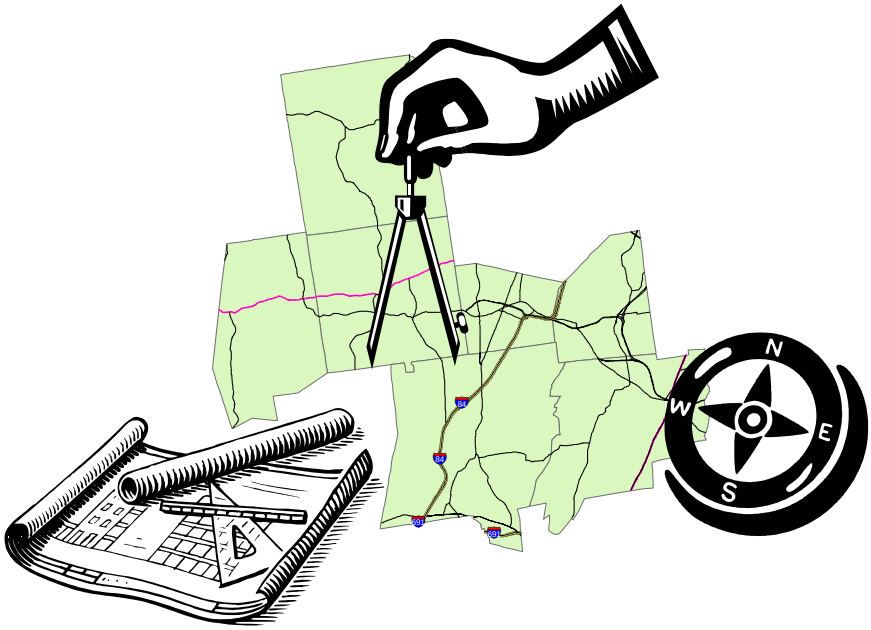
REGIONAL
BUILD-OUT ANALYSIS

FOR
THE CENTRAL CONNECTICUT REGION



Prepared by the Central Connecticut Regional Planning Agency

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Build-Out Analysis Concept

Background and Process - The Regional Build-Out Analysis (RBOA) is a CCRPA project that analyzed land use projections to form a forecast of the future shape of development in the region under several scenarios. The project was funded through the Connecticut Department of Environmental Protection, by the Clean Water Act, Section 604b, Water Quality Planning Grant.

The RBOA utilized updated current land use information by community and applied natural and manmade constraints (slope, wetlands, regulatory buffers, floodplains) to development of land susceptible to development, including agricultural land. Current zoning regulations were applied to the net developable land to produce maps and tables of build-out yields in terms of residential, commercial and industrial parcels. The project assumes three build-out scenarios: 25%, 50%, and 70%. The process produces theoretical growth scenarios for each community, and the region, based on development constraints and zoning in effect.

The build-out analysis is a tool to project all possible future growth in a town given present environmental constraints and its land use regulations utilizing a Geographic Information System (GIS). Buildout analysis can be used to visualize current land use in a town and simulate a visual scenario of future development and determine where it can be subdivided and how much additional development could be permitted under the current zoning. It is a very important tool to encourage and empower local actions to preserve and enhance the quality of life by streamlining future development to maintain balance between environment and development. Buildout analysis helps in the understanding of growth patterns under current zoning and the long-term impacts of growth on population increases, land consumption, traffic and water demand, to name a few. This process enables towns to formulate development strategies that can enhance the pattern of new development.

Buildout Methodology

The Central Connecticut Regional Buildout Analysis project is a combination of several small buildout analyses. The Central Connecticut Region comprises seven cities and towns, Town of Berlin, City of Bristol, Town of Burlington, City of New Britain, Town of Plainville, Town of Plymouth and Town of Southington. Each of these cities and towns has its own zoning and subdivision regulations. A buildout analysis was developed for each individual city and town and the results were combined to produce a regional view.

