NEMO

NONPOINT EDUCATION
FOR MUNICIPAL OFFICIALS

TECHNICAL PAPER NUMBER 5

Parking Lots

By Jim Gibbons, *UConn Extension Land Use Educator, 1999*

Introduction

As more and more people own cars, more and more parking lots become necessary. Unfortunately, parking lots can adversely affect the environment as well as detract from "community character". Paved parking lots are typically designed to collect and concentrate large areas of storm water runoff, which can impact a receiving streams hydrography as well as water quality.

Paved parking lots can generate heat, raising the surrounding areas air temperature as well as the temperature of the first flush of storm water which can have significant ecological impacts. The City of Olympia Washington's Public Works Department found that parking lots account for 53% of imperviousness on a commercial site and 15% of multifamily sites. These figures are typical of most communities. Therefore careful attention to their design will go a long way toward protecting your community's water resources.

While eighty to ninety percent of all parking demands in America are met by surface parking, many view parking lots as necessary yet unattractive, even hostile places. While we need places to park cars, parking lots in summer can be flame-thrower hot and in winter, ice rink cold and slippery. Parking lots can be real or perceived danger zones, where drivers battle for choice parking spaces and pedestrians try to dodge kamikaze hits from myopic drivers. At night parking lots can become dark, desolate, Stephen King designed, landscapes harboring a rich assortment of imagined shadow lurking predators. Visually parking lots are often urban eyesores and broken tooth gaps in the Pepsodent smile of the urban streetscape.

In addition to their negative aesthetic characteristics, parking lots can also adversely impact the environment. For example, they act as heat islands greatly increasing summer temperatures. As car holding areas, they can transmit odors, noise, glare and a host of airborne pollutants. Paved parking lots seal the earth, preventing rainfall infiltration and ground water recharge. Impervious parking areas collect and convey storm water. As runoff traverses impenetrable asphalt or concrete, its' volume, velocity and pollutant loads increase, resulting in increased flooding, peak stream flows, stream channel erosion and polluted water resources.

As storm water quantity and quality is directly related to the amount of impervious cover on the landscape, water resources can be protected and enhanced by reducing impervious parking areas.

Local land use officials are charged with developing plans and regulations related to parking. This paper analyzes parking lot location, size, and design from a land planning perspective, emphasizing their potential adverse impact on water resources. Suggestions are offered as to how the imperviousness of these ubiquitous modern landscape features can be reduced.

Parking Lot Location

Parking lots are common in commercial, industrial and certain residential areas, such as apartment complexes. Often clustered in densely developed areas, parking lots may become part of a large network of interconnected impervious surfaces, collectively serving as polluted runoff storage and conveyance facilities. Parking lots may be proposed on or near fragile areas such as wetlands. Unless properly located and designed, parking lots can adversely impact water resources. Local officials should develop plans and adopt land use regulations that minimize or negate the potential environmental impacts of improperly sited impervious parking lots.

As a practical standard, parking should be located close to the building it serves. Parking is traditionally placed in the front yard of the building served, producing a common development pattern where blacktop replaces front yard landscaping. With front yard parking, side yard setbacks and controlled curb cuts are often forgotten. As a result, parking lots flow together onto the street forming massive asphalt sheets stretching door front to door front into what is commonly referred to as "strip commercial development." The macadamized landscape raincoats the earth allowing the preparation of a rich bouillabaisse of polluted runoff that is ultimately fed to unsuspecting rivers and streams.

Where parking lots are a requirement of commercial or industrial use, they should be placed at the rear of the building served. Rear parking reduces potential conflicts of cars crossing sidewalks at many points. The City of Fort Collins, Colorado in a effort to reduce the overall large scale of paved surfaces associated with big box retail development, requires that no more than 50 percent of the parking be located between the principle building and the primary abutting street. By distributing parking around a large building, walking distances from cars to the store are reduced.

Another way to reduce the amount of impervious parking exposed to rain, is to place parking underground, within the building it serves, or in multi-storied, shared parking garages.

NEMO Recommendations Regarding Parking Lot Location

- Plans of Conservation and Development should identify impervious surfaces, such as parking lots, as part of an existing land use inventory. The Plan should reference the potential and known adverse environmental impacts of impervious surfaces and recommend ways to reduce them.

- Plans of Conservation and Development should contain an "impervious cover build out analysis," showing the location and amount of imperviousness that will be generated if the community develops according to present zoning.

