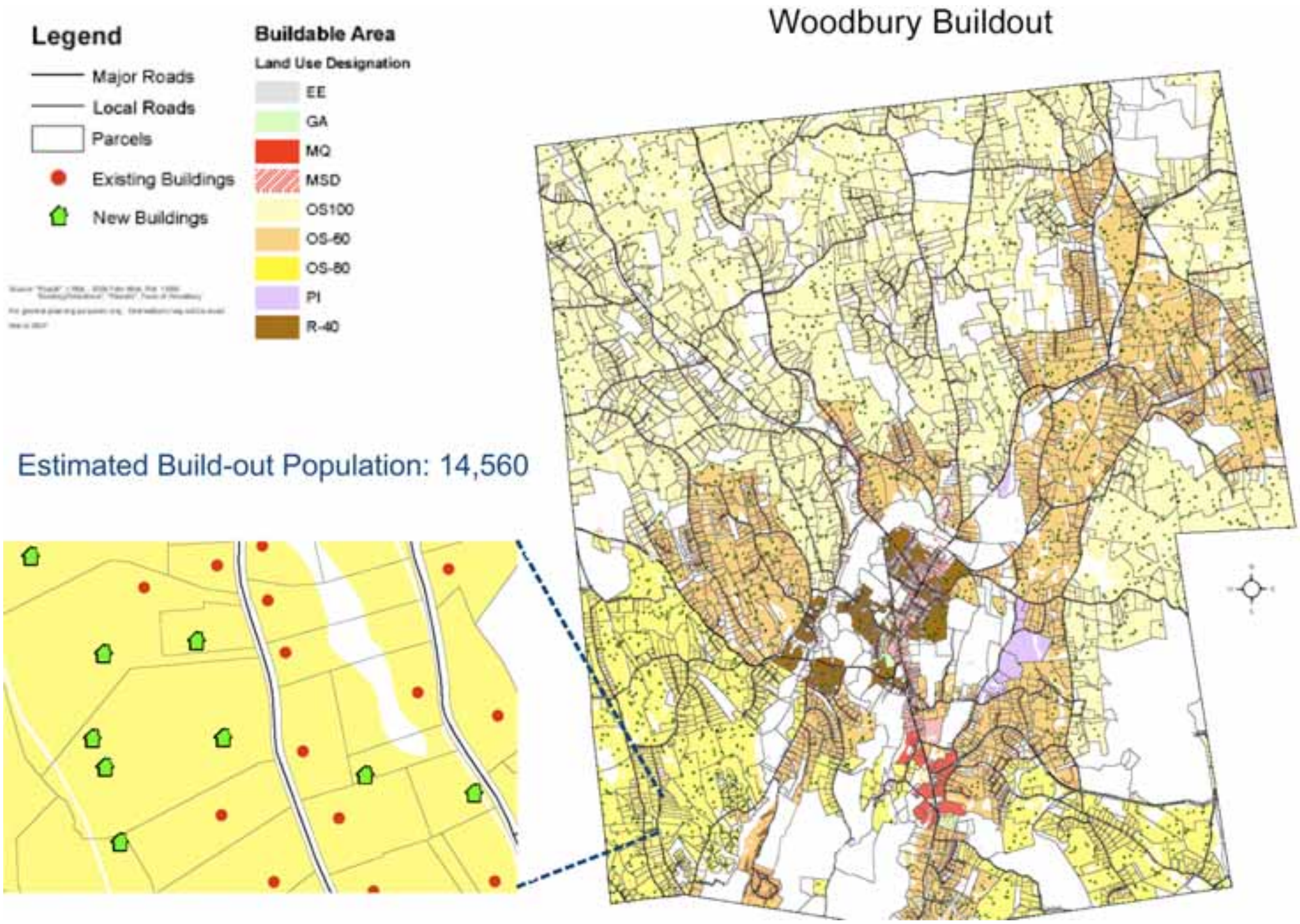


Figure 4. ComunityViz buildout for Woodbury, CT. Map on the right shows the buildout for Woodbury. Inset map shows a close up of one section of town showing both existing (red dots) and predicted (green icons) housing sites.

How Do the Methods Compare?

