CHANNELING METROPOLITAN GROWTH: IN WHAT DIRECTION, TOWARD WHICH END?

DALE L. KEYES*

INTRODUCTION

Concern with the spatial patterns of development in urban areas has stemmed from a belief that better land use planning could achieve more efficient and more livable urban forms. If one were to distill the mainstream of current thought on the spatial dimensions of development[1] the essence would be this: Dispersed, low-density development (or peripheral growth in existing communities) is costly, wasteful, and environmentally degrading.[2] Perhaps the most influential argument for more spatially limited, higher-density growth was made in *The Costs of Sprawl*, a federally sponsored study of alternative submetropolitan development patterns.[3] This study estimated that subdivisions characterized by single family homes on large lots require about twice as much infrastructure investment, about 10 percent more in public service operating costs, and about twice as much land as a hypothetical development featuring a mix of smaller single family detached dwellings, townhouses, and multifamily structures. In addition, emissions of air pollutants were about two-thirds higher in the dispersed pattern; soil erosion and other storm water runoff problems were somewhat more serious; and energy use was twice as high.[4]

Rather than probing the assumptions and methods of analysis employed in *The Costs of Sprawl*, a task already undertaken by others,[5] this article will independently identify and document the effects of differing development patterns,[6] addressing the questions of which spatial arrangements of urban activi-

* Senior Policy Analyst, Energy & Environmental Analysis, Inc., Arlington, Virginia.

1. For a review of urban spatial analysis, *see* B. ROBSON, URBAN ANALYSIS (1969).

2. Admittedly, the consensus runs in cycles. Only a few years ago, the benefits of dispersed settlement patterns were being praised. *See* A. DOWNS, *Alternative Forms of Future Urban Growth*, 36 J. AM. INST. PLANNERS 3–11 (Jan. 1970).

3. REAL ESTATE RESEARCH CORPORATION, THE COSTS OF SPRAWL (1974) [hereinafter cited as THE COSTS OF SPRAWL].

4. *Id.* at 49.

5. *See* 43 J. AM. INST. PLANNERS 207 (1977).

6. A necessary starting point for this inquiry is the identification of alternative "development patterns." The task is to choose the dimensions that will be the most useful in classifying spatial arrangements of urban activities according to the effects of interest.

The planning literature suggests that population variables are the key descriptors used to spin the fabric of urban structure. Variations in population density, both radially and circumferentially, are employed to communicate notions of alternative structures, for example: sprawl, comties are least consumptive of resources, most efficient to service, least polluting, or otherwise desirable. In examining the available data, I will look for evidence of variation in the costs borne by society—monetary outlays, externalities, intangible benefits forgone. I question, however, the propriety of society's concern where the cost differentials between alternative patterns are borne by the residents alone.

I
THE BENEFITS OF SPATIAL PLANNING

A. Energy

Energy has become the most expedient, if not the strongest, lever used by proponents of higher-density living patterns to throttle the outward expansion of metropolitan areas. Arguments are made on two quite different points: (a) higher-density buildings are more efficient to heat and cool; and (b) certain arrangements of land uses combined with higher population densities lead to urban travel economies.

The first assertion is derived from a growing body of evidence from thermal loss simulations of individual buildings and from statistical analysis of groups of households. Figure 1 summarizes the results of four such studies. Though the absolute values of energy consumed for heating and cooling for similar types of structures vary among the four studies (due primarily to climatic variations and differences in insulation characteristics of the indivdual buildings), a similarity in the trend lines can be observed. Garden apartments and small high-rises are more efficient than detached single family units. Interestingly, however, one study found large thermal inefficiencies in tall high-rises, due primarily to the energy needs of common services in these buildings.[7]

pact, corridor oriented, and multi-nucleated. Population size serves further to suggest the areal extent of development, and thus the operation of certain (dis)economies of scale.

Non-residential variables such as employment and retail trade should also play an important role in differentiating spatial structures. This is especially true where the effects of interest are related to the spatial congruity of certain activities. Again, the planner's integrating terms (sprawl, compact, etc.) can be used to suggest general spatial arrangements.

Finally, the extent and location of non-developed areas may be of some interest for environmental and aesthetic considerations. A "wedge" pattern of open spaces frequently appears in land use plans, though this is but one possible configuration.

The superposition of individual development characteristics can obviously generate a myriad of patterns for which the planner's jargon soon loses meaning. "Sprawl", for example, could connote a simultaneous dispersal of jobs, people, and open spaces; or any two of the three; or any one. To minimize confusion, I will normally use individual or selected combinations of development characteristics. However, where efficiency or variety dictates, I will utilize the terms "compact", "focused", or "concentrated" to imply a pattern of development where jobs and people are centralized and densities are necessarily high. "Dispersed" will indicate less dense, more land extensive metropolitan development with people considerably more decentralized than employment opportunities.

