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# **Who pays for Sprawl?**

**The Economic, Social, and Environmental  
Impacts of Sprawl Development**

**April 1998**



Chesapeake Bay Program

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*Prepared by*  
Redman/Johnston Associates, Ltd.

*on behalf of the*  
Chesapeake Bay Program's Land, Growth, and Stewardship Subcommittee  
and the  
Chesapeake Bay Local Government Advisory Committee.

*Members of both groups provided valuable insight and comments  
to the text and bibliographies.*

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# The Chesapeake Bay Program

Recognizing the effect local decisions have on the health of the Chesapeake Bay, its rivers and streams, the Chesapeake Bay Program adopted two new initiatives in 1996 — the *Local Government Participation Action Plan* and the *Priorities for Action for Land, Growth, and Stewardship in the Chesapeake Bay Region*. The Chesapeake Bay Local Government Advisory Committee developed the *Local Government Participation Action Plan* to encourage local governments to broaden their participation in Chesapeake Bay restoration and protection initiatives by implementing or enhancing implementation of local initiatives in three theme areas: land use management, stream corridor protection and infrastructure improvements.

The Chesapeake Bay Land, Growth and Stewardship Subcommittee developed *Priorities for Action for Land, Growth and Stewardship in Chesapeake Bay Region*. The goal of the *Priorities for Action* is to encourage sustainable development patterns, which integrate resource protection, community participation and economic health. Adopted by the Chesapeake Executive Council, which consists of the governors of Maryland, Pennsylvania, and Virginia; the mayor of the District of Columbia; the chair of the Chesapeake Bay Commission, a tri-state legislative body; and the Administrator of the U.S. Environmental Protection Agency representing the federal government, the *Priorities for Action* has six objectives, including one that encourages efficient development patterns. These patterns are represented in compact, contiguous, transit-oriented, and mixed-use development which is ecologically-sound.

The Chesapeake Bay Program is considered the national and international model for estuarine restoration and watershed protection.

# Introduction

For nearly fifty years, changes in the patterns and densities of land use in the Chesapeake Bay watershed have reflected a national trend — a migration of businesses and residents from urban centers to new rural and suburban developments. This migration has blurred the once distinct urban and rural landscape of the Chesapeake Bay region. Economists, citizens, environmentalists, local governments and others have begun to realize the economic and environmental costs associated with this sprawl pattern of development.

Sprawl affects us all. Local governments are affected by increasing costs of services, migration of businesses, and loss of a community identity. Higher taxes, longer commutes and loss of a sense of place are some examples of how landowners are affected by sprawl. Sprawl also affects the Chesapeake Bay, its rivers and streams. The Chesapeake's fragile ecosystem is negatively impacted by sprawl development's effect on sensitive areas such as wetlands, forests and stream corridors.

A growing number of articles are surfacing on how sprawl impacts our economy, environment and community. For instance, a recent Washington Post article reported on the effects of sprawl on Prince William County, Virginia. Officials in the County estimated that the costs of providing public services to a new residential home exceeds what is collected in taxes and other fees by \$1,600 (Shear and Casey).

There are alternatives to the patterns of development that create sprawl including establishing urban growth boundaries, clustering development, and creating attractive infill developments. Although these alternatives reduce the impact of sprawl development, they have not been fully embraced by land use decision-makers, citizens, landowners and others.

The following literature review synthesizes recent regional and national studies which demonstrate the economic, social and environmental consequences of sprawl development to local governments, residents, developers, and farmers in the Chesapeake Bay watershed.

---

## **Sprawl:**

**"To develop irregularly...  
To spread out carelessly  
or awkwardly."**

-Webster's New Collegiate  
Dictionary

**"...an inefficient use of the  
land, difficult to service  
with infrastructure and  
transportation, requiring  
extensive use of  
automobiles, and  
consuming large areas of  
land."**

- 2020 Panel Report

**"...a specific form of  
suburbanization that  
involves extremely low-  
density settlement at the  
far edges of the settled  
area, spreading out far  
into previously  
underdeveloped land."**

-Anthony Downs  
The Brookings Institute

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## What is Sprawl?

Though frequently discussed, sprawl is a term without a commonly accepted meaning, interpreted in a variety of ways with only subtle differences. At times, the definition may be quite specific. For example, *Cost of Providing Government Services to Alternative Residential Patterns* defines sprawl as development with a density less than 3 dwelling units per acre (CH2M-Hill p. 1). For the purpose of this work, sprawl assumes a broader meaning: it is low-density, land-consumptive development that separates jobs from homes, encourages the reliance on the automobile, and underutilizes existing community facilities and public services.

## What Causes Sprawl?

Since few agree upon the definition of sprawl, it is not surprising that there is also little consensus about the origins of the development pattern. According to Anthony Downs of the Brookings Institute, sprawl can be attributed to five factors:

- Occupancy of single-family homes in wide-spreading, low-density developments.
- Universal use of private automobiles.
- Dominance of scattered low-density workplaces, most of them providing convenient free parking.
- Fragmentation of powers of governance over land use.
- Reliance on the “trickle-down” economic process to provide housing for low-income households (qtd. Young p. 6).

One prominent cause of urban sprawl is the nation’s reliance on automobiles. As the standards of living rose in the post-war era, many families were able to afford an automobile and, therefore, a house located a considerable distance from work.

The universal use of automobiles in the United States led to sprawl by allowing the distance between jobs, homes, and shopping centers to increase, while still remaining connected. As sprawl increases, so does the need for automobiles; it is a relationship in which one perpetuates the other.

---

**“If we continue to rely on highways and automobiles, and if we continue with the same patterns of growth, it is virtually impossible that the quality of life in the region will get anything but worse.”**

**(2020 Panel Report p.18)**

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## What are the Effects of Sprawl?

Characterized by low-density development, sprawl disperses residential, employment, and retail centers over a broad geographic area and requires long trips by automobile. As the Bank of America report *Beyond Sprawl* illustrates, sprawl creates decentralized employment centers, housing that pushes deeper into agriculture and environmentally sensitive lands, an increased dependence on automobiles, and an isolation of older communities (p. 4). The migration to suburban and rural areas associated with sprawl has stressed natural resources. The Maryland

Office of Planning projects the following growth and development trends for the state:

- 21% - The projected population increase by the year 2020.
- 20% - The decline in city population due to out-migration to suburban areas between 1970 and 1990.
- 30% - The increase in number of households by the year 2020 as a result of shrinking household size.
- 36% - The average increase in the size of lots created in new development since 1985.
- 100% - the projected increase in land consumed by development by the year 2020 if the current trends continue.

These patterns of growth and the costs they entail are threatening the identity and blurring the character of communities throughout the Chesapeake Bay watershed. Sprawl touches upon *every* aspect of our communities — family life, business and economic development, housing, farming and forestry, local governance, natural resources, and the Bay.