The results or output of a buildout analysis are determined by the questions you have asked at the beginning of the process. In this exercise, we asked what the increase in population and dwelling units would be in Woodbury at buildout. In order to compare the different methods, the investigators used the town of Woodbury as the example and used the number of dwelling units and the population at buildout as the final output. Table 3, below, shows the number of dwelling units and estimated population of Woodbury at buildout.

As expected there is considerable variation between buildout methods. The simple mathematical method used no geospatial information to arrive at its results, using an "efficiency factor" to approximate the effects of various cultural and environmental constraints. Table 3 shows that the final buildout population varied considerably when using efficiency factors of 50 and 70%. The basic GIS method, which subtracts environmental and cultural constraints to determine the amount of buildable land, arrived at a buildout population somewhat greater than the 50% efficient mathematical buildout, but less that the 70% efficient buildout. The final and most technically sophisticated method, the spatially specific *CommunityViz* buildout, had the smallest buildout population. The reasons for this smaller number, only 50% greater than Woodbury's current population, is probably multifold, but principally lies in the use of setbacks and road frontages to determine future building sites and thus the final population at buildout. This additional level of constraint, one that exists in the real world of local land development, is what makes *CommunityViz* a compelling tool.

Table 3. Estimated population of Woodbury, CT at buildout using three different buildout methods.

	Mathematical Method Efficiency Factor		Basic GIS Method	CommunityViz Method
	50%	70%		
Potential New DU	2299	4863	2656	2012
Existing DU	4104	4104	4104	4104
Potential New Population	5517	11617	6374	4828
Current Population	9734	9734	9734	9734
Buildout Population	**15251**	**21351**	**16108**	**14562**
% Population Increase	57%	119%	65%	50%

Buildouts of a Different Stripe

Up to this point all of the case studies have focused on population or housing based buildouts, but this planning technique is not limited to only those "future" indicators. Indeed, the buildout technique can be applied to any land development or policy question that is dependent upon the use of the land. One buildout technique we have used for years in the NEMO program is that of an impervious surface buildout. Impervious surfaces - like roadways, parking lots and rooftops - have been shown to be a key indicator of the health of water resources. The buildout technique can be used to assess how current regulations would influence the amount of future impervious surfaces in a watershed and hence the future impact on streams and rivers (Figure 5).

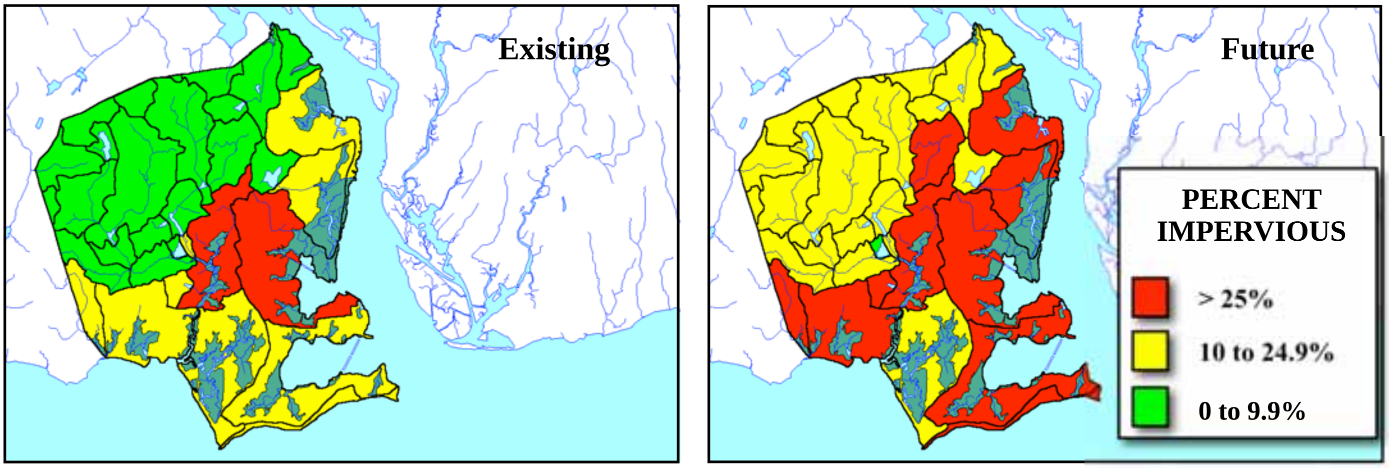


Figure 5. Impervious buildout analysis of Old Saybrook, CT. The figure on the left show existing impervious cover colored according to research-based water quality thresholds. The figure at right shows impervious cover at buildout, using the town's current land use regulations to estimate density. Black lines are local watershed boundaries.