- Plans of Conservation and Development should make recommendations regarding the location, size, and design of future parking facilities emphasizing their potential environmental impact. Special attention should be paid to future policies regarding parking lots located near or draining to, watercourses and wetlands. The Plan should also address the issue of mass transit, garages versus surface parking, shared parking in mixed-use areas and porous versus impervious parking surfaces.

- Plans of Conservation and Development should recommend the use of porous surfaces on parking lots and other impervious surfaces as a way to improve storm water quality, control runoff volume and velocity and promote infiltration and groundwater recharge.

- Plans of Conservation and Development should review parking requirements found in local regulations and compare them to standards in other communities and national studies such as "The Parking Generation Manual," prepared by the Institute for Transportation Engineers, to determine if local standards are excessive.

- Plans of Conservation and Development should contain or recommend parking utilization studies, to see if required spaces are used. The common planning goal of "providing ample off-street parking" might be substituted with "adopting parking standards that meet actual demand."

- Communities, regions and watersheds should establish growth management policies that encourage growth in areas with infrastructure and conservation in areas deemed, unique or fragile. These policies should promote urban infilling and discourage suburban sprawl. The growth areas should contain mass transit and where feasible, require garages, shared parking or porous parking surfaces. Green areas designed to infiltrate runoff should be promoted in highly impervious urban areas.

- Communities should require rear yard parking while prohibiting parking in front and side yards. Rear yard parking prevents streetscape domination of door front to door front macadam flows. Also, consider requiring that structures be built at the street line to force rear yard parking.

- If front yard parking is permitted, limit parking and driveway coverage to no more than 50 percent of the front yard area. To avoid adjoining parking lots flowing together and eventually onto the street, maintain side yard setbacks and limit curb cuts and curb cut widths.

- To reduce the amount of impervious parking surface exposed to rain, require shared parking, parking be under or within the building served or within multi-storied parking garages.

Parking Lot Size

Few municipalities have developed formal parking policies. However, when parking regulations are reviewed two assumptions emerge:

1. Enough spaces will be supplied to meet the highest demand, and
2. Most drivers will park for free. Many planners feel these assumptions have produced too many large parking lots that accumulate and convey too much polluted runoff.

The number of off-street parking spaces and minimum parking space size required by zoning determines parking lot size. Typical zoning regulations produce surface parking that occupies 2 to 3 times more space than the floor area in the building served. A 1995 survey conducted by the city of Olympia, Washington found that over half of the city's commercial sites were devoted to parking and driveways. In her 1997 study entitled, "*The Bay Area's Love-Hate Relationship With The Motorcar*," Ellen Marie Miramontes estimates that between 30 and 40 percent of the land in a typical American downtown is consumed by parking spaces. Parking requirements for regional facilities such as shopping malls, airports and sport stadiums can generate parking lots that occupy 10 to 50 acres. Suburban shopping malls, multiplex theaters, "big box" stores and high rise apartments, are common modern land uses featuring large buildings surrounded by uninterrupted seas of asphalt or concrete parking.

Parking Spaces Required by Zoning

Research now shows that typical zoning regulations require more parking spaces than are actually utilized. For example, space utilization studies show that the common zoning standard of 4 parking spaces for every 1,000 square feet of gross floor area generates twice the number of parking spaces used. Most parking standards are based on peak hour traffic volumes or "peak hour, in peak season" demand, such as shopping during the weeks between Thanksgiving and Christmas. While the lots may be filled during this peak period, they are often greatly underutilized the rest of the year. As a case in point, from 1965 to 1981 shopping mall parking lots were designed for use at the 10th busiest hour of the year, using a standard of 6 spaces per 1,000-sq. ft. of retail space. In 1981 a study by the Council of Shopping Centers suggested shaving the standard to 4 spaces per 1,000-sq. ft. using the 20th busiest hour. Designing for the 20th busiest hour still leaves at least half of a shopping center's parking spaces vacant a minimum of 40 percent of the time. Similarly, large parking areas serving seasonal uses such as beaches, fairs, sporting events and festivals may be filled only a few days, remaining vacant the rest of the year.

Zoning traditionally requires a "minimum" number of parking spaces, allowing developers to provide more spaces, if they wish. It is this, "bigger is better" approach that has resulted in excess parking, particularly at "big box retail" sites where developers routinely build more parking spaces than required by zoning. Olympia, Washington surveys showed most land uses had more parking than required by zoning and a majority of these parking stalls were not used. Rather than relying on open-ended minimum ratios, communities should consider median parking ratios that truly reflect parking needs. If minimum ratios are kept, they should be used in conjunction with maximum ratios so developers cannot build as many spaces as they wish.

