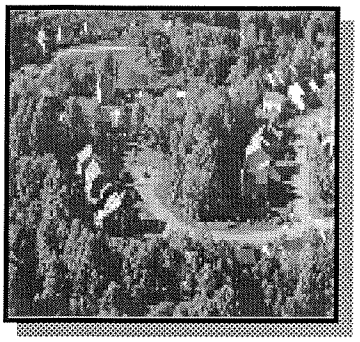


*Source: Arendt 1996*

# PRINCIPLE NO. 11

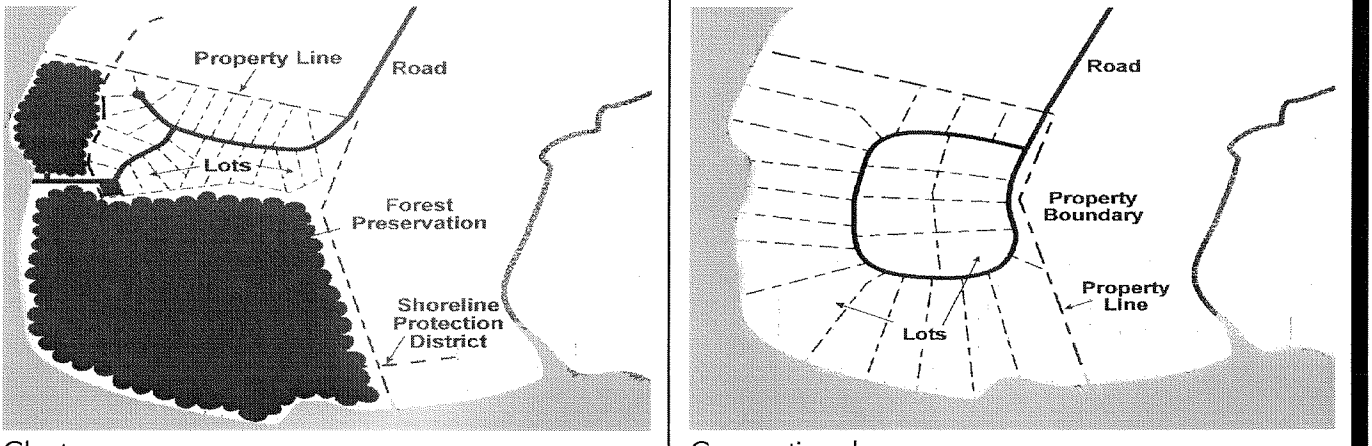
**Advocate open space development that incorporates smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection.**

## CURRENT PRACTICE

Open space development, also known as cluster design, is a compact form of development that concentrates density on one portion of the site in exchange for reduced density elsewhere. Minimum lot sizes, setbacks and frontage distances are relaxed to provide common open space (see Figure 11.1).

Although open space development has been advocated by planners for many years, they are not included in the zoning regulations in all communities. Those communities that do allow open space development have done so for reasons largely unrelated to stream protection such as community design, preservation of rural character, or creation of affordable housing (Heraty, 1992). Fifteen percent of communities that allow open space development also provide density bonuses as an incentive which could actually increase the amount of impervious cover created at a site.

**Figure 11.1 Open Space (Cluster) Development versus Conventional Development**




When communities allow open space development it is usually the exception rather than the rule. In 95% of communities surveyed by Heraty (1992), clustering is a voluntary, rather than a mandatory, development option.

As it turns out, open space development is not always a widely exercised option by developers. Open space designs often require a special permit exception or zoning variance (i.e., they are not a by-right form of development). On the average, only 37% of all new subdivisions in these communities were clustered. Further, 18% of the communities reported that they had yet to receive a cluster proposal since first implementing the cluster program. Developers using open space designs often must submit more studies and undergo closer review than developers of conventional developments.

Some early cluster developments were badly designed, made poor use of open space, and were not marketable. In addition, adjacent residents frequently opposed cluster developments due to fears about density, traffic congestion, and property values.

## Recommended Practice

Communities that currently allow open space development or cluster designs may wish to re-evaluate their current criteria to determine if they really meet impervious cover reduction and land conservation goals. In addition, they may want to implement program changes that will provide additional incentives to developers to make greater use of this option. In particular, communities should consider making open space development a "by-right" development option. Many communities impose an extended special review process on developers of open space developments. The certainty and speed of project approval are a prime consideration for developers, and until both become comparable to conventional subdivisions, it is not likely that many developers will choose to use cluster designs.

Arendt (1994) has suggested that the side-by-side, visual comparison of open space and conventional subdivisions will go a long way toward gaining acceptance for these new concepts by plan reviewers and developers.

The ability to implement open space designs depends to a great extent on the base zoning density of the open space design. Flexibility sharply declines as the density of the base zone increases. Generally, high density residential zones (more than six dwelling units per acre) are not feasible for open space developments simply due to the lack of space.

## Benefits Provided by Open Space Design

Some measure of the value of open space design in reducing impervious cover can be gleaned from a series of "redesign" analyses (see Table 11.1). In each case, an existing conventional residential sub-division was "redesigned" using open space design, and the resulting change in impervious cover was measured from the two plans. These studies suggest that open space designs can reduce impervious cover by 40 to 60%, when compared to conventional subdivision designs, particularly if narrow streets can also be utilized at the site. The value of open space designs in reducing impervious cover is evident over most residential zones, although only minor reductions in impervious cover occur in areas which used very small lot size (1/8 acre lots and smaller) in the original zoning.

Less impervious cover translates directly into less stormwater runoff. According to the redesign analysis presented in Table 11.1, open space designs can produce about a 20 to 60% reduction in the annual runoff volume from a site. A corresponding increase in the amount of infiltration and groundwater recharge is also predicted by hydrologic models for the site.

**Table 11.1: Redesign Analyses Comparing Impervious Cover and Stormwater Runoff from Conventional and Open Space Subdivisions**

| Residential Subdivision | Conventional Zoning for Subdivision | Impervious Cover at the Site | | | % Reduction in Stormwater Runoff |
|---|---|---|---|---|---|
| | | Conventional Design | Open Space Design | Net Change | |
| Remlik Hall [1] | 5 acre lots | 5.4 % | 3.7% | - 31% | 20% |
| Duck Crossing [2] | 3-5 acre lots | 8.3 % | 5.4 % | - 35% | 23% |
| Tharpe Knoll [3] | 1 acre lots | 13% | 7% | - 46% | 44% |
| Chapel Run [3] | ½ acre lots | 29% | 17% | - 41% | 31% |
| Pleasant Hill [3] | ½ acre lots | 26% | 11% | - 58% | 54% |
| Prairie Crossing [4] | ½ to ⅓ | 20% | 18% | - 20% | 66% |
| Rapahannock [2] | ⅓ acre lots | 27% | 20% | - 24% | 25% |
| Buckingham Greene [3] | ⅛ acre lots | 23% | 21% | - 7% | 8% |
| Belle-Hall [5] | High Density | 35% | 20% * | - 43% | 31% |

Sources: [1] Maurer, 1996; [2] CWP, 1998a; [3] DE DNREC, 1997; [4] Dreher, 1994; and [5] SCCCL, 1995.

Decreased stormwater runoff translates to less stormwater pollution. Again, several redesign analyses have compared the stormwater pollution loads of conventional and open space developments using simple models (see Table 11.2). As can be seen, significant reductions in stormwater pollutant loadings generally occur when open space designs are used— roughly on the order of what can be achieved if stormwater best management practices were installed at the conventional site.

**Table 11.2: Redesign Analyses Comparing Stormwater Pollution Loads from Conventional and Open Space Subdivisions**

| Residential Subdivision | Change in Phosphorous Load | Change in Nitrogen Load | Other |
|---|---|---|---|
| Remlik Hall [1] | -42% | -42% | |
| Prairie Crossing [2] | -81% | N/A | 92% TSS reduction |
| Rapahannock [3] | -60% | -45% | |
| Belle-Hall [4] | -67% | -69% | |

Sources: [1] Maurer, 1996; [2] Dreher, 1994; [3] CWP, 1998; and [4] SCCCL, 1995.

## PERCEPTIONS AND REALITIES ABOUT OPEN SPACE DEVELOPMENT

Despite the apparent benefits of open space design, there are many barriers and impediments toward its widespread use. Developers, for example, are often reluctant to use open space design. Smaller lot sizes and compact development are sometimes perceived as less marketable, and the lack of speed and certainty in the review process can be a concern. Prospective homebuyers may be reluctant to purchase homes in open space developments due to concerns regarding management of the community open space. Open space developments are also often perceived as applying only to upscale and affluent consumers. Finally, local governments may be reluctant to promote open space development because they believe the public is opposed to open space design. Open space developments are sometimes opposed due to concerns about incompatibility with older developments and traffic noise and congestion. As several case studies have shown, many of these impediments can be successfully addressed through thoughtful site design and a clear local ordinance (see Table 11.4).

**Table 11.4: Perceived Impediments to Open Space Development**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. Smaller lot sizes and compact development are perceived as less marketable. | FACT: | Many studies show that open space designs are highly desirable and have economic advantages including cost savings and higher market appreciation. |
| | FACT: | A survey of recent home buyers conducted by American Lives, Inc. noted that 77% of the respondents rated natural open space as extremely important (Fletcher, 1997). |
| 2. Open space developments often require a special exception approval process. | CHALLENGE: | Generally, additional time, public hearings, and special reviews are required to implement open space designs, even when the community has an open space ordinance (see Principle No. 21). While developers are interested in reduced construction costs and market absorption rate, the total amount of time required for the project is a major driving force. |
| 3. Community association management of open space areas can be unreliable. | FACT: | There are several options for maintaining open space which can be reliable when properly implemented (see Principle No. 17). |
| | FACT: | Natural open space reduces maintenance costs and can help keep community association fees down (Arendt et al., 1994). |
| 4. Open space developments are perceived as applicable only for upper income housing. | FACT: | There are many examples of moderate and lower income open space developments (see Table 11.6). |

**Table 11.4: Perceived Impediments to Open Space Development (Continued)**

| Perception | Facts, Case Studies, and Challenges |
|---|---|
| 5. Open space developments are perceived as incompatible with adjacent land uses and are often equated with increased noise and traffic. | FACT: Open space design allows preservation of natural areas, using less space for streets, sidewalks, parking lots, and driveways (BASMAA, 1997).<br>FACT: A good design utilizing buffers can help alleviate incompatibility with adjacent land uses and still maintain the character of the area (NEIPC, 1997).<br>FACT: Sound level is measured as a function of vehicle speed (AASHTO, 1994). Open space designs include skinnier streets and other traffic calming features which decrease the speed of cars (FHA, 1996), and consequently, the level of sound.<br>FACT: If the number of residential units built is kept the same as the non open space designs, traffic impacts on the surrounding area should be similar. |

## Marketability of Open Space Development

Many studies have shown that a well designed and marketed open space developments can be very desirable to home buyers. A few examples of successful open space developments are presented in Table 11.5.

**Table 11.5: Some Examples of Successful Open Space Developments**

| Subdivision | Location | % Open Space | Notes |
|---|---|---|---|
| Farmview | Bucks County, PA | * | The fastest selling subdivision in its price range with lots from ½ to ⅓ the size of competing projects (Arendt, et al., 1994) |
| Haile Plantation | Gainesville, FL | 29% | Captured 14% of the Gainesville market in 1994 (Ewing, 1996) |
| Palmer Ranch | Sarasota, FL | 36% | 93% of existing wetlands at the site preserved<br>Accounted for 30% of new home market in Sarasota in 1994<br>Developer has experienced positive cash flow every year (Ewing, 1996) |
| Fields of St. Croix | Lake Elmo, MN | 60% | 80% of home sites in first phase sold within 6 months (NAHB, 1997) |
| Chatman Village | Pittsburgh, PA | 64% | Built during the Depression<br>Earned a 4.32% return on investment (NAHB, 1997) |
| Westgreen | Leesburg, VA | 39% | Targeted to young professionals and empty-nesters<br>Every lot in Phase I sold during first weekend (ULI, 1992) |

* More than 23% was preserved as open space and 31% was preserved as productive farm land.

**Table 11.5: Some Examples of Successful Open Space Developments (Continued)**

| Subdivision | Location | % Open Space | Notes |
|---|---|---|---|
| Spinnaker Ridge | Gig Harbor, WA | 45% | Targeted to young professionals and older families<br>Successful marketing campaign included radio and newspaper ads (ULI, 1992) |
| Apple Hill Lane | Duxbury, MA | 55% | Built in 1981, one of the first cluster developments in Duxbury<br>Approved within 2 months (Porter et al.,1988) |
| Chinook Way at Fairview Village | Fairview, OR | 40% | Targeted to high wage earners and empty nesters<br>Mix of apartments and townhomes |

## Open Space Management

Community associations are just one of several options for open space management. Other options include dedication to land trusts, establishing conservation easements. and local, state, or federal ownership. These various options are discussed in detail in Principle No. 15.

## Affordable Housing

Since housing prices tend to decrease as housing density increases, open space development could be used as one method for promoting affordable housing within local communities. The Haile Plantation development near Gainesville, Florida, represents one such community where the use of open space design techniques has yielded a variety of lot sizes and preserved significant expanses of agricultural, natural, and recreational open space areas (Ewing, 1996). As shown in Figure 11.2, several of the neighborhoods in Haile Plantation fall within the moderate income price range. These homes correspond to net densities of approximately two to five units per acre. Other examples of successful moderate- and lower-income open space developments are presented in Table 11.6.

## Quality of Life

A well designed open space development can enhance the quality of life in neighborhoods and communities. A 1996 homeowner survey revealed that 75% of all buyers would pay more to live in a community where one could walk and bike everywhere (Harney, 1996). Studies also show that traditional big lawns are not necessarily desirable by all prospective homeowners. In fact, a 1996 homeowner survey found that many homeowners are willing to tradeoff the bigger yard to upgrade housing amenities and housing design (Probuilder Magazine, 1997). Another study found that in households where both members of the couple are working, there is a strong preference for smaller lawns to keep lawn maintenance minimal (Newsweek, 1995).

**Table 11.6: Moderate and Lower Income Open Space Developments***

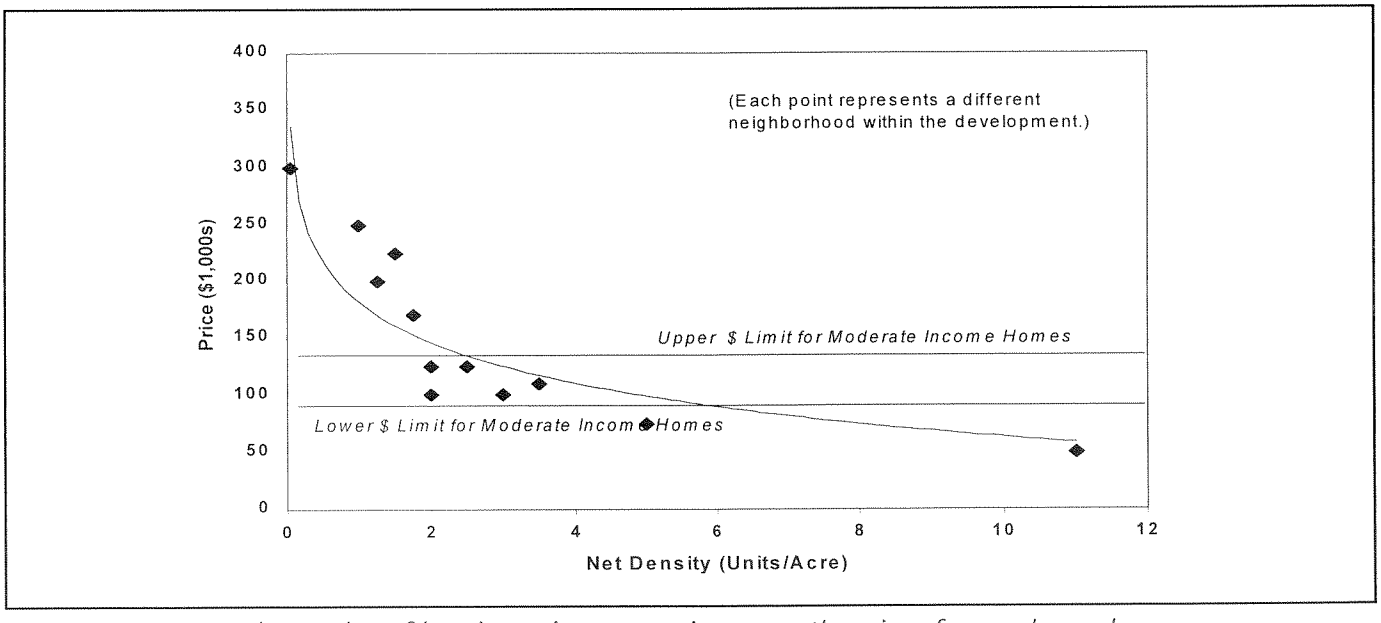
| Development Name | Location | Base Price Range | Source |
|---|---|---|---|
| Haile Plantation | Gainesville, FL | $89,000 - $134,000 | Ewing, 1996 |
| Oakbridge | Lakeland, FL | $50,000 - $70,000 | Ewing, 1996 |
| Spinnaker Ridge | Gig Harbor, WA | $122,000 - $153,000 | ULI, 1988 |
| Westgreen | Leesburg, VA | $108,500 - $119,500 | ULI, 1988 |
| Casa Del Cielo | Scottsdale, AR | $118,900 - $135,900 | ULI, 1988 |
| California Meadows | Freemont, CA | $130,000 - $171,000 | ULI, 1988 |
| Coach Houses of Town Place | Boca Raton, FL | $ 97,500 - $143,000 | ULI, 1988 |
| Riverplace | New Haven, CN | $79,900 - $179,900 | ULI, 1988 |
| Sea Colony | San Diego, CA | $34,500 - $49,000 | ULI, 1988 |

* *The 1996 national average price for a new home was $165,800 and $144,600 for an existing home (NAHB, 1997)*

# ECONOMIC BENEFITS

Open space development can be significantly less expensive to build than conventional subdivision developments. Most of the cost savings are due to savings in road building and stormwater management conveyance costs. The use of open space design techniques at a residential development in Davis, California provided an estimated infrastructure construction costs savings of $800 per home (Liptan and Brown, 1996). Other examples demonstrate infrastructure costs savings ranging from 11 to 66%. Table 11.7 lists some of the projected construction cost savings generated by the use of open space redesign at several residential sites.

**Figure 11.2: New Home Prices Versus Net Density at Haile Plantation (Florida), based on Ewing (1996)**




*As the number of housing units per acre increases, the price of a new home drops.*

**Table 11.7 : Projected Construction Cost Savings for Open Space Designs from Redesign Analyses**

| Residential Development | % Construction Savings | Notes |
|---|---|---|
| Remlik Hall [1] | 52% | Includes costs for engineering, road construction, and obtaining water and sewer permits |
| Duck Crossing [2] | 12% | Includes roads stormwater management, and reforestation |
| Tharpe Knoll [3] | 56% | Includes roads and stormwater management |
| Chapel Run [3] | 64% | Includes roads, stormwater management, and reforestation |
| Pleasant Hill [3] | 43% | Includes roads, stormwater management, and reforestation |
| Rapahannock [2] | 20% | Includes roads, stormwater management, and reforestation |
| Buckingham Greene [3] | 63% | Includes roads and stormwater management |
| Canton, Ohio[4] | 66% | Includes roads and stormwater management |
| Sources: [1] Maurer, 1996; [2] CWP, 1998; [3] DE DNREC, 1997; [4] NAHB, 1986 | | |

# Case Study: Fields of Saint Croix

The Fields of Saint Croix is an open space development in Lake Elmo, Minnesota. More than 60% of the 226-acre site is open space. Included in the open space is farmland, horticultural gardens, wooded slopes, and restored prairie (NAHB, 1998). Specific open space design techniques that are incorporated into the Field's of Saint Croix include:

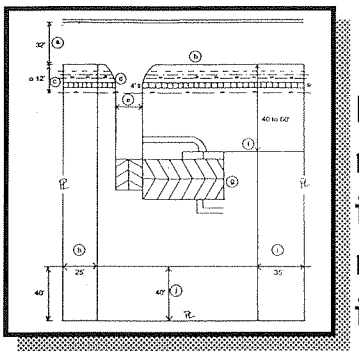
- irregular-shaped and narrow lots
- a density transfer
- onsite treatment of stormwater runoff (Principle No. 22);
- thirty acres of prairie restored with native vegetation (Principle No. 20);
- a public transit stop located at the entrance to the development (Principle No. 7);
- miles of pathways through the common open areas (Principle No. 13); and
- a conservation easement guaranteeing the open space owned by the community association and the developer (Principle No. 15).

Eighty percent of the homes offered during the first phase of the development sold within six months. The second phase is expected to do equally as well.

While reviewing the Field's of St. Croix proposal, and based on the success of similar developments, the City of Lake Elmo decided to develop a comprehensive open space development ordinance. The ordinance provides a base density of six dwelling units per 20 acres with a density bonus for common areas, pathways, and historic preservation. This ordinance covers residential development in 4,400 acres of the city.