In another case, researchers at the Center for Land Use Education and Research (CLEAR) at the University of Connecticut were interested in the potential impact of future development on Connecticut forests. Large blocks of forest land tend to support higher quality habitat for many native species and provide wood and other renewable resources that support local economies. CLEAR investigators used the buildout technique to determine where future growth would occur and how it might potentially effect the forest (Figure 6).

Other buildouts in the state have gone beyond the town boundaries, focusing on watersheds or regional planning districts or looking at other impacts of growth, such as the cost of community services. The buildout analysis can be used as a tool to assess a variety of questions you may have about the future of your community. Implicit in these analyses, as we have seen, are some fundamental assumptions about how your town or region will grow. The art of the buildout resides in making (and explicitly stating) these assumptions clearly and logically.

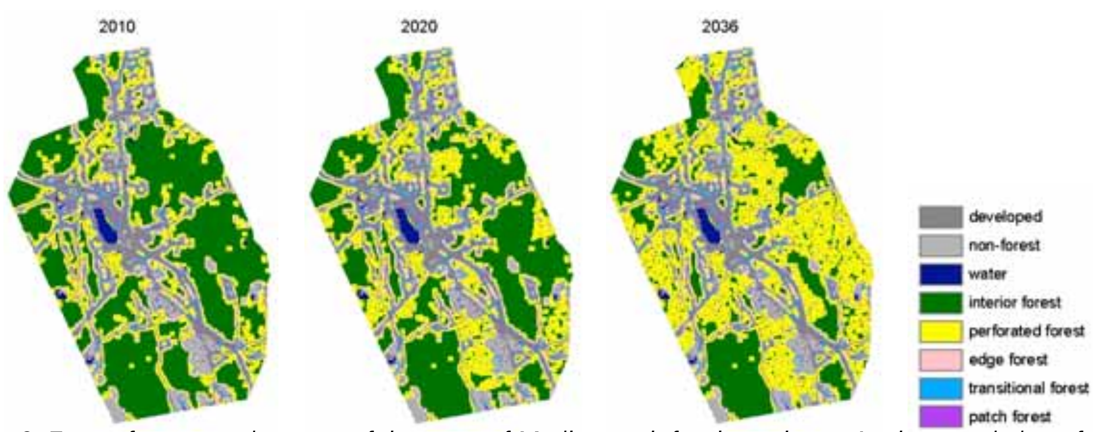


Figure 6. Forest fragmentation map of the town of Marlborough for three dates. As the population of the town increases, new dwellings begin to carve into the unfragmented forest (green) and convert it into smaller, more perforated patches (yellow). This analysis was done using a feature of the CommunityViz software that allows the user to set rules for how the buildout will take place over a specified time period (in this case 30 years).

Visualization: How to Display the Results of a Buildout?

Once you have an analysis completed, the next step is to develop a set of maps and tables that will communicate the results of the study in a meaningful way. The maps and tables used in the case studies are often the way these data end up getting presented to the public. However, new tools are becoming available that help to give an even more "intuitive" sense of what buildout conditions may bring.

The NOAA Coastal Services Center, working with NEMO and CLEAR, has developed a series of visualizations of the Woodbury *CommunityViz* buildout (See page 10) using GoogleEarth, a freely available landscape visualization tool. The visualization in Figure 7 shows the same information presented in the previous analysis, but by placing these data on a landscape with aerial photography and topography, the viewer can more quickly get a sense of the scale of the buildout. By allowing users to pan, zoom and fly through the landscape,these visualization tools can help the public grasp and understand the results of an analysis.

