

PROJECT BRIEF

What is the NEMO Project?

NEMO stands for “Nonpoint Education for Municipal and Elected Officials,” originally a three-year project of the University of Connecticut Cooperative Extension System, in cooperation with the Connecticut Sea Grant College Program and the University’s Department of Natural Resources Management and Engineering. As the full name implies, NEMO is a project focused on helping municipal and elected decision makers to understand nonpoint source water pollution, or polluted runoff.

NEMO in Alabama is funded by the Alabama Department of Environmental Management through a 319 federal grant, and is one of a number of projects directed at helping improve water quality on a watershed basis through education. Ongoing studies by the Environmental Protection Agency have shown that polluted runoff is a major factor in the degradation of the critical water resources. The diffuse, incremental nature of this type of pollution dictates that education—not regulation and enforcement—will be the key to combating it.

While this has always been the case, the recent proliferation of new federal and state “nonpoint” laws and programs has underscored the growing need for local officials to be knowledgeable about the causes, effects, and management of polluted runoff. The sheer number of local officials involved, plus their continual turnover, present a challenge to those interested in bringing education into public policy process. NEMO, a pilot program working along with three towns along the Connecticut shore, was aimed at devising a useful and workable way to assist municipalities in dealing with polluted runoff. The success of this program has spread to 19 states.

*Linking
Land Use to
Water Quality*

NEMO’S GOAL

To develop a process for educating professional and volunteer municipal officials about the impacts of land use on water quality and about the options available for managing those impacts.

The Need for NEMO

The NEMO Project is based on the conviction that reduction of polluted runoff can only be achieved through informed land use decisions at the local level.

Project Description

NEMO makes use of geographic information systems (GIS) technology to help illustrate the connection between land use and water quality (see box). A series of GIS images based on satellite-derived land cover/land use data is the heart of the NEMO program, which also includes an informational videotape and a series of fact sheets.



The core presentation of NEMO can be roughly divided into three parts. First, GIS images of topography and drainage systems are used to emphasize the water cycle, the watershed concept and the need for watershed management. Second, the land cover/land use data interspersed with ground and aerial photographs to show municipal officials the current land use patterns in their town and the common polluted runoff problems associated with each major type of land use.

Finally, existing land use in critical watersheds is compared with “build-out” scenarios based on the town’s zoning regulations. The emphasis here is on potential increases in the amount of impervious surface, which has been demonstrated in the literature to be a key determinant of receiving stream water quality. This relationship can be used as a simple and unifying principle which town officials can reference in the course of their day-to-day land use decisions.

A Collaborative Effort

The NEMO team itself is already a successful collaborative effort between the Alabama Department of Environmental Management, the Alabama Association of Regional Councils of Government, CAWACO Resource Conservation and Development, Storm Water Management Authority, Inc., USDA-Natural Resource Conservation Service, Alabama Cooperative Extension Service, Alabama

Water Watch Association, representatives of the Water Works and Sewer Board, and other dedicated individuals, agencies, and businesses

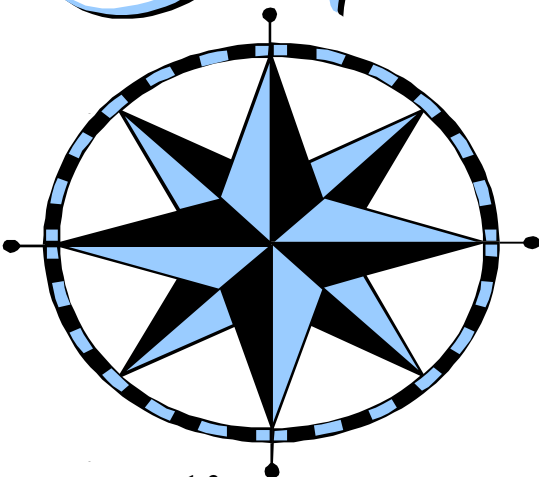
WHAT IS GIS?

GIS stands for “geographic information systems”, which is, very generally speaking, computerized mapping. A GIS is a computer system capable of assembling, storing, manipulating and displaying any data that is referenced to a location. This data can be anything from a typical map data (locations of highways or houses) to natural resources data (topography, soil types) to demographic data (population density).

GIS allows geographic data of this type to be displayed, compared and analyzed in ways that would be prohibitively time consuming, or even impossible, using conventional maps and overlays. Because of this, GIS is rapidly becoming an invaluable management and planning tool in all types of professions worldwide. In the case of NEMO, GIS images are used to show the relationship of a town’s land use to its water quality in a dramatic and understandable way.

NEMO

ALABAMA



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NONPOINT SOURCE WATER POLLUTION

What is Nonpoint Source Pollution?

Nonpoint source pollution is a fancy term for polluted runoff. Water washing over the land, whether from rain, car washing or the watering of crops or lawns, picks up an array of contaminants including oil and sand from roadways, agricultural chemicals from farmland, and nutrients and toxic materials from urban and suburban areas. This runoff finds its way into our waterways, either directly or through storm drain collection systems.