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Guidelines for Open Space Management in the Land Preservation District** by the Montgomery County (Pennsylvania) Planning Commission | Montgomery County (Pennsylvania)<br>Planning Commission<br>Courthouse<br>Norristown, PA 19404<br>215-278-3722 |
| **Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks** (1996) by Randall Arendt<br>Discusses how to rearrange housing density so that no more than half of the buildable land becomes developed. Includes model zoning and subdivision ordinance provisions. | American Planning Association<br>Planners Book Service<br>122 S. Michigan Avenue<br>Suite 1600<br>Chicago, IL 60603<br>312-786-6344 |
| **Rural by Design** (1994) by Randall Arendt<br>Provides information on alternative neighborhood designs, including open space design, street design, greenways, zoning, and growth management. | American Planning Association<br>Planners Book Service<br>122 S. Michigan Avenue<br>Suite 1600<br>Chicago, IL 60603<br>312-786-6344 |
| **Site Planning for Urban Stream Protection.** (1995) by Thomas R. Schueler<br>Chapter 3 examines how conventional zoning techniques relate to stream quality and how local governments can institute watershed-based zoning. | Center for Watershed Protection<br>8391 Main Street<br>Ellicott City, MD 21043<br>410-461-8323 |
| **Conservation Design for Stormwater Management** (1997) by the Delaware Department of Natural Resources and Environmental Control and The Environmental Management Center of the Brandywine Conservancy<br>Provides guidance for site design that incorporates conservation into land development. Emphasis is on retaining natural features in the development process to reduce the need for structural stormwater management controls. | Delaware Department of Natural Resources and Environmental Control<br>Division of Soil and Water Conservation<br>Sediment and Stormwater Program<br>89 Kings Highway<br>Dover, DE 19901 |



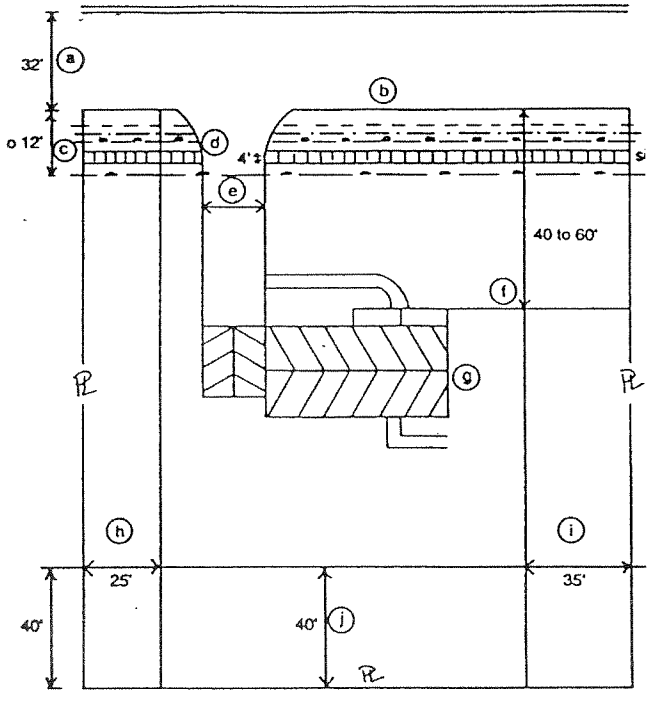
# PRINCIPLE NO. 12

**Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce overall lot imperviousness.**

## CURRENT PRACTICE

Many current subdivision codes have very strict requirements that govern the geometry of the lot. These include side yard setbacks, minimum lot frontages, and lot shape (Figure 12.1). These criteria constrain, and in some cases, prevent site planners from designing open space or cluster developments that can reduce impervious cover (see Principle No. 11). Minimum setbacks and frontage distances can increase impervious cover in the following ways. Front yard setbacks, which dictate how far houses must be from the street, can extend driveway length. Large side setbacks and frontage distances directly influence the road length needed to serve individual lots. In most local codes, the size of setbacks and frontage distances usually increase as housing density decreases. Smaller setbacks and frontage distances, which are often essential for open space designs, are typically not permitted, or require a zoning variance (which may be difficult to obtain).

**Figure 12.1: Geometry of a Typical One Acre Lot (Schueler, 1995)**




**LEGEND**

| | |
|---|---|
| a | minimum street width |
| b | minimum lot frontage |
| c | minimum right-of-way, one side of the street, not including pavement |
| d | minimum sidewalk width |
| e | minimum driveway width |
| f | minimum front yard setback |
| g | maximum lot footprint |
| h | side yard setback |
| i | side yard setback |
| j | rear yard setback |

Setbacks and frontage widths evolved over time and have been used in local jurisdictions to satisfy a variety of community goals. Often, setback and frontage distances are used to ensure uniform, equally-sized lots. Setbacks are often used for fire safety purposes (i.e., to prevent fire from spreading from forests to a house or from one house to another) and traffic concerns. Frontage distances are often set to provide residential parking. The availability of on-street parking is largely determined by the street length serving each lot, which is set by minimum frontage distance. Examples of typical setback and frontage requirements are presented in Tables 12.1 and 12.2.

**Table 12.1: Minimum Setbacks for a Typical Conventional, Single Family Detached Home**

| Location | Front | Side | Back | Minimum Lot Area |
|---|---|---|---|---|
| Lenexa, Kansas | 30' | 7' | 20' | 8,000 sq. ft. |
| Newton, Massachusetts | 30' | 10' | 15' | 10,000 sq. ft. |
| Jonesboro, Arkansas | 30' | 10' | 10' | 8,000 sq. ft. |
| Carroll County, Maryland | 25' | 10' | 40' | 7,500 sq. ft. |
| Lake County, Illinois | 30' | 10' | 40' | 10,000 sq. ft. |
| Calvert County, Maryland* | 25' | 5' | 20' | 10,000 sq. ft. |
| Fort Worth, Texas* | 20' | 5' | 5' | 5,000 sq. ft. |
| Albemarle County, Virginia* | 25' | 10' | 20' | ~10,000 sq. ft. |
| Dekalb County, Georgia* | 25' | 15' | 30' | 6,000 sq. ft. |

**These counties also have codes for open space development (clustered zoning).*

**Table 12.2: Minimum Frontage Distances for Typical, Conventional Single Family Detached Homes**

| Community | Lot Size | Minimum Frontage Distance |
|---|---|---|
| James City County VA | ≤ 20,000 ft$^2$ | 75 feet |
| | 20,000 ft$^2$ - 1.0 acre | 100 feet |
| | > 1 acre | 150 feet |
| Loudon County VA | ≤ 20,000 ft$^2$ | 100 feet |
| | 20,000 ft$^2$ - 1.0 acre | 175 feet |
| | > 1 acre | 200 feet |

# RECOMMENDED PRACTICE

Communities can improve impervious cover by relaxing or reducing front and side yard setbacks and allowing for narrower frontage distances. Allowing for narrower side yard setbacks leads to narrower lot widths. With narrower lots, shorter roads are required which reduces site imperviousness. Relaxing front yard setbacks leads to shorter front yards. This eliminates the need for long driveways which are found

in many conventional subdivisions. Flexible setback and frontage requirements allow developers creativity in producing attractive, more compact lots with sufficient room for living, recreation, and open space. An example of a flexible criteria is presented in Table 12.3.

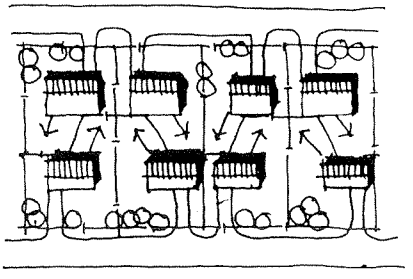
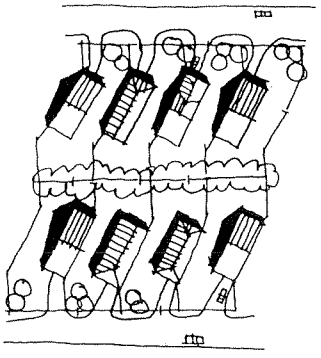
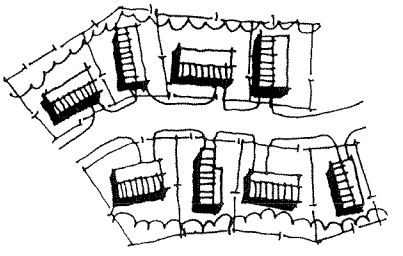
**Table 12.3: Comparison of Conventional vs. Flexible Lot Dimensions for Development Density of 1 Dwelling Unit/ Acre (Schueler, 1995)**

| Site Factor | Detached Single Family - Conventional | Detached Single Family - Open Space* |
|---|---|---|
| Lot Size | 40,000 sq. ft. minimum | 10,000 sq. ft. minimum |
| Front Yard | 40 ft. minimum | 20 - 25 ft. minimum |
| Side Yards | 25 ft. minimum/ 60 ft. total | 10 ft. minimum |
| Rear Yard | 40 ft. minimum | 25 ft. minimum |
| Frontage Distance | 150 ft. minimum | 75 ft. minimum |

* Note that these may be reduced further for a neo-traditional site design or village cluster.

Flexible setback, lot shape, and frontage distances allow site designers to create attractive and unique lots that provide homeowners with enough space for personal recreation while still creating common open space areas. Nontraditional lot designs which are commonly used include zipper lots, angled z-lots, and alternative lot widths (see Figure 12.2).

**Figure 12.2: Nontraditional Lot Designs (ULI, 1992)**

| Zipper Lots | Angled Z-Lots | Alternative Lot Widths |
|---|---|---|
|  |  |  |

## PERCEPTIONS AND REALITIES ABOUT SMALLER LOTS

Impediments to flexible lots include concerns about potential lack of parking, safety issues, livability, and marketability. These are discussed below and summarized in Table 12.4.

**Table 12.4: Perceived Impediments to Smaller Lots**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. Narrow lots are less marketable. | FACT: | Home sales in many developments that incorporate narrow lots have been successful (ULI, 1998). See the ***Case Studies*** discussion for specific examples. |
| 2. Narrow frontages and shorter driveways due to reduced setbacks will reduce the amount of available parking. | FACT:<br>FACT:<br>FACT: | The average number of vehicles in a household is 1.66 which can usually be accommodated between the driveway, garage, and on-street parking (Pisarski, 1996).<br>Many open space designs include garages and/or driveways.<br>Designers must consider the trends in vehicle ownership. The percentage of households with 3 or more vehicles decreased by 1% from 1980 - 1990. However, this decrease is significant in light of the extraordinary increase in such households (10-fold) between 1960 and 1980. (Pisarski, 1996). |
| 3. Reduced setbacks will reduce homeowner privacy. | CHALLENGE: | They do reduce privacy, but site designers can include accommodations for privacy by eliminating windows on one side of a building, facing garages next to one of the neighbor's walls, etc. |
| 4. Houses that are closer together may require fire walls and increased costs. | FACT: | A typical requirement allows detached housing to be as close as 5 feet without specific fire protection measures. For houses closer than 5', fire protection measures will most likely be required. These requirements may increase construction cost. |
| 5. Homes placed close to the street will reduce drivers' sight distance (i.e., the length of roadway that can be easily viewed). | FACT: | Potential sight distance impairments can be minimized or avoided by placing visual obstructions (e.g., garages, front porches, etc.) 1.5 - 2.0' back from the curb. This setback is far less than the 30' front setback required by many jurisdictions (AASHTO, 1994). |
| 6. Decreasing the front setback will increase the amount of noise. | FACT: | Site designers can incorporate narrower streets and traffic calming devices which decrease the speed of cars (FHA, 1996). Slow speeds reduce traffic noise as sound level is a function of speed (AASHTO, 1994). |

## Parking

Reduced frontages reduce overall street length and result in less on-street parking. However, a frontage distance of fifty feet allows for on-street parking of two cars for each resident. Parking concerns can usually be addressed through site design in most residential zones.

A common parking concern are extra automobiles or large recreational vehicles. In the unlikely event that the additional parking demand cannot be met, communities may consider providing a parking area adjacent to the housing site. When many homeowners are expected to own recreational vehicles or boats, "expanding" an existing driveway using a pervious material could provide adequate parking (see Principle No. 8 for discussion of pervious materials).

## Safety

Safety considerations include fire protection and adequate sight distances for drivers. Fire protection concerns specifically focus on the proximity of structures to each other. When front and side setbacks are reduced, homes are closer together. This has led to the concern that fire could spread easily from one home to another. With the development of fire retardant materials and the use of fire walls, however, the need for large setbacks has been reduced.

Adequate sight distance is an important aspect of safe road design. Site designers tend to rely on local government street criteria (e.g. minimum horizontal and vertical curve criteria) and rarely consider site-(and lot) specific conditions when developing road layouts. According to AASHTO (1994), potential sight distance impairments can be avoided if visual obstructions (e.g., garages, front porches, etc.) are placed 1.5 feet or more from the curb, which is significantly less than the 30' front setback required by many communities.

## Livability/Marketability

Market research and homeowner surveys have shown that, for the most part, flexible setbacks and frontage requirements can provide communities that are attractive to both homeowners and potential buyers (ULI, 1992).

# CASE STUDIES

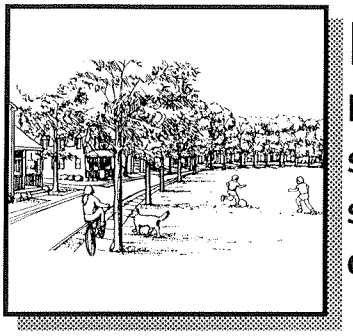
There are numerous examples of residential developments with these lot types that have performed well in the real estate market, including:

- Villa D'Este at Sweetwater in Longwood, Florida
- Casa Del Cielo in Scottsdale, Arizona
- Deerfield Knoll in Chester County, Pennsylvania
- Oakbridge in Lakeland, Florida
- Palmer Ranch in Sarasota, Florida

Sources: ULI, 1992; Arendt, 1994; Ewing, 1996

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Density by Design** (1992) by James W. Wentling and Lloyd Bookout<br>Over 20 case studies of higher density communities, many achieved through the use of flexible lot designs and reduced setbacks and frontages. Focus on design of lot and marketing. | Urban Land Institute<br>1025 Thomas Jefferson Street, NW<br>Suite 500 West<br>Washington, DC 20007<br>800-321-5011 |
| **Designing Open Space Subdivisions** (1997) by Randall Arendt<br>Presents case studies of developments using flexible lot standards. Also includes more expansive discussion regarding large, Euclidean lots versus flexible, smaller lots. | Natural Lands Trust<br>Hildacy Farm<br>1031 Palmers Mill Road<br>Media PA 19063<br>610-353-5587 |



*Source: Arendt 1994*

# PRINCIPLE NO. 13

**Promote more flexible design standards for residential subdivision sidewalks. Where practical, consider locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas.**

## CURRENT PRACTICE

Sidewalk requirements are a common element of many subdivision codes. Most codes require that sidewalks be placed on both sides of residential streets (e.g., double sidewalks) and be constructed of impervious concrete or asphalt. Sidewalks can serve important functions in residential communities. Sidewalks protect children as they play and walk to and from schools, neighbors, and parks. They also provide a travel path for adults walking to and from parks, neighborhood shopping, and transit stops (ITE, 1993).

To ensure that these functions are met, many subdivision codes require sidewalks to be 4 to 6 feet wide and 2 to 10 feet from the street. Since sidewalks are provided along streets, little consideration is given to improving pedestrian movement to adjacent communities, parks, and shopping areas away from the streets.

## RECOMMENDED PRACTICE

While sidewalk requirements protect pedestrians, needless sidewalks can also increase the amount of site imperviousness, thereby preventing infiltration of stormwater runoff into the soil. In general, the placement and width of sidewalks can be modified without impairing travel access or minimizing pedestrian safety.

Communities should consider more flexible sidewalk requirements that are based on improving pedestrian movement and diverting it away from the street. Communities may wish to allow sidewalks on only one side of the street, or eliminate them altogether where they don't make sense. In addition, communities can reduce the width of their sidewalks to 3 or 4 feet, and place them further away from the street. Lastly, sidewalks should be graded so that they drain to the front yard rather than to the street. These alternatives reduce imperviousness and provide practical, safe, and attractive travel paths.

## PERCEPTIONS AND REALITIES ABOUT SIDEWALK PLACEMENT

Double sidewalk requirements have evolved in response to perceived safety and liability concerns as well as to provide convenience for residents. Accident research, however, has shown that single sidewalks are nearly as safe as double sidewalks. Another perception is that residents want sidewalks on both sides of the street. The reality is that many would prefer to have single sidewalks, thereby giving home buyers a choice of whether they want a sidewalk in front of their home or not (Woodsmall, 1998). Table 13.1 discusses perceived impediments to limiting sidewalks in residential areas.

**Table 13.1 Perceived Impediments to Limiting Sidewalks**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. Sidewalks on only one side of the street are unsafe. | FACT: | A recent survey showed that 7.7% of pedestrian accidents occurred on roads with single sidewalks and 7.3% of such accidents occurred on roads with double sidewalks (NHI 1996). Roads without sidewalks at all are by far the most hazardous to pedestrians, with 83.5% of pedestrian accidents (Knoblauch et.al., 1988; NHI, 1996). |
| 2. Roads without sidewalks on both sides are a legal liability | FACT: | Careful design and policy implementation protects governments and professionals from undue liability (NHI,1996). |
| 3. The ADA requires sidewalks on both sides of the street | FACT: | The ADA requires at least one accessible route from public streets, parking areas, and passenger loading zones along a route that generally coincides with that of the general public. There are no specific restrictions on roadway sidewalks. |
| 4. Local government officials do not want to hear complaints from residents regarding sidewalk placement. | FACT: | Most complaints occur when sidewalks are installed after the development has been built and occupied, and not during initial construction. |
| | CHALLENGE: | Many local government officials feel that having sidewalks on both sides of the street will minimize complaints. One way to alleviate these concerns is by educating officials regarding homeowner preferences and by not trying to establish a blanket solution to resolving sidewalk complaints. The sidewalk application policy would not be required in existing neighborhoods, but only for new development projects. |
| 5. Residents want sidewalks on both sides of the street | FACT: | There is no appreciable market difference between houses that are directly served by sidewalks (i.e., the sidewalk is on the same side of the street) and houses not directly served (i.e., sidewalk is on the opposite side of the street) (Woodsmall, 1998). Some residents do prefer to have access to a sidewalk in front of their property, while others prefer no sidewalks. These types of preferences are logically resolved at the time buyers purchase the property. |

## Safety Concerns

Safety considerations justifiably govern many local subdivision ordinances. One such ordinance is to require sidewalks on both sides of residential streets. While this is safer than having no sidewalks, safety statistics show that having a sidewalk on only one side of the street provides approximately the same level of safety as providing sidewalks on both sides of the street (NHI, 1996). See Table 13.2 for more information.

In residential areas, walking in the roadway is more hazardous than walking on sidewalks, but not as dangerous as one might think. Pedestrians walking in roadways account for slightly over 9% of the total pedestrian volume, yet only 5.8% of pedestrian accidents (Knoblauch et. al., 1988). This conclusion can

be attributed in part to the relative safety of residential streets in comparison to other pedestrian areas. Less than 30% of all pedestrian accidents occur in suburban or rural areas. Most (over 70%) pedestrian accidents occur in highly urban areas.

In addition, the placement of sidewalks along the street right-of-way may discourage pedestrian movement, since the travel way is defined solely by the street, and may not connect to adjacent communities, parks or open spaces.

**Table 13.2 Survey of Pedestrian Accidents Related to Sidewalk Presence (NHI, 1996)**

| Sidewalk Location | % of accidents |
|---|---|
| No sidewalk present | 83.5% |
| Pedestrian sidewalk only | 0.9% |
| Multi-Use sidewalk | 0.6% |
| Sidewalk present on both sides of street | 7.3% |
| Sidewalk present on at least one side of street | 7.7% |
| Total: | **100%** |

## Liability Concerns

While safety is probably the most important issue governing pedestrians and the use of sidewalks, more and more governments, well insured organizations and professionals are being sued as a result of accidents involving pedestrians. It is true that taking simple and straightforward steps can reduce the occurrence of legal challenges and reduce the liability involved. The most important factor involving a government official or design professional in protecting themselves from legal challenges is the use of "ordinary care." Ordinary care means that design decisions are based on a basic level of care that can be expected of a reasonably experienced and prudent professional. Ordinary care is usually determined by using the "85 percentile rule," which simply means that designs are based on accommodating the behavior that can be expected of 85% of the travelers who use the facility in a reasonable manner (NHI, 1996). Other perceived impediments are presented in Table 13.1.

There are fewer suits claiming design flaws, as opposed to other potentially negligible behaviors (e.g., poor maintenance or improper signage), since design elements involve a longer term and more complex set of planning, policy, and budget decisions. Courts tend to support design decisions so long as significant professional errors were not made (NHI, 1996). Table 13.3 identifies some of the primary components which should be incorporated into sidewalk design to ensure a safe environment with a minimum of liability.