## Cost of Sprawl to Local Governments

Local governments are one of the groups that sprawl affects most directly. It impacts the socio-economic conditions, business climate, and infrastructure costs of a jurisdiction. Although adequate public facilities ordinances and impact fees are tools used by local governments to minimize the impacts of sprawl, they do not cover the full costs of such development. In many cases, the impact fees paid by the developers remain constant whether the new home is located two miles or ten miles from a treatment plant, though the costs of providing services increase with distance, leaving the rest of the bill to be paid by the local governments (Kasowski p. 1). Taxes, the main source of revenue for local governments, also do not cover the development expenses. In Loudoun

County, Virginia, the average family paid only \$1,280 in taxes, but received \$5,800 in services each year, covering only a quarter of the costs (Kinsley and Lovins).

### **Paying for Growth...Estimated additional local government expenditures required to meet needs of 400,000 new Wisconsin residents by the year 2010.**

Development Pattern	Cost (billions)
Suburban low-density significant "leapfrogging"	\$4.4
Dispersion beyond suburbs, but minimal "leapfrogging"	\$4.2
Higher density, urban containment	\$4

Source: UW-Madison Dept. Of Urban and Regional Planning. Costs include transportation, public works, public safety, culture, recreation, and government.

(Hulse p. 5)



## Social Costs

Sprawl also has social implications that local government officials must face. According to Henry Richmond of the National Growth Management Leadership Project, as middle and upper class residents flee the city for the suburbs, poverty becomes concentrated in urban areas and leads to a host of problems. Dealing with social problems left to fester in older neighborhoods costs time and money. “For example, concentration of poverty makes urban schools dysfunctional, and lack of education becomes a major factor in rising crime rates” (Young p. 10).

## Effects on Business Climate

Sprawl affects the business climate of a community by reducing the quality of life in an area while making other regions more attractive to potential business owners and employees. The business climate of an area is key: local governments rely on businesses to provide tax revenue to the area since business typically requires relatively fewer government services. Businesses may avoid an area characterized by sprawl because of the higher direct business taxes levied to compensate for sprawl’s side-effects. On the other hand, businesses may follow the flight of residents from cities and leave their downtown locations. Chicago is feeling the effects of such urban disinvestment as businesses and residents gravitate to the suburbs, leaving a growing problem of joblessness and poverty behind. Between 1980 and 1990, 81 percent of the region’s new jobs went to suburban locations (McMahon).

A geographic mismatch between workers and jobs may also arise as a result of sprawl. This leads to an increase in labor costs as worker productivity declines. As jobs and people spread out, the commuting time increases and workers cannot reach new jobs because their homes are simply too far removed from employment centers (*Beyond Sprawl* p. 6).

## Infrastructure Costs

Many studies show that infrastructure expenditures prove to be sprawl’s highest cost to local governments. The price tag of building and maintaining a single parking space can be \$10,000 to \$15,000 over the course of 20 years (CBF/EDF p. 5). Though the actual plans for managing growth vary from area to area, the results all point in the same direction — planned growth is less expensive than unplanned, sprawl-type growth.

Consider the following findings:

- The use of compact, higher density development has been shown to produce a **4% to 8% savings** in capital costs of infrastructure at the regional and state levels (CH2M-Hill p. 5-4).
- *The Search for Efficient Growth Patterns* (Duncan et al. 1989) found a **30% savings** in capital costs for roads and utilities with a planned configuration as opposed to scattered development (*Impact Assessment of DELEP* p. III-8).

- Studies in Florida, New Jersey, California, and Minnesota have reported average infrastructure savings related to planned growth to be:
  - **25%** for roads
  - **5%** for schools
  - **15%** for utilities (*Impact Assessment of DELEP* p. 9).
- James Frank's well-known literature review, *The Costs of Alternative Development Patterns*, determined that the capital costs for streets, sewers, water, storm drainage, and schools could be **reduced by \$17,000 per dwelling unit**, "by choosing a central location, using a mix of housing types in which single-family units and townhouses constitute 30 percent of the total and apartments 70 percent, and by planning contiguous development instead of leapfrogging" (Frank p. 39).
- *Fiscal Studies*, a report prepared for the Governor's Commission on Growth in the Chesapeake Bay Region in 1991, calculated a **\$1.2 billion savings** in infrastructure costs relating to, "the efficiencies of targeting much of the projected growth to previously developed and/or adjacent growth areas" (p. 109).

### Savings in Infrastructure Costs as a result of Planned Development

	<b>New Jersey</b> (Over 20 yrs.)	<b>Delaware<sup>2</sup></b> <b>Estuary</b> (Over 25 yrs.)	<b>Maryland<sup>3</sup></b> (Over 20 yrs.)
<b>Roads</b>	<b>\$740 million</b>	<b>\$31.5 million</b>	<b>\$700 million</b>
<b>Water and Sewer</b>	<b>\$440 million</b>	<b>\$17.4 million</b>	<b>\$200 million</b>

1. *Impact Assessment of the New Jersey Interim State Development and Redevelopment Plan, Report II* (1992).
2. *Impact Assessment of DELEP CCMP versus STATUS QUO on Twelve Municipalities in the DELEP Region* (1995).
3. Burchell 1991[a].

Robert W. Burchell has conducted numerous studies to measure the economic costs of sprawl. To the left, three of Burchell's major studies summarize the reductions in infrastructure costs as a result of planned development.

Studies show that redirecting growth to areas with established infrastructure systems, as opposed to rural areas where infrastructure does not exist, results in significant savings. As people move out of areas with existing infrastructure,

services must be extended. For example, the exodus of residents from urban centers caused one Maryland county to close over 60 existing schools, only to build the same number in outlying areas. The cost to the county totaled \$500 million over a 20 year period (McMahon p. 4).

The density of development also impacts the cost of providing infrastructure. The National Association of Home Builders determined that as housing densities increase, the unit cost for

infrastructure costs decrease (*2020 Panel Report* p. 31). According to the 2020 Panel, high-density development, as opposed to sprawl, could save \$10.8 billion (in 1988 dollars) in road construction costs by the year 2020 (p. 33)

Burchell's studies also show infrastructure savings with higher density development patterns. For example, cost to serve single-family development in Maryland to the year 2020 is estimated to be twice as much as to serve townhouses with a higher density, and three times as much as the cost of apartments (Burchell 1991[a] p. 13).

## Cost of Sprawl to Developers

Although developers would appear to benefit from sprawl, low-density development proves to be costly in impact fees and infrastructure costs. The costs increase because low-density development generates a need for additional miles of roads, curbs, sewer and water lines to serve new development.

### Impact Fees

Impact fees are charges placed on new development to pay for a proportionate share of infrastructure costs resulting from growth. As of 1991 in Maryland, impact fees were being used by a total of 9 counties (Burchell 1991[a] p. 97) bringing in over \$10 million per year. This amount is expected to continue to rise as more impact fees are initiated. As of 1991, Calvert County, Maryland imposes a school impact fee of \$3,000 per single-family dwelling unit and a \$1,000 to \$2,000 fee for attached units (p. 98). Jim Nicholas, professor of Urban Planning and an economist at the University of Florida, found fees to be as high as \$50,000 per single-family home for schools, roads, and sewers. He determined the average impact fee to be \$10,000, growing at a rate of 20 percent annually (Kasowski p. 2).