The term *nonpoint* is used to distinguish this type of pollution from *point source* pollution, which comes from specific sources such as sewage treatment plants or industrial facilities. Scientific evidence shows that although huge strides have been made in cleaning up major point sources, our precious water resources are still threatened by the effects of polluted runoff. In fact, the Environmental Protection Agency had estimated that this type of pollution is now the single largest cause of the deterioration of our nation's water quality.

Linking
Land Use to
Water Quality

Whatever They Call It, Why Should I Care About It?

The effects of polluted runoff are not limited to large lakes or coastal bays. In fact, chances are that you don't have to look any further than your neighborhood stream or duck pond. Water Pollution in your town, and perhaps in your own backyard, can result in anything from weed-choked ponds to fish kills to contaminated drinking water.

There's not much chance that you can ignore this problem, even if you want to. Concern over polluted runoff has resulted in an ever-increasing number of state and federal laws enacted over the last five years. At the federal level, a permit program for stormwater discharges from certain municipalities and businesses is now underway, and coastal zone management authorities are in the process of adding nonpoint source control to their existing programs. In addition to implementing these federal programs, many states have passed laws altering local land use (planning and zoning) processes and building codes to address the problem of polluted runoff. ***The bottom line is that both polluted runoff and its management are likely to affect you and your town in the near future.***

What Causes Polluted Runoff?

You do. We all do. Polluted runoff is the cumulative result of our everyday personal actions and our local land use policies. Here's a brief rundown on the causes and effects of the major types of pollutants carried by runoff.

Pathogens: Pathogens are disease-causing microorganisms, such as bacteria and viruses, that come from the fecal waste of humans and animals. Exposure to pathogens, either from direct contact with water or through ingestion of contaminated raw shellfish, can cause a variety of illnesses. Because of this, bathing beaches and shellfish beds are closed to the public when testing reveals significant pathogen levels. Pathogens wash off the land from wild animal, farm animal, and pet waste, and can also enter our waterways from improperly



functioning septic tanks, leaky sewer lines and boat sanitary disposal systems.

Nutrients: Nutrients are compounds that stimulate plant growth, like nitrogen and phosphorous. Under normal conditions, nutrients are beneficial and necessary, but in high concentration, they can become an environmental threat. Nitrogen contamination of drinking water can cause health problems, including “blue baby” syndrome. Overfertilization of ponds, bays and lakes by nutrients can lead to massive algal blooms, the decay of which can create odors and rob the waters of life-sustaining dissolved oxygen. Nutrients in polluted runoff can come from agricultural fertilizers, septic systems, home lawn care products, and yard and animal wastes.

Sediment: Sand, dirt and gravel eroded by runoff usually end up in stream beds, ponds or shallow coastal areas, where they can alter stream flow and decrease the availability of healthy aquatic habitat. Poorly protected construction sites, agricultural fields, roadways and suburban gardens can be major sources of sediment.

Toxic Contaminants: Toxic contaminants are substances that can harm the health of aquatic life and/or human beings. These contaminants are created by a wide variety of human practices and products, and include heavy metals, pesticides, and organic compounds like PCBs. Many toxins are very resistant to breakdown and tend to be passed through the food chain to be concentrated in top predators. Fish consumption health advisories are the result of concern over toxins. Oil, grease and gasoline from roadways, and chemicals used in homes, gardens, yards, and on farm crops, are major sources of toxic contaminants.

Debris: Trash is without doubt the simplest type of pollution to understand. It interferes with enjoyment of our water resources and, in the case of plastic and styrofoam, can be a health threat to aquatic organisms. Typically this debris starts as street litter that is carried by runoff into our waterways.

What Can I Do About All This?

First of all, you can begin to clean up your own act. There are many good publications and programs that can help you to do simple but important things, like conserving water, disposing of hazardous waste properly and gardening in an environmentally responsible manner.

As you can see, polluted runoff is largely the result of the way we develop, use and maintain our land. These policies are largely decided at the municipal level, through the actions of town officials and local commissions like planning, zoning and wetlands. There are many techniques and regulations that can greatly reduce the effects of polluted runoff, and there are more being developed every day. The rest of this fact sheet series is devoted to telling you about your options. If you're on a local commission, learn a little more about polluted runoff and how you can combat it in the course of your everyday decisions. If you're not on a commission, ask your friends and neighbors who are what *they* are doing about polluted runoff!

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IMPACTS OF DEVELOPMENT ON WATERWAYS

Key Finding

Standard land development can drastically alter waterways. Increased stormwater runoff associated with development often begins a chain of events that includes flooding, erosion, stream channel alteration and ecological damage. Combined with an increase in man-made pollutants, these changes in waterway form and function result in degraded systems no longer capable for providing good drainage, healthy habitat or natural pollutant processing. Local officials interested in protecting town waters must go beyond standard flood and erosion control practices and address the issue of polluted runoff through a multilevel strategy of planning, site design and stormwater treatment.