- Steps in the build-out process
    - collection and updating of land use, zoning and area information GIS layers
    - collection of development constraints layers such as wetlands, water bodies, watercourses, slope and soils

- analysis of build-out potential using overlay and CommunityViz tools
- calculation of yields and impacts
- presentation of results in integrated map form

Source Data

A variety of source materials and information was collected from different sources. CCRPA is the repository for most of the GIS layers regarding land use, zoning, and parcels for the region. Other GIS data such as floodplains, slopes, roads, wetlands, streams and waterbodies, were obtained from CTDEP, USGS, and NRCS. Several overview maps of the towns with various data layers were plotted for local review. It is critical that the appropriate town officials review the various GIS layers developed or updated for this project. These maps were reviewed with the town planner and/or the zoning enforcement officer in each city and town for accuracy.

The land use, zoning, and parcel maps were updated as per the town planners' advice to reflect the current state for each town. Careful attention was given to update these data layers as these will be the most important source layers in developing buildout scenarios. Land use mapping was compared with digital orthophotos to check for errors. This took a great amount of of the time required to complete the entire process.

GIS Methodology

After the datasets described above were updated, the following series of steps were taken to start the build-out analysis.

1. The assumption is that development will occur on land that is not now developed, so the analysis began by creating a GIS layer of all developed land by combining all uses in a single coverage, representing all developed land.

2. All developed lands were subtracted from the potential available land shown on the land-use maps to produce a GIS layer of undeveloped land with attributes of the zoning code.

3. A layer of all the buildout constraints was created to simplify the GIS process. Buildout constraints included wetlands, 100 feet buffer of streams, 100 year floodplain areas, waterbodies, and land with slope over 25 percent.

4. The newly created constraints layer was subtracted from the unprotected, undeveloped land to produce a GIS layer of all unprotected, undeveloped land which could potentially be developed or contribute to development.

5. The developable layer was then merged with the updated parcel layer to produce an accurate developable parcel layer.

6. Three types of summary tables were produced from the polygon attribute table for potentially developable land from Step 4. One table showed the total area

within each town for each current land use distribution. A second table showed total vacant land in each town, and the third table comprised developable land in each town with attributes of zoning.

Analysis and Yield

After the preliminary GIS analysis, the layers were prepared for the buildout processing. An ArcGIS extension called CommunityViz was utilized to develop buildout scenarios for each cities and towns. The newly created developable parcels with zoning attributes were the Input data for this process. The zoning regulations such as floor area ratios, percent lot coverage, heights limit and lots requirements for each zone were provided as the buildout condition. CommunityViz produces numerical and visual buildout data based on current zoning regulations. Three buildout scenarios were developed for each city and town. Buildout analyses were conducted for 25%, 50%, and 70% buildout scenarios[1]. During the 70% buildout analysis, the buildout capacity for industrial zones were kept at 50% as the 70% density is not a reasonable scenario for the industrial zone because of the amount of land industry needs for parking, open space, and utilities.

Impact Calculations

Once all the buildout scenarios were run, results from each analysis were summarized on spreadsheets for further analysis and impact calculations. The buildout analysis reported on number of dwelling units, number of buildings and total floor area for each zones. Based on those results, impact analyses were done as described below.

a. Impervious Surface

Once the total number and size of developable parcels was calculated, total impervious surface that can be generated by those areas, if fully developed, was calculated. Based on studies done by NRCS and NEMO, coefficients of imperviousness for different land use were used to calculate total imperviousness. Also, imperviousness as a result of existing development was also calculated. Once the existing and estimated imperviousness was calculated, the impact on the watersheds was determined.

b. Housing

The total number of dwelling units per town for each level of buildout was calculated from the build-out analysis and tabulated on a spreadsheet for impact calculations. The buildout analysis provided three different scenarios of development for each town. Once the total floor area and number of dwelling units were tabulated, average household size (2000 Census) was used to determine potential population increase with the corresponding development.