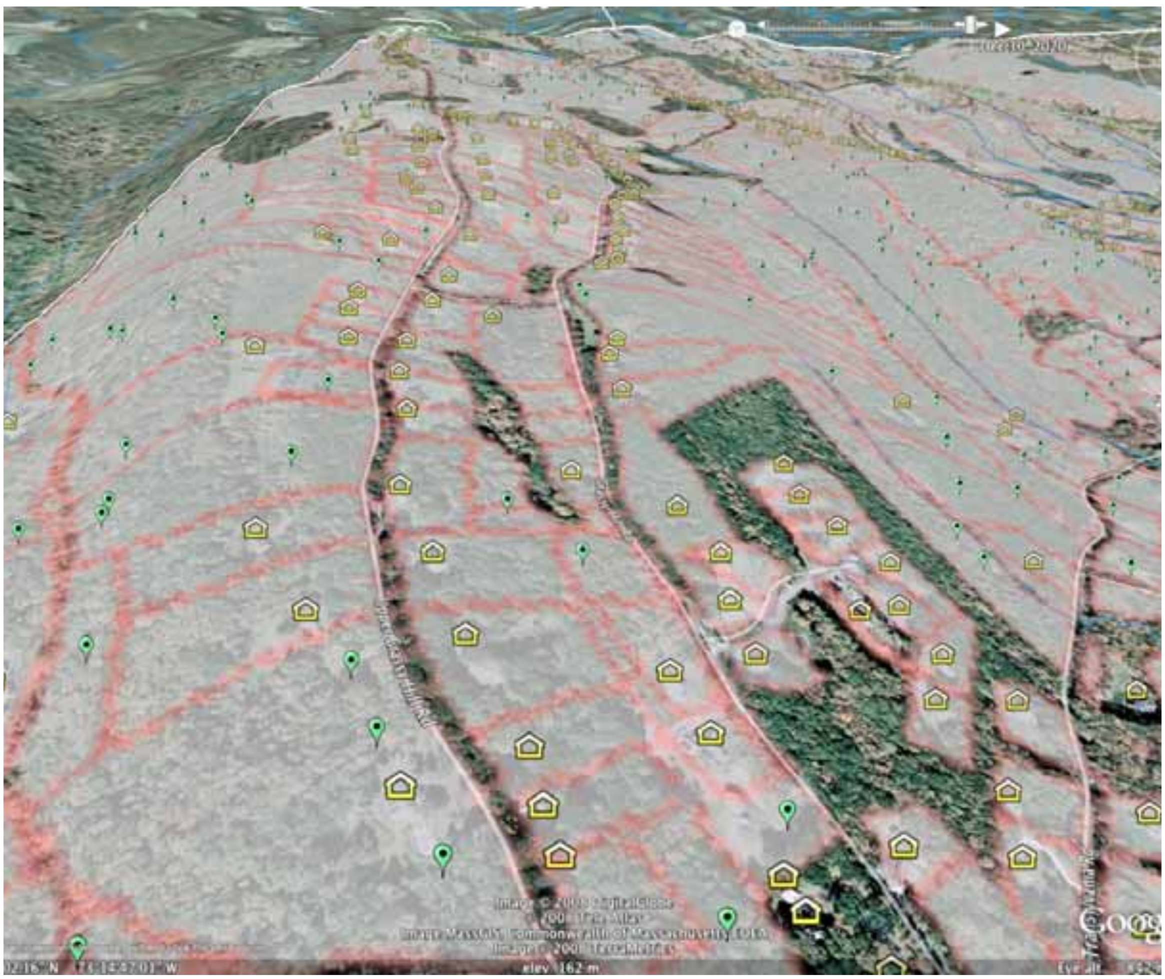


Figure 7. This perspective of the Woodbury, CT buildout is roughly in the same location as shown in Figures 3 & 4 and shows buildable areas (gray polygons with red outlines) and all buildings (existing buildings are yellow house icons and potential buildings are green pin icons). Data from the buildout project were projected in GoogleEarth to create this image.

4. Which Buildout Method is best?

First, what do you want to accomplish?

The key driver of a buildout is not a technical one but rather figuring out *what are you trying to accomplish by doing the analysis.* Only by having a specific set of goals or questions that the analysis is designed to answer is it possible to select the proper method to use. For instance, if you just want to estimate the ultimate number of school children in the town, you may want to choose the mathematical buildout, or even skip the buildout in favor of using demographic trends. When we wanted to focus on the impact of development on water resources, the NEMO team developed an impervious cover buildout analysis (page 14), which told us nothing about school children but a whole lot about pavement and stormwater runoff.