7. Sweet, *Effects of Residential Building Type on Energy Consumption*, BUILDING RESEARCH (April/June 1974), at 18.

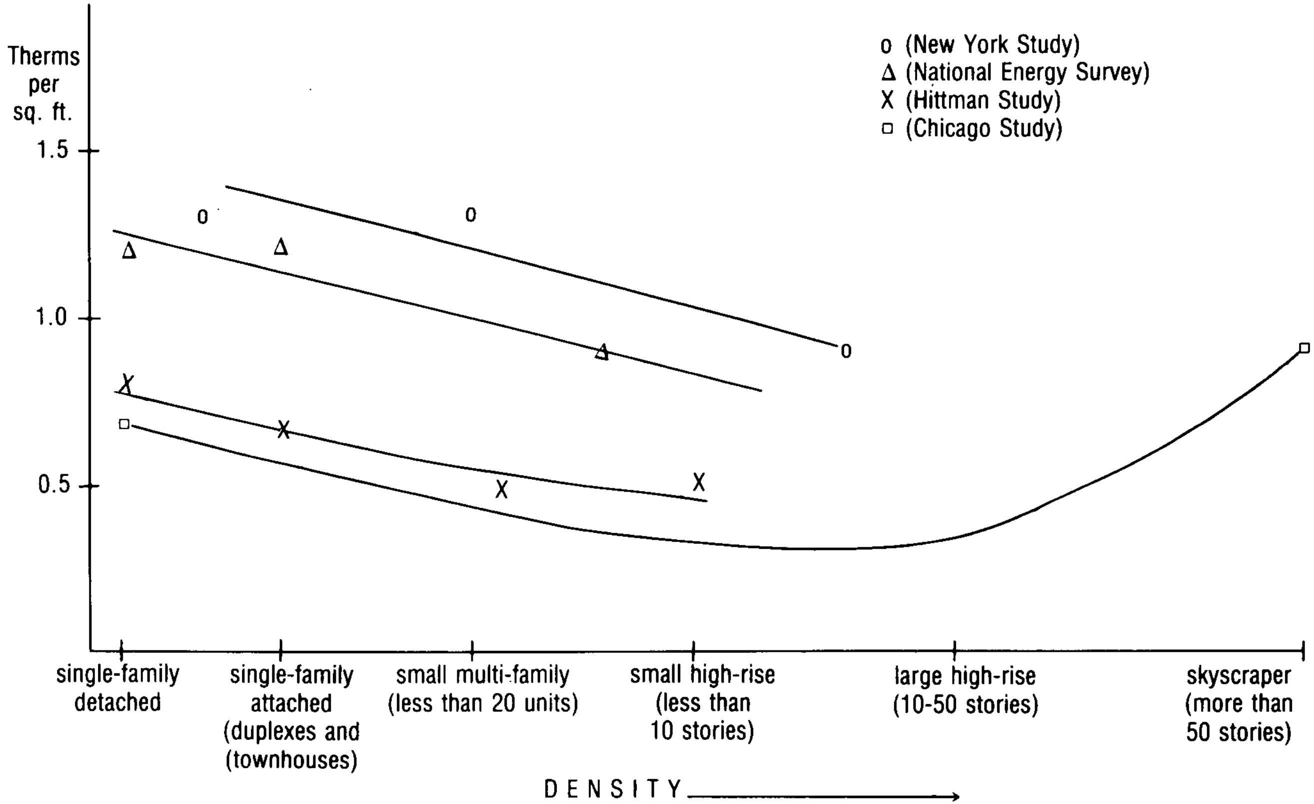

Figure 1

Relative Energy Efficiency by Type of Dwelling

Sources: Regional Plan Association, Inc. and Resources for the Future, *Regional Energy Consumption*, RPA Bulletin 121, RPA, N.Y. Jan. 1974, (Data from this study analyzed in note 8); Response Analysis Corporation, *Lifestyles and Energy, 1973, National Survey* (Report prepared for the Washington Center for Metropolitan Studies, Washington, D.C.: December 1974) (Data from this survey analyzed in note 8); R.W. Anderson, RESIDENTIAL ENERGY CONSUMPTION, SINGLE FAMILY HOUSING (March 1973); M. Tokmanhekin and D.G. Harvey, RESIDENTIAL ENERGY CONSUMPTION, MULTI-FAMILY HOUSING FINAL REPORT (June 1974); A. L. Sweet, *Effects of Residential Building Type on Energy Consumption* in BUILDNING RESEARCH (April/June 1974), at 18-24.

Note: Reproduced from D. Keyes & G. Peterson, Metropolitan Development and Energy Consumption (Urban Institute working paper no. 5049-15, March 1977).