## Disability Access

The Americans with Disabilities Act (ADA) does not specifically address sidewalks, but it does require accessible routes. There must be at least one accessible route within the site boundary from public

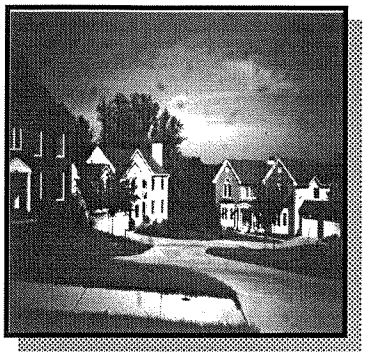
transportation stops, parking, and passenger loading zones. There must be at least one accessible route from public streets or sidewalks to the buildings or facilities they serve. Accessible routes must coincide with the routes for the general public "to the maximum extent feasible." Sidewalks must be at least three feet wide (ADA Hotline, 1997; Dey, 1997).

**Table 13.3 Design Elements for User Friendly, Safe and Legally Defensible Sidewalks (Partially adapted from NHI, 1996)**

| Sidewalk Design Element | Use, Safety, and Liability Considerations |
|---|---|
| 4 feet minimum width | Allows users to walk side by side, helping to keep one user from walking in street |
| Provide a buffer from traffic | Limits potential accidents and resulting lawsuits |
| Provide access to streets and destinations | Provides linkage between automobiles, transit and other destinations, avoids "dumping" pedestrians out at unsafe locations |
| Provide shade where possible | Makes walking more pleasant in the heat of summer |
| Design to avoid areas of standing or flowing water across sidewalk | Standing or flowing water can freeze in the winter creating a hazard and potential liability situation |
| Design at the street level | Encourages sidewalk use and awareness of traffic situations |
| Limit the amount and strictly regulate vending machines (e.g., news stands, FedEx boxes, etc.) | These items take up valuable sidewalk space, potentially hinder sight distances, and can infringe on sidewalk area at critical locations, such as road crossings. |
| Provide places to sit | Provides rest spots and places for people to stop, out of the way of traffic and congestion |
| Provide adequate and well designed crossings | Helps minimize one of the major reasons for pedestrian accidents, that is, darting out in front of oncoming traffic |

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Residential Streets (2nd Edition)**<br>Includes discussion of design considerations for pedestrian walks and paths. | Urban Land Institute<br>1025 Thomas Jefferson Street, NW<br>Suite 500 West<br>Washington, DC 20007<br>800-321-5011<br>Also available from the American Society of Civil Engineers and the National Association of Homebuilders |
| **Pedestrian and Bicyclist Safety and Accommodation** (1996)<br>Course book that provides practical design information and an overview of laws and ordinances applicable to sidewalks. | National Highway Institute<br>Federal Highway Administration<br>US Department of Transportation<br>To obtain a copy, call 301-577-0818 and ask for Publication No. FHWA-HI-96-028 |



# PRINCIPLE NO. 14

**Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.**

## CURRENT PRACTICE

Most local subdivision codes are not very explicit as to how driveways are designed. Most simply require a standard apron to connect the street to the driveway, and are silent about the width and surface material for the driveway. Typically, the single lane driveway for a residential home is 10 - 12 feet wide (Montgomery County, MD; El Paso, CO; Bucks County, PA) and 18 - 20 feet wide for homes with two car garages. Most builders use concrete or asphalt for the driveway surface. Local subdivision codes indirectly influence the length of the driveway when excessive front yard setbacks are required (see Principle No. 13). Taken together, most suburban driveways create from 400 to 800 square feet of impervious cover, or enough room to park two to four cars.

Most communities discourage or even prohibit the use of shared driveways that connect two or more homes together. The primary reason for this is a concern that multiple homeowners may not be able to agree on the long-term maintenance of the driveway.

## RECOMMENDED PRACTICE

As much as 20% of the impervious cover in a residential subdivision consists of driveways (Schueler, 1995). The total site impervious area can be reduced when more than one home is served by a shared driveway. Impervious surfaces can be further reduced by using alternative paving surfaces (e.g., gravel, paver blocks, porous pavement) for some or all driveway surfaces.

Communities can reduce the impervious cover of driveways in a number of ways. First, they can specify narrower driveway widths. Second, they can reduce the length of driveways by relaxing front yard setbacks (see Principle No. 13). Third, communities can provide incentives for using permeable paving materials, two track driveways, and allow gravel or grass for the driveway surface. Lastly, communities can encourage the use of shared driveways where enforceable maintenance agreements and easements can be obtained.

### Alternative Driveway Surfaces

Several alternative driveway surfaces are available that allow for more infiltration and reduce site imperviousness than conventional asphalt. A detailed comparison of alternative paving materials is provided in Table 8.2 (see Principle No. 8) that reviews their durability, performance, and cost.

## Shared Driveways

Shared driveways can provide access from the street to the front door for up to six homes, depending on local regulations (see Figure 14.1). Typically paved, these driveways are privately owned and maintained. Most shared driveways are approximately 16 feet in width (wide enough for two cars to pass).

Successful use of shared driveways requires the developer, homeowners association, or some other legal entity to ensure that maintenance obligations are clearly explained to all affected homeowners. A mechanism should be provided to ensure that potential disagreements and misunderstandings are avoided. Some communities require shared driveway easements and covenants or legal agreements.

Proper design can ensure that all homeowners have sufficient access with shared driveways. Design criteria include adequate space to park vehicles without blocking a neighbor. Some inconveniences, however, are likely to occur when visitors are present.

**Figure 14.1: Shared Driveway in Howard Co., Maryland**

## PERCEPTIONS AND REALITIES ABOUT DRIVEWAYS

Table 14.1 presents some perceived impediments to alternative driveway design. The major impediments regarding shared driveways are adequate access and maintenance responsibilities. These concerns can be alleviated, for the most part, through careful site design, material selection, and homeowner education. The major impediments include concerns regarding the impact of pervious paving materials on snow removal, handicap accessibility, and housing marketability. These concerns are also addressed in Principle No. 8.

**Table 14.1 Perceived Impediments to Shared Driveways and Alternative Driveway Surfaces**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. Alternative driveway surfaces make snow removal more difficult. | CHALLENGE: | Paver blocks can be damaged by snowplows and stone, gravel, or cobble driveways are difficult to plow. Brick, porous asphalt and pervious concrete will perform similar to conventional pavement although sand cannot be used on porous pavement (Caraco and Claytor, 1997). |
| 2. Alternative driveway surfaces may limit disability access. | FACT: | The Americans with Disabilities Act (ADA) requires accessible routes on firm and stable surfaces to and between public facilities. Single family houses do not necessarily have to meet this requirement. Developers can choose to provide some houses with conventional paving or select alternative surfaces which will not become an obstacle to those with disabilities. |
| 3. Developers have expressed concerns that some alternative surfaces are less marketable than conventional paving materials. | FACT: | Green development projects that incorporate environmentally sensitive techniques such as the use of pervious paving materials are increasingly being sought out by a range of consumers (Ewing, 1996). |
| | FACT: | More aesthetically pleasing alternative driveways, (e.g., brick pavers) while more expensive, can be quite marketable. |
| 4. Homeowners and public works officials are wary of the uncertain maintenance obligations of shared driveways. | CHALLENGE: | Whenever there is more than one entity involved in maintenance of common areas there is a potential for inequitable sharing of responsibility. Some communities require shared driveway easements and covenants or other legal agreements to ensure that future disagreements will be minimized. |
| 5. Homeowners have expressed concerns over insufficient access with shared driveways. | FACT: | Proper design can resolve many of these potential conflicts, by ensuring that adequate space is available to park vehicles, without blocking a neighbor. |
| | CHALLENGE: | Some inconveniences are likely to exist when visitors are present. |

## CASE STUDY: LEESBURG, VIRGINIA

Westgreen is a 4.07 acre development in Leesburg, Virginia (ULI, 1992). Designed and built by Alternative Building and Design, Inc., Westgreen demonstrated that developments that use environmentally sensitive site design techniques such as shared driveways can be successfully marketed.

The site designers emphasized preservation of mature (greater than two inches in diameter) trees on each

of the seventeen small-lot, single family home sites. One strategy used to minimize impacts to existing vegetation was to eliminate all seventeen separate driveway cuts. One common entrance and drive to the community was provided. Access from the common drive to the homes is provided by driveways. Many of the homes, however, share common driveways, further minimizing the need to cut down trees.

The development was marketed in two phases. The first phase completely sold out during the first weekend. The second phase sold during the second year with minimal advertising in spite of price increases ranging from $15,000 to $25,000 per home. Maintenance of the common drive and all driveways is included in the homeowner association fee.

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Start at the Source** (1992) by Bay Area Stormwater Management Agencies Association<br>Detailed discussion of permeable pavements and alternative driveway designs presented. | Bay Area Stormwater Management Agencies Association<br>2101 Webster Street, Suite 500<br>Oakland CA<br>510 286-1255 |
| **Impervious Surface Reduction Study** (1995) by Cedar Wells<br>Presents recommendations for pervious materials and shared parking. Based on results of study to identify strategies for reducing impervious surface in Olympia, Washington. | City of Olympia Public Works Department<br>PO Box 1967<br>Olympia, WA 98507<br>360-753-8454 |
| **Shared Parking Planning Guidelines** (1995) by Institute of Transportation Engineers<br>Presents guidelines, research findings, and case studies of cities that actively promote shared parking | Institute of Transportation Engineers<br>525 School Street, SW<br>Suite 410<br>Washington, DC 20024-2797<br>202-554-8050 |
| **Density by Design** (1992) by James W. Wentling and Lloyd Bookout<br>Over 20 case studies of higher density communities, many achieved through the use of flexible lot designs and reduced setbacks and frontages. Focus on design of lot and marketing. | Urban Land Institute<br>1025 Thomas Jefferson Street, NW<br>Suite 500 West<br>Washington, DC 20007<br>800-321-5011 |

# PRINCIPLE NO. 15

**Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space.**

## CURRENT PRACTICE

Many communities do not allow for open space developments in their zoning or subdivision codes (see Principle No. 11). Even communities that encourage open space development often restrict its use to larger development projects. A survey of local open space design regulations conducted by Heraty (1992) revealed that the open space requirements were poorly defined in most communities. For example, less than a third of local cluster ordinances required that open space be consolidated. Only 10% required that a specified portion of the open space be maintained and managed in a natural state. Similarly, few communities clearly specify allowable uses for open space areas. Instead, most communities rely on community associations to manage open space and determine allowable uses. Few community associations, however, have the legal or financial resources to adequately manage open space, particularly if it is intended for active recreation. Individual homeowners may be unwilling or unable to pay association fees. Community associations and residents may lack informational resources to understand the maintenance requirements of different types of common areas. A frequently cited reason for prohibiting or restricting open space designs is a concern that homeowners lack either the money or organization to adequately maintain common areas.

## RECOMMENDED PRACTICE

Open space managed in natural condition has a minimal annual maintenance cost. This is one reason why communities should encourage designers to retain as much open space as possible in a natural condition. Communities should also explore more reliable methods to assure that the responsibility for open space management can be met within a development. The two primary options are to create a community association or to shift the responsibility to a third party, such as a land trust or park, by means of a conservation easement. The latter technique is especially useful in developments that have high quality conservation areas retained in open space. Lastly, communities that have cluster or open space ordinances should revisit them to ensure that open space is well planned. Clear performance criteria for open space consolidation, maintenance in natural condition, allowable uses, and future management should be carefully considered.

### Community Associations

A successful community association begins with mandatory membership and a legal mandate to collect association fees. Availability of information on maintenance of common areas is also essential to keeping the open space properly managed through the long term. The development of a sound financial plan,

assessing both yearly operating costs and possible long term requirements, is a key element to the success of the association. Table 15.1 outlines the primary elements found in association documents.

During site design, it is important to ensure that planned uses for open space areas (e.g., natural areas, stormwater management facilities, or pools) are in line with the expected future cost of maintenance. An overburdened community association cannot always manage open space, particularly in light of the traditional costs for street maintenance, snow removal and other common tasks of the homeowners associations.

**Table 15.1: Elements of a Successful Community Association**

| Element | Description |
|---|---|
| **Property Rights** | Establishes owner's right to use common area and the right of the Association to delegate use and a fee for maintenance of the common area. |
| **Membership and Voting Rights** | Defines the voting rights of homeowners as members of the association. |
| **Covenant for Maintenance Assessments** | Outlines homeowner fees, uses of the fees, and obligates homeowner to make payments to the association (otherwise a of lien may be placed on the property). |
| **Architectural Controls** | Outlines any particular restrictions on color, architecture, or other design changes to promote harmony. |
| **Use Restrictions and Easements** | Establishes any rules on your personal property and/or easement. |
| **Maintenance** | Itemizes the specific responsibilities of the association for maintenance of common property and members personal obligation for maintenance of unit or building. |
| **Insurance** | Establishes associations obligation for obtaining insurance including liability and fiduciary coverage. |
| **Party Walls (if applicable)** | Outlines the rules for shared walls. |
| **Management** | Authorizes the associations' Board of Directors to obtain a management agent to carry out day-to-day operations on behalf of the association. |
| **General Provisions** | Includes issues of enforcement, rights of the local government and other disclosures about the document itself. Also includes a signature page making the document official. |
| **Bylaws** | Outlines the corporate responsibilities for meetings, elections, authority, and duties of directors, and other member issues. Bylaws may contain many of the provisions listed above when not included in the declaration or covenants, especially with condominiums. |

## Other Options for Open Space Management

Other options for managing open space include transfer to land trust ownership and public ownership. There are limitations to the different types of options and some options may not be applicable for all tracts of land. A comparison of the most commonly used management options is presented in Table 15.3.

**Table 15.3: Options for Open Space Management**

| Option | Positive Factors | Limiting Factors |
|---|---|---|
| **Conservation Easement** | • guarantees protection from further development<br>• may be tax deductible<br>• can be tailored to different levels of giving<br>• ownership maintained | • often not an option for smaller or non-contiguous tracts of land<br>• monitoring responsibilities for easement holder<br>• owner often expected to make contributions for monitoring |
| **Transfer to Land Trust Ownership** | • guarantees protection from further development<br>• may be tax deductible<br>• donator doesn't have to worry about monitoring | • loss of ownership<br>• often not an option for smaller or non-contiguous tracts of land<br>• public use may infringe on residents privacy |
| **Community Association** | • guarantees protection from further development<br>• representation by homeowners | • community association fees<br>• maintenance and enforcement decisions are reliant on association members |
| **Publicly Owned Land** | • no additional fees for homeowner<br>• not being taxed<br>• ensures some certainty over future land use<br>• public funds for maintenance | • land use decisions may depend on political climate<br>• community association interests compete with other groups<br>• public use (park) may infringe on residents privacy |

### Conservation Easements

Since the goal of open space design is to form large areas of contiguous and natural common space, an alternative management scheme for the larger tracts of land is a conservation easement. A conservation easement legally and permanently limits the use of the land while leaving the property under private ownership (Land Trust Alliance, 1993).

By electing to protect open space with a conservation easement, the land trust or local, state, or federal government agency assumes the responsibility of monitoring the terms of the easement and, if necessary, enforcing them. Open space management by a third party provides greater certainty that the land will be maintained in a natural state. In addition, conservation easements can be written to provide the modest funding needed to pay for inspection, management plans, and maintenance for the natural areas. The specific elements of conservation easements are enumerated in Table 15.2.

**Table 15.2: Elements of Conservation Easements (Barrett and Diehl, 1988)**

- Legally binding
- Ownership retained by landowner, but permanently limits the uses of land it order to protect its conservation values.
- Managed by a 501(c)3 conservation or historic preservation organization.
- Tax deductible for perpetual conservation easements only (if donation is not required as part of the subdivision process).
- Can be written for as long as owner and grantee desires (although most land trusts deal only with perpetual easements).
- Owners usually asked to contribute to maintain the easement.
- Land must fit certain criteria for acceptance by the 501(c)3.
- Easement monitoring is responsibility of owner.

# PERCEPTIONS AND REALITIES ABOUT OPEN SPACE MANAGEMENT

Proper open space design, enforceable maintenance responsibility, and sound budgetary considerations should allay most fears about the financial stability and sustainability of community associations. For larger open space designs, effective management requires that homeowners be continually educated about the purpose and boundaries of open space, and the financial responsibility of the community association to manage open space. Homeowners should also be included in the responsibilities of the associations. By keeping open space in its natural state, maintenance costs can be kept low. Table 15.4 examines some of the perceived impediments to community open space management.

**Table 15.4: Perceived Impediments to Community Open Space Management**

| Perception | Facts, Case Studies, and Challenges |
|---|---|
| 1. Maintaining common areas, stormwater BMPs, and other facilities can be costly. | FACT: Open space design reduces the amount of impervious area and should alleviate some of the stormwater BMP and paving costs required in a highly developed area (Table 15.5).<br>FACT: Common areas can be maintained naturally to minimize the costs associated with them (Table 15.5).<br>FACT: The cost to maintain natural open space areas as forests in a conservation easement is fairly low. Roser et al. (1997) estimated it to be less than $250/year. |
| 2. Community fees may be a burden for low and moderate income housing. | FACT: Open spaces can be protected either through outright donation or donation of conservation easements to land trust (Zepp,1998). |

**Table 15.4: Perceived Impediments to Community Open Space Management (Continued)**

| Perception | Facts, Case Studies, and Challenges |
|---|---|
| 3. Smaller community associations are perceived as potentially financially unstable and unable to effectively manage some properties. | FACT: There are methods of assuring small maintenance fees and assuring that certain costs are always paid for by homeowners (Table 15.2).<br>CHALLENGE: Many uses (e.g., natural areas, stormwater management facilities, or pools) and types of common areas (e.g., open space areas, infrastructure maintenance) can strain community association resources. Care can be taken at the design stage to avoid overburdening the community association. |
| 4. Enforcement of allowable and unallowable uses may be difficult. | FACT: Allowable uses can be a voting issue for homeowner associations and in extreme cases legal action can bind homeowners. |
| 5. Information regarding maintenance for residents and community associations is not readily available. | CHALLENGE: There is a responsibility for the on-going collection and dissemination of maintenance information. There is often no procedure for accomplishing this task since education of residents is not implicit to actual maintenance of common space. |

# ECONOMIC BENEFITS

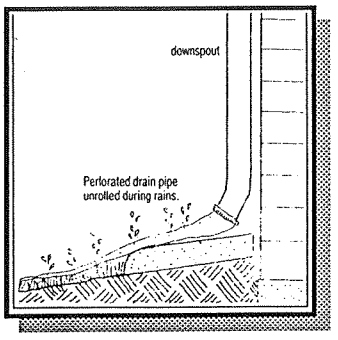
A survey of the annual cost to manage open space is provided in Table 15.5. At about $75/acre/year, managing open space in a natural condition is the least expensive maintenance strategy for community associations. By contrast, managing open space as turf increases maintenance costs by a factor of 5 to 10. If natural open space is designed to allow for passive recreation, such as trails and bike paths, annual maintenance costs may reach $200/acre.

**Table 15.5: The Cost of Open Space Management**

| Maintenance Item | Approximate Annual Maintenance Costs | Source |
|---|---|---|
| **Natural Open Space**<br>Only minimum maintenance, trash/debris cleanup | $75/acre/year | NPS, 1995 |
| **Lawns**<br>Regular mowing | $270 to $240/acre/year | Wildlife Habitat Council, 1992 |
| **Passive Recreation**<br>Trails, bike paths, etc. | $200/acre/year | NPS, 1995 |

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **The Conservation Easement Handbook** (1988) by Janet Diehl and Thomas Barrett<br>In-depth discussion of conservation easements. Includes review of tax benefits, acquisition guide, sample easement application, and model easement. | Land Trust Alliance<br>1319 F Street, NW<br>Suite 501<br>Washington, DC 20004-1106<br>202-638-4725 |
| **Land Protection Options: A Handbook for Minnesota Landowners** (1996) by Laurie Allman<br>Describes options and incentives for protecting non-regulated natural areas. Discusses potential economic benefits for landowners. | The Trust for Public Land<br>Midwest Region<br>420 North Fifth Street<br>Suite 865<br>Minneapolis, MN 55401<br>612-338-8494 |
| **Guidelines for Open Space Management in the Land Preservation District** by the Montgomery County (Pennsylvania) Planning Commission | Montgomery County (Pennsylvania) Planning Commission<br>Courthouse<br>Norrisstown, PA 19404<br>215-278-3722 |
| **Cluster Development Programs** (1993) by Maureen A. Heraty<br>A guidance report that uses the results of a national survey of cluster development regulations to examine the advantages and disadvantages to varying types of regulation and how improvements in regulations can provide more runoff control. | Metropolitan Washington Council of Governments<br>Information Center<br>777 North Capitol Street, NE<br>Suite 300<br>Washington, DC 20002-4201<br>202-962-3256 |
| Community Associations | Website: www.caionline.org |
| American Farmland Trust | 1200 18th Street, NW<br>Suite 800<br>Washington, DC 20036<br>202-331-7300 |




# PRINCIPLE NO. 16

**Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system.**

## CURRENT PRACTICE

Most subdivision codes require that yards have a minimum slope to ensure positive drainage away from the home (i.e. runoff moves away from the foundation of a home). A common code requirement is a minimum slope of 2.5% for all overland flow on yards or lawns and a minimum longitudinal gradient for swales, channels or ditches of 2.0%. In northern climates, codes may further specify that downspouts from rooftops to be directly connected to the stormwater conveyance system. These requirements stem, in part, from a desire to minimize nuisance ponding or puddling of water on private lots, and to prevent ice formation on driveways and sidewalks. Engineers are also accustomed to design criteria that mandates quick movement of stormwater through lots, ditches and roads. These code requirements discourage the storage and treatment of rooftop runoff on individual lots. Thus, a cost-effective opportunity for builders and homeowners to promote bioretention and infiltration is bypassed.