- Increased frequency and severity of flooding
- Peak (storm) flows many times greater than in natural basins
- Loss of natural runoff storage capacity in vegetation, wetlands and soil
- Reduced groundwater recharge and
- Decreased *base flow*, the groundwater contribution to stream flow. (This can result in streams becoming intermittent or dry, and also affects water temperature.)

Impacts on Stream Form and Function

Impacts associated with development typically go well beyond flooding. The greater volume and intensity of runoff leads to increased erosion from construction sites, downstream areas and stream banks. Because a stream's shape evolves over time in response to the water and sediment load that it receives, development-generated runoff and sediment cause significant changes in stream form. To facilitate increased flow, streams in urbanized areas tend to become deeper and straighter than wooded streams, and as they become clogged with eroded sediment, the ecologically important "pool and riffle" pattern of the streambed is usually destroyed.

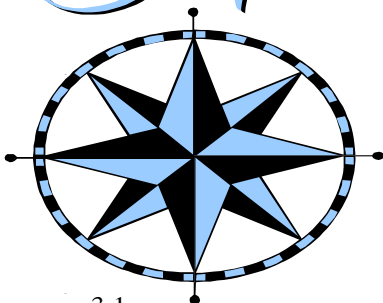
These readily apparent physical changes result in less easily discerned damage to the ecological function of the stream. Bank erosion and severe flooding destroy valuable streamside, or *riparian*, habitat. Loss of tree cover leads to greater water temperature fluctuations, making the water warmer in the summer and colder in the winter. Most importantly, there is substantial loss of aquatic habitat as the varied natural stream bed of pebbles, rocks ledges and deep pools is covered by a uniform blanket of eroded sand and silt.

Disruption of the Water Cycle

When development occurs, the resultant alterations to the land can lead to dramatic changes to the *hydrology*, or the way water is transported and stored. Impervious man-made surfaces (asphalt, concrete, rooftops) and compacted earth associated with development create a barrier to the percolation of rainfall into the soil, increasing surface runoff and decreasing groundwater infiltration. This disruption of the natural water cycle leads to a number of changes, including:

- Increased volume and velocity of runoff

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Hydrology:

A science dealing with the properties, distribution and circulation of water

Riparian:

Of or related to or living or located on the bank of a watercourse.

Habitat:

The place where a plant or animal species naturally live and grow.

All this, of course, assumes that the streams are left to adjust on their own. However, as urbanization increases, physical alterations like stream diversion, channelization, damming and piping becomes common. As these disturbances increase, so do the ecological impacts - the endpoint being a biologically sterile stream completely encased in underground concrete pipes. In addition, related habitats like ponds and wetlands may be damaged or eliminated by grading and filling activities.

Then There's Water Quality...

With development comes more intensive land use and a related increase in the generation of pollutants. Increased runoff serves to transport these pollutants directly into waterways, creating *nonpoint source pollution*, or *polluted runoff*. Polluted runoff is now widely recognized by environmental scientists and regulators as the single largest threat to water quality in the United States. The major pollutants of concern are pathogens (disease-causing microorganisms), nutrients, toxic contaminants, and debris. Sediment is also a major nonpoint source pollutant, both for its effects on aquatic ecology, and because of the fact that many of the other pollutants tend to adhere to eroded soil particles. NEMO Fact Sheet #2 provides more detail on polluted runoff and its effects.