[1] The maximum buildout was kept at 70% because the potentially buildable acreage within any zoning district is generally reduced by 25-30% for roads, open space requirements, and configuration loss.

Population projections from the Connecticut Department of Transportation (ConnDOT) were used to estimate the rate of population increase for towns in the region. Once the rate was derived, the time to reach the estimated level of buildout was calculated. Also, the number of vehicles added, drinking water demand, and potential new jobs related to the commercial and industrial development were also calculated based on buildout results.

Final Review and Comment

The final buildout scenarios will be presented to the Central Connecticut Transportation Improvement Committee (CCTIC) for review. The CCTIC serves as the advisory committee for this project.

Findings – The net developable land (NDL) in the region totaled approximately 17,000 acres, of which the vast majority is zoned for residential use (approximately 15,000 acres). This total represents approximately 16% of the total land in the region, indicative of the fact that people have been developing the region for hundreds of years. Within the region, there is wide variation in the acreage of land available for development, from urban New Britain (3.4%of the City's land is considered developable) to rural Plymouth (27.7% of the town's total acreage is considered developable). Although Burlington is decidedly more rural than Plymouth, only 17.5% of its land could be considered developable, due to the high percentage of acreage owned as state forest and water company watershed land.

In total area of land considered developable, Southington leads the region with 5,224 net acres of developable land. Thus, in terms of impact, Southington can be expected to experience the greatest impacts associated with build out.

Municipality	Net Developable Land (NDL) in Acres	NDL as a Percentage of Municipality's Total Land	NDL as a Percentage of Total NDL for Region
Berlin	1,754	10.5%	10.2%
Bristol	1,759	10.2%	10.2%
Burlington	3,358	17.5%	19.5%
New Britain	280	3.4%	1.6%
Plainville	940	14.1%	5.4%
Plymouth	3,907	27.7%	22.6%
Southington	5,224	22.7%	30.3%

A much higher rate of land consumption than that of population increases is symptomatic of sprawl conditions. For the communities that experienced increases in population in the ten years between 1990 and 2000, the following table contrasts population increase during the period against acres developed.

Municipality	1990-2000		Additional Residents per Acres Developed over the Period
	Population Increase*	Land Developed (Acres)**	
Berlin	1,428	261	5.5
Burlington	1,164	154	7.5
Southington	1,210	455	2.6

**University of Conn. Center for Land Use Education and Research (CLEAR), **Conn. Economic Research Center (CERC)*

Impacts – Growth produces positive and negative impacts. These impacts affect land use, natural resources, transportation and economic development. Cumulatively, such impacts affect the quality of life in the communities of the region.

Population – Variables affecting changes in population include actual developable land available, residential zoning requirements and historical household sizes. The build-out process calculates estimated population increases based on historical data on household size. Calculations were made at 25%, 50% and 70% build-out. The percentages in the following table represent increases above the base of land already developed.

Municipality	Additional Residents per Build-Out Scenario		
	25%	50%	70%
Berlin	1,005	1,635	2,198
Bristol	3,236	4,648	5,931
Burlington	2,794	4,763	6,409
New Britain	1,147	1,439	1,720
Plainville	1,051	1,813	2,383
Plymouth	3,051	5,392	7,374
Southington	5,967	7,895	9,690
Central Connecticut Region	18,251	27,585	35,705

Traffic – Increased population will affect traffic. Single-occupancy vehicles per household are based on average number of vehicles for that community from Census 2000 data multiplied by the household increases produced in each build-out scenario. In a general sense, trip generation can be estimated by applying the values utilized by the ConnDOT (10 trips daily for single-family homes). The RBOA does not assign trips to specific routes.

