From June 2006, Planning Magazine, APA

Water and the Density Debate

When it comes to protecting water resources, higher density may be the way to go.

By Lynn Richards

Most of our regions, cities, towns, and neighborhoods are growing. Every day, new buildings and houses are proposed, planned, and built.

Growth has its benefits, but communities are also grappling with related challenges — for example, the impacts on water resources. To protect those resources, local governments are adopting a wide range of land-use strategies, including low-density development.

But is that strategy misguided? Current research shows that the answer may be yes.

A new report from the U.S. Environmental Protection Agency, *Protecting Water Resources with Higher-Density Development*, helps communities to better understand the impacts of high- and low-density development on water resources. This article takes the argument a step further by discussing how four communities — Portland, Oregon; Tacoma, Washington; Boca Raton, Florida; and Emeryville, California — have used a combination of higher densities and innovative site-specific stormwater strategies to create great places and reduce their stormwater runoff.

What the research shows

Virtually every metropolitan area in the U.S. has expanded in recent decades. According to the U.S. Department of Agriculture's National Resources Inventory, the amount of developed land area in the U.S. almost quadrupled between 1954 and 1997, from 18.6 million acres to about 74 million acres in the contiguous 48 states. From 1982 to 1997, when population in those states grew by about 15 percent, developed land increased by 25 million acres, or 34 percent.

Most of this growth is taking place at the edge of developed areas, on greenfield sites, which can include forestland, meadows, pasture, and rangeland. In one analysis of building permits issued in 22 metropolitan areas between 1989 and 1998, about 95 percent of the permits were for development on greenfield sites.

According to the 2000 American Housing Survey, 35 percent of new housing is built on lots between two and five acres in size, and the median lot size is just under a half acre. Some local zoning codes encourage or require relatively large lots, in part because local governments believe that approach helps protect their water quality. They get support from research showing that impervious cover can degrade water quality. Studies have shown that a watershed may start becoming impaired at 10 percent imperviousness, and that impairment grows worse as imperviousness increases.

This research has prompted many communities to adopt low-density zoning and limits on site-level imperviousness — specifying a maximum percentage that can be covered by impervious surfaces like houses, garages, and driveways. These types of zoning and development

ordinances are biased against higher density development because higher density typically produces more impervious cover at the site level.

But is that the whole story? Do low-density approaches really protect our water resources?

Check the assumptions

A planning department typically analyzes the projected stormwater runoff impacts of a development proposal based on the acreage involved, not the number of housing units being built. Using a one-acre model, communities may conclude that lower density development minimizes runoff because runoff from one house on one acre equals roughly half the runoff from eight houses.

However, one should consider where the other houses and their occupants are located. Almost always, they are located somewhere within the same region — very often within the same watershed. Those "displaced" households still have a stormwater impact.

To better understand the stormwater runoff impacts from developing at low densities, the impacts of original and displaced houses need to be taken into account. This approach has two advantages. It acknowledges that the choice is not whether to grow by one house or 20 or 10,000, but where and how to accommodate whatever number the region is expected to grow. It also emphasizes that total imperviousness and runoff should be minimized within a region or watershed rather than from particular sites.

To more fully explore this dynamic, the EPA modeled scenarios at three scales — one acre, development site, and watershed — and at three different time periods of build-out to examine the premise that lower density development better protects water quality. Stormwater runoff was examined from different development densities to determine the comparative difference between scenarios.

Notably, we found that the higher density scenarios generated less stormwater runoff per house at all scales and time periods. We found that:

- With more dense development (eight houses per acre), runoff rates per house decrease by about 74 percent from one house per acre.
- For the same number of houses, denser development produces less runoff and less impervious cover than low-density development.
- For a given amount of growth, lower density development covers more of the watershed.

Taken together, these findings indicate that low-density development is often not the best strategy for reducing stormwater runoff. In addition, the findings indicate that higher densities may better protect water quality, especially at the lot and watershed levels. Higher density developments consume less land while accommodating the same number of houses as lower density developments. Consuming less land means less impervious cover is created.

Site-specific strategies

While increasing densities regionally can better protect water resources at a regional level, higher density development can create more site-level impervious cover, which can increase water quality problems in nearby or adjacent bodies of water. Numerous site-level techniques are available to address this problem.

When used in combination with regional techniques, these site-level techniques can prevent, treat, and store runoff and associated pollutants. Many of these practices incorporate low-impact development techniques (rain gardens, bioretention areas, and grass swales). Others go further by changing site-design practices, for example by reducing parking spaces, narrowing streets, and eliminating cul-de-sacs.

Overall, we know that to fully protect water resources, communities must employ a wide range of land-use strategies based on local factors. Among them: building in a range of development densities, incorporating adequate open space, preserving critical ecological and buffer areas, and minimizing land disturbance.