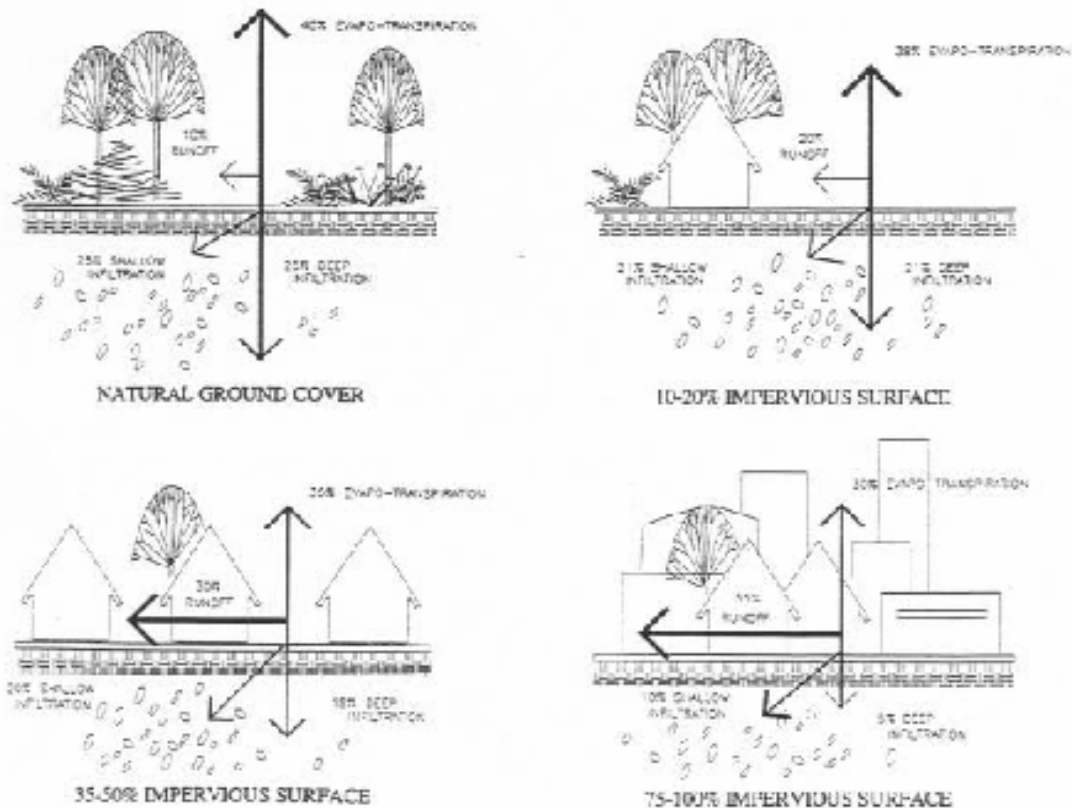


Figure 1. Water cycle changes associated with urbanization (after Toubier and Westmacott, 1981).

The Total Picture: A System Changed for the Worse

The hydrologic, physical and ecological changes caused by development can have a dramatic impact on the natural function of our waterways. When increased pollution is added, the combination can be devastating. In fact, many studies are finding a direct relationship between the intensity of development in an area as indicated by the amount of impervious surfaces and the degree of degradation of its streams. These studies suggest that aquatic biological systems begin to degrade at impervious levels of 12% to 15%, or at even lower levels for particularly sensitive streams. As the percentage of imperviousness climbs above these levels, degradation tends to increase accordingly.

The end result is a system changed for the worse. Properly working water systems provide drainage, aquatic habitat, and a degree of pollutant removal through natural processing. Let's look at those functions in an urbanized watershed where no remedial action has been taken:

Drainage: Increased runoff leads to flooding. Drainage systems that pipe water off-site often improve that particular locale at the expense of moving flooding (and erosion) problems downstream. Overall

systemwide water drainage and storage capacity is impaired.

Habitat: Outright destruction, physical alteration, pollution and wide fluctuations in water conditions (levels, clarity, temperature) all combine to degrade habitat and reduce the diversity and abundance of aquatic and riparian organisms. In addition, waterway obstructions like bridge abutments, pipes and dams create barriers to migration.

Pollutant removal: Greater pollutant loads in the urban environment serve to decrease the effectiveness of natural processing. Damage to bank, stream and wetland vegetation further reduces their ability to naturally process pollutants. Finally, the greater volume and irregular, "flashy" pulses of water caused by stormwater runoff impair natural processing by decreasing the time that water is in the system.

What Towns Can Do

Flood and erosion control have long been part of the municipal land use regulatory process, and are usually addressed with engineered systems designed to pipe drainage off-site as quickly and efficiently as possible. Flooding and erosion, however, are only two of the more easily recognized components of the

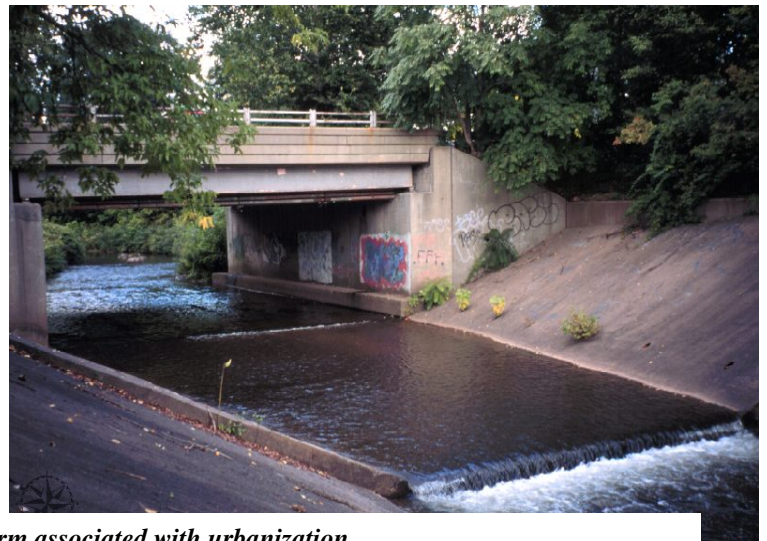
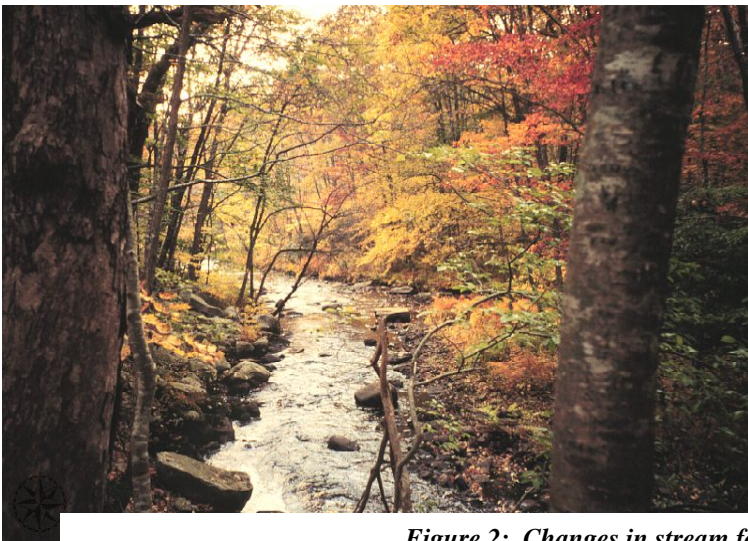


Figure 2: Changes in stream form associated with urbanization.