Municipality	Additional Vehicles per Build-Out Scenario		
	25%	50%	70%
Berlin	693	1,129	1,516
Bristol	2,341	3,363	4,291
Burlington	1,996	3,402	4,578
New Britain	661	829	991
Plainville	738	1,272	1,672
Plymouth	2,162	3,821	5,225
Southington	4,196	5,551	6,813
Central Connecticut Region	12,787	19,367	25,086

Environmental – Human development impacts the quality of natural resources – land, water and air. Mitigating those environmental impacts can lessen their severity. As natural land is developed, the amount of pervious surface is altered. Structures and infrastructure, such as roads and utilities, require covering soil with nonporous materials. If rainfall and snowmelt cannot percolate through the soil, it becomes runoff, in search of a pervious surface or a waterway, often picking up pollutants on its way. It follows logically then that a build-out scenario implies environmental impacts based on the increase of impervious surface. The build-out assumes no manufactured drainage facilities that normally accompany development activity.

The following is from the "Pequabuck River State of the Watershed Report (July 2004): *"Impervious surfaces in a watershed adversely impact the health of the watershed. These effects include adverse impacts on water quantity, degraded water quality, changes to habitat, diminished stream and landscape aesthetics, bank erosion and flash floods. Similarly, impervious surfaces dramatically increase peak discharges during storm or snowmelt events, resulting in the increased flow and possible downstream flooding. According to different studies, biological integrity and habitat quality of streams are inversely affected by the amounts of impervious surfaces adjacent to them (Arnold & Gibbons1996; Klein1979; Schueler1994). A watershed is considered to be impacted when the impervious surface exceeds 10% of the total watershed (Schueler 1994)."*

The following table lists subregional watersheds in the central Connecticut region and the percentages of increased impervious surface caused by the development that accompanies build out of available raw land. Figures in gray represent the "impacted" threshold of 10% or above. Impervious percentages of 25% (highlighted in red) or in excess are indicative of watersheds that will experience "degraded" streams caused by runoff.

Central Connecticut Regional Contribution to the Total Basin Imperviousness

SUBREGIONAL BASIN	Existing	With 25 Percent Buildout	With 50 Percent Buildout	With 70 Percent Buildout
Bass Brook	14.65%	14.90%	15.15%	15.34%
Belcher Brook	20.08%	21.08%	22.08%	22.88%
Burlington Brook	13.63%	15.32%	17.01%	18.37%
Copper Mine Brook	18.98%	20.07%	21.16%	22.03%
Eightmile River	16.49%	18.18%	19.88%	21.23%
Farmington River	0.24%	0.31%	0.37%	0.42%
Hancock Brook	8.76%	10.87%	12.99%	14.68%
Leadmine Brook	0.78%	1.03%	1.29%	1.50%
Mad River	0.52%	0.53%	0.54%	0.55%
Mattabesset River	9.88%	10.42%	10.96%	11.40%
Misery Brook	21.29%	22.93%	24.56%	25.87%
Naugatuck River	0.54%	0.71%	0.87%	1.01%
Nepaug River	0.57%	0.65%	0.73%	0.79%
Pequabuck River	22.61%	23.58%	24.56%	25.34%
Piper Brook	9.69%	9.77%	9.84%	9.90%
Poland River	5.19%	6.18%	7.17%	7.96%
Quinnipiac River	9.49%	10.15%	10.80%	11.32%
Rock Brook	0.03%	0.04%	0.04%	0.04%
Sodom Brook	1.60%	1.83%	2.06%	2.25%
Tenmile River	3.51%	3.98%	4.46%	4.83%
Webster Brook	11.78%	11.87%	11.95%	12.02%
Willow Brook	28.45%	29.60%	30.76%	31.68%
Total	**5.77%**	**6.20%**	**6.63%**	**6.97%**

With diminished capacity for flood storage by the soil, runoff volumes can exceed what the floodway can handle. Flood mitigation strategies must take into account the amount of impervious surface throughout the watersheds in question.

Other water-related impacts of future build-out involve household consumption of potable water. As the population of each community increases, the additional households will put pressure on water resources, both public and private. Per capita water usage is estimated at 77 gallons per day (gpd). The increases in population, as estimated by the build out process, illustrate how these new residents will stress water resources.