## RECOMMENDED PRACTICE

Sending rooftop runoff over a pervious surface before it reaches an impervious surface can decrease the annual runoff volume from residential development sites by as much as 50% (Pitt, 1987). This grading technique can significantly can reduce the annual pollutant load and runoff volume being generated at a development site.

Perceptions about wet basements and/or soggy yards are legitimate concerns when it comes to rooftop runoff. Two recent publications, however, suggest that these concerns can be alleviated through careful design, construction inspection, and grading (see Table 16.1). The Low Impact Development Design Manual (PGDER, 1997) provides detailed guidance on methods to re-direct rooftop runoff to pervious surfaces. The Draft Maryland Stormwater Design Manual (MDE, 1997) also provides design criteria for rooftop runoff re-direction, and provides a stormwater management credit as a financial incentive.

**Table 16.1 Design Elements for Re-Directing Rooftop Runoff to Pervious Areas**

| Low Impact Development Manual (Adapted from PGDER, 1997) | Draft Maryland Stormwater Design Manual (Adapted from MDE, 1997) |
|---|---|
| Encourage shallow sheet flow through vegetated areas. Use rock trenches to create level flow where necessary. | Rooftop runoff from certain land uses should not be re-directed over vegetated areas (e.g., industrial roofs). |
| Direct flow into BMPs specifically designed to receive rooftop runoff, such as, infiltration swales, infiltration trenches, and/or dry wells. | Limit the contributing path of stormwater flows off rooftops to a maximum length of 75 feet. |
| Direct flows from small drainage swales to stabilized vegetated areas. | Limit the contributing rooftop area to a maximum of 500 sq. ft. per downspout. |
| Divert runoff to on-lot swales and bioretention facilities. | The length of vegetated areas receiving runoff from the rooftop shall be equal or greater than the flow length of the contributing rooftop. |
| Provide wider drainage swales and/or swales with check dams. | Lot sizes must be greater than 6000 sq. ft. in area to receive a stormwater management reduction credit. |
| Direct rooftop runoff to depression storage areas. | The average slope of the vegetated area receiving rooftop runoff must be less than 5.0% for 75 ft. |
| | Downspouts must outlet flow at least 10 feet away from the nearest impervious surface. |
| | Flow from redirected downspouts must not contribute to basement seepage. |

# PERCEPTIONS AND REALITIES ABOUT RE-DIRECTING ROOFTOP RUNOFF

While the benefits of re-directing rooftop runoff have been documented, concerns regarding wet basements and/or soggy yards remain. It is true that diverting runoff through yard areas may result in creating small erosion gullies or shallow soggy areas. Careful design criteria and construction inspection can minimize these conditions. Likewise, if rooftop runoff is diverted to a depression storage area specifically designed to receive these flows, such as a bioretention area or an infiltration area, soggy lawn areas will be minimized or eliminated altogether. Figure 16.1 illustrates an on-lot bioretention area.

Similarly, specific criteria regarding the discharge from downspouts away from building foundations or basements can minimize or eliminate seepage or foundation damage. Additional concerns and perceived impediments to implementation are presented in Table 16.2.

**Figure 16.1: Residential On-Lot Bioretention Area (Adapted from Claytor and Schueler, 1996)**

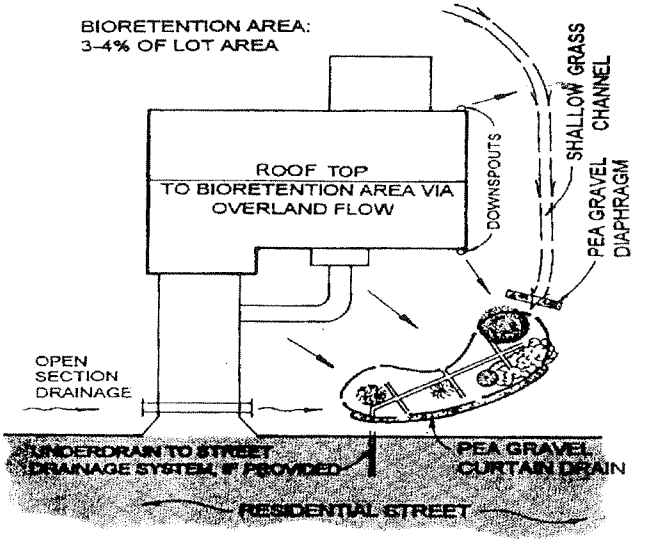



**Table 16.2 Perceived Impediments to Re-Directing Rooftop Runoff**

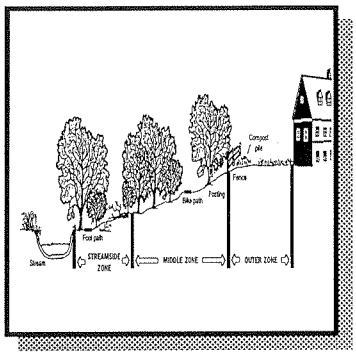
| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. Re-directed rooftop runoff may increase a property owner's maintenance burden. | FACT: | When designed properly, on-lot bioretention areas provide an attractive landscaping feature that does not require supplemental water. |
| 2. Re-directed rooftop runoff can be directed onto impervious surfaces in the future. | CHALLENGE: | True, homeowners can always reconnect downspouts to the drainage system in the future. They are not likely to do so, however, unless they encounter problems due to poor grading or design. |
| 3. Wet basements will result from re-directing rooftop runoff. | FACT: | These conditions can be minimized by setting specific criteria regarding the distance that downspouts must discharge from foundations, minimum adjacent slopes away for houses, and adequate construction inspection. |
| 4. Local government codes and FHA lending criteria prohibit on-lot ponding and specify minimum slope requirements. | CHALLENGE: | Some local governments have grading ordinances which dictate minimum grades for lawns, yards, and drainage swales. These restrictions prohibit or discourage re-directing rooftop runoff. Developers must obtain waivers or exceptions to implement practices such as on-lot bioretention, water quality swales, or other flow attenuating BMPs. |

## CASE STUDY: SHAKER HEIGHTS, OHIO

An ordinance requiring re-direction of rooftop runoff was recently implemented in this neighborhood east of Cleveland. Principally motivated by a need to reduce stormwater volumes within a combined sewer overflow (CSO) system, the ordinance required homeowners to hydraulically disconnect rooftop runoff from the regular drainage network. The ordinance is backed up with enforcement measures, such as potential fines or civil citations. Nearly 100% of the residents have implemented their disconnections within a pilot study area. After the first year of monitoring, results suggest that annual runoff volumes are being reduced by approximately 25% (DeVaul, 1997).

## WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Maryland Stormwater Design Manual** (draft 1997) by the Maryland Department of the Environment<br>Describes disconnection of rooftop imperviousness as a potential nonstructural stormwater control. | Maryland Department of the Environment<br>Water Management Administration<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3543 |
| **Low Impact Development Design Manual** (1997)<br>Discusses utility of and methods for disconnection of rooftop leaders. | Prince George's County Department of Environmental Resources<br>9400 Peppercorn Place<br>Suite 600<br>Largo, MD 20785<br>301 883-5800 |
| **Start at the Source** (1997) by Bay Area Stormwater Management Agencies Association.<br>Section 5.5 describes techniques for collecting and treating rooftop runoff from individual buildings. | Bay Area Stormwater Management Agencies Association<br>2101 Webster Street, Suite 500<br>Oakland, CA<br>510-286-1255 |




# PRINCIPLE NO. 17

**Create a variable width, naturally vegetated buffer system along all perennial streams that also encompasses critical environmental features such as the 100-year floodplain, steep slopes and freshwater wetlands.**

## CURRENT PRACTICE

Typically, communities have established stream buffer requirements for two reasons. The first is to regulate the type and location of development within the floodplain of a stream. The second is to protect the water quality of streams that have been designated as providing either valuable resources such as drinking water or unique aquatic habitat. A national survey of buffer programs indicated that for communities with buffer ordinances, the average width of the buffer is 100 feet. Expansion of the buffer to include all of the 100-year floodplain, steep slopes, and freshwater wetlands is not usually required.

## RECOMMENDED PRACTICE

A small, but growing number of communities is now implementing buffer programs. Not merely a setback, a buffer is a vegetated system managed to protect the area adjacent to a shoreline, wetland, or stream. Characteristics such as width, target vegetation and allowable uses within the buffer are managed to ensure that the goals designated for the buffer are achieved.

The creation of a riparian buffer system is key in protecting the water quality of streams in urban areas. Buffers create a natural "right of way" for streams that protect aquatic ecosystems and provide a safe conduit for potentially dangerous flood waters. Buffers can also be used to treat stormwater and prevent drainage problems for adjacent homeowners. Stream buffers offer many economic advantages to the local community. The flood protection afforded to homeowners can represent a fairly significant economic benefit. Table 17.1 summarizes some of the environmental benefits that can be achieved with buffer systems.

Stream buffers can be valuable in other ways. They can serve as valuable park and recreational systems that enhance the general quality of life for residents. Buffers can also provide valuable wildlife habitat and act as wildlife corridors for smaller mammals and bird species which are present in urban areas. Wildlife biologists often recommend a much wider buffer to maintain wildlife corridor habitat. Table 17.2 presents a summary of buffer width recommendations based on wildlife corridor functions.

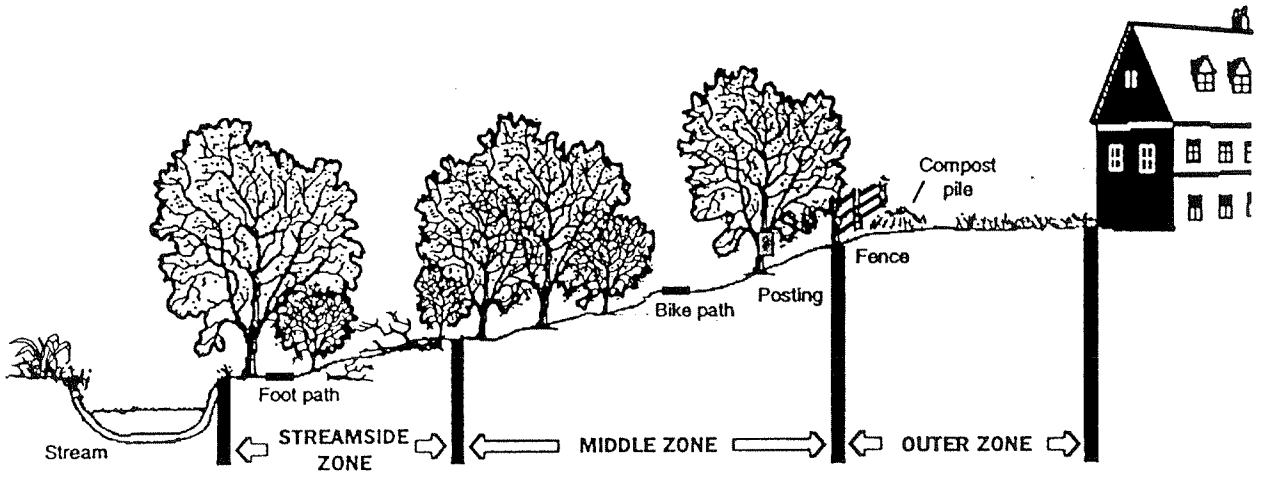
| Table 17.1: Benefits of Urban Stream Buffers |
|---|
| 1. Reduces small drainage problems and complaints |
| 2. Allows for lateral movements of stream |
| 3. Provides flood control |
| 4. Protects from streambank erosion* |
| 5. Increases property values* |
| 6. Enhances pollutant removal |
| 7. Provides a foundation for present or future greenways |
| 8. Provides food and habitat for wildlife * |
| 9. Protects associated wetlands |
| 10. Prevents disturbances to steep slopes * |
| 11. Mitigates stream warming* |
| 12. Preserves important terrestrial habitat * |
| 13. Supplies corridors for conservation* |
| 14. Essential habitat for amphibians* |
| 15. Fewer barriers to fish migration |
| 16. Discourages excessive storm drain enclosures/channel hardening |
| 17. Provides space for stormwater ponds |
| 18. Allows for future restoration |
| ** benefit amplified by or requires forest cover* |

**Table 17.2: Buffer Width Recommendations for Wildlife Corridors**

| Study | Recommendation |
|---|---|
| Cohen, 1997 | 300 feet is the generally accepted minimum width needed to provide adequate habitat and movement corridors for most wildlife species. |
| Keller et al, 1993 | Corridors < 165 feet do provide habitat for many edge species, several of which are showing population declines (Droege and Sauer 1990, as cited in Keller et al, 1993). |
| Spackman and Hughes, 1994 | To capture 90% of bird species (including forest interior species ) requires a 450-525 foot corridor width on larger urban streams |
| Castelle et al, 1994 | Buffer width to encourage species diversity: range: 10 - 350 ft |

A three-zone urban buffer system may be the best option for protecting aquatic resources while providing flexibility for development (Welsch, 1991). Each of the three zones performs a different function, and each has a varying width requirement, vegetative type, and management scheme. Figure 17.1 shows the three zones and each of their characteristics.

**Figure 17.1: The Three-Zone Urban Stream Buffer System (Adapted from Welsch, 1991)**




| Characteristic | Streamside Zone | Middle Zone | Outer Zone |
|---|---|---|---|
| **Width** | Minimum 25 feet plus wetlands and critical habitats. | 50 - 100 feet depending on stream order, slope, and 100-year floodplain. | 25 foot minimum setback from structures. |
| **Vegetative Target** | Undisturbed mature forest. Reforest if necessary. | Managed forest, some clearing allowed. | Forest encouraged, but usually turfgrass. |
| **Allowable Uses** | **Very Restricted**<br>e.g., flood control, utility right-of-way, footpaths | **Restricted**<br>e.g., some recreational uses, some stormwater BMPs, bike paths, tree removal by permit | **Unrestricted**<br>e.g., residential uses including lawn, garden, compost, yard wastes, most stormwater BMPs |

*Three lateral zones comprise the foundation of an effective urban stream buffer zone. The width, function, management and vegetative target vary by zone.*

Table 17.3 highlights several examples of buffer ordinances that have been implemented by communities in the United States.

**Table 17.3: Example Buffer Ordinances and Programs**

| Program | Description |
|---|---|
| Loudoun County, VA Scenic Creek Valley Buffer Ordinance | Prohibits construction activities in areas adjacent to scenic rivers and major stream areas draining greater than 640 acres or one square mile. Measured from the stream bank, ordinance requires the following stream buffer sizes:<br>• 250 ft along Potomac river<br>• 200 ft along two state designated scenic rivers,<br>• 150 feet along other county streams<br>Buffer widths may be reduced by up to 100 feet provided stormwater BMP's are used or if streamside forests are preserved or planted. TDR allowed. |
| Baltimore County, MD Riparian Forest Buffer Regulation | A forest buffer for a stream system shall consist of a forested strip of land extending along both sides of a stream.<br>1st & 2nd order - measure from centerline<br>Class I stream buffer shall be the greater of the following<br>a) 75 feet<br>b) 25 ft from outer wetland boundary<br>c) 25 ft from the 100 yr floodplain reservation or easement boundary |
| MD MNCPPC Guidelines for Stream Valley Protection | Slope Range (ft) / Water Contact Rec. Aquatic Life / Natural Trout Waters / Recreational Trout Waters<br>Width of buffer on each side of the stream (ft)<br>0 to < 15: 100 / 150 / 125<br>15 to < 25: 125 / 175 / 150<br>≥ 25: 150 / 200 / 175 |
| Portland, OR Willamette River Greenway System | Initiated by the state government and imposing a strict review process for public and private sector development within the greenway. The goal is to keep most of the greenway privately owned. Requires 150ft setback from both banks that incorporates existing urban areas. Requires developers to dedicate certain areas to open space which has resulted in a nature trail that links several riverfront parks and nature preserves (Flink and Searns, 1993). |
| Charles County, MD Resource Protection Overlay Zone | Established buffer widths based on stream order.<br>1st and 2nd order streams -- 50 foot minimum<br>3rd and 4th order streams -- 100 foot minimum<br>Minimum buffer extended outward to include all adjacent 100 year floodplains, adjacent non-tidal wetlands or wetlands within 25 feet, and steep slopes greater than 15 % adjacent to the buffer. |
| City of Austin, Texas Watershed Protection Ordinance | Establishes development restrictions and buffer zone requirements for suburban and rural water supply watersheds. Buffer zone sizes range from a minimum of 100 feet to a maximum of 300 feet depending on stream class (minor, intermediate, or major). The buffer extends from the outer edge of a Critical Water Quality Zone which is defined by the boundaries of the 100-year floodplain. |

# PERCEPTIONS AND REALITIES ABOUT BUFFER SYSTEMS

Potential impediments to buffer programs include concerns regarding private property owners rights, complaints about pests and nuisances, and additional costs to local governments due to implementation, regulation, and enforcement of a buffer program. Table 17.4 summarizes pertinent research regarding these concerns.

**Table 17.4: Perceived Impediments to Buffers**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. Buffers may result in a potential loss of developable land. | FACT: | A 100-ft wide stream buffer typically consumes only 5% of land in a typical watershed, depending on drainage density. |
| | FACT: | Regulatory tools and other incentives are available to protect the interests of property owners (See Principle No. 21). |
| 2. Private landowners may be required to provide public access to privately held stream buffers. | FACT: | Effective buffers can be maintained in private ownership through deed restrictions and conservation easements. Heraty's (1993) survey of jurisdictions with buffer ordinances indicated that 95% of the jurisdictions considered buffers to be private open space for property owners use only. |
| 3. Excessive nuisance species will be present due to the natural buffer area. | FACT: | The ultimate vegetative target for a streamside buffer is the pre-development riparian community - typically mature forests (Petit, 1995). Mature forests usually do not encourage the presence of nuisance vegetative species (i.e., poison ivy). |
| | CHALLENGE: | Buffers may encourage the presence of nuisance animal species. However, this can be controlled by managing the outer zone of the buffer to discourage animal habitation (e.g., fencing, selective thinning, good housekeeping practices) (Adams, 1994). |
| 4. Buffer programs will place additional demand on scarce local government resources. | FACT: | In the Heraty (1993) buffer survey, a majority of local government respondents indicated that their staff spent only an additional 1-10 % of their time on site plan review and inspection due to implementation of a buffer program. |

# ECONOMIC BENEFITS

Stream buffers offer many economic benefits to the local community. These benefits can be either non-market which result in cost savings to community budgets or market related such as increases in property values for landowners. Examples of cost savings which may be realized due to buffer presence include:

- The Minnesota DNR estimated a cost savings of $300 per acre-foot associated with a minimized need for floodwater storage due to the preservation of riparian wetlands.
- Forested stream and shoreline buffers situated on the flat soils of the coastal plain have been found

to be effective in removing sediment, nutrients and bacteria from stormwater runoff and septic system effluent in a wide variety of rural and agricultural settings along the East Coast (Desbonnet et al., 1994).

- Buffers can sharply reduce the number of drainage complaints received by local public works departments and they are often an effective means to mitigate or even prevent stream or shoreline erosion.

The presence of buffers also tends to have a positive impact on the value of property adjacent to the buffer system. Examples of the positive market influence of buffers include:

- When managed as a "greenway", stream buffers can increase the value of adjacent parcels as illustrated by several studies. Pennypack Park in Philadelphia is credited with a 33% increase to the value of nearby property. A net increase of more than $3.3 million in real estate is attributed to the park (Chesapeake Bay Foundation, 1996). Another greenway in Boulder, Colorado was found to have increased aggregate property values by $5.4 million, resulting in $500,000 of additional tax revenue per year (Fausold and Lilieholm, 1996).
- Homes situated near seven California stream restoration projects had a 3 to 13% higher property value than similar homes located on unrestored streams (Streiner and Loomis, 1996). Most of the perceived value of the restored stream was due to the enhanced buffer, habitat, and recreation afforded by the restoration.
- Housing prices were found to be 32% higher if they were located next to a greenbelt buffer in Colorado (Correll et al., 1978). Nationally, buffers were thought to have a positive or neutral impact on adjacent property in 32 out of 39 communities surveyed (Schueler, 1995).
- Effective shoreline buffers can increase the value of urban lake property. A recent study in Maine found that water clarity was directly related to property values. Specifically, a measurable improvement in water clarity (visibility depth increased by 3 feet) resulted in $11 to $200 more per foot of shoreline property, potentially generating millions of dollars in increased value per lake (Michael et al., 1996).