In California, contiguous development has been shown to incur reduced impact fees. Public fees for new development cost \$15,000 to \$30,000 per dwelling in the suburban sprawl areas surrounding Sacramento. In contrast, a 25 unit condominium project located within the city required only \$6,500 in fees because roads, sewers, and water system already exist (Mogavero p. 1).

### Infrastructure Costs

The cost of infrastructure is an expense a developer will have to pay for directly or indirectly through impact fees. Concentrated development and taking advantage of existing facilities has been proven to defray the costs of providing infrastructure. Higher density development is cheaper to build; dwellings built at a density of 5 units per acre cost \$5,000 to \$20,000 more to build than development at a density of 15 to 25 units per acre (Mogavero p. 2).

A comparison study of conventional rural subdivision design versus clustered rural subdivision design at Remlik Hall in Middlesex County, Virginia showed concentrated development to be cost effective (Mauer p. 27). The clustered plan reduced infrastructure costs by \$525,000 for the site (see table). A substantial portion of the savings came from a 53 percent reduction in road length over the conventional subdivision plan. In addition to the cost benefits of the concentrated development, the clustered plan “preserves rural character, field and shoreline vistas, and large acreages of forested and workable farmland” (p. 29).

<b>Remlik Hall Farm Infrastructure Costs</b>		
	<b>Conventional Plan</b>	<b>Cluster Plan</b>
<b>Engineering Costs</b>	<b>\$79,600</b>	<b>\$39,800</b>
<b>Road Construction Costs</b>	<b>\$1,012,500</b>	<b>\$487,500</b>
<b>Sewer and Water Costs</b>	<b>\$25,200</b>	<b>\$13,200</b>
<b>Total</b>	<b>\$1,117,300</b>	<b>\$540,000</b>
<b>x .10</b>	<b>\$111,730</b>	<b>\$54,050</b>
<b>GRAND TOTAL</b>	<b>\$1,229,030</b>	<b>\$594,550</b>

Figures by Land Ethics, Inc.

(Mauer p.31)

*The Impact Assessment of the New Jersey Interim State Development and Redevelopment Plan* revealed significant savings in infrastructure costs — \$1.38 billion over the course of 20 years.

### **Planning will save New Jersey... Infrastructure Savings Over the Next 20 Years**

Roads	\$740 million
Water	\$61 million
Sewer	\$379 million
Schools	\$200 million
<b>TOTAL</b>	<b>\$1.38 billion</b>

(Impact Assessment of New Jersey)

The greatest portion of the savings arises from road costs. A reduction of 1,600 lane-miles contributes to a \$740 million savings. Concentrated, planned growth has also been shown to reduce the costs of water, sewer, and schools for new development (see table).

Higher densities of development decrease the construction costs. The 2020 Panel found that, “at densities of one unit per 1-5 acres, approximately \$3,500 in site development costs can be saved for each one unit increase in density.” Furthermore, there is potential for \$1,800 in development costs to be saved for each one unit increase in density from 2 to 5 units per acre and

\$400 for each one unit increase in multifamily dwellings (2020 Panel Report p. 32)

Sprawl increases the costs of new development by creating the need for infrastructure extension. Concentrated development is more cost efficient because it uses the existing infrastructure. For example, James Frank found development located 10 miles from central services added \$15,000 per dwelling to the capital costs (Frank p. 39)

## Cost of Sprawl to Citizens

Residents of the sprawling subdivision which characterize today's suburban landscape may perceive neighborhoods as symbols of affluence and security, but with those perceived benefits come substantial costs. Sprawl costs *everyone* — from the owners of a three acre lot ten miles out of town, to the tenant of an inner city apartment building. Increased taxes, commuting time, automobile maintenance, and a reduction in the quality of life are some of sprawl's "hidden costs."

### Taxes

Although suburbs are perceived to be low-tax locations, and may be in the short-term, the hidden costs of low-density development are passed on to all taxpayers. One major expense is the building and maintenance of infrastructure improvements serve outlying areas. A Maryland study found that residents will pay \$10 billion by the year 2020 to construct schools, roads, and sewers to serve sprawl development (McMahon p. 4).

In McFarland, Wisconsin, it was estimated that all local residents paid an additional \$30 in taxes to cover police, fire, schools, and other services for each \$1 million in new construction (Hulseley p. 5). The City of Franklin, Wisconsin found every new single-family detached home to cost taxpayers \$10,607 to serve (p. 6). Although the residents of the new sprawl-type developments may enjoy the benefits of a large front lawn and privacy, but they are also paying for their space, and passing the costs onto other taxpayers.

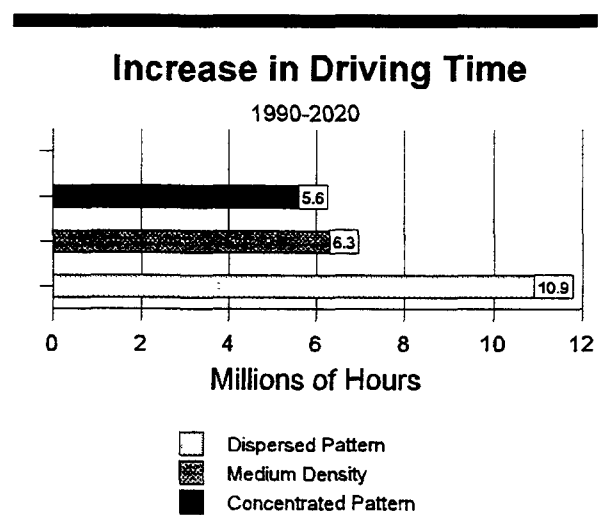
### Housing Costs

Sprawl development can also increase the cost of homes. Developers who pay for extensions of roads, water and sewer infrastructure to support sprawl development patterns pass on the costs to homebuyers. In fact, the cost of infrastructure in new sprawl developments can amount to half the cost of development (CH2M-Hill p. 168). In addition, the cost of sprawl development also reduces the amount of affordable housing available.

## Commuting Time and Automobile Costs

As employment centers and homes spread farther from each other and established urban centers, the distance between activity centers increases, necessitating more automobile trips. Commuting times have risen 13 percent between 1980 and 1990 for residents of 10 cities in the Alameda/Contra Costa, California area (*Beyond Sprawl*). In the Washington D.C. area, the average speed of the beltway was 47 miles per hour in 1981, but by 1988 the average speed slowed to 23 miles per hour (2020 Panel Report p. 24).

Experts expect that if sprawl continues at its current rate, commuting times will continue to rise as the reliance on the automobile becomes more pronounced. Burchell's *Technical Studies* determined that for the Chesapeake Bay Region, a dispersed development pattern will generate 10.9 million hours of driving time from 1990 to 2020 (p. 69). In contrast, concentrated development is expected to only produce 5.6 million hours of driving and medium-density 6.3 million hours (see chart). Between 1970 and 1995, the Chesapeake Bay watershed experienced a 27 percent increase in population while the amount of vehicle miles traveled (VMT) jumped by 106 percent. Population projections expect a 12 percent rise by the year 2010, but VMT is predicted to rise another 39 percent during the same period (Chesapeake Bay Program's Environmental Indicators). These traffic delays not only cost time, but money. In the San Francisco Bay area, research estimates that \$2 billion per year is lost while sitting in traffic (Mogavero p. 2).