Land use officials are recognizing their regulations may generate more parking spaces than are commonly used and are interested in revising them accordingly or placing caps on the number of parking spaces permitted in certain areas. For example, Boston and Portland have set limits on the number of parking spaces that can be built in their downtowns. Boston has already reached its cap of 35,500 spaces. San Francisco limits parking to no more than 7 percent of the floor area of the building it serves.

Some states, including Connecticut, allow planning and zoning commissions to request payment in lieu of constructing off street parking spaces, where the required spaces are felt to be unnecessary or they cannot be built due to poor site conditions. Fees are based on costs of installing the usually required parking space. Collected revenue is deposited into a fund dedicated to parking or other transportation facilities.

Most zoning regulations contain "maximum lot coverage" provisions meant to regulate the size and bulk of development. Many of these regulations define coverage as, "the area occupied by buildings." A more comprehensive definition of coverage includes all impervious surfaces, such as rooftops, roads, parking areas, patios, sidewalks and compacted earth. All of these areas can contribute to increased storm water runoff and other potential adverse environmental impacts.

Another way to obtain fewer and smaller parking lots is to encourage or require shared or joint parking. Shared parking reduces the parking area for mixed uses with non-competing hours of operation such as residential units above a store or the use of church parking lots by schools. Joint parking refers to two or more multi-tenant buildings using the same parking facilities.

Parking Space Size Required by Zoning

Traditionally communities require that each parking space have minimum dimensions. A minimum stall of 10' by 20' or 9' by 18' is common. The City of Olympia, Washington has calculated that during a two-year rain event (2.8 inches in 24 hours), approximately 38 cubic feet of runoff would be generated by a 9' by 18.5' parking stall. Over the last decade the average size of cars sold in the United States has in declined. In recognition of the popularity of smaller cars, many communities are downsizing required parking space size. Los Angeles for example, permits 8'4" by 18' parking stalls. In a 1982 survey of 900 local governments, the American Planning Association found 33% of the respondents had downsized the minimum parking space size required by zoning. According to the APA survey, small car stall widths ranged from 7'6" to 8'6" with lengths ranging from 14' to 19.' The most commonly used small car dimension was 7'. 6" in width by 15' in length.

Adherence to older parking space standards results in land unnecessarily being paved. Smaller parking stalls mean less impervious coverage for the same number of parking spaces. In a 100-space parking lot, using a 112.5-sq. ft. stall, as opposed to the older 200-sq. ft. standard will reduce the lot's total paved area by 8,750 sq. ft. Palo Alto, California requires that lots with over 150 spaces have a minimum of 20% of the spaces designed for small cars.

Parking Lot Drives, Curb Cuts and Stall Arrangements

In addition to parking space standards, parking lot driveways, curb cuts and parking space arrangement influence the amount of paved area associated with parking lots. A general planning standard is to minimize the number and size driveways and curb cuts associated with parking lots. Lengths and widths of parking lot driveways should be kept as short and narrow as possible. Driveway widths of 9' for single lane drives and 18' for double lanes are often adequate. In most instances, one curb cut will adequately serve a parking lot. Where curb cut standards are disregarded, parking areas and the street become one. Phoenix, Arizona stipulates that, with the exception of safety considerations, the location of driveway curb cuts for parking lots shall not cause the removal of existing mature landscaping.

There are four common angles used to design parking space arrangement, 90°, 60°, 45° and 30°. The angle used depends on the situation and the available space. 30° and 45° parking

are used when the parking area is narrow and reduced traffic aisle widths (13') are needed. However, both require a large amount of paved area per vehicle, approximately 252- sq. ft. per car. The 60º stall is commonly used due to the ease of entering and backing out of stalls and the relatively narrow (18') traffic aisle required. However the angle requires 217-sq. ft. gross area per car. The 90° parking uses only 171 -sq. ft. of pavement per vehicle, thus achieving the highest car capacity of the four different angles. Some planners feel the 90º stall is best used for all day parking as it presents some difficulty for entering stalls. However, most people are quite used to this arrangement as it is often used in retail areas.

NEMO Recommendations Regarding Parking Lot Size

- All parking areas, other than those associated with single family detached residential units, should require special permits and be subject to site plan review.