As impressive as the gains in efficiency may be for small multifamily structures, the significance of these savings remains to be established. In calculating overall impact, one must consider the amount of new residential construction over the next several decades. Assume that 1.35 million new units per year will be built in metropolitan areas[8] and that all new units are small multifamily structures.[9] Within a ten-year period, the savings in annual energy consumption would be about 0.5 quadrillion Btu's, and within twenty-five years, about 1.2 quadrillion Btu's per year.[10] To put these figures in perspective, the first equals about 0.5 percent of the estimated national energy budget in 1985, and the second, about 0.7 percent of the total in the year 2000.[11] More realistic assumptions about the types of new homes to be built would lower these modest figures considerably. Furthermore, upgrading insulation standards for new construction would affect the least efficient units (single family detached homes) the most, thus further eroding these savings.[12]

The conclusion seems inescapable: Development patterns that feature higher-density residential structures (that is, townhouses and small apartment buildings) in contrast to single family detached dwellings will save energy. However, the savings are likely to be modest. Extending the analysis to commercial structures may increase the savings to some degree, but this is not likely to reverse the conclusion.

The case for transportation energy savings should be, in concept, more convincing. Unlike energy for space heating and cooling, where the development effect is primarily related to one land use variable (building type), urban travel behavior is the product of many factors related to development. Thus,

---

8. During the period 1970–73, years of high housing construction rates, 1.51 million units were added each year. U.S. BUREAU OF THE CENSUS, ANNUAL HOUSING SURVEY: 1973 (Part A, General Housing Characteristics for the United States and Regions XVI), at Table B. (Current Housing Reports Series 4–150–73A, 1975).

9. This is an unrealistic assumption, of course, even if certain planners would ideally prefer this configuration for new housing units. During the 1973–75 period, the National Association of Homebuilders estimated that the new housing mix was 50 percent single family detached, 20 percent townhouse, 30 percent mid-rise, 1 percent high-rise. Any change from existing patterns will likely be incremental. 10 NAT'L ASS'N HOME BUILDERS (Oct. 1974), at 1.

10. These calculations further assume that the average annual fuel consumption for residential units is: single family detached, 1600 therms; townhouse, 1200 therms; small multifamily, 960 therms.

11. These are based on projections for 1985 of energy consumption made by the Federal Energy Administration. However, the percentages are not very sensitive to variations among different projections. *See* FEDERAL ENERGY ADMINISTRATION, NATIONAL ENERGY OUTLOOK 16 (February, 1976). *See also* CONGRESSIONAL RESEARCH SERVICE, ENERGY INFORMATION HANDBOOK 483–95 (July 1977). *But see* Federal Energy Administration (FEA) National Energy Outlook 16 (Feb. 1976). The Congressional Research Service makes projections for both 1985 and 2000 and cites the FEA as supporting authority; however, the FEA makes projections for 1985 only.

12. For a more elaborate discussion, *see* D. Keyes and G. Peterson, Metropolitan Development and Energy Consumption (Urban Institute working paper no. 5049-15, March 1977) (unpublished paper available from the Urban Institute) [hereinafter cited as Metropolitan Development and Energy Consumption].

the potential for urban form-initiated transportation energy savings seems to be relatively large.

The argument is straightforward: Urban spatial structure can reduce the demand for travel while simultaneously increasing the opportunity to use more energy-efficient modes to satisfy the remaining demand. That is, concentrating metropolitan development in a smaller area will shrink the distance between trip origins and destinations, and the higher density will increase the feasibility of mass transit service. To further reinforce this effect, the resulting increase in congestion will encourage less reliance on cars and greater use of mass transit (though congestion will make the residual vehicular travel more fuel consumptive). Moreover, if these higher density areas provide a mixture of commercial, residential, and industrial land uses, residents will be encouraged to substitute bicycle and pedestrian trips for vehicular ones, thereby saving more fuel.

These speculations have been the driving force behind several simulations of land use–transportation interactions. Edwards and Schofer,[13] Fels and Munson,[14] Roberts,[15] and T. O. Caroll and his research group[16] have attempted to simulate the travel effects of either rearranging entire metropolitan areas or accommodating growth in alternative spatial arrangements.[17] Differences between the most and least efficient spatial patterns have been estimated to be as large as 50 percent.[18] However, differences between *probable* future patterns and those achievable with more stringent, but still realistic, development controls are much smaller. Furthermore, Caroll has modeled the effect of the simultaneous decentralization of people and jobs and has concluded that the impact on travel is not large.[19]

The approach my colleagues and I adopted in estimating the strength of the linkages between metropolitan form and urban travel differs somewhat from those noted above. We relied on the historical determinants of automo-