Some site-specific strategies have spinoff effects. They can enhance a neighborhood's sense of place, increase community character, and save taxpayers money. The strategies that meet multiple community objectives are generally not the traditional engineered approaches, such as detention ponds, which are often difficult to install in urban areas or on sites where there are land constraints.

These nontraditional approaches work best in dense urban areas because they use the existing elements of a neighborhood, such as roads, roofs, abandoned shopping malls, or courtyards, and add some engineering to landscaping elements, to help retain, detain, and treat stormwater on site. When done correctly, these approaches address stormwater and add value to a community to help to make the neighborhood a more desirable place to live.

The city of Portland, Oregon, has been a pioneer in developing site-specific stormwater strategies that reduce stormwater runoff, enhance community character, and save money. Portland is required, under various provisions of the Clean Water Act, to reduce pollutants in its stormwater discharges and reduce combined sewer overflows. In addition to installing traditional engineered systems, the city has constructed numerous vegetative systems that are integrated with urban design as a way to minimize runoff.

One example is the city's green-roof program. City officials estimate that the city has 25 square miles of roof. To eliminate some of the runoff generated from this amount of impervious surface, the city developed an eco-roof program. The program offers a sliding scale of density bonuses based on the size and relative scale of the eco-roof. Developers can earn as much as three square feet of additional floor area for each square foot of green-roof area.

The city estimates that an eco-roof extends roof life by at least 20 years. Further, in the combined sewer areas, the city estimates that it has an annual operation and maintenance savings of $0.003 per gallon of stormwater removed from the system. If one of Portland's industrial districts were to cover its 330 acres of rooftops with eco-roofs, the annual sewer operation and maintenance savings would be $480,000.

"We're encouraged by the results of our sustainable stormwater management approaches," says Tom Liptan, urban environment specialist for Portland's Bureau of Environmental Services. "Addressing our stormwater problems with integrated stormwater design that protects our rivers, saves money for the city and developers, and improves neighborhoods just makes sense."

To further reduce stormwater flow, city engineers and landscape architects have installed vegetated landscape stormwater systems as integral elements of streets, parking lots, playgrounds, and buildings. These systems have helped create distinctive neighborhood features, and many community members have approached the city to ask if they could pay to have these stormwater elements installed in their street, parking lot, school, or grocery store.

Both the city and property owners can save money. Landscape bioswales were installed at the Oregon Museum of Science and Industry parking lot in 1992. If the museum qualifies for the city's stormwater fee discount, it could save close to $13,000 annually because most of its

runoff is retained and treated on site instead of being piped and transported to a treatment facility.

Multiple goals

A development in Tacoma, Washington, shows the effectiveness of addressing stormwater at the site level by increasing densities. The Salishan Housing District was built on the city's eastern edge in the 1940s as temporary housing for ship workers. It is currently a public housing community with 855 units. Redevelopment will increase densities to allow 1,270 housing units (public housing, affordable and market rate rentals, and for-sale units), local retail, a senior housing facility, a health clinic, an education-technology center, and an expanded community center.

An important priority is restoring the water quality of the T-Street Gulch, which feeds into Swan Creek and ultimately into the Puyallup River. With phase one completed, the redevelopment seeks to reduce impervious surface area, treat runoff on site, and provide areas for runoff infiltration.

Planners estimate that when the redevelopment is finished, 91 percent of the runoff will be treated and infiltrated through bioswales located next to streets and on the periphery of the T-Street gulch. The water flowing into the gulch will be clean.

In addition, wetlands and buffer areas along the gulch have been restored and enhanced using native vegetation, and pedestrian paths have been integrated into swale and buffer areas. "We're really excited about doing this project," says Tom Gallas, executive vice president for Torti Gallas and Partners, the firm hired to do the planning and designs for the project. "In our mind, this type of project represents the best of both worlds: how to create a vibrant, healthy, diverse, and affordable urban neighborhood while enhancing the ecological integrity of the neighborhood's largest natural asset, Swan Creek."

Redevelopment opportunities

Communities can enjoy a further reduction in runoff if they take advantage of vacant or underused properties, such as infill, brownfield, or grayfield sites. If abandoned shopping centers were redeveloped, the net increase in runoff would be zero — or even better, it might decrease. After all, most shopping centers are built with totally impervious surfaces and produce high volumes of runoff.

Take the case of Mizner Park in Boca Raton, Florida. The 29-acre site originally held a large shopping mall surrounded by surface parking lots. That mall has been replaced with 272 apartments and townhouses, 103,000 square feet of office space, and 156,000 square feet of retail space. Most parking is accommodated in four multistory parking garages.

Designed as a village within a city, Mizner Park has a density five times higher than the rest of the city and a mix of large and small retailers, restaurants, and entertainment venues. Most notably, Mizner Park decreased overall impervious surface on the site by 15 percent. That is because asphalt was replaced by a central park plaza, flower and tree planters, and a large public amphitheater.