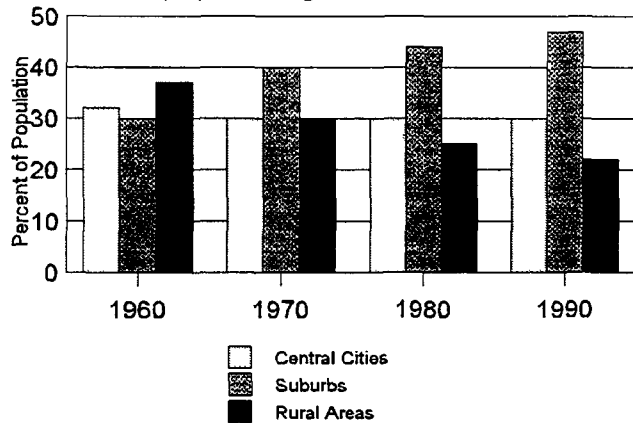
(Burchell 1991[b], p.69)

The increased travel time due to sprawl makes the automobile a necessity for the suburban resident, but the flexible mobility that this form of transportation provides is costly:

- **16% to 20%** of household expenditures in the United States go to auto-related expenses (Young p. 7).
- The average Californian spends **1 out of every 5 dollars** buying or maintaining automobiles (*Beyond Sprawl* p. 6).
- **\$4,000** per household annually could be saved if the number and distance of trips were reduced, which would allow families to own fewer cars (CBF/EDF p. 6).

## Population Distribution

Since 1970, more people are living in the suburbs than in the cities.



- If the price of gasoline reflected the true social and environmental costs of utilizing a car, gasoline would cost between \$6 to \$8 per gallon (CBF/EDF p. 5).

## Quality of Life

Residents move into new communities characterized by low-density development in search of a better life — safer streets, more privacy, a larger house — but their quality of life does not always improve. Studies show that the population of suburbs, characterized by low-density development, has been steadily rising in the past few decades

(see chart). Although many seek distance from the cities, sprawl development is not self-supportive and contact with urban centers is still necessary. As development spreads farther from central places, automobile travel and commuting time increases. This commuting time poses psychological consequences. Roger Ulrich of Texas A&M said the commuter, “grows more and more tense as he drives...and then spends the beginning of his work day trying to unwind” (Young p. 11). Commuting not only creates stress, but lowers worker productivity as well.

The long commutes for suburban residents not only affects those making the drive, but also the children that they leave behind. Time spent in the car commuting is time that children lose with parents at home. Sylvia Ann Hewlett, author of *When the Bough Breaks: The Costs of Neglecting our Children*, concludes that children have lost approximately 12 hours per week of parental time over the last 30 years (Mogavero p. 2). A portion of this lost parental time is from the long commutes resulting from dispersion of residential areas and jobs.

One *intangible* cost of suburban sprawl is the loss of a “sense of place.” Many of the new housing developments that sprawl creates are virtually identical and lack those traits which give older neighborhoods their traditional, but individualistic look, i.e., shallow setbacks, narrower streets, and varied architectural styles and types. Kenneth T. Jackson, author of *Crabgrass Frontier: The Suburbanization of the United States*, notes that a major characteristic of suburbs, beginning with those constructed in the post-war era, is their architectural similarity “contributing to the disappearance of distinctive regional styles in American architecture.” James Howard Kunstler discusses the perception of a

**“...as the middle class vacates older urban (and now suburban) neighborhoods, they leave a concentration of poverty and poor children with fewer role models for economic success...”**

(Mogavero p.2)

loss of community in *Home from Nowhere*: “American’s sense that something is wrong with the places where we live and work and go about our daily business. We hear this unhappiness expressed in phrases like ‘no sense of place’ and ‘the loss of community’” (p. 43).

Sprawl profoundly affects those who reside in the central cities and established suburbs. They do not experience the positive aspects of sprawl, but instead remain isolated in the deteriorating central places. The quality of life declines for these residents as they experience economic segregation and a loss of social stability created by the void of middle-class residents who have migrated to the periphery. Studies reveal that, “low-density development has led to an intensification of residential segregation by race and social class” (Nelson p. 7). Central cities have a high concentration of poverty and unemployment because many of the residents cannot afford to own an automobile and have, as a result, lost access to the jobs now concentrated in the suburbs (*Beyond Sprawl* p. 7).

Sprawl development is the result of American prosperity, that is, the ability to afford an automobile and own a home a considerable distance from the work place. As time progresses and sprawl continues to consume our countryside and degrade our cities, residents of older cities and new developments alike are becoming increasingly aware of the harmful effects of this development pattern.

## Cost of Sprawl to Farmers

Agriculture is a staple of the American economy at both the national and international level — the grain belt alone accounts for 25 percent of the world’s grain output. For the Chesapeake Bay region, the importance of the agricultural industry cannot be overlooked. In 1987, the market value of agricultural products sold was over \$3 billion in Pennsylvania, over \$1.5 billion in Virginia, and approximately \$1 billion in Maryland (*1987 Census of Agricultural*, vol. 1, pts. 20,38,46). Despite agriculture’s economic importance, prime farmlands are not spared from sprawl development. For example, in Maryland where agriculture accounts for 14 percent of the State’s gross product, there was a net loss of 147,400 acres of agricultural lands between 1971 and 1988. If current trends persist, the State is predicted to lose an additional 333,000 acres — a 13 percent reduction in agricultural land — by the year 2020 (Burchell 1991[b] p. 39).

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**“Agriculture is not only an important component of the State’s economy, it is also an important resource for the future of a state whose population is expected to increase from 4.7 to 5.8 million people in the next several decades.”**

(Burchell 1991[b], p.38).

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## Loss of the Industry Land Base

A decline in farmland acreage is not only a characteristic of Maryland. The American Farmland Trust released a March 1997 report entitled *Farming on the Edge* that declares the Mid-Atlantic



Coastal Plain of Delaware and Maryland is the ninth most threatened agricultural region in the nation. Urban growth from the Wilmington-Newark and Washington-Baltimore regions is endangering 60 percent of the area's best farmland. The American Farmland Trust determined that, on the national level, 4.3 million acres of prime farmland were destroyed between 1982 and 1992. In addition, it states that 79 percent of the nation's fruits, 69 percent of the vegetables, and 52 percent of the dairy products are produced on land seriously threatened by sprawl (Sorensen et. al.).