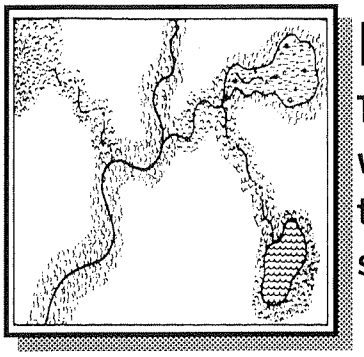
## Case Study: Cane Creek Reservoir

(Source: Orange Water and Sewer Authority Board of Directors, 1997)

The Cane Creek reservoir is located in North Carolina and owned and operated by Orange Water and Sewer Authority. The reservoir supplies drinking water to the Towns of Chapel Hill and Carrboro as well as portions of Orange County. The long term watershed management plan for the reservoir recommended buffer requirements along the reservoir shoreline, and along all perennial and intermittent streams within the reservoir watershed. There are two types of recognized buffers; agricultural and development buffers. For development activities throughout the watershed, buffers are required to be a minimum width of 30 feet for low density development and a minimum of 100 feet for high density development. Property owners are encouraged to maintain at least the first 25 feet of the buffer next to the stream in a naturally vegetated or undisturbed state.

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Subdivision Design in Flood Hazard Areas** (1997) by Marya Morris<br>Provides detailed support for keeping development out of the floodplain, discusses function of buffers in reducing flood damage, discusses how cluster development can be used to reduce flooding. | American Planning Association<br>Planners Book Service<br>122 South Michigan Avenue<br>Suite 1600<br>Chicago IL 60603<br>312-786-6344 |
| **Site Planning for Urban Stream Protection, Chapter 5: The Architecture of Stream Buffers** (1995) by Thomas Schueler<br>Describes benefits of stream buffers, community experience with buffer programs, pollutant removal capability of stream buffers, performance criteria, and resources needed for implementation. | Center for Watershed Protection<br>8391 Main Street<br>Ellicott City, MD 21043<br>410 461-8323 |
| **Riparian Forest Buffers** (1991) by David J. Welsch<br>Provides detailed information on the function and design of riparian forest buffers. | U.S. Department of Agriculture<br>Forest Service<br>Northeastern Area<br>Radnor PA<br>(610) 975-4024 |



# PRINCIPLE NO. 18

**The riparian stream buffer should be preserved or restored with native vegetation that can be maintained throughout the plan review, delineation, construction, and occupancy stages of development.**

## CURRENT PRACTICE

Few communities specify mature riparian forest as a target for their buffer program. Heraty (1993) found that over two-thirds of programs surveyed simply required that pre-development conditions be maintained, regardless of whether it was trees, weeds, turf, or concrete. Indeed, 20% of all buffer programs failed to specify any vegetative goal at all. Given the importance of riparian forests in the ecology of headwater streams, specific vegetative targets for stream buffers are desirable.

In many communities that have stream buffer ordinances, the buffer is merely a line drawn on a map, which is virtually invisible to contractors and landowners. Few communities require that buffer boundaries be marked or define allowable uses within the buffer. Moreover, few communities have notification or enforcement tools to prevent buffer encroachment either during construction or by future landowners (see Table 18.1). For example, in Heraty's (1993) survey of buffer programs, only 53% require buffers to be marked on the clearing and grading plan. Furthermore, only 3% require a preconstruction meeting to discuss buffer boundaries with contractors and construction crew. In addition, while most buffers are held in private ownership, only slightly more than half of all communities employed education and outreach programs to ensure that homeowners were aware of buffer uses and limits. For these and other reasons, encroachment of buffers is the norm rather than the exception.

**Table 18.1: Typical Buffer Management Strategies (based on survey of 36 local buffer programs)**

| Requirements and Strategies | Respondents Enacting |
|---|---|
| Buffers must appear on site plan. | 65% |
| Buffers must appear on the clearing and grading plan. | 53% |
| Strong buffer awareness programs are implemented. | 53% |
| A preconstruction meeting is held to ensure that the buffer is not damaged during construction. | 3% |
| Allowable or unallowable uses are not defined in the buffer ordinance. | 33% |

# RECOMMENDED PRACTICE

The key to effective preservation and management of a local buffer program is development of a strong buffer ordinance. A buffer ordinance should outline the legal rights and responsibilities of the local government and the organization or landowner responsible for long-term management and maintenance of the buffer. Specific items which should be noted in the ordinance include:

- Criteria for a three-zone buffer system
- Defining allowable and unallowable uses for the buffer
- Conditions for buffer expansion or contraction
- Physical delineation requirements
- Conditions where the buffer can be crossed
- Integrating stormwater and BMPs within the buffer
- Buffer limit review
- Buffer education, inspection, and enforcement
- Buffer flexibility

## Other Buffer Management Tips

In order to preserve and maintain the integrity of the buffer during all stages of development, communities should require that all buffers appear on clearing and grading plans and require that contractors attend a preconstruction meeting to ensure awareness of buffer boundaries. During the pre-construction phase, the local plan reviewer should meet with the developer and the construction representative to determine site constraints that may impact the buffer and to ensure that construction activities do not harm the buffer. Clearing and grading and erosion and sediment control plans should all be reviewed at this point

Throughout the construction phase the local plan reviewer should visit the site to determine if ongoing construction activities have violated the buffer integrity. The local government may require a construction maintenance bond to ensure that the developer repairs any damage to the buffer resulting from construction activity.

As discussed above, post-construction buffer maintenance requirements should be clearly outlined in the buffer ordinance. A buffer maintenance agreement can be useful in ensuring long-term buffer integrity. The agreement lists management activities (e.g., removal of dead trees) that can be performed by the landowner without a permit. Allowable uses may also be listed. This agreement gives the local government the authority to enter the buffer for the purpose of inspection. It also cites the conditions under which the landowner is responsible for repairs. Landowner liability for repairs is also listed.

Public information programs, such as signage along the buffers, should be considered to ensure long-term buffer maintenance. Other public outreach programs include:

- written disclosures regarding the buffer that convey with the deeds of buffer owner and all landowners adjacent to the buffer
- outline of buffer uses and maintenance requirements in the community association covenant
- occasional public service announcements or newspaper articles on the buffer program
- government sponsored "buffer walks"

## PERCEPTIONS AND REALITIES ABOUT BUFFER MANAGEMENT

Some concerns have arisen over management of buffer systems. In particular, there are concerns that buffer regulations may be too restrictive, or interfere with individual property rights (Table 18.2). Most of these concerns can be alleviated with a carefully constructed and thoughtfully implemented buffer ordinance.

**Table 18.2: Perceived Impediments to Stronger Stream Buffer Management**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. The regulation of buffer programs will lack flexibility and create excessive restrictions for property owners. | FACT: | Techniques such as "buffer averaging" (Schueler, 1995) can limit the inflexibility of buffer requirements. |
| | FACT: | Buffers can be held in conservation easements, reducing the need for regulatory intervention (Heraty, 1993). |
| 2. Buffer programs may lack the tools for delineation of buffer areas, which can create requirements that are too ambiguous or inflexible. | FACT: | "Ambiguity" of buffer delineation can be overcome through a program that incorporates specific delineation criteria and by clearly marking the buffer boundary on site plans and in the field. Heraty (1993) found that 65% of respondents required that buffers be delineated on a site plan. |
| 3. Limitations on allowable uses in the buffer may be too restrictive, with no real mechanism to enforce them. | FACT: | Buffer restrictions can vary based on the distance from the stream, with only the innermost zone being severely restricted (Schueler, 1995). |
| | FACT: | While enforcement of buffer regulations has been weak, Cooke (1991) finds that simply making land owners aware of the buffer and its importance can increase the viability of the buffer system. |
| 4. Forest succession may not be attractive to all residents. | FACT: | Mature trees add to property values (See Principle No. 21), but the succession of forest understory vegetation may detract from property values. |
| | FACT: | Only 3% of the respondents to the Heraty (1993) survey complained that the buffer was aesthetically unattractive. |

**Table 18.2: Perceived Impediments to Stronger Stream Buffer Management (Continued)**

| Perception | Facts, Case Studies, and Challenges |
|---|---|
| 5. Many suburban residents desire lawns and views instead of trees. | FACT: 60% of homeowners would accept a smaller yard in exchange for design amenities on their houses (Probuilder Magazine, 1997).<br>FACT: Lots with trees have an average value of approximately 5% to 7% higher than lots without trees, and these lots sell faster (MD DNR, 1996). |

## CASE STUDY: BALTIMORE COUNTY, MARYLAND

The buffer ordinance of Baltimore County, Maryland has several features that encourage effective maintenance and management of the buffer system. Among the key features are flexibility in delineating the buffer based on the field conditions, and a legally binding enforcement mechanism. Other features include:

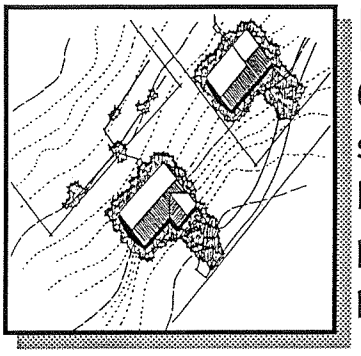
- Requirement that the forest buffer appear on any plans submitted to the county.
- Provisions for forest re-vegetation in some circumstances.
- Adjustment of the buffer width depending on stream quality and erosion potential.
- Restrictions on specific uses within the buffer system.
- List of specifically permitted uses.
- Enforcement mechanisms in the form of criminal and civil penalties.

## ECONOMICS OF BUFFER MANAGEMENT

The economics of buffer management may, at first glance, seem unattractive to local governments. The additional management required for a more effective stream buffer program does mean that more resources will be needed for the plan review and delineation process. However, Heraty (1993) found that the additional time required on the part of the local planning staff should represent, on the average, less than 10% more staff time during the development review process.

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Greenways: A Guide to Planning, Design, and Development** (1993)by Charles Flink and Robert Searns<br>Discusses creation, funding, and management of greenway systems including riparian buffers. | Island Press<br>1718 Connecticut Avenue, NW<br>Suite 300<br>Washington, DC 20009<br>202-232-7933 |
| **Forest and Riparian Buffer Conservation: Local Case Studies from the Chesapeake Bay Watershed** (1996)<br>A collection of case studies that focus on innovation programs and implementation by local communities. | Rick Cooksey or Albert Todd<br>USDA Forest Service<br>Northeastern Area State and Private Forestry<br>Chesapeake Bay Program<br>410 Severn Avenue, Suite 109<br>Annapolis, MD 21403<br>800-968-7229 |
| **Site Planning for Urban Stream Protection** (1995) by Thomas R. Schueler<br>Provides a summary of key performance criteria for designing urban stream buffers. | Center for Watershed Protection<br>8391 Main Street<br>Ellicott City, MD 21043<br>(410) 461-8323 |



# PRINCIPLE NO. 19

**Clearing and grading of forests and native vegetation at a site should be limited to the minimum amount needed to build lots, allow access, and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner.**

## CURRENT PRACTICE

Most communities allow clearing and grading of an entire development site except for a few specially regulated areas such as jurisdictional wetlands, steep slopes, and floodplains. A handful of communities do encourage the preservation of some forests or specimen trees. However, very few communities clearly restrict clearing or grading of buffers, open space, and native vegetation during construction.

A survey conducted by Corish (1995) revealed that when jurisdictions do have clearing and grading restrictions, the specific regulations and measures available to enact them are relatively weak (Table 19.1). For example, less than 20% of the communities responding to the survey set specific limits or targets on how much vegetation could be cleared. Furthermore, barely half of the communities had enforcement mechanisms to ensure that grading occurs as planned.

**Table 19.1: Characteristics of Local Clearing and Grading Programs (Based on Corish's Survey of 43 Communities with Erosion and Sediment Control Programs, 1995)**

| Item | % of Respondents |
|---|---|
| Community has developed laws that specifically address clearing and grading | 77% |
| Community has established tree preservation requirements | 65% |
| Community has provisions for enforcing compliance during the construction phase | 63% |
| Community requires site inspection to confirm clearing/grading requirements prior to start of construction | 40% |
| Community requires bond or other measure of assurance required before construction | 40% |
| Community has regulations that specify percent of the site that can be cleared | 17% |

## RECOMMENDED PRACTICE

It is desirable that as much of a site be conserved in a natural state as possible. Areas of a site that are conserved in their natural state retain their natural hydrology and do not erode during construction. As a general rule, clearing should be restricted to the minimum area required for building footprints, construction access, and safety setbacks. Communities have several existing tools that might be adapted to limit clearing, including:

- erosion and sediment control ordinances;

- grading ordinances;
- forest conservation or tree protection ordinances; and
- open space development.

## Erosion and Sediment Control Ordinances

Many communities do have an erosion and sediment control (ESC) ordinance that can be modified to reduce clearing and grading of forested areas and native vegetation. Some areas that deserve scrutiny are:

- Clear delineation of tree or vegetation "save" areas on the ESC plan;
- Clear posting of the limits of disturbance by flag or fence at the site; and
- On-site pre-construction meetings to ensure that contractors are fully aware of the tree save areas.

Another key area is site fingerprinting. This technique minimizes the amount of clearing and grading conducted at a site by limiting disturbance to the minimum area necessary for the construction of buildings and roadways. Clearing of construction roads is permitted. However, the construction access should coincide with planned roadways whenever possible. A suggested limit of disturbance around structures is five to ten feet outward from the building pad (MD DNR, 1991). This distance may need to be increased in areas where potential wildfires are a concern.

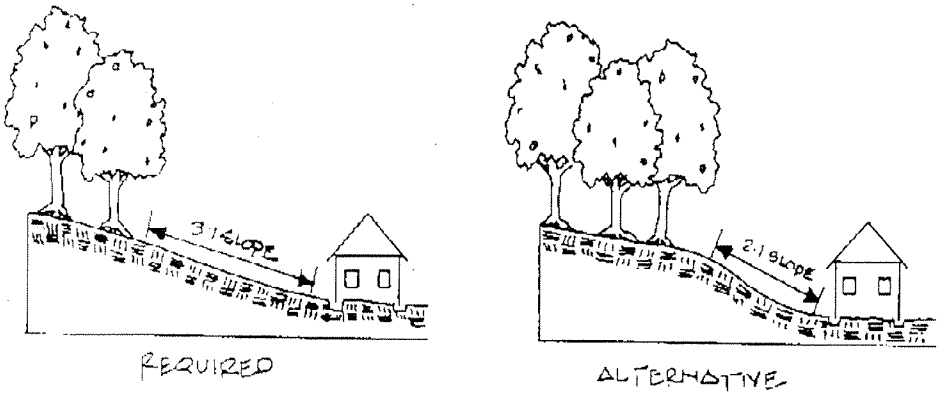
## Grading Ordinances

Some communities also have grading ordinances that prescribe maximum and minimum slopes for house lots. To maximize preservation of trees and other vegetation, some variances to slope criteria should be considered. For example, allowing a steeper engineered slope than authorized (e.g., 2:1 versus 3:1) may preserve more trees (see Figure 19.1).

## Forest Conservation Ordinance

Several communities and a few states have begun to require that developers conserve forests present at a site. Forest conservation ordinances typically outline targets for conservation of valuable forest habitat, and focus on preservation of high quality forests such as stands with high structural diversity; large contiguous forest tracts, particularly those that connect to other existing forest stands; and forests along streams, wetlands, and lakes (MD DNR, 1991).

**Table 19.1: Example Showing Use of Grading Variance to Minimize Clearing and Grading and Preserve Trees (Based on MD DNR, 1991)**




Maryland's Forest Conservation Act (Table 19.2) outlines specific thresholds for post-development forest cover depending on the zoning category. Reforestation is required for clearing in excess of the conservation threshold and tree planting may be required if no trees are currently present at the site.

**Table 19.2: Forest Conservation Threshold (MD DNR, 1991)**

| Land Use | Conservation Threshold * |
|---|---|
| Residential Development (0.2 - 1.0 du/ac) | 25 % |
| Residential Development (1.0 - 20 du/ac) | 20 % |
| Commercial and Industrial | 15 % |

* Represents the minimum percentage of the site that must be preserved in a forested condition. Any clearing of forest areas below the threshold requires reforestation at a ratio of two acres for every one cleared, either at the site or at an off-site location.

## Open Space Development

Open space development can conserve large forest stands in permanent open space. This approach to development facilitates the preservation of large, contiguous tracts of forest. Arendt (1994) suggests that to maximize the extent of open area preserved, site designers should begin the site layout process by first identifying areas that are to be preserved. These include primary conservation areas such as jurisdictional wetlands and steep slopes and secondary conservation areas such as forests and natural meadows. Open space should be designed to include both primary and secondary conservation areas and to connect them whenever possible.

# PERCEPTIONS AND REALITIES ABOUT CLEARING LIMITS

Most of the concerns associated with clearing limits center on the added expense to developers, siting septic systems, liability, and wildfire concerns (see Table 19.3).

**Table 19.3: Perceived Impediments to Clearing and Grading Restrictions**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. The preservation of trees during construction is prohibitively expensive. | FACT: | Minimizing clearing during the construction phase can reduce earth movement and erosion and sediment control costs by up to $5,000/acre (DE DNREC, 1997). |
| | CHALLENGE: | More complex grading strategies may be required to preserve trees close to foundations and other structures. |
| 2. Where septic systems are used to treat wastewater, the septic field area of a site will be affected by restricting clearing. | CASE STUDY: | In the State of Maryland, between 340 and 1,000 square feet septic area is required for a four bedroom house. This area can be accommodated while still restricting clearing of treed areas. Although 10,000 $ft^2$ of reserve disposal area is required in case the system fails, this area need not be cleared until the reserve field is needed (MD Department of the Environment, Title 26 Chap 02). |
| 3. Local governments, or the developer may be liable for damage to property as a result of fallen trees. | FACT: | The government has liability for fallen trees only if the government owns the land the tree is on, and is negligent in maintaining the property (Widener, 1997). |
| | FACT: | Land owners are only responsible for tree damage if reasonable care and inspection would have prevented the damage, as in the case of an obviously damaged or diseased tree (Widener, 1997). |
| | FACT: | There is no precedent for the government being held liable for a tree preservation ordinance (Widener, 1997) |
| 4. Vegetation near homes can be a fire risk; local governments may be responsible for this risk. | FACT: | In arid areas, such as chaparral regions in California, clearing is required within 100' of homes. This can be accommodated while still minimizing clearing over the entire site, particularly for open space development (Cochran, 1998). |
| | FACT: | The landowner is only held responsible for wildfire damage if the landowner negligently allows the fire to spread to other properties (Widener, 1997). |
| | CHALLENGE: | Wildfires are a potential risk to properties in the wildlands/urban interface. Greater clearing and grading distances may be required to reduce the risk of fires (see following discussion). |
| 5. People prefer large lawns to treed areas. | FACT: | Lots with trees tend to sell more quickly than lots without trees. Treed lots also have an average value of 5 to 7 % more than lots without trees (MD DNR, 1996). |
| | FACT: | The American Lives survey of recent home buyers noted that 77% of the respondents rated natural open areas as extremely important. Further, 52% rated wilderness areas as extremely important (Fletcher, 1997). |

## Fire Hazard and the Wildlands/Urban Interface

In some communities, clearing and grading restrictions need to be carefully evaluated in light of the potential risk of wildfires. Increasingly, development in the western portion of the country is occurring in wildland environments where wildfire is a major element of the native plant community. Increasing development is expanding into the wildland/urban interface where structures are located next to large areas of natural vegetation. In these zones, structures are extremely vulnerable to large wildfires (e.g., California chaparral).

When development is being planned within the wildland/urban interface, clearing of vegetation or elimination of potential wildfire fuels (dead vegetation) may be a primary design consideration. Table 19.4 presents a rating system for estimating the hazard potential of developing in a wildland/urban interface area. If your community has a high potential risk for wildfire, then it makes sense to consider the vegetation management techniques that are described in Table 19.5. The most common technique is to clear or reduce vegetation that is within 70 feet of structures.