---

13. J. Edwards & J. Schofer, Relationships Between Transportation Energy Consumption and Urban Structure (Jan. 1975) (available from Dep't of Civil Engineering, Northwestern University).
14. Fels & Munson, *Energy Thrift in Urban Transportation: Options for the Future*, in THE ENERGY CONSERVATION PAPERS 7 (R. Williams ed. 1975).
15. J. Roberts, Energy, Land Use, and Growth Policy: Implications for Metropolitan Washington (2d ed. Aug. 1975) (report prepared by Real Estate Research Corp. for the Metropolitan Washington Council of Government) [hereinafter cited as Energy, Land Use, and Growth Policy].
16. T.O. Carroll, A. Kydes, & J. Sanborn, A Regional Land Use and Energy Modelling System (Brookhaven Nat'l Laboratory, April 1976) (unpublished paper presented at the Seventh Annual Pittsburgh Conference on Modeling and Simulation, available from authors) [hereinafter cited as A Regional Land Use and Energy Modelling System].
17. For a review of these and related studies *see* Metropolitan Development and Energy Consumption, *supra* note 12, at 16–23.
18. Regional Land Use and Energy Modelling System, *supra* note 16.
19. Energy, Land Use, and Growth Policy, *supra* note 15, at Table 5-1 as corrected (p. 5-2).

bile travel behavior (as measured directly by gasoline consumption) in U.S. metropolitan areas to provide insight into the possible transportation energy effects of future changes in urban development patterns.[20] Data on travel characteristics, transportation features, economic conditions, energy prices, and development patterns were drawn from over forty metropolitan areas and analyzed. We found that per capita gasoline consumption was indeed less in urban areas with (a) smaller populations, (b) a greater proportion of people living in high-density areas, and (c) similar spatial distribution of jobs and people. But we also found that a fairly substantial change in these variables would be needed to bring about even a 10 percent reduction in average metropolitan-wide per capita fuel consumption.[21]

Of course, to achieve this level of change in both development pattern and fuel consumption for the metropolis as a whole, new development would have to deviate considerably from the current spatial pattern. Although the impact of new, more central, higher-density residential locations (or the co-location of residential, commercial and employment areas) on travel behavior for new residents may be dramatic, the area-wide pattern of development will change more gradually and will have a much less jolting effect on current residents. I have estimated that a reasonable savings in transportation fuel use (that is, the difference between fuel consumption associated with a continuation of current patterns and that associated with realistically achievable changes in growth patterns) over the next few decades is 15 to 20 percent.

Once again, I will attempt to place these savings in perspective. With an assumed annual rate of growth in transportation fuel consumption of 2 percent (the 1950 to 1970 growth rate was 3 percent), annual gasoline use would increase about twelve quadrillion Btu's (quads) in the period between 1975 and 2000.[22] When one assumes that urban travel would account for about 30 percent of this increase[23] and that energy-efficient growth patterns could reduce the urban fraction by, at most, 20 percent, the savings attributable to spatial control of new development would be in the neighborhood of 0.8 quads per year. This is extremely modest in comparison with both the annual national energy consumption likely to be reached in 2000 and other strategies to conserve transportation energy.[24] In short, even if one assumes the desirability of employing land use controls as a means of conserving energy, it ap-

---

20. Metropolitan Development and Energy Consumption, *supra* note 12, at 23–33.

21. *Id.* Specifically, a change equal to one standard deviation in all development variables would be needed to decrease per capita gasoline use by 10 percent.

22. 2 Council on Environmental Quality, Federal Energy Administration, Project Independence and Energy Conservation: Transportation Sectors (November 1974).

23. Hirst & Moyers, *Efficiency of Energy Use in the United States*, 179 SCIENCE 1299 (1973).

24. Given Eric Hirst's estimates, we can infer that increasing auto fuel efficiency could save almost three quads by 1985 alone. *Id.* at 1300–01.

pears that such development controls will make only a modest contribution to energy conservation.[25]

B. Fiscal Costs

Justification for the public's interest in fiscal cost variations associated with development is beyond challenge. Wherever public service costs are larger than the average, public subsidies flow to the recipients. Where these subsidies are the result of particular patterns of settlement, the public is justified in either regulating development practices so as to reduce or eliminate this social cost or adjusting for the cost differential by the imposition of special assessments or user fees.

Fiscal costs can be decomposed into: (a) expenditures for constructing the service infrastructure, and (b) costs of providing services, including those of operating and maintaining the infrastructure. Proponents of urban growth controls have emphasized the alleged capital cost economies flowing from compact, focused development as sufficient justification for development regulation.[26] Though certain infrastructure economies are clearly associated with particular development patterns, caution must be exercised in applying these results to larger spatial scales, and, more importantly, when interpreting the savings as impacts on the public fisc.