Water Demand (Gallons per Day) per Build-Out

	Scenario		
Municipality	25%	50%	70%
Berlin	77,373	126,008	169,217
Bristol	249,168	357,919	456,718
Burlington	215,169	366,736	493,508
New Britain	88,316	110,769	132,474
Plainville	80,933	139,570	183,460
Plymouth	234,892	415,216	567,769
Southington	459,487	607,918	746,099

Housing Impact – The RBOA estimates the number of housing units established based on zoning regulations in effect that govern setbacks, minimum lot sizes, and maximum lot coverage. The table below illustrates estimated new units per percentage of build out. The RBOA assumes conventional subdivision development.

	Estimated New Dwelling Units per Build-Out Scenario		
Municipality	25%	50%	70%
Berlin	385	627	842
Bristol	1,377	1,978	2,524
Burlington	988	1,701	2,289
New Britain	472	592	708
Plainville	461	795	1,045
Plymouth	1,201	2,123	2,903
Southington	2,331	3,084	3,785

As stated earlier, the vast majority of available land for development is zoned residential; although, there are some commercially and industrially zoned lands. Following the same protocol for units derived from zoning regulations, there are some implications in terms of job creation by the build-out of commercial and industrial land. The pace of such development is historically slower than that of residential development, but it can be noted that the build-out analysis indicates that there is significant floor area available for commercial and industrial development.

Public Facilities

In consideration of forecasting need for public facilities, it is helpful to understand the numbers of dependent populations in the communities and the region that can be projected through a build out process. Dependent populations include the “under 19 years old” cluster (which would require school facilities and other services) and the “over 65 years old” cluster (requiring senior housing and other services.

Assuming a constant age distribution ratio, the total population increases experienced in a build-out scenario are broken out into projected increases per cluster. In the review of these figures, it is important to note that the population increases expected in each build-out percentage are tempered by the fact that population growth rates are forecasted to be

almost flat when averaged over 30 years (the forecasted rates of population growth used are from ConnDOT's Forecast and Inventory Bureau). By contrast, the rate of land consumption is much sharper. Using those population growth rates along with a 25% build-out projection result in the following:

Community	Percent of Population Increase Associated with 25% Build-Out	Projected Average Population Growth Rate	Estimated Years to Achieve Population Increases Associated with 25% Build-Out
Berlin	5.52%	.60%	9
Bristol	5.39%	.18%	30
Burlington	34.12%	1.34%	25
New Britain	1.6%	.39%	4
Plainville	6.07%	.34%	18
Plymouth	26.22%	.53%	49
Southington	15.02%	.17%	88