This redevelopment effort had a tremendous impact on the city's tax base. In 1990, the abandoned mall had a value of $26.8 million while the rest of downtown Boca Raton had a value of $83 million. When the project was completed in 2001, the mall — which accounts for 42 percent of downtown — had a value of over $68 million whereas the rest of downtown was worth over $229 million.

"Redeveloping Mizner Park was a great decision for Boca Raton," says Bob George, one of the planners for the project. "Not only did we increase our tax base, we were able to accommodate new residents in an area close to many amenities without further impacting our natural resources. It was a win-win for the city, the residents, and the environment."

Redeveloping brownfield and grayfield sites can reduce regional land consumption as well. A 2001 George Washington University study found that for every brownfield acre that is redeveloped, 4.5 acres of open space are preserved.

Likewise, a recent analysis by King County, Washington, showed that property eligible for redevelopment in the county's growth areas can accommodate 263,000 new houses — enough for 500,000 people. Redeveloping this property is an opportunity to accommodate new growth without expanding into other watersheds.

Kurt Zwikl, executive director of the Pottstown, Pennsylvania-based Schuylkill River Greenway Association, makes this point. "Certainly, if we can get redevelopment going in brownfields and old industrial sites in older riverfront boroughs like Pottstown and Norristown, that's a greenfield further out in the watershed that has been preserved to absorb more stormwater," he says.

A pioneer

A downtown area, first ring suburb, or other land-constrained community may find it difficult to push for higher density redevelopment or infill redevelopment in the face of strict stormwater regulations. This was the issue facing Emeryville, an industrial city located between Oakland and Berkeley, California, on the east shore of San Francisco Bay. In finding a way to balance various needs, the city has earned a national reputation as a pioneer in reclaiming, remediating, and redeveloping its decaying industrial lands.

Emeryville's massive brownfield pilot program succeeded in attracting new business and residents to the city over the past decade. Its next challenge was to meet new standards for water quality and improve the environmental sustainability of continued revitalization efforts. To address this issue, the city's Planning and Building Department hired Community, Design + Architecture to write *Stormwater Guidelines for Green, Dense Redevelopment: Stormwater Quality Solutions for the City of Emeryville.*

These guidelines, issued earlier this year, provide a vision for integrating green stormwater treatment into the site planning and building design of new development. Pedestrian-friendly parking strategies are part of the package. Solutions range from shared parking facilities to green roofs to containerized bioretention gardens. All are tailored for Emeryville's unique situation: heavily urbanized sites, compacted or even contaminated soils, and a high water table.

Because the guidelines include a thorough hydraulic sizing methodology for various types of facilities, they will enable city staff planners, designers, and developers to implement sustainable design on many scales throughout Emeryville.

"Developing these guidelines was critical for Emeryville," says Diana Keena, AICP, an associate planner for the city. "We want to create a vibrant, diverse urban community and could only continue our revitalization efforts if we figured out how to meet the new National Pollution Discharge Elimination System requirements."

Implementation of the guidelines will help Emeryville compete for research and knowledge-based businesses and to develop additional housing for those interested in Emeryville's urban lifestyle.

In Emeryville, as in the other communities mentioned here, the trick was to abandon fixed ideas about density and find a new path to the future.

Next steps

More and more state and local governments are considering the environmental implications of development patterns. Increasing development densities is one way that communities can minimize regional impacts on water quality.

In addition, there are many ways to reduce local stormwater runoff and achieve other community goals, such as enhanced neighborhood character and quality of life. By developing densely in appropriate areas and employing a wide range of site-specific stormwater strategies, communities create a win-win situation for their water resources — and for their residents.

Lynn Richards is a senior policy analyst for the U.S. Environmental Protection Agency.

Sidebar: On the Supply Side

Resources

Images: Top — To reduce stormwater runoff, Highlands' Garden Village in Denver, Colorado, uses smaller lot sizes and native landscaping. Photo courtesy of U.S. EPA. Middle — Redevelopment of the Salishan Housing District in Tacoma, Washington, will result in less runoff despite a 50 percent increase in housing density. Photo Torti Gallas. Bottom — Mizner Park, a village within the city of Boca Raton, Florida, redeveloped a former shopping mall site. It has reduced impervious surface 15 percent. Photo courtesy of U.S. EPA.

See www.epa.gov/smartgrowth for relevant reports.

Three EPA reports are: *Protecting Water Resources with Higher Density Development, Using Smart Growth Techniques as Stormwater Best Management Practices,* and *Protecting Water Resources with Smart Growth.* Also on the EPA site is a publication from the Local Government Commission and the National Association of Realtors: *Creating Great Neighborhoods: Density in Your Community.*

The city of Emeryville's *Stormwater Guidelines for Green Dense Development* is at www.ci.emeryville.ca.us.