Highway investments are illustrative. Developments comprised of low-density subdivisions do indeed require more miles of roadway for internal circulation than do less land-extensive developments. But studies that have simulated the metropolitan-wide consequences of large-scale development alternatives report that high-density development incurs costs that offset and typically outweigh the savings that come from the reduction in total mileage.[27] Unit costs of road construction are greater in highly built-up areas than in low-density areas, and higher densities necessitate a greater number of costly

25. Of course, one can pose the fundamental, provocative question: Why should planners and public policymakers be interested in the energy consequences of new development? Were fuels fairly priced to reflect their scarcity, then each consumer would adjust his/her consumption (both directly and by way of such choices as housing type and location) to meet with his/her tastes and financial situation. In the absence of external effects or redistributive consequences, the social cost of energy use would disappear. Nevertheless, for a variety of reasons the market for energy resources has been controlled, and the government's interest in regulating energy use has developed apace. For an excellent review of the issues involved with deregulation of energy prices, *see* Mead, *An Economic Appraisal of President Carter's Energy Program*, 197 SCIENCE 340 (1977).

26. Several examinations of local growth alternatives have pointed to the capital cost savings of constrained growth. Though most are closely patterned after THE COSTS OF SPRAWL (*see* note 3 *supra*), they represent a range of settings in which the general analytic approach has been applied. *See, e.g.*, P.A. STONE, THE STRUCTURE, SIZE AND COSTS OF URBAN SETTLEMENTS, at 209-10 (1973).

27. P.A. STONE, *supra* note 26, at 91-93; U.S. DEP'T OF TRANSPORTATION, NATIONAL HIGHWAY NEEDS REPORT PART II (1972).

interchanges. Moreover, from the perspective of public expenditure, costs for road construction in subdivisions can be, and often are, imposed on developers directly—either through fees or through subdivision regulations that require a developer to construct roads within the subdivision. This shifting of the cost burden to private developers (and ultimately in some measure to residents in the new units) diminishes the fiscal burden on the public sector.

Similar reasoning applies to sewers. Though sizeable cost savings may exist here for focused as opposed to dispersed development patterns, the principal factor in the financial calculus for sewage treatment is the treatment plant, the cost of which is almost totally insensitive to settlement patterns. Likewise, developer fees for the installation of sewer trunk lines and connectors may be (and are) used to reduce the impact of whatever cost differential remains.

Other capital costs for public investments, most noticeably for schools, do not show the same initial variability with development patterns as do roads and sewers. No matter where new development is directed (urban core or suburbia), expenditures for the modernization of old buildings or for the construction of new ones will have to be made.[28]

Consideration of service operating and maintenance costs further dilutes the strength of arguments for growth control. A growing body of evidence points to increased costs in large urban areas with high population densities.[29] This pattern is observed both among and within metropolitan areas. Recent work at The Urban Institute in Washington has demonstrated that, controlling for demographic and socioeconomic factors, the likely causes of this effect are higher wage rates in large, densely settled urban areas and the increased probability of crime and fire.[30] The reputed efficiencies induced by shorter service routes in compact areas are simply overwhelmed by these other factors.

All of this does not necessarily demonstrate the fiscal superiority of low-density, dispersed growth patterns. A good deal of uncertainty accompanies the abbreviated findings reported above. Careful inspection of the service operating cost versus population density curves, for example, suggests that they may be U-shaped: increases in densities may lead to cost savings at the low end of the scale before the trend reverses itself. In sum, while the relationship between development characteristics and fiscal costs is somewhat ambiguous, it is far from clear that higher-density patterns of development are the fiscal panacea often suggested in the literature.

---

28. It must be conceded, however, that the locationally dispensed developments that necessitate investment in new infrastructures, when existing capacity goes underutilized, do increase public expenditures.

29. Bahl, *Studies on Determinants of Public Expenditures*, in S. MUSHKIN AND J. COTTON, SHARING FEDERAL FUNDS FOR STATE AND LOCAL NEEDS 184 (1969).

30. T. Muller & G. Peterson, Economic and Fiscal Costs (Urban Institute working paper no. 5049-19, 1977) [hereinafter cited as Economic and Fiscal Costs].

C. Environment

1. *Air Quality*

Much of the recent literature on the benefits of growth control has emphasized the role that concentrated, higher-density development can play in improving environmental quality.[31] The case for air quality improvements rests on the reduced amount of mobile source emissions that results from the lower levels of travel associated with constrained settlement patterns. Indeed, total emissions of air pollutants are less where automobile trips are shorter and fewer, just as gasoline consumption is lower in cities where many people live in high-density neighborhoods and jobs are located near residential areas. But air quality is not necessarily a simple function of emission levels. The spatial array of sources, other meteorological factors (including wind direction and speed), and terrain characteristics interact to determine the atmospheric concentration that a given level of emissions will produce at any location.