- To reduce the size of parking spaces, review existing zoning regulations pertaining to parking space size and compare them to national standards. For example, do your regulations reflect the trend to smaller sized cars and do they provide variations in space requirements for compact versus full size cars?

- Where necessary revise land use regulations to define "Maximum lot coverage," by all impervious surfaces, not just building size and bulk.

- To reduce parking lot size, conduct random utilization studies of existing parking lots to determine if required spaces are being utilized. Revise your regulations based on survey results.

- To provide fewer parking spaces, allow median or maximum, rather than "minimum" number of spaces required by zoning.

- To provide fewer spaces, ask for fees in lieu of required spaces in areas where the required spaces are not needed or because of site limitations, they cannot be built. Fees should be deposited in a fund dedicated to improving transit and parking facilities.

- To provide fewer spaces, allow reductions of parking requirements if developers provide transportation alternatives, such as ridesharing, transit pass subsidies and employee busing.

- To provide fewer and smaller lots, encourage the use of shared parking, especially in mixed-use areas.

- To reduce or avoid large impervious areas, require that parking in areas generating large individual or collective parking lots, such as central business districts, malls, universities, hospitals, theaters and sports arenas provide underground, 1st floor or muti-story garage parking.

- To reduce the adverse impacts of large impervious parking surfaces, revise local zoning regulations to encourage or require that parking lots have porous rather than impervious surfaces. Porous surfaces may be required for the entire lot or in certain areas such as the parking stalls, pedestrian walkways, landscaped areas and overflow parking. Porous surfaces such as crush stone, paver stone, grass and porous asphalt mixtures should be considered.
- Set limits on the number of permitted parking spaces in certain areas, such as downtowns. Encourage several smaller parking lots accommodating no more than 20 to 25 cars, rather than fewer, larger facilities.

- In areas served by mass transit, provide incentives for its use, while making surface parking difficult.

- Require grass or other porous parking surfaces at seasonal sites such as beaches, parks, stadiums and fairs.

- Where possible encourage the used of 90º angle parking as it is the arrangement that uses the least amount of pavement per vehicle.

- Minimize the number and size of parking lot curb cuts and driveways.

Parking Lot Design

After a community reviews its' plans and regulations regarding the location and size of parking lots, it should look at parking lot design. Planners have long suggested that sections of parking lots be landscaped to keep vehicles cool in summer, improve the lot's appearance and function and to break up the flow of storm water. Perimeter landscaping can screen the lot from public view, while interior landscaping can break up large expanses of asphalt, promote driver and pedestrian safety and help define different lot areas, such as long-term versus visitor parking.

In addition to their positive contributions to parking lot appearance and safety, landscaped areas can help moderate dust, wind, heat, noise, glare and air pollution. They can also abate water pollution by reducing the volume and velocity of runoff flowing over large paved areas. Landscaped areas can be sunk below grade and designed to serve as drainage or bio-retention filters to receive runoff from adjacent paved areas.

Some communities require landscaping in all parking lots while others require it in minimum sized lots, expressed either in total area or number of parking spaces. For example, a five or six car lot is a common minimum size for required landscaping.

Suggested minimum areas of parking lots to be landscaped range from 5 to 25% of the total paved area. A 1964 planning advisory service report entitled, "parking lot aesthetics" recommends a minimum of 10% of a parking lot's total area be landscaped. This percentage is the minimum standard used by most planners, engineers and landscape architects. Anything

less than 10% is felt to not provide enough area for effective landscaping.

Regulations should encourage the use of existing vegetation in both perimeter and interior landscaped areas. Preserving existing vegetation is an excellent way to minimize site disturbance and maintain existing drainage patterns. Austin, Texas requires that for development along county roads, at least forty percent of the site remain in an undisturbed, natural state and 100' vegetative buffers be maintained or provided. In some instances it may be necessary to supplement existing vegetation with additional plantings to effectively shade or screen the parking lot.

Definitions of landscaping found in zoning regulations vary tremendously. Some regulations include hard, man-made or artificial materials such as: fences, wood or masonry walls, fountains, pools, screens and sculpture. Other regulations limit the definition of landscaping to natural vegetation, including turf, shrubs, trees, flowers, hedges and earthen mounds or berms. However, most regulations permit combinations of materials. For example, sand, stone and decorative mulches are commonly permitted as groundcovers, while plants, hedges and vines are often planted next to wood or masonry walls.