**Table 19.4: Sample of Fire Hazard Rating System in the Wildland/Urban Interface (adapted from National Wildland/Urban Interface Fire Protection Program)[1]**

| Hazard Rating Category | Description of Hazard | Point Range | |
|---|---|---|---|
| I. Fuel Hazard Rating [2] | Low, medium or high hazard fuels (grasses, mixed hardwoods, evergreen timber) | Grasses<br>Woodland (open understory)<br>Woodland (heavy brush)<br>Large evergreen timber | 1 pt<br>2-3 pts<br>4 pts<br>5 pts |
| II. Slope Hazard Rating [2] | Mild, moderate, steep, to extreme slopes | Mild slopes (<5%)<br>Moderate slopes (6-15%)<br>Steep slopes (16-25%)<br>Extreme slopes (>25%) | 1 pt<br>2 pts<br>3 pts<br>4 pts |
| III. Structure Hazard Rating [2] | Roof and siding material combustibility | Non-combustible roof & siding<br>Non-comb. roof, comb. siding<br>Comb. roof, non-comb siding<br>Comb. roof & siding | 1 pt<br>3 pts<br>7 pts<br>10 pts |
| IV. Safety Zone Rating [2] | Number of homes that do not have a safety zone of at least 30 ft | 30% of homes<br>31-60% of homes<br>61-100% of homes | 3 pts<br>6 pts<br>10 pts |

**Table 19.4: Sample of Fire Hazard Rating System in the Wildland/Urban Interface (adapted from National Wildland/Urban Interface Fire Protection Program)[1]**

| Hazard Rating Category | Description of Hazard | Point Range | |
|---|---|---|---|
| V. Means of Access for Emergency Vehicles [3] | Number of access points or width of access | Only one access point | 3 pts |
| | | Width for one-way traffic only | 3 pts |
| | | Road grades > 15% | 2 pts |
| | | Turn-around inadequate | 3 pts |
| | | Bridge width limits emerg. equip. | 3 pts |
| VI. Additional Factor Rating [3] | Other items that contribute to hazard potential | Most roads names not marked | 2 pts |
| | | Subdivision entrance not marked | 2 pts |
| | | Individual home #s not marked | 2 pts |
| | | Power lines not buried | 2 pts |
| | | Lack of municipal water sources | 2 pts |
| | | Area lacks static water sources | 2 pts |
| | | Long distance from fire dept. | 2 pts |
| | | Ease of plowing for fireline | 1-5 pts |

**Total Hazard Rating:** (0-19 Low Risk, 20-39 Medium Risk, 40-60 High Risk)

[1] Total hazard rating is the sum of all points awarded.
[2] For Hazard Rating Categories I - IV, assign points based on the one criterion that best describes the existing site conditions.
[3] For Hazard Rating Categories V and VI, points are awarded for all criteria that apply.

**Table 19.5: Recommendations for Target Vegetation Around Structures in Medium to High Hazard Wildfire Areas (adapted from National Wildland/Urban Interface Fire Protection Program)**

| Zone | Distance from Combustible Structure | Target Vegetation |
|---|---|---|
| A | Primary setback zone - 20 feet | All natural vegetation cleared, plant only low level, fire-resistant vegetation (lawn, low level ground covers, examples include: lily-of-the-valley, periwinkle, bearberry, lilac). |
| B | Wet zone - 70 feet | Most natural vegetation removed, area irrigated during dry conditions, planted with low level, fire-resistant vegetation. |
| C | Thinning zone - 120 feet | Remove all dead/dying vegetation and up to 50% of live natural vegetation (target most flammable, large foliage, shaggy bark, plants that develop dry or dead undergrowth for removal). |
| D | Thinning zone - 150 feet | Remove all dead/dying vegetation and up to 30% of live natural vegetation. |

## Economic Benefits

The economic benefits associated with minimizing clearing and grading are two-fold. First, DEDNREC (1997) estimated that minimizing clearing during the construction phase can reduce earth movement and erosion and sediment control costs by up to $5,000/acre. Second, through minimizing clearing, the volume of runoff generated at the site is reduced, thus the cost of stormwater management is reduced.

The cost to maintain forests in a conservation easement is fairly low. Roser et al. (1997) estimated it to be less than $250/year. Principle No. 20 discusses the economics of tree conservation in greater detail.

## Case Study: West Bloomfield, Michigan

One method of retaining native vegetation is to incorporate clearing and grading requirements within tree preservation or natural resources preservation ordinances. While most tree preservation ordinances focus on protecting individual trees (e.g., trees with a specific diameter or historical value), natural resources preservation ordinances protect habitat areas. This type of legislation has the advantage of protecting a stand of trees, as opposed to individual large trees that may not survive alone. The woodland preservation ordinance of West Bloomfield, Michigan, protects forests of three acres or larger. Specific features of the woodland preservation ordinance include:

- Protects stands of trees greater than three acres in size.
- Requires a woodland permit for encroachment on woodlands.
- The developer must show woodland protection through selective clearing to create wooded lots or the creation of an open space area.
- The developer must pay a fee based on woodland loss.
- Application for a woodland permit must be accompanied by a site grading plan.

## Where to Get Started

### Suggested Resources

**Clearing and Grading: Strategies for Urban Watersheds** (1995) by Kathleen Corish

Guidance report discussing problems associated with the clearing and grading activities which precede land development, and recommendations for minimizing impacts to receiving water bodies.

### How to Get a Copy

Metropolitan Washington Council of Governments
Information Center
777 North Capitol Street, NE
Suite 300
Washington, DC 20002-4201
202-962-3256

## Suggested Resources

## How to Get a Copy

**Fire Protection in the Wildland/Urban Interface: Everyone's Responsibility** by the National Wildland/Urban Interface Fire Protection Program

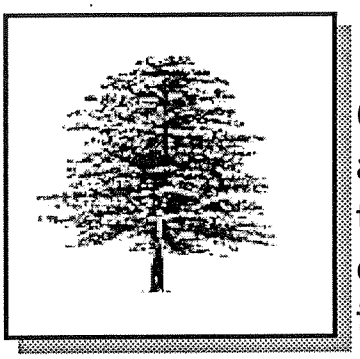
Presents five step method for assessing fire hazards in wildland/urban interface. Presents case studies demonstrating how local governments can reduce the risk for fires in the wildland/urban interface.

National Interagency Fire Center
Branch of Supply
3833 South Development Avenue
Boise ID 83705-5354
208-387-5542

**Forest Conservation Manual: Guidance for the Conservation of Maryland's Forests During Land Use Changes Under the 1991 Forest Conservation Act (1991)**

Provides guidance for preparing forest stand delineations and forest conservation plans. Includes methods for determining the size, location, and orientation of the forest areas to be retained; forests protection techniques; and reforestation and afforestation methods.

Maryland Department of Natural Resources
Resource Conservation Service
Forestry Division
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401



# PRINCIPLE NO. 20

**Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native plants. Wherever practical, manage community open space, street rights-of-way, parking lot islands, and other landscaped areas to promote natural vegetation.**

## CURRENT PRACTICE

Currently, few communities require that trees and native vegetation be conserved during the development process. In communities that do have tree ordinances, the focus is often on "specimen trees" which represent trees that are old or rare to the area. Many communities promote the use of lawn instead of native vegetation. Today, over 24 million acres of lawn exist in the suburban environment (Daniels, 1995). In many jurisdictions, local ordinances set standards for the maintenance of lawns and open areas. These laws often include restrictions on the height of "weeds" and have been used to prevent landowners from managing their yards with native vegetation. Further, subdivision covenants and homeowner associations may determine exactly what plants may be used for landscaping and in what planting style. A few communities, however, require that a fixed percentage of the natural vegetation at the site be retained or replaced with native specimens.

## RECOMMENDED PRACTICE

Native trees, shrubs, and grasses are important contributors to the overall quality and viability of the environment. Therefore, existing codes should be revised to promote the preservation of trees and native vegetation. Care should be taken to identify and preserve the highest quality forest stands prior to development. Specific mature tree/native vegetation targets should be established at the pre-development stage. These targets should be based on reference sites and historical records. Explicit conservation regulations with enforcement measures should be adopted. Many tools that can be used to achieve these goals.

Several tools which can be used for tree conservation have been discussed in previous principles. Forest conservation ordinances can be used to cluster stands of forest and place structures around designated tree clusters. Open space development practices can be employed to protect vegetation and still allow for human activity. Planting of vegetation can be a requirement for street rights-of-way in order to reduce imperviousness. Clearing and grading requirements can include preservation of trees and native vegetation. Parking lots can be reduced in size and include vegetated islands.

### Techniques for Vegetation Conservation

In some parts of the country where water supplies are limited, Xeriscaping is gaining in popularity. This technique uses drought tolerant native plants to landscape and thereby reduces the amount of water required to maintain a lawn. In some areas of the Southwest, programs have begun which provide a monetary rebate to homeowners who replace their lawn with native plantings.

Standards for the conservation of trees vary across the country. While some jurisdictions have adopted tree conservation ordinances, the specific regulations and measures to enforce these ordinances vary widely. Most ordinances seek to preserve some desirable trees during construction while providing for the replacement of other trees removed during the building process. As an example, the State of Maryland passed the Forest Conservation Act in 1991. This act seeks to prioritize the conservation or preservation of forest stands through forest stand delineation and development of a forest conservation plan. The primary intent of the conservation plan is to preserve existing forest cover and to restrict forest clearing to the minimum area essential to a development project. If retention of the existing tree stand is not possible, reforestation and off-site mitigation techniques are available.

## PERCEPTIONS AND REALITIES

Perceived economic hardship due to tree conservation and additional plantings, and concerns about human safety are often used as arguments against tree conservation and native landscaping. Table 20.1 reviews some of the research associated with urban tree conservation and native landscaping and their impacts on the urban environment.

**Table 20.1: Perceived Impediments to Tree and Vegetation Conservation**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. The additional costs of conserving of trees outweigh the benefits. | FACT: | Two regional economic surveys documented that conserving forests on residential and commercial sites enhanced property values by an average of 6 to 15% and increased the rate at which units were sold or leased (Morales, 1980 and Weyerhauser, 1989). |
| | FACT: | It has been conservatively estimated that over $1.5 billion per year is generated in tax revenue for communities in the U.S. due to the value of privately-owned trees on residential property. (USDA, as cited by the National Arbor Day Foundation, 1996). |
| | CASE STUDY: | Single family homes in Athens, GA with an average of five trees in the front yard sold for 3.5 to 4.5 percent more than houses without trees (National Arbor Day Foundation, 1996). |
| 2. Native vegetation may harbor undesirable wildlife and insects. | FACT: | In a 1988 survey of wildlife acceptance, some 65% of the adult population reported that they enjoyed seeing or hearing wildlife while pursuing other activities around the home (US F&WS, 1993). |
| | FACT: | Natural vegetation does not provide a steady supply of the sort of food required to sustain a population of vermin. (Daniels, 1995). |
| | CHALLENGE: | Perceptions linger among many homeowners that natural vegetation harbors undesirable wildlife and insects. Public education programs must continue to alleviate these concerns. |

**Table 20.1: Perceived Impediments to Tree and Vegetation Conservation (Continued)**

| Perception | Facts, Case Studies, and Challenges |
|---|---|
| 3. Trees in street right-of-ways may be a safety hazard to motorist. | FACT: Vegetation need not be cleared from the entire right-of-way but only as needed to accommodate utilities and sidewalks and permit a clear sight distance ( ULI, 1990).<br>FACT: ITE guidelines for TND street design call for planting strips and street trees to provide a buffer between vehicles and nonmotorists. These planting strips also provide a snow storage area in northern climates (ITE, 1997).<br>FACT: Traffic calming designs for reducing traffic speed on residential streets often incorporate the presence of trees (see Figure 20.1). |
| 4. Trees may represent a fire risk for homeowners. | FACT: A Fire Hazard Rating System and National Wildland/Urban Interface Fire Protection Program has been established which provides recommendations for target vegetation around structures (See Principle No. 19 for greater detail).<br>FACT: In arid areas, such as chaparral regions in California, clearing is required within 100' of homes. This can be accommodated while still minimizing clearing over the entire site, particularly for open space development (Cochran, 1998). |

# BENEFITS OF CONSERVING TREES AND NATIVE VEGETATION

The evidence is very strong that trees have noticeable economic benefits for developers and homeowners. A 1993 survey of members of the National Association of Homebuilders indicated that 69.2% of the respondents described themselves as increasing the number of trees on their properties and were either thinking of or committed to continuing the practice (Andreasen and Tyson, 1993). Another study found that large old street trees were the most important indicator of community attractiveness (Coder, 1996). This community attractiveness is important due to its positive impact on property value.

## Economic Benefits

The beneficial economic impacts of the presence of trees on property value has been well documented. Studies from numerous sources have found the following:

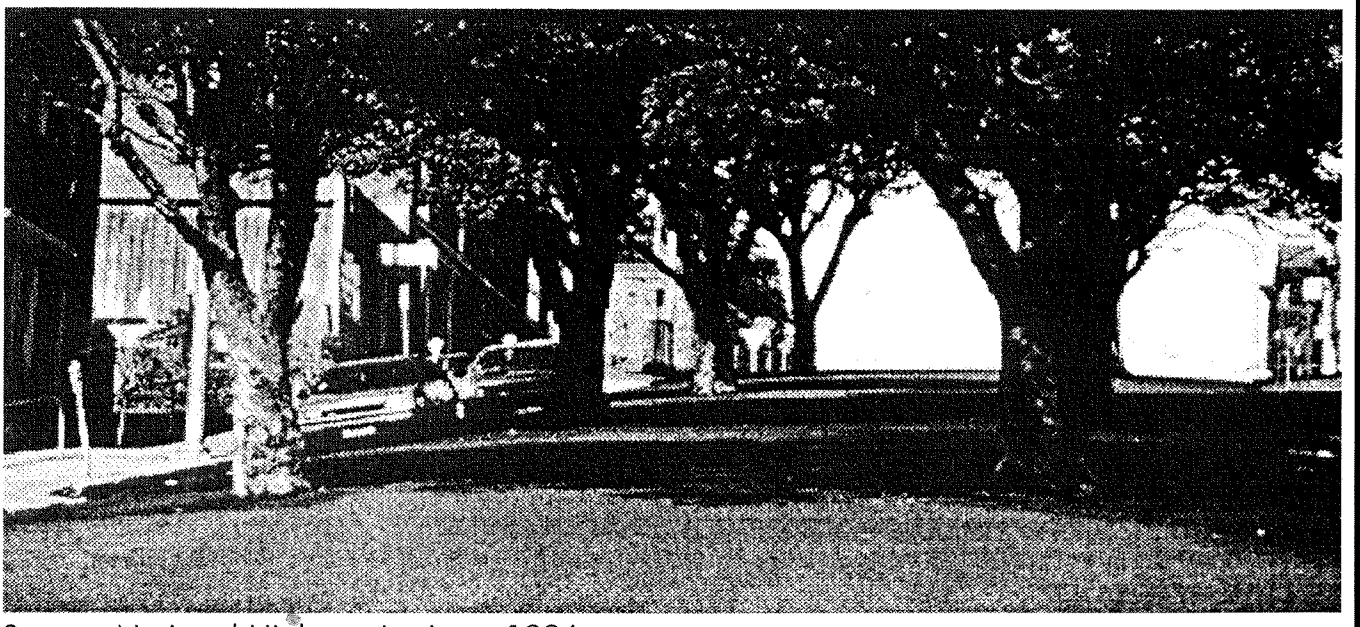
- The resale value of a home may be enhanced by as much as 15% with landscaping (American Nursery and Landscape Association, as cited in the Laurel Creek Nursery Newsletter, 1997).
- Landscaping has a 100-200% recovery value when selling a home (Laurel Creek Nursery Newsletter, 1997).
- A South Carolina developer found that bare house lots sold much faster after planting trees, with a $1,500 increase in the selling price (National Arbor Day Foundation, 1996).
- A study of 14 variables that might influence the price of suburban homes in Manchester, Connecticut and Greece, New York found that trees ranked sixth in influencing the selling price. Trees on the property increased sale prices by 5 to 15 percent (National Arbor Day Foundation, 1996).

- A 1990 survey of Seattle residents found that 62% of the respondents listed environmental factors such as greenery and greenbelts as one of the things they liked best about living in the city (SEATRAN, 1998).

## Environmental Benefits

The environmental functions trees and other vegetation perform can also present a significant savings. Table 20.2 highlights some of the environmental benefits of trees in the urban landscape and their corresponding economic values.

**Figure 20.1: Trees Incorporated into the Streetscape**



Source: National Highway Institute, 1996

**Table 20.2: Benefits of Trees in the Urban Landscape**

| Benefit | Case Study and Estimated Economic Benefits |
|---|---|
| Lowers air conditioning costs | In Atlanta, GA a six to nine degree temperature rise in the past 25 years which corresponds with a 65% loss in tree cover.[1] **Estimated Benefit: $73/tree/year[2]** |
| Trees can be used to retain carbon dioxide and control ozone. | In Milwaukee, WI urban forests sequester approximately 1,677 tons of carbon annually.[1] **Estimated Benefit: $50/tree/year[2]** |
| Trees reduce stormwater flows by encouraging infiltration and detaining rainfall. | In Austin, TX tree canopy reduced stormwater flows by up to 28%, saving the city $122 million.[1] |
| Trees reduce erosion and sediment control costs. | In a survey of erosion and sediment control programs, forest conservation that reduces exposed soil is ranked as a very effective erosion control measure with no maintenance costs (Brown and Caraco, 1996).[1] **Estimated Benefit: $75/tree/year[2]** |
| Trees provide wildlife habitat. | **Estimated Benefit: $75/tree/year[2]** |

[1] *Case studies cited in MacDonald, 1996*
[2] *Economic benefit expressed as dollars saved per tree per year (MD DNR, 1996)*

Other studies have also found considerable benefits from the presence of trees in urbanized areas:

- The loss of trees in urbanized areas can have significant economic impacts in terms of cooling costs. A $242 savings per home per year in cooling costs is realized when trees are present (Coder, 1996).
- It has also been estimated that the urban-heat island effect created in large cities due to lack of vegetation and its cooling effects costs Washington, DC some $40,000 per hour in the summer (Petit et. al., 1995).
- In Atlanta, Georgia, it was found that a 20% loss in trees and other vegetation in the metropolitan region produced a 4.4 billion-cubic foot increase in stormwater runoff; officials estimated that at least $2 billion would be required to build containment facilities capable of storing the excess water (American Forests, as cited in US Water News, 1997).

Other environmental benefits derived from trees include air pollution control, oxygen production and carbon dioxide reduction, erosion and sediment control, and noise abatement.

## Cost Savings

Conserving native vegetation results in significant cost savings for maintenance. Native vegetation is usually low-maintenance and is better adapted to the climatic changes and pests occur in various parts of the country. Native vegetation typically does not require the use of fertilizer or the constant watering is characteristic of the turf lawn. Americans spend over $7.5 billion each year on lawn care products to

maintain turf lawns. This includes the purchase of over 67 million pounds of pesticides which often end up in stormwater runoff. It has also been estimated that the average lawn also requires about 10,000 gallons of water each summer to maintain its green state (Daniels, 1995).

Some indication of the savings associated with maintenance of native vegetation has been documented in a 1992 study by the Wildlife Habitat Enhancement Council. The Council found that corporate land owners can save between $270 - $640 per acre in annual mowing and maintenance costs when open lands are managed as a natural buffer area rather than turf.

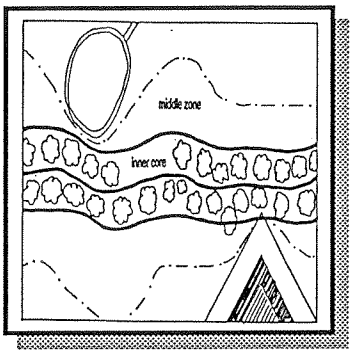
## CASE STUDIES

Two case studies illustrate the positive benefits of tree conservation. In the first case, an Indiana developer, Brad Chambers of The Buckingham Companies, redesigned a 130-unit apartment complex in order to reserve as much of the existing vegetation as possible. Roads and parking areas were reduced and relocated to conserve existing trees, and redesigned building units were fit into hillsides to reduce the need for grading. The changes resulted in an additional $300,000 in project costs, which translated into an additional $2.50 per square foot of construction. However, increased revenue and higher than normal resident retention rates offset the increased construction costs. The apartment complex reached full occupancy within its first year with minimal advertising, with a greater than normal retention rate for residents. The units commanded a higher rental rate and the property value also increased, which allowed the developer to secure an additional mortgage. These benefits help offset the added costs of the tree saving measures (Petit et.al., 1995).

The second case involves the conservation of trees during a road construction project. In 1993, Westminster, Maryland, began an effort to reconstruct East Main Street. The town identified a desire to avoid removal of 42 mature trees from the downtown area as one of its foremost concerns. By modifying the original plan to reduce street widths and extend curbing areas into the parking lane, 34 of the 42 trees were saved. In addition, 104 trees were added to the road section to create a more pedestrian-friendly streetscape. Realtors estimate that due to increased demand for downtown office and retail space, the added cost of the improved design will be recovered in 4 years (FHA, 1997).