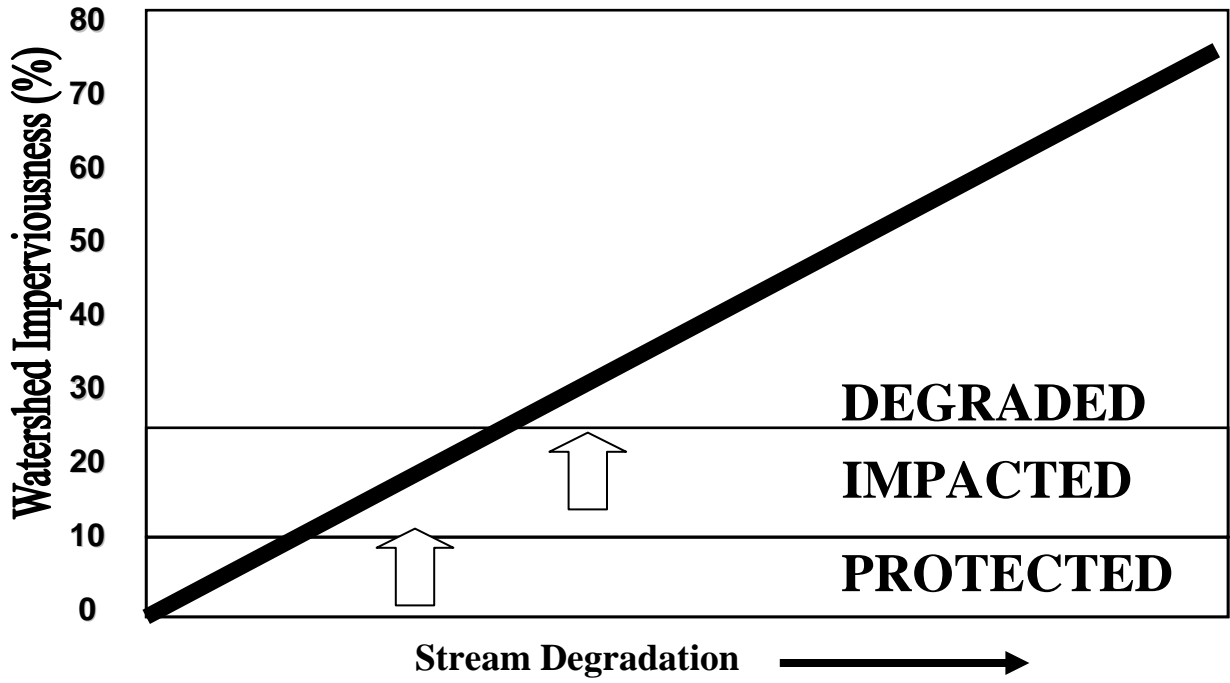


Figure 3: Stylized relationship between imperviousness and receiving stream impacts (adapted from Schueler, 1992).

overall impact of development on waterways. Standard drainage “solutions” address neither the root cause of these symptoms increased runoff due to the way we develop land nor the resultant environmental effects.

To begin to truly address the impacts of development, town officials need to look at their waterways as an interconnected system and recognize the fundamental changes that development brings to the water cycle, stream form and function, aquatic ecology, and water quality. Incorporating this understanding into local land use decisions can help to guide appropriate development. There are a number of options that can be employed to reduce the impacts of development on water quantity and quality. Preventing such impacts in the first place is the most effective (and cost effective) approach and should always be emphasized. To this end, town officials should consider a three-tiered strategy of natural resource based planning, appropriate site design and stormwater treatment. NEMO fact sheet #4 goes into this strategy in more detail.



STRATEGIES FOR COPING WITH POLLUTED RUNOFF

Key Findings

As the intensity of development increases, so does the generation of nonpoint source water pollution, or polluted runoff. A good indicator of the intensity of development in a given area is the amount of impervious surface. Studies have shown that the greater the impervious surface coverage in a watershed, the greater the potential degradation of that watershed's water systems. Thus, local officials can do much to protect their water resources by considering the location, extent, drainage, and maintenance of impervious surfaces on the town, watershed and individual site levels. Natural resource planning, site design and use of the best management practices form an effective three-tiered approach to the problem.