The Environmental Protection Agency has established National Ambient Air Quality Standards to protect human health.[32] Though the Standards apply at any location in an urban area, it is useful to focus on the level of air quality where people live and work. The rationale is twofold: (a) for cities in which the Standards are being violated, the severity of the hazard will depend on how many people are exposed to levels above the Standards; and (b) accommodation of future growth without creating a health hazard will depend in part on the capacity for increasing ambient concentrations at the locations at which people are exposed.

Cast in this light, conclusions about the effect of development patterns on air quality are changed significantly. Harvard researchers, for example, have simulated the effect of various schemes for centralizing and decentralizing employment and population in the Boston Region.[33] Their conclusions are unambiguous: Increasing population densities by focusing people and jobs on the urban core increases the atmospheric concentrations of auto-related pollutants (specifically, carbon monoxide) throughout the core, despite the fact that region-wide *emissions* of auto pollutants are reduced. Fewer auto trips are taken, and the average trip is shorter; but the remaining trips are more

31. Environmental concerns of growth control advocates and others as well are grounded on the concept of externalities. Since, to some extent, we all suffer the consequences of pollutant discharges to the environment, society is fully justified in regulating the polluters, be this in the form of emission controls at individual sources or the more subtle management of environmental resources via land use controls.

32. 40 C.F.R. § 50 (1977). Primary standards are designed to protect health. Secondary standards are designed to protect plant and animal life and to prevent material damage. *See* 36 FED. REG. 8186–87 (1971) (to be codified in 42 C.F.R. § 410).

33. G.K. Ingram and A. Pellechio, Air Quality Impacts of Land Use Patterns: Some Simulation Results for Mobile Source Pollutants (Dept. of City and Regional Planning, Harvard University, Cambridge, Mass.) (Jan. 1976) (contact authors for limited copies).

highly concentrated spatially and occur where people live and work, thus increasing exposure.

I have extended this line of analysis to cover emissions from stationary sources, using an air quality simulation of alternative development patterns in a hypothetical metropolitan area.[34] In general, the results are strikingly similar to the findings of the Boston study: As measured by levels of population exposure, the air is less polluted where sources and people are dispersed throughout the region or where sources (or people) are isolated at remote locations. In the case of stationary sources, emission levels are constant across all patterns of development. Consequently, separating people from sources of pollution serves to reduce atmospheric concentrations and the resulting exposure levels by making better use of the atmosphere's dispersion capabilities.[35]

These findings support the conclusion that dispersed, not compact, land use arrangements are more desirable from an air quality perspective, at least with respect to pollutants that are relatively inert (for example, carbon monoxide from mobile sources, particulates and sulfur dioxide from stationary sources). For pollutants such as photochemical oxidants (the constituents of smog), which are formed in the atmosphere as a result of chemical reactions among other pollutants, the situation is far more complex.

Ambient concentrations of photochemical oxidants arise following the emissions of precursors (from both mobile and stationary sources) in ways that are imperfectly understood at the present time. Some experts believe that the level of photochemical oxidants observed at any location within an urban region is most closely associated with region-wide levels of precursor emissions. Others believe the spatial pattern of emissions is also important.[36] This uncertainty prevents us from drawing firm conclusions about the effect of settlement patterns on air pollution caused by photochemical oxidants.

On balance, dispersed development would seem to imply net air quality benefits. Only in the case of photochemical oxidants could the opposite conclusion be reached and, even here, we are faced with inconclusive evidence.

2. *Water Quality*

Linkages between water quality and the pattern of urban development derive principally from the effects of dispersed or "area" sources of pollution. Research has shown that storm water runoff from developed areas is highly polluted and, in some cases, the runoff can seriously degrade the quality of

34. D.L. Keyes, Metropolitan Development & Air Quality (Urban Institute working paper no. 5049-16, Apr. 1977).

35. *Id.* at 12.

36. Observed concentrations of photochemical oxidants in urban regions reveal considerable spatial variation, with suburban areas usually experiencing higher levels than central cities, *supra* note 34. Taken alone, this variation would support the view that location of individual sources does influence the nature of smog problems.

local surface water.[37] Moreover, the areal extent of paved surfaces in an urban area is believed to affect the volume and perhaps the pollutant strength of the runoff (that is, more pavement, more pollution). Since compact, high density urban areas have less paved surface *per capita* than dispersed, low density cities, one can argue that centralization produces a water quality benefit.

Unfortunately, the evidence in support of this hypothesized relationship is less than definitive.[38] In general, the data on rates at which waste materials accumulate in urban areas (and are thus available for washoff during storms) are too unreliable or have been collected with too little documentation of the relevant environmental conditions to allow a conclusion to be reached.