Other findings/projections include:

- In the Delaware Estuary region, **2,350 acres of prime farmland could be saved** over a 25 year period by initiating concentrated, planned development (*Impact Assessment of DELEP* p. 10).
- Sprawl development will **consume 108,000 acres** of mostly high-quality agricultural land by 2010 in New Jersey. Planned development will save 30,000 acres during the same period, without a loss in "prime" or "marginal" farmlands from 1990 levels (*Impact Assessment of New Jersey* p. 12).
- The Central Valley of California experienced a **permanent loss of a half-million acres** of productive farmland between 1982 and 1987, including the irreplaceable and highly productive coastal farmlands and land in micro-climates supporting unique agricultural products (*Beyond Sprawl* p. 7).
- Literature has shown that planned development consumes **40% less** agricultural land than low-density sprawl (*Impact Assessment of DELEP* p. III-22).

## Residential Intrusion and Conflicts

Any one of a number of land use conflicts with farming activity can arise as a result of sprawl development. Land use conflicts, or nuisances, frequently cited by farmers include: residential complaints (and often law suits) over farm odors and flies, agricultural noise, dust, chemical and pesticide spraying; livestock predation by domestic pets, especially dogs; indiscriminate refuse disposal and littering; trespassing, theft and vandalism; significantly altered traffic patterns and farmland removed from production as roads are widened to accommodate new growth. Farmers can also be held financially responsible for any damage caused to residential areas by wandering farm animals. Coping with these nuisances has proven financially burdensome for most farmers (RJA).

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**"Clustering development is an effective way to allow development and also save farmland and open space in rural areas undergoing suburbanization. And as far as the Chesapeake Bay is concerned, farmland is preferable to developed land. Properly managed farmland minimizes polluted runoff and maintains the land's permeability to stormwater."**

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( Mauer p. 27)

## **Loss of Farm Support Services**

The agricultural industry depends on farm support services for its survival. As more and more farmers and farmland are displaced by development, fewer farmers and less farmland are left to retain the critical mass needed to maintain farm support services. Farm implement dealers, seed feed and fertilizer sales companies, and grain elevators depend upon a minimum level of business generated by area farmers. As farmers sell out and business levels decline, those engaged in the farm support services industry move on to more agriculturally intense communities or retire. As support services vanish from the community, existing farmers find it increasingly difficult to farm efficiently and cost effectively.

For example, *Alternative for Future Growth in California* determined that for the Central Valley region in California, low-density development could reduce direct agricultural commodity sales by \$1.13 billion per year as opposed to more efficient patterns of development. Related sales of suppliers, processors, and other agricultural support businesses would decline by \$1.7 billion per year. By the year 2040, the cumulative loss of direct and indirect agricultural sales for sprawl development in the Central Valley versus concentrated growth would be \$72 billion (*Alternative for Future Urban Growth in California's Central Valley*). Sprawl's implications for the agriculture industry are far-reaching.

## **Loss of Productivity**

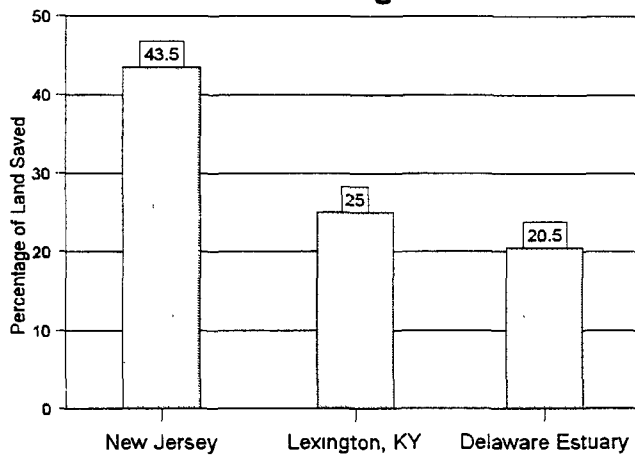
Air pollution results from increased car and truck emissions that occur due to longer commutes and higher auto use. This pollution resulting from sprawl is detrimental to agricultural productivity. According to the Agricultural Issues Center at the University of California-Davis, ozone-pollution has been shown to reduce crop yields by 30 percent and incur a cost of \$200 million per year (*Beyond Sprawl* p. 7).

Sprawl development directly affects the agriculture industry by robbing farmers of prime land and by causing financial losses that can be felt throughout the agricultural support businesses. Indirectly, sprawl-induced pollution lowers agricultural productivity. The current trends in development are threatening one of the most prominent industries in the region, as well as the nation.

# **Cost of Sprawl to the Environment and the Chesapeake Bay**

**S**prawl costs local governments and landowners money, but equally importantly, it negatively impacts the health of the environment. Low-density, land-consuming development compromises the land, air, and water quality which ultimately affects the Chesapeake Bay, its rivers and streams.

### Amount of Land Saved by Growth Management



Sources: *Impact Assessment of New Jersey* ( p. 11), *Impact Assessment of DELEP* (p. 9)

## Land

The rate at which land is being developed eclipses the rate of population growth. In Maryland, the population grew 29 percent between 1970 and 1995. During roughly the same time period (1973-1990), residential development increased 79 percent and low-density residential development grew by 79 percent (Chesapeake Bay Program's Environmental Indicators, July 1996). For the Chesapeake Basin as a whole, the population increased by almost 50 percent between 1950 and 1980. The amount of residential and commercial land jumped 180 percent during the same 30 year period (2020 Panel Report p. 29).

Sprawl's consumption of the land will continue unless growth measures are enacted. It is estimated that Maryland will consume as much land in the next 25 years as it did in the State's first 300 years if current development trends continue (McMahon p. 4). Numerous studies have shown that planned growth reduces the amount of land developed (see chart). Findings from three reports project a 20-45 percent reduction in land consumption with growth management over a 20 year period.

Environmentally sensitive areas such as wetlands, forests and other kinds of sensitive lands are impacted by low-density development.

- The loss of wetlands in the mid-1950's to the late-1970's was 24,000 acres for Maryland, 63,000 acres for Virginia, and 28,000 acres for Pennsylvania (2020 Panel Report p. 29).
- More recently, from 1982 to 1989, wetland losses in Virginia were 17,815 acres and in Maryland were 4,882 acres. Pennsylvania experienced a net gain of 4,683 wetland acres (Tiner p. 33).
- In the last 200 years, 95 percent of California's wetlands have been destroyed (*Beyond Sprawl* p. 8).
- Today, although many forest have returned or have been replanted, less than 60 percent of the Chesapeake Bay

**"Forests are essential to the health of Maryland's natural environment, particularly the quality of the Chesapeake Bay, and are an important component of the State's economy."**

(Burchell 1991[b] p.46)

watershed remains forested. Forests are under pressure from urban expansion, lost to suburbanization at an average rate of 100 acres a day (*Making the Connection* p. 101).

Concentrated, planned development has proven to preserve wetlands and other sensitive lands containing forests, steep slopes, and critically sensitive watersheds. The *Impact Assessment of the New Jersey State Interim Development and Redevelopment Plan* indicates that 80 percent of the fragile environmental lands — a savings of 30,000 acres — could be protected by the implementation of growth management techniques (p. 12). In the Delaware Estuary, 1,075 acres of fragile lands could be saved by avoiding sprawl, a 27 percent reduction (*Impact Assessment of DELEP* p. 10). Literature reveals that planned growth requires only 17 percent of the level of development on fragile lands as compared to traditional sprawl development (p. III-22).