The Problem

Development affects both the quantity and quality of stormwater runoff, which in turn has impacts on watercourses. By enhancing and channeling surface drainage in favor of natural drainage systems, impervious surfaces like asphalt, concrete and roofing increase the volume and velocity of the runoff, often resulting in flooding, erosion and permanent alterations in stream form and function (see NEMO fact sheet #3). In addition, by blocking the infiltration of water and its associated pollutants into the soil, impervious surfaces interfere with natural processing of nutrients, sediment, pathogens and other contaminants, resulting in degradation of surface water quality.

Because of these impacts, a growing body of scientific research is finding a direct relationship between the amount of impervious surface in a watershed and the water quality of the watershed's receiving stream. Many studies find that without nonpoint source management of some kind, stream water quality becomes increasingly degraded as impervious levels climb above 15%; in highly sensitive streams, degradation can begin when as little as 8% to 10% of the watershed area has impervious cover.

What Towns Can Do

Pavement is an avoidable fact of modern life. However, there are still many options available to the municipality interested in reducing the water quality impacts of existing or future development. Strategies can be organized into a three-tiered approach, which can be summarized as: *plan, minimize, and mitigate*.

1. **Plan Development Based on Your Town's Natural Resources.** Remember, preventing pollution by wise planning is by far the least expensive and most effective way to protect your town's waterways. To this end, a working knowledge of your town's natural resources and setting protection provides a framework within which the impacts of proposed or existing development can be evaluated. Formal inclusion of these priorities in town plans and procedures is also important (see NEMO Fact Sheet #5).

Broad resource planning strategies applied at the town or watershed level, such as buffer zone and setback requirements, are increasingly coming into use. With regard to impervious surfaces, local officials should consider a "budget" approach that sets an overall limit for key areas, and above that limit requires increases in pavement on one site to be compensated for with decreases on another site (or some other acceptable method of compensation). This technique might be appropriate, for instance, in a watershed where analyses show a threat to critical water resources from future growth.

2. **Minimize Impacts Through Site Design.** The site planning stage offers the best chance for local officials, designers and builders to work together to reduce runoff from a site. Evaluate site plans with an eye to minimize both impervious areas and disruption of natural drainage and space, should be considered. Are the proposed sidewalks, roads, and parking lot sizes absolutely necessary, or could they be

reduced? Designs which reduce grading and filling and retain natural features should be encouraged. In addition to protecting waterways, such designs can often be less expensive and more pleasing to the eye.

3. **Mitigate Unavoidable Impacts by Using Best Management Practices.** Best management practices (BMPs) include a whole range of methods designed to prevent, reduce or treat stormwater runoff. Choosing the correct BMPs is often highly site-specific. There are a number of agencies and publications that can provide guidance (see NEMO Fact Sheet #5). Here are some basic BMP concepts to keep in mind:

- ❑ *Slow that stormwater.* This is the basic idea behind both detention basins, which are meant to slow and hold stormwater before releasing it, and retention basins, which are designed to hold the water permanently until it infiltrates into the ground. In both cases, pollutant removal takes place through settling of particles and through chemical and biological interactions in the standing water or in the soil. As with any device, these BMPs must be correctly designed in order to work properly. For instance, basins must be large enough to treat runoff generated by the combination of local climate and site configuration.
- ❑ *Avoid direct connections.* Break up the “expressway” of polluted runoff by using grass swales, filter strips, or other forms of vegetative BMPs whenever possible, in place of curbing and piped drainage. In many cases, these methods are most effective when used in combination with structural BMPs like detention ponds.
- ❑ *Ensure regular maintenance.* Most structural BMPs require regular maintenance to retain peak pollutant-removal efficiency. Maintenance ranges from the frequent, but simple (sweeping parking lots, cleaning storm drains) to the infrequent, but complex (sediment removal from detention/retention ponds), but in all cases it must be budgeted and planned for.
- ❑ *Don't forget the two “e’s”: enforcement and education.* It's important to make sure that contractors are following through on agreed-upon methods. Don't underestimate things

like storm drain stenciling, and hazardous waste disposal days, which can reduce pollution, raise public awareness and help to engender support for all your town's water protection activities.



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How To Get Started: Protecting Your Town From Polluted Runoff

Key Finding

Protecting your town's water resources from polluted runoff will require the involvement of many municipal departments and commissions, as well as other sectors of the community. A coordinated approach, combined with a clearly stated goal of protecting your town's waterways, is an excellent way to start.

The Problem

Nonpoint source pollution, or polluted runoff, is the cumulative result of personal and municipal actions (see NEMO fact sheet #2). As such, only an organized, collaborative approach to solving the problem will be successful. Local land use decisions will continue to be made on a case-by-case basis. However, an action plan incorporating certain key elements into the municipal decision-making processes will serve to strengthen and consolidate your town's effort to protect its waterways.

A Coordinated Approach to Polluted Runoff: Key Considerations

Communication: Many municipal commissions and departments must be involved in managing polluted runoff. For instance, the zoning commission makes land use decisions, the planning commission determines the general direction of future development and the public works department oversees design, construction, maintenance, and repair of roadways and catch basins. Each one of these players must be informed about their role in protecting town water resources, as well as the roles of other players and how they fit together. In other words, a *plan* is needed. In some towns, this has meant a new board or group (many times *ad hoc*) made up of representatives of the key players. Some examples of who might be involved include planning, zoning, wetlands, harbor and conservation commissions; public works and public health

departments; water and sewer, erosion control, economic development, and finance boards.