Where to Get Started

| Suggested Resources | How to Get a Copy |
|---|---|
| **Building Greener Neighborhoods: Trees as Part of the Plan** (1995) by Jack Petit, Debra Bassert, and Cheryl Kollin<br>Demonstrates the environmental, economic, and aesthetic benefits of conserving and preserving trees in residential developments. | American Forests<br>PO Box 2000<br>Washington DC 20013-2000<br>202-667-3300 |
| **The Wild Lawn Handbook: Alternatives to the Traditional Front Lawn** (1995) by Steven Daniels<br>Guidance for creating and maintaining a non-conventional lawn. | Check your local public library for this book. |
| **Forest Conservation Manual** (1991) by Jennifer Greenfeld, Lorraine. Herson, Natalie Karouna, Giselle Bernstein<br>Provides guidance in preparing forest stand delineations and forest conservation plans the Maryland Forest Conservation Act. Also provides guidance on reforestation or afforestation methods. | Maryland Department of Natural Resources<br>Tawes State Office Building<br>580 Taylor Avenue<br>Annapolis, MD 21401 |
| **Forest and Riparian Buffer Conservation: Local Case Studies from the Chesapeake Bay** (1996)<br>Cites examples demonstrating how buffer programs have been implemented on the local level. | USDA Forest Service<br>Washington DC |




# PRINCIPLE NO. 21

**Incentives and flexibility in the form of density compensation, buffer averaging, property tax reduction, stormwater credits, and by-right open space development should be encouraged to promote conservation of stream buffers, forests, meadows, and other areas of environmental value. In addition, off-site mitigation consistent with locally adopted watershed plans should be encouraged.**

## CURRENT PRACTICE

A limited number of communities require conservation and protection of non-regulated areas such as stream buffers, forests, and meadows. Even fewer provide incentives for developers to consider better site design techniques that promote preservation of natural areas. Indeed, existing conservation efforts are generally characterized by excessive administrative requirements, lengthy plan reviews, additional up-front costs for the developer, and unclear appeal procedures. These experiences have created friction between developers and communities, dissuading many developers from participating in conservation programs. Further, the small number of communities which do provide incentives or flexibility when administering conservation programs may be regarded with suspicion by some parties that worry that resource protection goals may be compromised.

## RECOMMENDED PRACTICE

Conservation of natural areas at the site level can be made a more attractive option through flexibility and incentives. Examples of methods to encourage conservation include open space development, reduced stormwater management requirements for environmentally sensitive developments, buffer flexibility, property tax credits, density bonuses, and transferrable development rights.

### By-Right Open Space Development

Open space development is a pattern of development that allows for increased density on one portion of a site in exchange for protected open space elsewhere on the site (Principle No. 11). One-third to four-fifths of the site may be preserved as open space (Heraty, 1992). Fifty percent or more of this open space may be dedicated to conservation areas, including regulated areas such as floodplains and jurisdictional wetlands and non-regulated areas such as forests and wild meadows.

In order to encourage open space development, communities should make sure that plan submittal requirements, plan review procedures, and the appeal process are no more arduous than that needed for approval of conventional subdivisions. Designation of open space development as a "by-right" option as opposed to a special exception or variance can further encourage this development option.

## Density Compensation

Conservation requirements can result in the loss of buildable land or house lots. Density compensation is a flexible approach to conservation that compensates developers for lost house lots. Specifically, developers are not penalized for conserving natural areas. Instead, they can build approximately the same number of homes in a more compact design (see Table 21.1). The purpose of density compensation is to encourage preservation of stream buffers or other natural areas without penalty to the developer.

**Table 21.1: Examples of Density Compensation for Base Density of 1 du/acre**

| % of Site Lost to Buffer or Other Natural Area | Density Compensation[1] |
|---|---|
| 1 - 10% | 1.0 |
| 11 - 20% | 1.1 |
| 21 - 30% | 1.2 |
| 31 - 40% | 1.3 |
| 41 - 50% | 1.4 |
| 51 - 60% | 1.5 |
| 61 - 70% | 1.6 |
| 71 - 80% | 1.7 |
| 81 - 90% | 1.8 |
| 91 - 91% | 1.9 |

[1] Additional dwelling units allowed over base density of 1 du/acre

## Stormwater Credits

Stormwater credits refer to different types of site level techniques that reduce stormwater management costs for developers. They are referred to as "credits" because they reduce runoff volumes and help to avoid construction of more costly stormwater management facilities. The different techniques include conserving natural areas, disconnecting impervious areas, crediting stream buffers, and utilizing environmentally sensitive development. These techniques are described in further detail in Table 21.2.

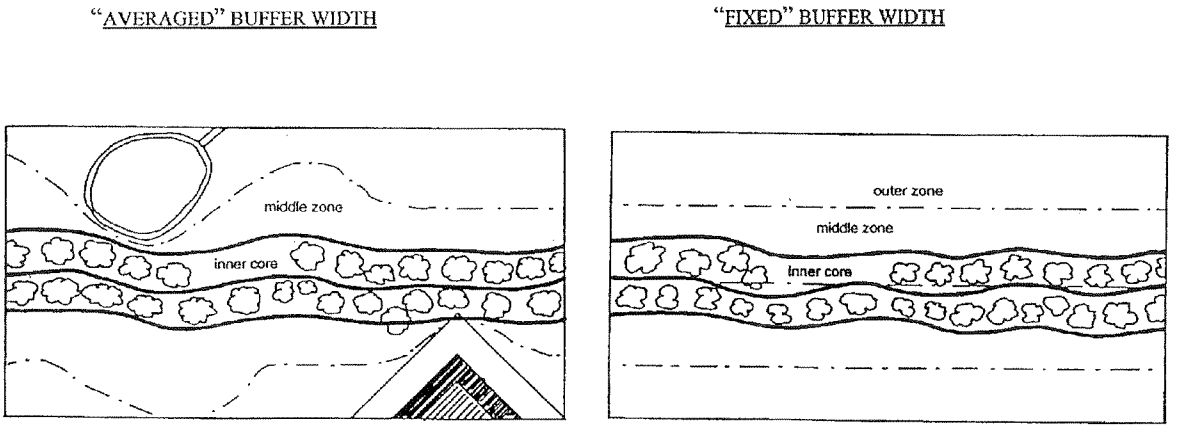
## Buffer Averaging

A one hundred foot stream buffer can convert approximately five percent of the total land in a given watershed into unbuildable land. At some sites, this could potentially be a significant hardship for developers. Flexibility can be provided through buffer averaging. Buffer averaging allows developers to narrow the buffer width at some points if the average width of the buffer and the overall buffer area meet the minimum criteria. Buffer averaging is typically used to accommodate existing structures and recover lost lots (Figure 21.1). Variances can also be granted if the developer or landowner can demonstrate severe economic hardship or a unique circumstance that makes compliance with the buffer ordinance difficult. This variance provision should include access to an administrative appeal in case the request for a variance is denied.

**Table 21.2: Examples of Stormwater Credits (MDE, 1997)**

| Types of Credits | Description |
|---|---|
| Natural area conservation | Given when natural areas are conserved at the site<br>Natural areas retain pre-developed water quality and hydrologic characteristics<br>Example: forest retention areas, non-tidal wetlands, floodplains, steep slopes |
| Disconnect impervious areas | Given when runoff from small impervious areas is directed to a pervious area where it can be infiltrated or filtered<br>Site is graded to promote overland filtering or bioretention is provided<br>Examples: disconnection of rooftop runoff, direction of parking lot runoff to filters strips |
| Stream buffers | Given when runoff from pervious and impervious areas is treated by an adjacent stream buffer<br>Buffer is grassed or wooded<br>Use of filter strip also recommended |
| Environmentally sensitive development | Given when suite of environmentally sensitive site design techniques is applied to low density development<br>Examples: large lot rural residential development |

**Figure 21.1: Buffer Averaging (Schueler, 1995)**




*Under buffer averaging, the width of the buffer can vary from point to point, as long as the average width in the parcel meets the local criteria. The streamside zone, however, should not be encroached on.*

## Property Tax Credit

Property tax credits provide incentives for the owners of conserved land. Under this type of program, communities can reduce, defer, or exempt property taxes on conserved land. The community stipulates how the property must be managed. Conservation easements are usually exchanged for the property tax credit. Owners receive the property tax credit as long as they comply with the conservation easement. Property tax credit programs are particularly attractive to landowners in rapidly developing regions. Market pressure in these regions often lead to significant property tax increases as well as utility, transportation, and other infrastructure special tax assessments (Allmann, 1996). Property tax credit can alleviate financial hardships to landowners affected by market-driven tax increases and may offset some or all of the tax burden associated with rising tax assessments in rapidly growing regions. Minnesota has several programs including:

- Native Prairie Tax Exemption Program: prairies five acres or more in size can be exempted from property tax when this land is maintained in a natural state.
- Minnesota Agriculture Preserve Program: offers $1.50 per acre per year property tax credit for conserved farmland. Farmland receives some protection from eminent domain and annexation, public utility development, and special tax assessments for public works projects (Allmann, 1996).

Other states such as Massachusetts and New Hampshire also allow local property tax credits for land conservation. To date, most property tax credit programs have been employed to conserve prairies and farmland but could be extended to protect natural areas such as forests, stream buffers, and floodplains.

In order to be effective, property tax credit programs must provide a penalty if property is taken out of conservation use to be developed. This "correct use" penalty can be 10 - 25% of the assessed value of the property.

## Density Bonus

Under the density bonus option, developers are rewarded for conservation of natural areas and are allowed to build more homes than would have been permitted under the base zoning density. The City of Maple Plains, New York, allows developers to increase the number of house lots by up to 5% based on the amount of open space conserved. Similar to density bonuses, density penalties also serve to encourage conservation of natural areas. Under this approach, the jurisdiction establishes a maximum and minimum density. Developers are allowed to build at the higher density if natural areas and open space techniques are used. If not, developers are restricted to the lower density (CBP, 1997).

## Transferable Development Rights (TDRs)

Unlike the options discussed above, transferable development rights (TDR) provide **off-site** rather than on-site density compensation. Under the TDR scenario, landowners in areas targeted for conservation transfer their development rights to areas designated as growth zones. These development rights, usually expressed as residential dwelling units, are sold to developers in the same manner that land is sold. TDR owners can

apply the development right to their site, effectively increasing density. For example, a developer in a designated growth zone owns a 20-acre parcel of land zoned at one dwelling unit per acre and wishes to increase the ultimate yield from 20 to 30 homes. The developer can achieve this goal by buying 10 TDRs. The sale of the TDRs means that 10 homes in the designated conservation area will not be built.

### Off-site Mitigation

Wetlands are sometimes filled during development. Other disturbances, such as interruption of flow to the wetland, may occur. Developers who impact wetlands may be subject to mitigation requirements. Mitigation requires developers to either minimize damage to wetlands, restore damaged wetlands, or create new wetlands. When the restoration or creation takes place off the development site, it is called off-site mitigation. Off-site mitigation is usually allowed when on-site mitigation (i.e., mitigation at the development site) is not feasible. In 1991, the City of Eugene (Oregon) implemented a policy requiring developers who impact wetlands in designated growth areas to provide off-site mitigation (Lane Council of Governments, 1991).

Off-site mitigation consistent with locally adopted watershed plans should be encouraged. Off-site mitigation can be used to maintain or increase the amount and diversity of wetlands in the watershed. Communities can identify specific wetlands to be protected or restored. Developers who impact wetlands in other portions of the watershed are then required to restore or create wetlands in this designated area. Developers are usually required to restore or create at least one acre for every acre impacted. Additional mitigation can be required for impacts to high value wetlands. Off-site mitigation can also be required for impacts to forests.

## Perceptions and Realities about Conservation Incentives

In general, no one is opposed to providing more economical and flexible approaches to conservation. However, some parties may feel that incentives and flexibility provide to many loopholes for developers, ultimately subverting conservation goals. Communities should carefully analyze these issues as they consider changes to their subdivision codes and zoning ordinances to better promote conservation.

## Economic Benefits

Proximity to natural areas can significantly increase the marketability of homes, allowing developers to obtain higher prices for homes located near conserved open areas. A survey conducted by Baxter et. al (1985) indicated that proximity to a natural area was one of the preferences most frequently noted by people considering purchasing a home. Fausold and Lilieholm (1996) noted that land use restrictions designed to protect the Chesapeake Bay resulted in an increase in housing prices, ranging from 14 to 27% for homes in the affected areas. Additional potential benefits for landowners as well as developers are presented in Table 21.3. The preservation of natural areas can also provide significant economic benefits for local communities. These benefits are outlined in Principles No. 17 and 20.

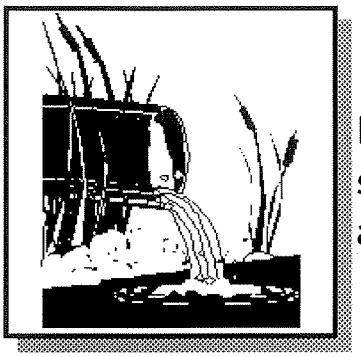
**Table 21.3: Incentives for Private Landowners to Preserve Natural Areas**

| Type of Program | Description | Potential Benefits and Advantages |
|---|---|---|
| Conservation Easements | Voluntary agreement to legal transfer of development and land use rights to a piece of property to a conservation trust. Easements may be temporary or permanent. | Landowner retains title to the property.<br>Public access is not required.<br>Easement is tied to the title so that future landowners are bound by agreement.<br>Potential tax deductions are available equal to the appraised value of the easement as a charitable gift.<br>In Maryland, there is a 15-year state and local tax exemption on the land if it remains unimproved. |
| Land Retirement | Programs administered by governmental agencies which provide financial incentives for the removal of agricultural land from production or to leave natural lands undeveloped. Many of these programs are legislatively funded, and their status relies on the political process. | May provide a reliable and significant source of income.<br>Landowners are capable of generating income from what could be marginal agricultural land.<br>Some financial incentives available at the federal level include:<br>• Partial debt cancellation of FHA loans for conservation easements.<br>• Federal long term rental payments and cost-sharing of up to 50% through the Conservation Reserve Program.<br>• Exclusion of the value of certain land from federal estate tax through the Taxpayer Relief Act. |
| Property Tax Relief | Reduces, defers, or exempts landowners from property tax assessments on land maintained in the condition stipulated by the program in which they are enrolled. | For some programs, property taxes for landowners are based on agricultural use value rather than market value.<br>Landowners may avoid or defer assessments for public work projects built in the vicinity of enrolled land. |
| Restoration Cost-share Programs | Compensates a landowner for a share of the cost of projects designed to restore natural areas on private lands. | Owner receives a percentage of the cost of labor and materials for projects.<br>Owners can receive free technical assistance.<br>Owners may use multiple cost share funding sources to piggy-back project costs. |
| Donation of Land or Sale to Conservation Organization | Self-explanatory | The use of a below market sale to a nonprofit conservation organization may allow the seller to qualify for a charitable donation on their taxes as well as reducing the amount of capital gains tax which may be levied. |

Source: Allman, 1996; MD Environmental Trust, 1997

# WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Land Protection Options: A Handbook for Minnesota Landowners** (1996) by Laurie Allman<br>Describes options and incentives for protecting non-regulated natural areas. Discusses potential economic benefits for landowners. | The Trust for Public Land<br>Midwest Region<br>420 North Fifth Street<br>Suite 865<br>Minneapolis, MN 55401<br>612-338-8494 |
| **Maryland Stormwater Design Manual** (draft 1997) by the Maryland Department of the Environment<br>Describes system of stormwater credits including preservation of natural areas. | Maryland Department of the Environment<br>Water Management Administration<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3543 |
| **West Eugene Wetlands Special Area Study, Draft Technical Report** (1991)by the Lane Council of Governments<br>Describes methods used to identify protected wetlands and designated development zones. Also describes various options for on-site and off-site mitigation. | Lane Council of Governments<br>125 East Eighth Avenue<br>Eugene OR 97401<br>(503) 687-4283<br>Contact: Steve Gordon, Senior Program Manager |
| **A Guidebook for Creating a Municipal TDR Program** (1995)<br>Describes basic process for creating a TDR program. Discusses the amendments to zoning ordinances and provides a step-by-step process. | Maryland Department of the Environment<br>Water Management Administration<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3543 |
| **Beyond Sprawl: Land Management Techniques to Protect the Chesapeake Bay** (1997)<br>Describes density bonuses and how they can be used to protect natural resources. | Chesapeake Bay Program<br>410 Severn Avenue<br>Annapolis MD 21403<br>410-267-5700 |



# PRINCIPLE NO. 22

**New stormwater outfalls should not discharge unmanaged stormwater into jurisdictional wetlands, sole-source aquifers, or other water bodies.**

## CURRENT PRACTICE

Stormwater runoff generated from impervious cover can represent a significant threat to the quality of wetlands, surface water and groundwater. Research has shown that wetlands can be adversely impacted by both the quality and quantity of stormwater from upstream areas (Azous, 1997). Other researchers have found that stormwater runoff exerts an adverse impact on the quality of urban streams (for a review, see CWP, 1998). Sole-source aquifers, which are a key part of the drinking water supply in many communities, can be contaminated if stormwater pollutants are discharged underground (Witten and Horsley, 1995). Stormwater pollutants have also been directly linked to the closure of beaches and shellfish beds in several communities and have affected water quality in water supply reservoirs and urban lakes.

To avoid these impacts, some communities have adopted stormwater management requirements to control the *quantity* and/or the *quality* of stormwater runoff from new development sites. *Quantity* control is usually achieved by detention ponds, and helps minimize flooding and, in some cases, protect downstream channels from erosion. A complementary approach to quantity control is *floodplain management*, where new development is prohibited within the boundaries of the 100 year floodplain. *Quality* control typically involves the construction of *stormwater best management practices (BMPs)*, such as wet ponds, created wetlands, filters, infiltration trenches, and swales that remove pollutants from stormwater runoff and, in some cases, increase groundwater recharge. A *pollution prevention plan* may also be required for some land uses or activities (e.g, industrial sites). The plans consist of ways to prevent pollutants from coming into contact with rainwater and being washed off in stormwater runoff (e.g., spill response, material handling, employee training etc).

More communities will need to adopt stormwater management requirements to comply with EPA's municipal stormwater NPDES permitting program (i.e., Nationwide Pollutant Discharge Elimination System under the Clean Water Act). Currently, communities that have a population greater than 100,000 must have a municipal program to manage stormwater and smaller communities (50,000 to 100,000 will come under these requirements in 1999).

The scope and effectiveness of most local stormwater programs vary considerably in different communities around the country. Some require quantity control, but not quality control. Some programs are limited to floodplain management alone. Others require that pollution prevention plans be submitted, but don't require that BMPs be installed at new development sites. Engineering criteria for local stormwater programs vary widely from one community to another, and few communities link their criteria to solve specific stormwater problems in the watershed.

The cost of providing stormwater quantity and quality can be very high, ranging from $2,000 to $25,000 per impervious acre treated (Brown and Schueler, 1997). The initial cost of constructing stormwater BMPs is borne by the developer, but the long-term cost of maintaining BMPs must be borne by local government or property owners. Maintenance costs can be high. For example, the cost of maintaining a BMP typically exceeds the cost of its construction within twenty years (Wiegand, et al., 1986). Few communities are financially equipped to handle stormwater maintenance (WMI, 1997). The performance, longevity, and appearance of stormwater BMPs drops sharply without regular maintenance.

## RECOMMENDED PRACTICE

Most communities will need to either establish new stormwater management programs or reinvent their existing ones to better protect local aquatic resources. To become more effective, local stormwater programs must recognize the fundamental importance of site design in solving stormwater problems. By starting at the source--reducing impervious cover and utilizing green space for stormwater treatment--communities can sharply reduce the volume of stormwater runoff that must be treated. The volume of stormwater runoff and the mass of pollutant loads can be reduced as much as 20 to 60% at most development sites simply by implementing the land development principles advocated in this document (see Tables 11.1 and 11.2). A more detailed explanation of the stormwater management benefits of the land development principles can be found in Table 22.1.

While better site design is a critical first step in solving stormwater management problems, most developments will still need stormwater BMPs to control the runoff from the site. Communities should carefully consider how their programs can improve the effectiveness and longevity of stormwater BMPs. Key program elements to consider include:

- Adjustment of existing sizing criteria to ensure that recharge, pollutant removal, channel protection, and flood control objectives are being achieved within the community.
- Clear guidance on how to select, design, and locate stormwater BMPs within local watersheds.
- Creation of detailed engineering performance standards on constructing stormwater BMPs to prevent future safety, aesthetic, and maintenance problems
- A strong local commitment to stormwater maintenance, including inspection, enforcement, and financing
- Meaningful incentives that give developers credit if they apply the land development principles on their sites and reduce stormwater runoff.
- Floodplain management regulations that prevent development within the floodplain where it is prone to damage during extreme floods.