Protecting environmentally sensitive areas is vital to the health of the Chesapeake Bay. Forested lands are very beneficial to the Bay's ecosystem by absorbing surface run-off and preventing sedimentation (Burchell 1991[b] p. 46). Each individual tree plays an important role in protecting the environment. The North America Forestry Association estimated that the annual monetary value of the environmental benefits of a 50 year old tree provides:

- \$75 in soil erosion and storm water control
- \$75 in wildlife shelter benefits
- \$73 in air cooling services
- \$50 in air pollutant controls

Over the course of 50 years with a 5 percent interest rate, each tree proves to be quite valuable, worth \$57,151 (Coughlin pp. 2-23). Wetlands are also important in improving the water quality by buffering against excessive nutrients, sediments, and pollutants (*2020 Panel Report* p. 29). In addition, they provide habitat supporting a variety of plant and animal species. In the Chesapeake Bay, between 80 percent and 90 percent of the total seafood harvest depends on wetlands during some life stage (*2020 Panel Report* p. 29).

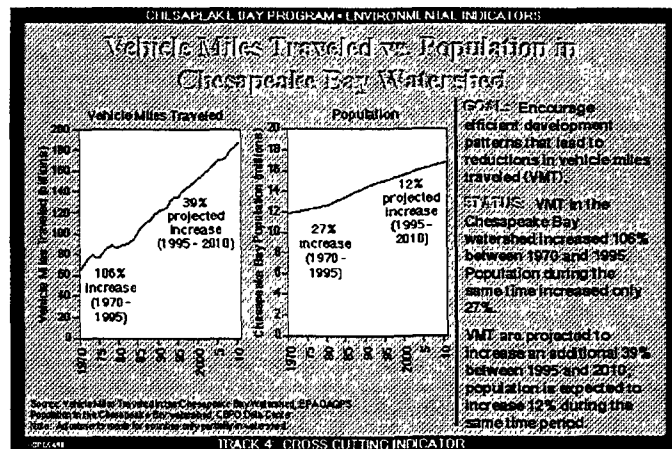
## Air

The increased dependency on automobiles, generated by sprawl, greatly affects air quality. The increased amount of vehicle miles traveled (VMT) resulting from low-density sprawl development contributes additional pollutants to the air. Research concludes that one-third of all air pollutants are traceable to automobile emissions (*Beyond Sprawl* p. 8).

The increase in VMT has serious environmental implications as well. Air quality could be significantly improved by a 10 percent annual reduction in the growth rate of VMT. By 2020, this would translate into a reduction of 19.2 tons per day for both ozone and oxides of nitrogen, as well as a 287 ton per day decrease in carbon monoxide (Burchell 1991[b] p. 31).

Growth generates more air pollution as automobiles become more prevalent in an area. Las Vegas has been known as the fastest growing city in the country throughout the decade, and because of this growth, the city is now among the five metropolitan areas with the worst air quality. Air pollution cannot be contained within the boundaries of a city or state, but instead affects large areas in what are called "air sheds". Salt Lake City has experienced the side-effects of sprawl-generated air pollution from Los Angeles.

The pollutants travel from Los Angeles becoming trapped by the Wasatch Mountain Front and cause a decline in air quality for the Salt Lake Valley (Egan p. 20).



Findings indicate that a continuation of current development trends will lead to the further decline of air quality. These trends do not have to persist. A concentrated pattern of development has been shown to reduce potential air pollution from automobile emissions twice as much as a dispersed pattern.

## Water

Decisions made on land ultimately affect the water. The 64,000 square mile Chesapeake Bay watershed has a vast land area that drains into thousands local streams, rivers and eventually the Chesapeake Bay. The run off from the large land area in the drainage basin flows into the relatively shallow Bay; making it extremely difficult for the Bay to dilute pollutants. Clearly, land use decision either help to protect local streams and the Bay, or dramatically harm them. The patterns and densities of development and what we apply on the land has a profound influence on the health of local ecosystems and the Bay.

The increase in impervious surfaces accompanying sprawl — roads, parking lots, rooftops — prevents the infiltration of rainfall. This significantly hinders the ground's ability to filter the contaminants from rainfall, increases the volume and pace of run-off, and has a significant impact on the health of local streams and rivers. A one acre area of parking lot creates 16 times more run-off than a meadow of the same size. Run-off washes the pollutants off of impervious surfaces, adding them to the contaminants already present in the rainwater, all of which drain into the Chesapeake Bay (Mauer p. 4).

Recent studies indicate that there is a direct correlation between the percentage of impervious surface and the quality of a stream ecosystem. In fact, once total impervious cover exceeds 10 percent, a stream ecosystem is profoundly influenced. Profound influences to a stream ecosystem include but are not limited to: increased flood peaks, more frequent bankfull flooding,

lower stream flow during dry weather periods, widening of the stream channel, increased streambank and channel erosion, increased risk of shellfish closing, decline in fish habitat quality (Pelley p. 464).

### Key Impacts of Alternative Development Patterns on the Chesapeake Bay and its Watershed from 1990-2020

	Dispersed Pattern	Medium Density	Concentrated Pattern
Increase in sedimentation	5.7 million tons	4.1 million tons	3.4 million tons
Increase in nitrous oxides	1.6 million pounds	.10 million pounds	.08 million pounds
Increase in water consumption	108.8 billion gallons	84.6 billion gallons	70.7 billion gallons

(Burchell 1991[b] p.5)

Concentrated development can curb the negative effects of growth. Planned growth has been shown to reduce the amounts of nutrients, like nitrogen oxides, from entering the Bay and its tributaries. Excess amounts of these nutrients increase the potential for algae blooms that cloud the water and deplete the oxygen needed by aquatic organisms.

Sediment run-off is also decreased by growth management measures as these leave more land in a natural state (see table). A concentrated pattern would contribute 2.4 million tons of sediment less than a dispersed pattern (Burchell 1991[b] p. 28). A high concentration of sedimentation can smother bottom-dwelling organisms and cloud the water. Cloudy water prevents sunlight from reaching grass beds which provide important habitat for fish and other aquatic species.

Avoiding sprawl would also reduce the demand for fresh water which is developing into a severe problem for some areas of the watershed, such as the Hampton Roads region of Virginia. Solutions to inadequate water supplies such as diverting water from streams and rivers and impounding wetlands often jeopardize indigenous resources (2020 Panel Report p. 31). Water availability is a nation-wide issue, especially in the arid west around Las Vegas (Egan p. 20).

## Conclusion

Based on the information and data collected, some general conclusions can be drawn concerning our patterns of development. Clearly, the effects of sprawl are felt by the local governments, residents, visitors, farmers, developers, and fish and wildlife of the Chesapeake Bay watershed. This can take the form of financial, social, or environmental repercussions. Current sprawl development trends raise infrastructure costs, increase the burden on the taxpayers, diminish the quality of life, threaten environmental resources, and consume substantial amounts of land. Therefore, the choices we make concerning the pattern, density and location of development will have far-reaching consequences, both economically and environmentally.