However, if your objectives are to shed light on critical land use planning issues, then the method you choose should have some level of geographic specificity. All of the buildout methods we used provided a seemingly reasonable final number, but the level of geographic specificity varied widely. This allows decision makers to easily observe where in their town or region future development may occur, and allows for specific decisions to be made, even down to the parcel level in some cases. For example, the advantage in having a buildout when doing open space planning would be to allow planners to look at the development potential for a given section of town. For economic development planning, knowing where there are plentiful amounts of developable land next to transportation corridors would also be a useful planning tool.

Second, what requirements are needed to meet your goals?

Accuracy: As noted, most buildout analyses, by definition, assess the ultimate developed condition at some indefinite future. So, until a town is finally built out, it is impossible to determine the “accuracy” of the estimates provided by the analysis. One must use the best data and the most likely assumptions, leavened with best professional judgment, and accept the results for what they are – an approximation. There exist versions of buildouts that use trends like population growth to project into the future, and these can give you “intermediary” snapshot estimates of where your town might be 5, 10 or 30 years from the present; in fact, the *CommunityViz* software we used has a “time scope” wizard that can help you to do this. These studies can be useful, but because they depend on an even greater number of assumptions, they are even more subject to variation.

Accurate prediction of the future, however, is not the ultimate goal of a buildout. Rather, the buildout method is nothing more than a tool to assess the effect of the *current* regulatory environment on future development of land. Through the use of this tool, you can start to determine if your regulations, which are the implementation guidelines for your land use plans, are really achieving the goals you have set for your community. If you feel they are not, you can make changes to those regulations, which in turn will help change how future development unfolds. So the buildout analysis tells us more about present aspirations than it does about the future.

Data: Clearly as the level of specificity increased, the data requirements and the level of expertise needed also increased. Any entity contemplating the cost/benefit of conducting a buildout must first factor in where each needed data layer is going to come from, and at what cost.

The need for digital data creation, even with the simplest method, is perhaps the biggest gap in undertaking a buildout analysis. What is apparent from this study is that even the simplest buildout, the mathematical method, would require some data creation, in the form of digitized zoning maps. The basic GIS method (Method #2) also requires a zoning layer. The other data sets needed for Method #2 (open space, environmental constraints, land use or land cover) are currently available in some form, statewide, but the current open space and land cover data leave something to be desired for this particular use. Higher resolution land use/land cover and an up-to-date committed open space layer – as were supplied by COGCNV in previous case studies – would make the analysis more relevant and accurate. Method #3, the spatially specific method, has the highest data and technical requirements. In addition to the data sets above, this method is most effective with a parcel layer (property boundaries) and with planimetric data, such as building footprints, roads and other structures. Although this spatial specificity is highly desirable for local visioning and planning, it requires a considerable investment and a high level of expertise from the technicians charged with doing the analysis.

Third, how do you want to use it?

Outputs: Related to site specificity is another key aspect of a useful buildout analysis – how important is it that your analysis have a compelling visual output? As noted, the value of a buildout is not in providing answers, but in stimulating discussion about intended and unintended impacts of current land use plans. If you envision your discussions as staff-only professional debates, then maybe a graph can suffice. However, if as in most cases the buildout results will serve as a springboard to land use commission discussions, public meetings and public hearing, the ability to visualize the impacts predicted by your analysis is critical to engendering understanding and forward progress.