Even if one accepts for the sake of argument the view that waste materials are deposited on streets and elsewhere at lower rates in compact, high density urban areas, the conclusion that these areas discharge lower quantities of pollutants to surrounding waterways does not necessarily follow. Dispersed areas, with their greater use of natural drainage networks (as opposed to storm sewers) and their lower *density* (though greater total coverage) of paved surface, may allow for a degree of pollutant removal from storm water runoff before its discharge to receiving waters.[39]

Findings of a recently completed study of water quality in Sonoma County, California,[40] reveal that metropolitan-wide variations in land use intensities and arrangements have little effect on water quality, even if the unreliable data on waste accumulation rates are accepted as accurate. Thus, water quality disbenefits may be conferred equally on all development patterns. Simply stated, the evidence is too weak to allow for distinctions among development patterns on the basis of water quality. More empirical research is clearly called for in this area.

3. *Other Resource Effects*

The literature suggests two additional resource protection benefits from planning and growth control: the preservation of farmland and the conservation of water. Since compact development is by definition less land intensive, it follows logically that pressure to develop surrounding farmland will be restrained. Similarly, with fewer lawns and gardens to water in high density urban areas, demand for water will be lower. While these arguments are ap-

37. Hydroscience, Inc., An Overview of Waste Loads and Urban : Suburban Stream Quality Response (softbound report available from Nat'l Technical Information Service, Springfield, Va.) (Aug. 1975).

38. D.L. Keyes, *supra* note 34.

39. *Id.*

40. Association of Bay Area Governments, Integrated Land Use/Air Quality/Water Quality Control Study for Sonoma County, California (softcover report, limited copies available from EPA Water Planning Division, 401 M. St., S.W., Washington, D.C. 20460) (1976).

pealing, their significance as rationales for growth control must be placed in perspective.

The loss of farms in metropolitan areas has been a common and highly visible occurrence for several decades. Even more distressing to some is the rather perverse nature of this conversion in land use: the most fertile and productive farms are typically the most attractive to developers. (Level terrain with good drainage and the lack of dense vegetation make for equally good farms and subdivisions.) Considered from a national perspective, however, urban encroachment is of no great significance. Less than 0.1 percent of America's farmland inventory is lost on an annual basis to urbanization.[41] By comparison, 28 million acres of agricultural land, an amount equal to almost 100 years of urban conversions, were put back into production between 1972 and 1973 in response to agricultural price increases.[42]

These cold statistics do not ease the anguish for those who long for fresh vegetables and a view of contented cows—as I do. They serve rather to redefine the problem. The loss of farmland to land-extensive urban development is a local, not a national problem.[43] Where a local community determines that local agricultural land is a resource to be protected (by whatever means), the justification must be on aesthetic or psychic and sociological grounds, not nutritional ones. But even here the mere encouragement of higher density development is likely to be less effective than direct limitations on farmland conversion. On the other hand, the strict channeling of development into high density corridors separated by wedges of farmland would ensure easy access for most urbanites to fresh produce and rural landscapes.[44]

A similar conclusion can be reached for water consumption. Not only does the magnitude of conservation from compact development seem modest on a national scale (though not necessarily on a regional scale), but the savings that should be achieved in theory lack empirical verification.[45] If one assumes that this verification will be forthcoming, however, building density would achieve

41. Economic Research Service, Our Land and Water Resources—Current and Prospective Supplies and Uses (Miscellaneous Publication Number 1290, U.S. Dept. of Agriculture, Washington, D.C. (May 1974)).

42. D.L. Keyes & G.E. Peterson, Other Urban Residuals and Natural Resources (Urban Institute working paper no. 5049-18, December 1976).

43. Some have argued that urban expansion threatens the loss of specialty crops, which can be grown only in limited environmental settings. For example, "Long Island" potatoes may no longer be available for lack of suitable environmental conditions. The loss of farmlands to urbanization in one region could have national impact.

44. Of course, there are equity problems involved in such a strategy. Why should a farmer be required to maintain his land in agricultural use when similarly situated land nearby is designated for more valuable developmental purposes? To the extent that government seeks to achieve such amenity benefits for society at large at the expense of specific landholders, by means of noncompensated regulation, issues of constitutionally protected rights may be questioned. This might pose a special problem if tax assessments reflected speculative values. On the other hand, compensation likely would be extraordinarily expensive for local governments.

45. *Supra* note 42.

water use economies by affecting that portion of consumption most sensitive to price increases—lawn sprinkling. Any serious attempt at urban water conservation, therefore, should begin with the pricing mechanism. Watershort areas will be hard pressed indeed, if the major weapon for depressing water demand is land use regulation.

II

THE COSTS OF GROWTH CONTROL

Though the purpose of this essay is to identify and document the effects of development patterns, any discussion of urban structure and form should touch upon the costs of a growth control policy, at least in passing. This, and no more, will be attempted here.