Legal Requirements: Depending on the location and size of your municipality, a number of recent federal and state laws on polluted runoff management may soon be coming your way (if they haven't already!). These include stormwater permitting and, in the coastal zone, new requirements related to coastal zone management. In addition, many states have enacted legislation affecting a range of local activities, from zoning decisions to septic system repair to setback requirements for development near wetlands and watercourses. Local officials need to be aware of these laws, both from the standpoint of compliance and with regard to the authority that they confer to municipalities wishing to aggressively manage polluted runoff. The Alabama Department of Environmental Management (ADEM) is usually the best place to call for information about these laws.

Focus: As part of a town-wide effort to control polluted runoff, there are certain basic things that may be done "across the board" for all existing areas or planned developments, such as requiring stormwater controls and minimizing the amount of impervious surfaces (see NEMO fact sheets #3 & #4). However, this does not preclude an approach that focuses on identifying and protecting your town's most important water resources. Your priorities will likely be set based on a combination of water resource information and the needs of the local populace. For instance, the primary goal might be improving the water quality of a heavily used lake, pond, or cove, it could be protecting a relatively pristine reservoir or critical groundwater recharge area. The NEMO technique of doing a zoning build-out analysis is only one way to help assess the threats to your waterways. Many other analytical techniques exist, from digging out old reports to taking field samples. Expertise can be found in many places, including consulting firms, local residents, state agencies, universities, or even your town hall.

Financing: Unfortunately, the rising tide of new nonpoint source regulatory programs has not yet resulted in an accompanying increase in funding sources. Currently available federal and state technical and funding sources are listed with the accompanying resources. It's clear, however, that local funding will have to account for most of the expenses involved in polluted runoff programs. General funds, capital funds, special tax districts (like stormwater utility fees), and local bond issues are all options. Costs associated with new development can and should be negotiated with the developers. A couple of positive things to remember include: 1) preventing pollution is by far the most cost-effective way to protect your resources, and 2) many of the nonstructural best management practices involving reduced impervious surfaces and use of vegetation can actually save you money compared to conventional development.

What Towns Can Do: Suggestions for an Action Plan

The technical aspects of polluted runoff can be complicated. However, just because your town doesn't have a water quality expert or 20 years of monitoring data doesn't mean that you can't protect your water reserves. There are a number of places to get help (see last section), and remember, communication is the most important aspect of any action plan. You are the final judge as to what will work in your town, but here are some suggestions:

1. Form an *ad hoc* committee of member of various appropriate commissions and departments to get the ball rolling. Remember to get the blessing of the town's chief elected official.
2. Educate yourself and your key commissions of the basics of polluted runoff and its management through programs and materials like those available through the NEMO Project and ADEM (see last section).
3. Seek local or private help to assess your town's water resources. Which are the most valuable to

your town (economically, historically, socially)? Which is the most impaired, or endangered, or polluted? Do state or federal agencies deem any water resources especially important? Weigh these factors and try to come up with a consensus priority list.

4. Assess what, if anything, your town is currently doing about polluted runoff. Factors to be inventoried include erosion control requirements, subdivision regulations, town maintenance of roads and storm drains, open space plans and any setback or buffer zone requirements.
5. Write and issue a polluted runoff policy statement, laying out the importance of polluted runoff management and the commitment of the town to address this problem.
6. Go ahead and dive in!! Write a brief Action Plan that spells out the roles of each of the key commissions/departments represented on the *ad hoc* committee. Don't forget funding, maintenance, and other points you'd just as soon forget!
7. Hold an educational meeting for all the commissions/departments and the public to brief them on your work and the Action Plan, and get comments. You can use the media to raise awareness of the problem in your town, through things like newspaper articles on the Action Plan and the NEMO videotape shown on public access television.
8. Incorporate your Action Plan into the appropriate town plans, procedures, and regulations.

Can We Really Do This?

Absolutely. Remember that the most important step in the process is a clearly stated desire on the part of the town to protect its water resources from polluted runoff and takes no technical or legal expertise. Establishing that priority, articulating it in town policy and setting up a framework for internal cooperation and communication will provide a solid foundation for all that follows.



ASKING THE RIGHT QUESTIONS

Raising the Issue of Polluted Runoff at a Public Meeting

Key Finding

The best way to protect your local waters from polluted runoff is to address the issue through your town's land use regulation process. This process can be addressed by planning commissions. The public meetings of these commissions provide an opportunity for concerned individuals to raise important environmental issues whenever development is proposed. By asking a few simple questions, you can ensure that the proper authorities duly consider water quality impacts.