Richard Moe of the National Trust for Historic Preservation makes an important point, “Being anti-sprawl is not being anti-growth” (qtd. Young p. 11). Growth management *does not* attempt to put an end to growth, but instead directs it by targeting areas suitable for new development. As we explore alternative development scenarios, we will acquire options to resist the tendency towards sprawl development.

The decisions we make today regarding our patterns of development will create the legacy for future generations. Will we continue our inefficient patterns of land use and leave depleted environmental resources? Will we control new growth and concentrate development to preserve the Chesapeake Bay and other natural treasures? Alternatives to existing development patterns provide the means to manage the characteristics of growth, including its location, diversity of land uses, density, and environmental, social and fiscal costs. Land use decision-makers, including local governments, citizens, and developers, all share the responsibility for making informed land management decisions to ensure that future growth and development benefits the economy, protects the environment, and preserves our communities.

***For more information, contact the Land, Growth, and Stewardship Subcommittee at 1 (800) YOUR-BAY or the Chesapeake Bay Local Government Advisory Committee at 1 (800) 446-LGAC.***

# Annotated Bibliography

Eleven works were selected as the “best” sources on the costs of sprawl. They are considered to be the most relevant studies on the topic and have proven to be the most useful resources for completing this project. The works were chosen based on the amount of information contained, accessibility, and applicability to the Chesapeake Bay watershed. A list of the audiences which each work appeals to is also provided.

## ***Alternatives to Sprawl***

**Dwight Young, 1995**

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\* **Local Governments**

\* **Residents**

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*Alternatives to Sprawl* is one report in a series by the Lincoln Institute of Land Policy examining the current land-related issues, each based on a workshop or conference. This report follows a conference, titled “Alternatives to Sprawl,” held in March 1995 cosponsored by the Lincoln Institute, the Brookings Institute, and the National Trust for Historic Preservation. Conference attendees included Henry R. Richmond of the National Growth Management Leadership Project, Anthony Downs of the Brookings Institute, and Robert W. Burchell of Rutgers University who is considered to be the expert on the fiscal impacts of development.

The report is very accessible and contains a significant amount of information on the causes and costs of sprawl providing background on the origins of this development pattern and the factors encouraging it. The discussion on the economic costs of sprawl contains valuable information for local governments as it summarizes three of Burchell’s major studies comparing planned development to unmanaged growth. The socio-economic factors of sprawl and its impacts on public health are also addressed.

The work not only educates on sprawl, but provides alternatives to it. The second half of the report consists of methods to create and encourage alternative patterns of growth including case studies on successful growth management attempts.



***Beyond Sprawl: New Patterns of Growth to Fit the New California***  
Bank of America, California Resources Agency, Greenbelt Alliance, and the Low  
Income Housing Fund, January 1995

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- \* Local Governments
  - \* Residents
  - \* Farmers
  - \* Environment/Bay
- 

The Bank of America, a California financial giant traditionally opposed to growth control policies, teamed with a variety of other organizations to release a controversial report in 1995. This unlikely advocate of growth management highlighted the costs of sprawl to taxpayers, residents, businesses, farmers, and the environment. The report declares that the state of California can no longer afford the costs of sprawl and must reconsider how it will accommodate future growth.

*Beyond Sprawl* provides a discussion on the causes of sprawl before addressing the far reaching consequences that sprawl has inflicted on California. The report also outlines possible steps of action that the state should take to remedy the situation.

This is a widely read work on sprawl, frequently referred to in other literature. It provides a general overview on the causes and effects of low-density development while also suggesting solutions to the problem.

***The Costs of Alternative Development Patterns: A Review of the Literature***

Prepared for the Urban Land Institute  
James E. Frank, 1989

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- \* Local Governments
  - \* Developers
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This is a key work on the cost of sprawl evaluating nine of the major documents on the cost of development. Frank examines the strengths and weaknesses of each study and adjusts the numbers to 1989 dollars to make the figures more current.

The work determines that low-density, discontinuous development increases the capital costs of public facilities. Frank found planned contiguous development in a central location with a mix of housing types (30% single-family dwelling units, 70% apartments) to have the lowest per unit cost of infrastructure. Areas for additional research on the subject are also suggested.

References to Frank's work are often made in other literature. The work is valuable for the amount of information it contains and its applicability to other regions.

**Cost of Providing Government Services to  
Alternative Residential Patterns**  
Prepared for the Chesapeake Bay Program by CH2M HILL  
May 1993

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**\* Local Governments**

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The purpose of the study is to determine how the type, form, and location of new residential development influence the capital costs of providing services and infrastructure. The Chesapeake Bay Program commissioned CH2M HILL to conduct a literature review on the cost of development studies, primarily focusing on capital costs and their impact on the local governments, but also discussing operating and maintenance costs. The work identifies the factors affecting the cost of providing local government services to residential areas, examines the range of variables influencing these costs, and describes the sensitivity of capital costs.

Appendices A and B contain the literature review. Appendix A reviews and analyzes the most relevant resources on the cost of development. Appendix B consists of other literature reviewed in less detail that is indirectly applicable to the study, but still interesting. Each review includes background information, methodology, results, summary and applicability to the Chesapeake Bay watershed. The literature review contains most of the major works on the topic providing a great deal of information that would be valuable to local governments.

***The Costs of Sprawl--Literature Review and Bibliography***  
**Real Estate Research Corporation, April 1974**

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**\* Local Governments**  
**\* Developers**  
**\* Residents**  
**\* Farmers**  
**\* Environment/Bay**

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*The Costs of Sprawl* is the most well-known and comprehensive literature review on the costs of development. Containing all major documents, it summarizes the existing knowledge on the costs of sprawl at that time (1974). Even though it was completed more than 20 years ago, it is still a useful work for the amount of information it encompasses and its very extensive bibliography. This has become the model for other literature reviews on the costs of sprawl.

The work is divided into three sections. The first section contains the literature review covering the environmental, economic, and socio-economic impacts of alternative development patterns. The second section consists of a general bibliography in which the works are categorized by the topic and rated on its relevance to geographical areas and functional considerations. The final section is an annotated bibliography which provides a brief description of the more relevant sources.

## ***Fiscal Studies for the Governor's Commission on Growth in the Chesapeake Bay Region***

**Robert W. Burchell and David Listokin, January 1991**

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- \* **Local Governments**
  - \* **Developers**
- 

*Fiscal Studies* consists of three studies conducted over a four-month period during 1990. The infrastructure costs and revenues at the local level are examined, each study evaluating a different aspect of determining capital costs. The three studies are:

- *Future Growth in the State of Maryland: The Scale, Capacity to Accommodate, and Costs of Trend Development (1990-2020)*
- *Capital Funding Alternatives to Support Future Growth: Revenue Sources and Their Potential for Revenue Generation*
- *Growth, Infrastructure Costs, Achievable Revenues, and the Infrastructure Revenue Gap: State of Maryland (1990-2010).*

The work compares two future growth scenarios: sprawl development, labeled trend, vs. a planned growth alternative, labeled vision. The focus is entirely on the effects of these growth alternatives on capital costs at the local level, making the work very useful for local governments. A clear conclusion is drawn by the report that "vision growth is less expensive than trend growth." The savings in infrastructure with vision growth over trend growth is reported to be \$1.2 billion, with 60 percent of the savings derived from a decrease in road infrastructure costs.