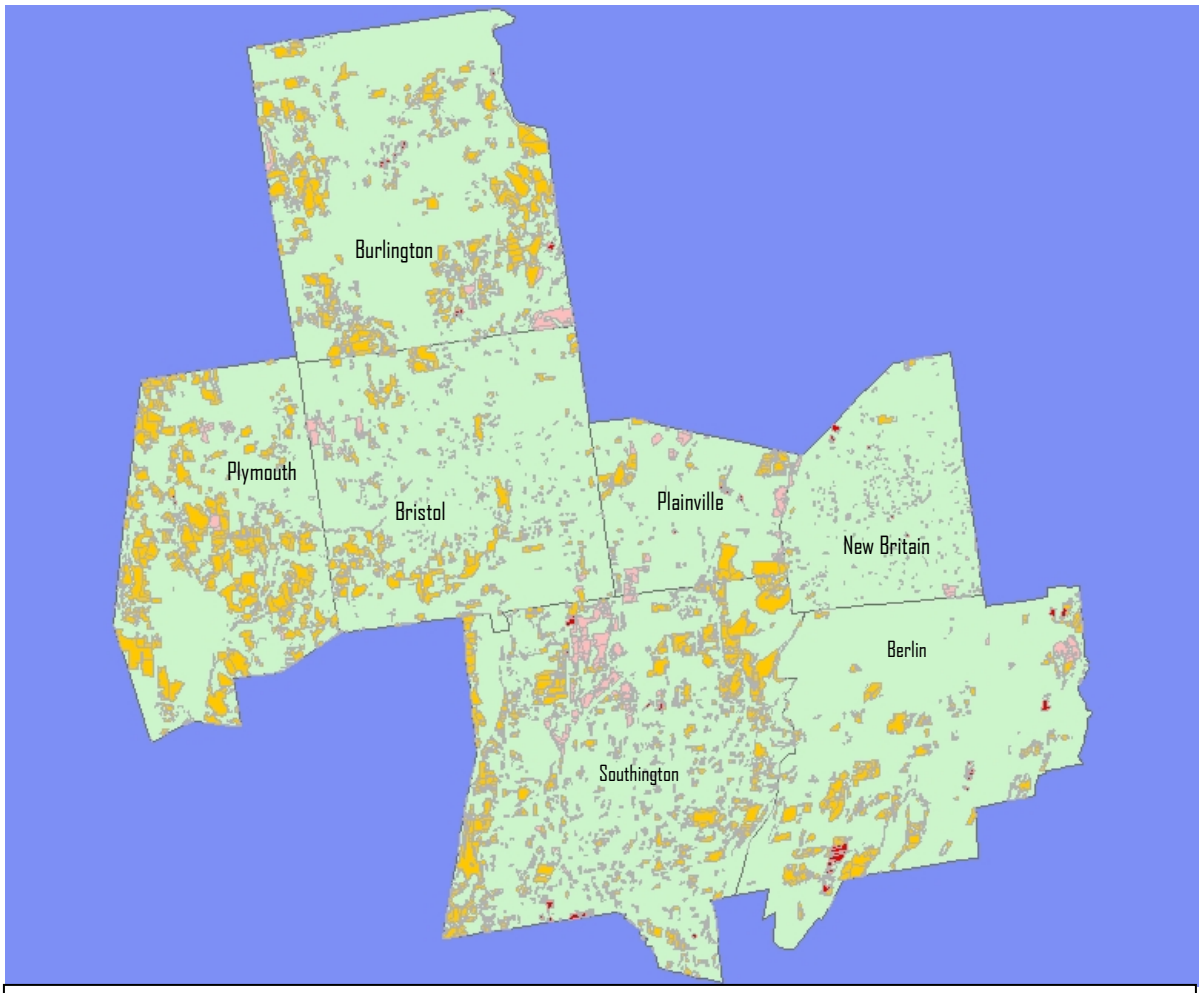
Considering a 25% build-out, the following increases would occur in dependent population clusters:

Community	Under 19 Years Old Cluster	Over 65 Years Old Cluster
Berlin	256	167
Bristol	783	479
Burlington	836	201
New Britain	297	180
Plainville	234	156
Plymouth	811	381
Southington	1,486	883
Region Total	4,703	2,447

The table above illustrates added population to the background population. In planning for municipal facilities, such as schools and senior housing, the existing wave of population groups must projected to a horizon date. It is not practical to consider the 50% or 70% build-out scenarios in estimating the growth of these population clusters since those build-outs will occur within a long-range timeframe.

Conclusion – While a build-out analysis is not a crystal ball that looks into the future with great precision, the process provides a graphic measurement of growth potential and its associated impacts. The analysis is a tool that can help guide where development is desired and where it might be discouraged. The pattern of future development in the region appears to be decidedly dispersed, based on the geographic distribution of buildable land. Such a pattern means that more vehicle miles will be driven by single occupancy vehicles that will be polluting the air. A dispersed pattern will involve extensive road building and home building that will add impervious surface to the region's watersheds, leading to water quality degradation. Implications of the graphic

and numerical data as illustrated here should be recognized by the communities and the region as a starting point for consideration of smart growth management techniques.



Shaded areas on the map indicate net developable land in the region. These lands are predominantly residentially zoned.