The most measurable, and perhaps the most obvious costs of land use manipulations, are those reflected in land prices. By depressing the supply of land available for development, the price of the remaining parcels will be bid upwards. This most basic example of market economics is clear in principle, but difficult to measure. Nevertheless, we now have a fairly rich collection of case studies that demonstrate the price effects of land constraints, be they natural (environmental) or artificial (social). A sample of these follows.

The effects of special policies to preserve agricultural land in Japan[46] and greenbelts in Britain[47] have been dramatic: the price of undeveloped land in Tokyo's urban zone is now between 100 and 150 times that of comparable land in the agricultural preserve; the ten-year increase in land prices in Southeast England has been estimated at over 30-fold due to land restrictions alone. A comprehensive study of land prices in Canadian cities[48] reveals that comparable building lots vary by over 40 percent between Calgary (where public policy encourages outward expansion), and both Vancouver (where mountains and water constrain growth) and Toronto (where restrictive development controls are in effect). Empirical studies of variations in U.S. housing costs[49] likewise show a positive effect of constraints on land supply (as inferred by population density)—that is, the greater the constraint on supply, the higher the cost.

These findings are not necessarily a universal indictment of urban planning and growth control. But they do underscore the necessity of

46. Information provided to George Peterson of The Urban Institute by Tatsuhika Kawashima, Japan Ministry of Construction.

47. Drewett, *Land Values and Urban Growth*, in REGIONAL FORECASTING 335 (M. Chisholm, A. Frey, & P. Haggett eds. 1971).

48. A. Derkowski, Costs in the Land Development Process (1975) (softcover report, available from Canadian Council on Urban and Regional Research, Suite 511, 151 Slater, Ottowa 4, Ontario, Canada).

49. Economic and Fiscal Costs, *supra* note 30.

allocating a sufficient supply of land with access to important destinations in the metropolitan region; otherwise, artificially induced land and housing price increases are unlikely to be avoided.

Other costs of higher density, more compact urban patterns could also be cited. A steady stream of central city residents has been flowing into suburbia for almost two decades, presumably to escape the crime, poor quality schools, and congestion of the city. On the theory that people "vote with their feet"—that their locational preferences reflect quality of life decisions—one can interpret this outmigration to indicate a lifestyle choice made by millions of families. For many, living in dense urban areas is undesirable and the cost of more compact living arrangements may be quite high. A compact development strategy imposed by the government must therefore count as a cost the loss to those consumers whose lifestyle values may be at odds with the preferences of planners or those controlling the political machinery of local government.[50]

CONCLUSION

If nothing else, this examination of our current state of knowledge has demonstrated the multidimensional nature of the rationales for growth management. We have seen that certain benefits accrue to compact development (less energy consumed for travel and, perhaps, lower levels of smog); other benefits to dispersed development (lower levels of other air pollutants); and still others to particular development characteristics that may be quasi-independent of development patterns (i.e., higher, more energy efficient building densities may be achieved with no change in area-wide population densities). For other effects, such as fiscal costs, no dramatic differences between patterns is evident. For still others, the evidence does not allow us to reach a firm conclusion (water quality) or suggests that the effects are relatively unimportant (farmland and water supply).

These are the general conclusions; what about particular applications? Undoubtedly, some will take issue with the evidence assembled and conclusions drawn, citing specific cases where the norm does not apply. I acknowledge a rather broad application of *ceteris paribus*. Local environmental conditions or particular tax-sharing arrangements between local and state governments or unusual resource requirements may well favor certain development characteristics over others. Some communities, for example, have limited the amount of paved surface (typically by zoning for large lots) to reduce storm water runoff in watersheds that may be subject to flash floods or severe problems of erosion. Numerous other examples of conceptually sound, wisely applied development controls could be cited.

---

50. A small but significant backflow is evident in some metropolitan areas, but we cannot cite this as evidence that most urban ills have been cured.

In general, however, citizens would be well-advised to approach the claims of planners and special interest groups with considerable skepticism. Seldom can all of the advertised benefits of a particular metropolitan-wide development pattern be supported by empirical evidence. "Sprawl" is an emotionally charged and poorly defined slogan bandied by growth control advocates. If sprawl means dispersed or peripheral development within metropolitan areas at low population densities, then we must conclude that restrictions on sprawl will produce few, if any, benefits for society at large. On the other hand, whether net benefits are conferred on the local populace will depend on local objectives and local conditions. A careful identification and, where possible, quantification of costs and benefits and an examination of equity considerations should accompany every proposal for controlling growth. Resource allocation choices are rarely simple and are never easy, but citizens must demand nothing less than timely, accurate information with which to make these decisions.

Human Rights and Dissent