This work is important to the Chesapeake Bay because it is focused on an area within the watershed -- the state of Maryland. The focus of the work appeals to local governments, but developers will also be interested in the information the study contains on impact fees and other methods to finance infrastructure. Burchell is considered to be the expert on the subject of the fiscal impacts of development, and has authored numerous additional studies mentioned in this literature synthesis.

## ***Impact Assessment of DELEP CCMP Versus Status Quo on Twelve Municipalities in the DELEP Region***

**Prepared for the Delaware Estuary Program**

**Robert W. Burchell and William Dolphin, August 15, 1995**

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- \* **Local Governments**
  - \* **Farmers**
  - \* **Environment/Bay**
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The goal of the study is to determine the effects over a twenty-five year period of two future growth scenarios in the Delaware Estuary, incorporating portions of New Jersey, Pennsylvania, and Delaware. One future development pattern is the continuation of current growth trends of low-density development labeled Status Quo. The other growth alternative is the Delaware Estuary Program's (DELEP) Comprehensive Conservation and Management Plan (CCMP) which attempts to contain

growth around existing centers. Twelve study communities were selected from the region to examine the effects the two growth scenarios would have on land taken, infrastructure costs, housing costs, and fiscal impacts created.

CCMP or planned development has been found to produce noticeable savings over Status Quo development. The results also reveal that CCMP protects environmentally sensitive lands and prime farmlands. The work contains an informative section that reviews major studies on growth management examining its effects on the land, infrastructure consumption, and housing and public service costs. The reviewed literature supports the finding in this work, that planned development saves money and protects the land.

***Impact Assessment of the  
New Jersey Interim State Development and Redevelopment Plan  
Robert W. Burchell, et al., February 28, 1992***

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|---|-------------------------|
| * | <b>Local Government</b> |
| * | <b>Developers</b>       |
| * | <b>Residents</b>        |
| * | <b>Farmers</b>          |
| * | <b>Environment/Bay</b>  |
- 

The purpose of this study is to determine whether or not the State of New Jersey will be better off with the Interim State Development Plan (IPLAN) than the continuation of current development patterns (TREND). The IPLAN scenario attempts to concentrate future growth in selected centers equipped with service systems and capital facilities with the capacity to handle such growth. TREND is defined as a pattern of unmanaged, low-density growth infringing on rural areas. The results showed significant savings in capital costs over the twenty year period of 1990 to 2010, particularly in local and state roads as well as water and sewer infrastructure costs.

The significance of this study lies in the fact that it not only examines the economic savings of planned development, but also its environmental benefits and effects on the quality of life. The findings on housing costs, quality of community life, and economic impacts on job location could be beneficial to citizens interested in the effects of growth management. Results revealed that planned development in New Jersey would reduce air pollutant emissions, generate fewer water pollutants, and consume less sensitive and agricultural lands than sprawl development. These results are important to the Bay watershed as they show that controlled growth produces environmental benefits that would improve the health of the Chesapeake Bay.

***Population Growth and Development in the Chesapeake Bay  
Watershed to the Year 2020***

***The Report of the Year 2020 Panel to the Chesapeake Executive Council  
December 1988***

- 
- \* **Local Governments**
  - \* **Residents**
  - \* **Environment/Bay**
- 

The 2020 Panel Report analyzes the effects of growth on the health of the Chesapeake Bay and the quality of life of the residents in the watershed. The report draws the conclusion that the methods for accommodating growth in the Chesapeake Bay region are insufficient which leads to a host of environmental problems. It calls for the development of rational growth patterns to protect the Bay and improve the quality of the communities of the area.

The report addresses the relationship between the Bay's problems and growth within the region. The effects of growth on key resources and infrastructure costs and a comparison of high, medium, and low density future growth alternatives are also included.

The 2020 Panel Report is fundamental to the study of the costs of sprawl in the Bay watershed because it contains valuable information on the effects of growth pertaining directly to the Chesapeake Bay region. The impacts of growth on the Bay are covered ranging from the effects on wetlands to fish harvests.

***A Smart Growth Bibliography  
A Bibliography of Fiscal, Economic, Environmental, and Social Impact  
Methodologies and Models***

***Abt Associates, Inc., October 2, 1996***

- 
- \* **Local Governments**
  - \* **Developers**
  - \* **Residents**
  - \* **Farmers**
  - \* **Environment/Bay**
- 

*A Smart Growth Bibliography* provides a comprehensive list of resources addressing growth and development issues. The work is divided into twenty categories with one category specifically being "sprawl." A one to two sentence description is given for each reference included.

The bibliography covers areas such as the economic, environmental, transit, and fiscal impacts of growth along with listing computer models, handbooks, and guides enabling others to determine the impacts of specific projects. It appeals to all groups because of the array of references the work contains. The bibliography provides an excellent starting point for researching the costs of sprawl as it includes all of the major works completed on the topic.

***Technical Studies for the Governor's Commission on Growth  
in the Chesapeake Bay Region***

**Robert W. Burchell and David Listokin, January 1991**

- 
- \* **Residents**
  - \* **Farmers**
  - \* **Environment/Bay**
- 

This work accompanies Burchell's *Fiscal Studies*, but instead focuses on the implications of alternative development patterns on the Chesapeake Bay and its watershed system. Three densities of development, a dispersed pattern, medium density, and a concentrated pattern, were examined to determine the influence each had on the natural environment, rural resources, and the built environment.

Results reveal an increase in driving time and vehicle miles traveled for residents with a more dispersed pattern of growth. The loss of farmland and forests are also analyzed in the study. Most importantly, *Technical Studies* researches the wide-range environmental ramifications of development. The impact of different densities of development on air pollution, sedimentation, water consumption, energy use, and living resources habitats are all evaluated. In each case, a concentrated pattern was shown to lessen the negative side-effects of growth on the environment.

When determining the effects of development on the Chesapeake Bay, *Technical Studies* is a key work because it focuses on Maryland and contains a significant amount of information on the environmental impacts of growth on the Bay, including very informative and helpful maps, graphs, and charts.

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<http://darkwing.uoregon.edu/~pppm/landuse/sprawl.html>

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<http://www.preservenet.com/StopSprawl.html>

Smart Growth Network Index

<http://www.sustainable.org/SGN/sgn.index.html>

Sprawl-Busters Web Page

<http://www.sprawl-busters.com>

Sprawl Net-Rice University

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Urban Land Institute

<http://www.uli.org>



*The Chesapeake Bay Program is the cooperative partnership among the states of Maryland, Pennsylvania, Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the U.S. Environmental Protection Agency, representing the federal government; and participating citizen advisory groups.*

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