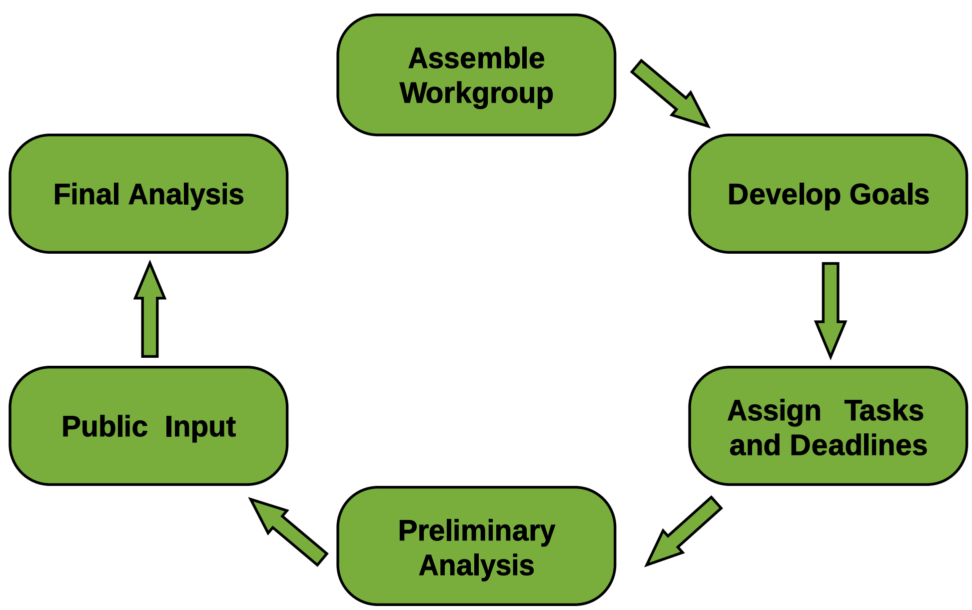
Use: The CLEAR NEMO program has conducted many town-level buildout analyses, starting with our impervious surface buildout analysis over 15 years ago, and more recently using *CommunityViz* to do geographically-specific buildouts in towns like East Haddam and the towns in the Niantic watershed. Our experience has been that by stimulating discussion these analyses, like many other good tools, actually create more questions than they answer. However, that is the nature of local land use planning. A well-constructed buildout analysis provides important fodder for discussion about plans, regulations and policies.

Getting Started

The hardest part of any complicated job is getting started and a buildout analysis for a community can be a daunting task. The key to success is to be organized and have very clear goals. We would suggest organizing a small workgroup comprised of people with backgrounds in the technical (i.e. people familiar with GIS or spreadsheets) and policy aspects of the analysis. Start by discussing why a buildout is necessary and what questions you would like answered by the analysis. Are you concerned about environmental impacts, fiscal impacts or school planning? With a clear idea of what you want to accomplish, the data needed and the process will fall into place.

Of course, once you have completed your analysis don't hide your accomplishments – show it to the world! In particular keep your town commissions informed about what you are doing and what you have found. Be up-front about your assumptions. Interacting with town citizens and commissions will help to improve your analysis through critical inquiry and discussion. These analyses are oftentimes iterative processes that require several passes before a good final product is produced. Feel free to use the examples and explanations in this guide to help you communicate the process to your fellow citizens. That's what its for.

The key is to get started. Ask questions of professionals in town or at the regional planning agency. They are trained in these analyses and may be able to help. In the back of this guide are some other resources to help guide you in the process. Good luck and happy analyzing!



Appendices

Appendix 1: Sources of GIS data used in the analyses in this booklet

Listing of GIS data used and sources of the information.

Method 1: Simple Mathematical Model	
Local zoning	COGCNV's uniform zoning
Method 2: Basic GIS Method	
Local zoning	COGCNV's uniform zoning
Slope	U.S. Geological Service Digital Elevation Model
100-year Floodplains	Federal Emergency Management Agency, 1998
Wetlands	U.S.Department of Agriculture Soils Survey
Hydrology	Connecticut Department of Environmental Protection
Committed Open Space	COGCNV's uniform zoning
Developed Land	COGCNV's 2004 Land Use
Method 3: Spatially Specific GIS Method	
All the data layers used in Method 2, plus:	
Parcels	Town of Woodbury
Building points	Town of Woodbury

Appendix 2: Resources and References

Connecticut Center for Land Use Education and Research (CLEAR)	http://clear.uconn.edu
Connecticut Community Resource Inventory Online	http://clear.uconn.edu/projects/cri/
U.S. EPA Green Communities: How to do a buildout analysis	http://www.epa.gov/greenkit/build_out.htm
State of Massachusetts' Smart Growth and Urban Environments: Buildout Book	http://commpres.env.state.ma.us/content/buildoutbook.asp#
Connecticut Department of Environmental Protection: Tools for Municipalities	http://www.ct.gov/dep/cwp/view.asp?a=2703&q=390248&depNav_GID=1634&depNav=|
Connecticut Office of Policy and Management, Office of Responsible Growth (state plan of conservation and development)	http://www.ct.gov/opm/cwp/view.asp?a=2990&q=385462&opmNav_GID=1807
Connecticut Department of Economic and Community Development (census information and town profiles)	http://www.ct.gov/ecd/cwp/view.asp?a=1106&q=251024&ecdNav=|

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