Parking lot landscaped areas have often been used as snow dumps. Ideally, trucks should remove snow from the lot. Where this is not feasible, snow-piling sites should be provided in locations other than parking stalls, sidewalks and landscaped areas.

There are two parking lot areas where landscaping may be required, perimeter and interior spaces.

1. Perimeter Landscaped Areas

Parking lot perimeter landscaped areas include screens and buffers located: between the lot and street, between the lot and adjacent uses and, the entrance to the parking lot.

Perimeter landscaped areas rely on the height, width, type, and density of landscape materials to screen or separate parking from adjacent land uses. Screens such as berms, fences, walls, evergreen plantings and hedges, are commonly placed along the street front and side yards. Screens separating parking lots from residential uses might be 8 to 10 feet high to provide privacy to dwellings on the first and second floors. Vehicle heights vary, but common ranges are from 4 to 8 feet tall. Walls or plant materials meant to screen parked cars from the sidewalk or adjacent uses, should use vehicle height as a design standard. Screens separating parking lots from streets might be limited to heights of 2 Whatever landscape design is chosen, regulations should contain provisions requiring continuous maintenance.

Porous Parking Surfaces

Another feature to consider when designing parking lots, is the use of porous surface materials such as grass, crushed stone, porous asphalt and concrete mixtures and blocks or brick laid in sand. The porous surfaces can cover the entire lot, or certain areas, such as parking stalls. Porous surfaces should be designed to encourage the direct infiltration and cleansing of storm water, thus reducing the adverse environmental impacts of large impervious parking areas. The Town of West Hartford, Connecticut required the developer of a major regional shopping mall to install a large “overflow parking area,” surfaced entirely of grass. The parking area surrounding Miami's Orange Bowl is also grassed. Both sites underlay the grass surface with sub-bases designed for infiltration and plastic grid systems to hold topsoil and grass and distribute vehicle weight.

As a minimum, communities should require that landscaped buffers and islands be designed as porous infiltration areas. Some communities require that pedestrian walkways be porous, while others require that everything other than the traffic lanes have pervious surfaces.

NEMO Recommendations Regarding Parking Lot Design

- The zoning regulation's “statement of intent” should describe why landscaping is required in parking areas. In addition to landscaping’s role of improving lot appearance and safety, mention its’ value regarding water quality protection and storm water management.

- Regulations lacking parking lot landscape standards should be revised to include them.
- Where feasible, porous parking surfaces should be used in place of impervious materials.

- Where feasible existing grades and vegetation should be retained and used for naturalistic landscaping of parking lots.

- Any paved parking areas should drain to on-site vegetative filter strips and any landscaped areas built above grade should have curb, berm or wall breaks to allow runoff inflow.

- Perimeter and interior landscaped areas should be designed as bio-retention filters or vegetated filter strips capable of cleansing and infiltrating storm water runoff. To be effective filters, the landscaped areas should be built below grade and planted with vegetation that is heat and salt tolerant and has filtration capabilities.

- Allow flexibility in landscape design. Buffer and screen width and height will vary based on adjacent uses and the landscape materials proposed to screen or buffer those uses from the parking lot.

- Require that a minimum percentage of the parking lot's landscaped area be devoted to interior landscaping.
- Adjacent parking lots should be separated with landscaped filter strips to break up large impervious areas and to filter runoff from these areas.
- Regularly sweep and vacuum impervious parking areas to remove pollutants.
- Where feasible, retrofit existing impervious parking lots with porous surfaces.

Contact Information
University of Connecticut, CES
Box 70, 1066 Saybrook Road
Haddam, CT 06438
Phone: (860) 345-4511
Email: nemo@canr.uconn.edu
Web Address: nemo.uconn.edu

University of Connecticut
COOPERATIVE EXTENSION SYSTEM
College of Agriculture and Natural Resources

NEMO is an educational project of the University of Connecticut, Cooperative Extension System, Connecticut Sea Grant College Program and Natural Resource Management and Engineering Department. In addition to support from UConn, NEMO is funded by grants from the CT DEP Nonpoint Source Program and the NOAA National Sea Grant College Program. NEMO is a program of the Center for Land use Education And Research (CLEAR). For more information about CLEAR, visit www.clear.uconn.edu. The Connecticut Cooperative Extension System is an equal opportunity employer. © 2002 University of Connecticut 11-02