**Table 22.1: Stormwater Management Benefits of Model Land Development Principles**

| Development Principle | Description |
|---|---|
| Minimize impervious area<br>• Principles No. 1 - 4, 12 (Streets)<br>• Principles No. 6 - 9 (Parking Lots)<br>• Principle No. 13 (Sidewalks)<br>• Principles No. 12, 14 (Driveways) | Minimize the amount of new impervious cover created by new residential development. Less impervious cover means that less stormwater runoff will be generated. Less stormwater runoff results in lower stormwater pollutant loads, and the need for smaller and less expensive stormwater BMPs. |
| Open space development<br>• Principle No. 11, 12, 15 | Open space development incorporates smaller lot sizes to minimize total impervious area and conserve natural areas, thus reducing the amount of stormwater runoff generated at the site. |
| Vegetated open channels<br>• Principle No. 5 | Vegetated open channels remove pollutants by allowing infiltration and filtering to occur. Open channels also encourage groundwater recharge, and can reduce the volume of stormwater runoff generated from a site. |
| Bioretention Areas<br>• Principle No. 10 | A stormwater management practice that uses landscaping and soils to treat stormwater runoff by collecting it in shallow depressions before filtering through soil. |
| Filter strips<br>• Principle No. 10 | A vegetated area that filters sheet flow, removing sediment and other pollutants. The strip may be grass-covered, forested, or of mixed vegetative cover. |
| Disconnect impervious areas<br>• Principle No. 13 (Sidewalks)<br>• Principle No. 16 (Rooftop Runoff) | Runoff from small impervious areas is directed to a pervious area where it can be infiltrated or filtered. The site is graded to promote overland filtering or bioretention is provided. Examples include directing parking lot runoff to filter strips. |
| Stream buffers<br>• Principles No. 17, 18 | Stream buffers include the 100 year floodplain, thereby preventing flood damages from extreme storms along the stream corridor. Runoff from pervious and impervious areas can also be directed to an adjacent stream buffer, providing some pollutant removal. |
| Natural area preservation<br>• Principles No. 19 - 21 | Natural areas at the site are conserved. These areas preserve pre-developed water quality and hydrologic characteristics. Examples include forest retention areas, non-tidal wetlands, floodplains, steep slopes. |

## PERCEPTIONS AND REALITIES ABOUT STORMWATER MANAGEMENT

Some communities are reluctant to require stormwater management. There is no one approach to stormwater management; so, to effectively protect waterbodies, communities must develop specific performance criteria based on local conditions. Further, additional staff and funding may be required. Some community associations may not be able to maintain onsite stormwater management facilities. Thus, the local government may ultimately become responsible for the maintenance of numerous residential stormwater facilities. Other impediments to stormwater management include concerns about costs to developers (Table 22.2).

**Table 22.2: Perceived Impediments to Stormwater Management**

| Perception | Facts, Case Studies, and Challenges | |
|---|---|---|
| 1. The term stormwater management is not universally understood and there is no one best approach to stormwater management. | FACT: | Stormwater management is usually defined by community and state regulators. Management techniques include quantity control for larger storms (e.g., the 2-, 10-, 25-, and/or 100-year storm event); quality control for the first flush of runoff and/or small storm events; and non-structural controls such as zoning restrictions. |
| | FACT: | There is no one choice for effective stormwater management. Stormwater management requirements should reflect local topographic, soil, and hydrological conditions. The requirements should be flexible and adaptable to local site conditions. A variety of options should be provided, including both structural and nonstructural controls. |
| 2. Implementation of stormwater management may require communities to get additional staff and funds. | FACT: | Implementation of management programs may require restructuring, new staff, or additional funding. However, these additional costs may be offset by the savings achieved due to reduced flooding, improved drinking water quality, and protection of sensitive shellfish and recreational areas among other benefits (fishing, boating, etc.).<br>For example, replacement of contaminated water supplies can be very costly. Witten and Horsley (1995) estimated that the cost for replacing a drinking well for a mid-size municipality ranged from $2.1 - $3.1 million (in1989 dollars). Stormwater management controls could be used to protect the groundwater supplies, reducing or eliminating replacement expenses. . |
| 3. Community associations will be unable to maintain stormwater management facilities. Local governments will be required to maintain the facilities. | FACT: | Communities may wish to promote open space development. Open space design can reduce the amount of stormwater generated at a site. Thus, stormwater management cost and maintenance requirements can be reduced. |
| | FACT: | Annual maintenance costs for structural controls is approximately 2% of the construction cost (Brown, 1997). Community associations should ensure that sufficient funding is available for maintenance. |
| | CHALLENGE: | Communities may wish to consider legal options to ensure maintenance. One option is setting a minimum development size requirement for structural controls. For example, only allowing stormwater ponds in developments of fifty homes or more. Liens are another option. |
| 4. The geotechnical and wetland studies required to confirm the location of wetlands and aquifers may be prohibitively expensive. | CHALLENGE: | True. However, NPDES regulations may require developers to provide stormwater management. |
| | FACT: | Open space design and other nonstructural controls can reduce stormwater management requirements. This reduced requirement may offset additional costs associated with geotechnical and wetland studies. |
| | FACT: | Communities can provide incentives to developers to protect and conserve natural resources such as wetlands (see Principle No. 21). |

## CASE STUDY: FALMOUTH, MASSACHUSETTS

The Falmouth, Massachusetts Planning Board has developed a stormwater management program to protect drinking water supplies and coastal waters. This program includes performance criteria for new development based on nutrient loading and carrying capacity. The nutrient load is the amount of nitrogen or phosphorous generated by the development and transported by stormwater runoff. The carrying capacity is the maximum nutrient concentration or load that can be sustained without degrading the water supply. In Falmouth, the carrying capacity for nitrate in drinking water supplies is 10 mg/l.

Developers building in public water supply watersheds or draining to coastal waters must compute the nutrient load for the proposed development. Stormwater management is required if the projected nutrient exceeds the carrying capacity. Developers must revise the site design to include management measures that will reduce the nutrient load to an acceptable level. Management measures that are effective in nitrogen removal are emphasized. These include nonstructural controls such as minimizing lot size.

## WHERE TO GET STARTED

| Suggested Resources | How to Get a Copy |
|---|---|
| **Green Growth: Protecting Storm Water During Development, A Guide for Local Community Officials** (draft 1997) by Brooks, Calhoun, and Tidwell<br>Emphasizes water quality control techniques during all phases of construction. Targeted at local officials. | North Texas Council of Governments<br>PO Box 5888<br>Arlington TX 76005-5888<br>817-695-9210 |
| **Maryland Stormwater Design Manual** (draft 1997) by the Maryland Department of the Environment<br>Describes structural and nonstructural stormwater management controls. Provides performance and design criteria for controls associated with new development. | Maryland Department of the Environment<br>Water Management Administration<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3543 |
| **Operation, Maintenance, and Management of Stormwater Management Systems** (1997) by E. Livingston, E. Shaver, and J. J. Skupien.<br>Provides detailed information on the operation, maintenance, and management of stormwater management systems, including model inspection forms. | Watershed Management Institute<br>P.O. Box 14<br>Ingleside, Maryland 21644<br>410 758-2731 |

| Suggested Resources | How to Get a Copy |
|---|---|
| **Conservation Design for Stormwater Management** (1997) by the Delaware Department of Natural Resources and Environmental Control and The Environmental Management Center of the Brandywine Conservancy | Delaware Department of Natural Resources and Environmental Control<br>Division of Soil and Water Conservation<br>Sediment and Stormwater Program<br>89 Kings Highway<br>Dover, DE 19901 |
| **A Guide to Wellhead Protection** (1995) by Jon Witten and Scott Horsley<br>Provides techniques for protecting aquifers. | American Planning Association<br>Planners Book Service<br>122 South Michigan Avenue<br>Suite 1600<br>Chicago, IL 60603<br>312-786-6344 |

# APPENDIX A

# MODEL SHARED PARKING ORDINANCE PROVISIONS

**Weekday Parking Occupancy Rates**
**Percent of Basic Minimum Needed During Time Period**
**(Source: ITE, 1995)**

| Uses | Weekday Night Midnight-6 a.m. | Weekday Day 8 a.m. - 5 p.m. | Weekday Evening 6 p.m. - Midnight |
|---|---|---|---|
| Residential ** | 100% | 60% (CBD=80%) | 100% |
| Office | 5 | 100 | 20 |
| Commercial-Retail | 5 | 90 | 80 |
| Hotel (CBD)+ | 100 | 80 | 100 |
| Hotel (non-CBD)+ | 100 | 70 | 100 |
| Restaurant | 10 | 70* | 100 |
| Movie Theater | 10 | 40 | 80 |
| Entertainment | 10 | 40 | 100 |
| Conference/Convention | 5 | 100 | 100 |

*Fast-food, breakfast or lunch-oriented establishment = 100 percent.

+Excludes conference/convention facilities.

**The minimum requirements for residents' own spaces must be met in exclusive (nonshared) parking, but guest parking and extra residents' parking may be shared.

**Weekend Parking Occupancy Rates**
**Percent of Basic Minimum Needed During Time Period**
**(Source: ITE, 1995)**

| Uses | Weekend Night<br>Midnight - 6 a.m. | Weekend Day<br>8 a.m. - 5 p.m. | Weekend Evening<br>6 p.m. - Midnight |
|---|---|---|---|
| Residential ** | 100% | 80% | 100% |
| Office | 5 | 5 | 5 |
| Commercial-Retail | 5 | 100 | 70 |
| Hotel (CBD)+ | 100 | 80 | 100 |
| Hotel (non-CBD)+ | 100 | 70 | 100 |
| Restaurant | 20 | 70* | 100 |
| Movie Theater | 10 | 80 | 100 |
| Entertainment | 50 | 80 | 100 |
| Conference/Convention | 5 | 100 | 100 |

*Fast-food, breakfast or lunch-oriented establishment = 100 percent.

+Excludes conference/convention facilities.

**The minimum requirements for residents' own spaces must be met in exclusive (nonshared) parking, but guest parking and extra residents' parking may be shared.

# Appendix B

# Model Legal Agreement for Shared Parking

# MODEL LEGAL AGREEMENT FOR SHARED PARKING

(Source: Wells, 1995)

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*NOTE: What follows is a shared parking easement which is offered as an example of an agreement which may be acceptable to the City of Olympia under the provisions of Section 18.38.180 - Shared Parking Facilities of the Olympia Municipal Code. This is not to say that other methods and approaches would not be acceptable to the City of Olympia, however, such agreements need to be reviewed by the City Attorney's office.*

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## EASEMENT FOR SHARED PARKING

WHEREAS, the parties to this easement wish to take advantage of the shared parking provisions of Chapter 18.38 of the Olympia Municipal Code.

1. For consideration of Ten Dollars ($10.00) paid in hand, present and future benefits to be derived by Grantor and other good and valuable consideration, receipt of which is hereby acknowledged, Grantor, _____,
(Name)

doing business as _____,
(Name)

hereby conveys and warrants to Grantee, _____,
(Name)

doing business as _____,
(Name)

its successors, heirs and assigns, a nonexclusive, perpetual easement for motor vehicle parking on the following described real property:

*[Legal Description of Servient Estate]*

situated in the City of Olympia, Thurston County, Washington for the benefit of Grantee's property described as:

*[Legal Description of Dominant Estate]*

situated in the City of Olympia, Thurston County, Washington.

Such parking easement shall be applicable only to the following parking lot(s) located on the above-described servient estate. *[Include a map or sketch of the lots or parking facilities applicable to this easement, should more than one exist upon the subject property.]*

SUBJECT TO THE FOLLOWING:

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1. This easement shall not be altered or terminated without the express written permission of the Director of Community Planning and Development of the City of Olympia or his/her designee.

2. Grantor covenants that there are ___(#)___ of motor vehicle parking spaces on the above-described property and that Grantor shall not decrease that number of parking spaces without the express written permission of the Director of Community Planning and Development of the City of Olympia or his/her designee.

3. Grantee shall post and maintain signage on the dominant and servient estates directing its customers and employees to parking.

4. Grantor may temporarily close the subject parking lot(s) for maintenance and repair. Cost of repair and maintenance shall be paid by _____ _____

5. Neither Grantee nor Grantor shall change, alter or expand the use of their respective properties described above so as to require additional parking under the provision of the Olympia Municipal Code in excess of existing parking spaces without the express written permission of the Director of Community Planning and Development of the City of Olympia or his/her designee.

**DATED** this _____ day of _____, 199___.

**GRANTOR**

_____
(Signature)

_____
(Print Name)

**GRANTEE**

_____
(Signature)

_____
(Print Name)

# GLOSSARY

**Access Street:**

The lowest order street in the hierarchy of streets, it conducts traffic between individual dwelling units and higher order streets.

**Alternative Lot Widths:**

Site design which utilizes a combination of narrow and wide lots to offer a varied streetscape. (See graphic in principle 12)

**Angled Z lot:**

A lot design where units are tilted at a 30 to 45 ° angle relative to the street. (See graphic in principle 12)

**Average daily traffic (ADT):**

The average total number of vehicles that traverse a road on a typical day. For residential streets, the ADT is usually about 10 trips per residence times the number of residences.

**Aquifer:**

A permeable geologic formation capable of storing and yielding groundwater to wells and springs.

**Best Management Practice (BMP):**

A structural device designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution and provide other amenities. BMPs include wet ponds, created wetlands, filters, and infiltration trenches.

**Bioretention:**

A water quality practice that utilizes landscaping and soils to treat urban stormwater runoff by collecting it in shallow depressions before filtering it through a fabricated planting soil media.

**Buffer:**

An area adjacent to a shoreline, wetland or stream where development is restricted or prohibited.

**Buffer averaging:**

A technique for delineating the width of a buffer such that the buffer boundary can be narrower at some points along the stream and wider at others such that its average width meets the minimum criteria.

**By-right open space development:**

A form of development in which the developer does not need to seek special approval from planning boards in order to use open space design at a site.

**CBD:**

Acronym for commercial business district.

**Community Association:**

A planned residential condominium, cooperative and/or homeowner group with the primary function of addressing the concerns and needs of residents within a specific geographic area. Community associations usually include fees and their responsibilities may include maintenance, enforcement of allowable uses, and protection of open space areas from encroachment and future development.

**Cul-de-sac:**

A local access street with a closed circular end which allows for vehicle turnarounds.

**Curvilinear street pattern:**

A street design which follows the natural topography of the land and uses curving roads and cul-de-sacs to reduce vehicle speeds and cut-through traffic.

**Density bonus:**

A form of incentive to promote conservation natural and open space areas. Developers are allowed to build more homes than allowed by local zoning ordinances if such areas are conserved.

**Density compensation:**

Granting a credit for higher density elsewhere on a site to compensate for developable land lost due to environmental considerations.

**Dryfall:**

The deposition of atmospheric pollutants on the land surface.

**Excess parking:**

Parking spaces that are constructed over and above the number required or predicted based on the parking demand ratio for a particular land use or activity.

**Floodplain:**

Areas adjacent to a stream or river that are subject to flooding or inundation during severe storm events (Often called a 100 year floodplain, it would include the area or flooding that occurs, on average, once every 100 years).

**Floodplain management:**

To limit flood damage by prohibiting new development within the boundaries of the 100-year floodplain. In existing developments within the floodplain, management includes maintaining and increasing open space areas along waterways.

**Frontage requirements:**

A requirement in the subdivision code that mandates that each lot within a particular zoning category have a minimum length that fronts along the street.

**Green space:**

The proportion of open space that is retained in an undisturbed vegetative state.

**Gross density:**

The maximum number of dwelling units allowed within a particular zoning class, expressed in terms of dwelling units per acre.

**HOV:**

Acronym for High Occupancy Vehicle, which is used in reference to highway lanes that are reserved for vehicles with two or more occupants (carpooling).

**Hybrid street network:**

A street layout which incorporates both grid and curvilinear street patterns in a "wheel-and-spoke" design that conserves important natural features but still allows for interconnected roads.

**Infiltration trench:**

A stormwater quality treatment practice that consists of a stone-filled reservoir that allows runoff and accompanying pollutants to settle into the soil where further filtering can take place.

**Impervious cover:**

Any surface in the urban landscape that cannot effectively absorb or infiltrate rainfall.

**Imperviousness:**

The percentage of impervious cover within a development site or watershed.

**Infill development:**

Directing development away from rural areas by developing vacant lots or enhancing existing property in urban areas.

**Jurisdictional wetland:**

A wetland which is regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act.

**Lot:**

A parcel of undivided land.

**Minimum lot size:**

The minimum area or dimension of an individual lot within a particular zoning category, as specified within the local subdivision code.

**Net site density:**

The maximum number of dwelling units which can be constructed on a site after all unbuildable land areas are subtracted out.

**NPDES:**

Acronym for the National Pollutant Discharge Elimination System, which regulates point source and stormwater discharge.

**Open space:**

A portion of a development site which is permanently set aside for public or private use and will not be developed with homes. The space may be used for passive or active recreation, or may be reserved to protect or buffer natural areas.

**Open space development:**

The use of designs which incorporate open areas into a development site. These areas can be used for either passive or active recreational activity or preserved as naturally vegetated land.

**Open space management:**

The legal and financial arrangements needed to manage open space according to its prescribed use (i.e., natural areas, recreation).

**Ordinary care:**

The basic level of care that can be expected of reasonably experienced and prudent professional in determining design decisions for roadways.

**Parking lane:**

A section of the roadway which has been designed to provide on-street parking for residential neighborhoods.

**Parking demand:**

The number of parking spaces actually used for a particular land use.

**Parking ratios:**

An expression of the required parking spaces that must be provided for a particular land use, often stated as a ratio of x spaces per y units.

**Parking stall:**

The total area needed to accommodate the parking of a single vehicle, extending outward from the curb, and between the stripes.

**Perennial stream:**

A stream channel that has running water throughout the year.

**Pollution prevention plan:**

A requirement for some land uses or activities (e.g., industrial sites) that outlines techniques to prevent pollutants from being washed off in stormwater runoff (e.g., spill response, material handling, employee training, etc.)

**Queuing street:**

A narrowed street which contains a single travel lane and which may occasionally require an opposing driver to pull over to allow an oncoming vehicle to pass.

**Right-of-way:**

The design area of a roadway which includes the pavement width, vegetated strip, sidewalk and space designated for utility location.

**Riparian:**

The land area which borders a stream or river and which directly affects and is affected by the water quality. This land area often coincides with the maximum water surface elevation of the 100 year storm.

**Sand filter:**

A stormwater quality treatment practice whereby runoff is diverted into a self-contained bed of sand. The runoff is then strained through the sand, collected in underground pipes and returned back to the stream or channel.

**Sedimentation:**

Soil particles suspended in stormwater that can settle in stream beds and disrupt the natural flow of the stream.

**Setback:**

The distance which a structure must be located from property lot lines or other structures as specified in the local zoning plan.

**Shared parking:**

A parking strategy which reduces the total number of parking spaces needed by allowing adjacent users to share a parking area during noncompeting hours of operation.

**Sight distance:**

The length of roadway ahead visible to the driver. The minimum sight distance should be long enough to allow a vehicle traveling at or near the speed limit to stop before reaching a motionless object in its path.

**Sole-source aquifer:**

An aquifer whose recharge area is the only source of drinking water to both public water supplies and private wells.

**Steep slope:**

An area of a development site that is too steep to (a) safely build on or (b) has a high potential for severe soil erosion during construction.

**Stormwater credits:**

A form of incentive for developers to promote conservation of natural and open space areas. Developers are allowed reductions in stormwater management requirements when they use techniques to reduce stormwater runoff at the site.

**Stormwater management:**

The programs to maintain quality and quantity of stormwater runoff to pre-development levels.

**Stormwater outfall:**

A discharge point for stormwater runoff which has been collected in a conveyance system.

**Stormwater quality control:**

The removal of pollutants from stormwater runoff through the use of stormwater best management practices (BMPs).

**Stormwater quantity control:**

To mitigate flooding through the use of detention ponds that restrict stormwater flow.

**Stream buffer:**

A variable width vegetated zone located along both sides of a stream.

**Structured parking:**

More commonly referred to as parking garages, these are parking facilities which expand vertically to provide parking on various levels. Structured parking allows more parking on sites where space for single level parking lots is no longer available.

**Subdivision:**

A new development that splits an existing tract, parcel or lot into two or more parts.

**Subdivision code:**

A set of local requirements that govern the geometric dimensions of a particular zoning category, and also specifies the nature and geometry of roads, drainage, waste disposal and other community services that must be constructed to serve the development.

**SUV:**

Acronym for sport utility vehicle.

**Swale:**

An open drainage channel or depression explicitly designed to detain and promote the filtration of stormwater runoff.

**Transferable development rights:**

A form of incentive for developers in which the developer purchases the rights to an undeveloped or underdeveloped piece of property in exchange for the right to increase the number of dwelling units on another site. Often used to concentrate development density in certain land areas.

**Transit share:**

The percentage of trips using a particular mode of travel.

**Unbuildable lands:**

The portions of a development site where structures cannot be located for physical or environmental reasons.

**Variance:**

A special allowance granted to a developer which permits the use of designs different from the requirements of the current code.

**Vegetated open channels:**

Also known as swales, grass channels, and biofilters. These systems are used for the conveyance, retention, infiltration and filtration of stormwater runoff.

**Wetfall:**

The deposition of atmospheric pollutants on the land surface that are washed out by precipitation.

**Xeriscaping:**

Landscaping which uses drought-tolerant vegetation instead of turf to reduce the amount of water required to maintain a lawn.

**Zero Lot Line:**

The location of a structure on a lot in such a manner that one or more sides of the structure rests directly on a lot line.

**Zipper lot:**

Lot design approach in which the rear lot line moves back and forth to vary the depth of the rear yard and concentrate open space on the side of the lot.

**Zoning:**

A set of regulations and requirements that govern the use, placement, spacing and size of buildings and lots within a specific area or in a common class (zone).

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Off-Street Parking Requirements for Loudoun County, Virginia

Off-Street Parking Requirements for Maple Plain, Minnesota

Off-Street Parking Requirements for Naperville, Illinois

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Off-Street Parking Requirements for Olympia, Washington

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