The Problem

Water quality is greatly influenced by land use. Stormwater runoff carries contaminants such as pathogens, nutrients, sediments, and debris from the land to your local waterways. This is known as polluted runoff, or nonpoint source pollution (see NEMO fact sheet #2). Municipal land use policies can therefore have a great impact on the health of local waterways, and because land use decisions are often made on a case-by-case basis, each individual development proposal counts.

We've all heard it said that in America, one person can make a difference. Although this axiom may be a little shopworn, it is nevertheless true when talking about local land use decisions. When development is proposed in your town, it is important that someone ask questions regarding the water quality aspects of that project. If that "someone" is not one of your municipal land use boards, then it might have to be you!

While each proposal is different, there are some basic water quality considerations that need to be taken into account. Until you hear otherwise, you can't assume that either the applicant or the commission has addressed these issues. Don't be afraid to ask

questions. The land use regulatory system was set up specifically to allow you to participate in the process, and lack of expertise on Robert's Rules of Order or stormwater engineering should not deter you from exercising that right.

Remember that the people on your land use boards probably aren't experts on polluted runoff either. They're volunteers and your neighbors, and no matter how conscientious, they can't be expected to always understand the environmental impact of each decision.

Question to Ask

Here are some basic questions that should be asked concerning proposed development and its possible effects on your town's water resources. They are roughly organized according to the three-tiered NEMO Project strategy of natural resource planning, environmentally sound site design and use of best management practices (see NEMO fact sheet #4). Although there is no guarantee that asking these questions will always result in stopping polluted runoff, there is no better way to ensure that at the very least, the issue will be put on the table for discussion.

Planning with an Eye to Natural Resource Protection

1. Does the town Plan of Development address watershed management and/or polluted runoff?
2. Where is the project located with respect to your town's water resources? For instance, is the project located within a watershed that drains into a key river, reservoir, or aquifer?
3. Does the proposed development encroach upon, *or through its runoff, affect* any recognized priority natural resource areas (ex: wetlands, watercourses, aquifer recharge area, wildlife areas, dedicated open space)?

Minimizing Impacts Through Sensitive Site Design

1. Is the natural topography and drainage system retained, or is the stormwater collected and piped off-site? Where will the stormwater runoff ultimately be discharged? Does it go directly into any wetlands or watercourses?
2. Is natural vegetation retained whenever possible?
3. Does the design minimize disturbance of water resources (i.e., road and driveway crossings and bridges; piped and channelized section)?
4. Are impervious surfaces minimized? Are parking lots and other paved areas larger than truly needed? Have pavement alternatives (concrete latticework, pervious pavement, crushed stone) been considered for use in low traffic areas?
5. Are wetlands or watercourses insulated from the development through buffer strips or open areas?
6. Is the project within any "setback" or "buffer" zone around wetlands and watercourses that

restricts certain types of development or activities? If so, who will be charged with enforcing the restrictions? Will signs be posted to inform residents/owners of the restrictions?

Mitigating Impacts Through best Management Practices (BMPs)

1. What erosion control measures will be used during construction phase? Who will make sure that they are effective?
2. Will stormwater be contained on site, or will it be allowed off site?
3. How is the stormwater runoff going to be treated? What BMPs (oil/grit separators, detention ponds, etc.) will be used? What pollutants, specifically, are they designed to remove? What volume of water are they designed to hold or treat?
4. Who will maintain the BMPs and how often? What is their projected life span?



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Reviewing Site Plans for Stormwater Management

Considering Stormwater Management in Site Plan Review

Volunteers serving on planning, zoning and wetland commissions routinely review site plans to determine compliance of proposed development with land use regulations. A major consideration of this site plan review should be the proposed development's impact on water resources, particularly from polluted stormwater runoff, or "nonpoint source pollution."

Traditionally, stormwater management has emphasized water quantity, with little concern for water quality. To address both of these factors in a comprehensive manner, each site plan should contain a stormwater management plan that details the impact of proposed land use on water quantity and quality, both on-site and within the watershed.

While the detailed engineering is best left to trained professionals, land use commissioners can review plans for compliance with general planning guidelines.

The Need for Stormwater Management in a Watershed Framework

When water falls to earth as rain or snow most of it seeps into the ground. However, if the ground is saturated, frozen or covered with impervious surfaces, excess precipitation flows over the land. Stormwater management is the process of controlling and cleansing excess runoff so it does not harm natural resources or human health.

A major focus of stormwater management should be prevention of nonpoint source water pollution. (See NEMO Project Fact Sheet #2.) It is more cost effective to prevent flooding and water pollution than to correct problems after damage has occurred.

Potential Impact of Development on Water Resources. Development may disturb land and create impervious surfaces such as roads, rooftops and compacted soil that in turn drastically change natural drainage patterns. During construction, existing grades and vegetation can be damaged, resulting in soil erosion. Runoff from these areas can pollute streams. Development, through increases in impervious surfaces and installation of storm sewers, speeds movement of concentrated pollutants off-site and interferes with water infiltration to the ground. (See NEMO Project Fact Sheet #3.)

Traditional Approaches To Stormwater Management. Most communities attempt to manage stormwater by emphasizing water quantity rather than water quality. The goal has been to drain water from developed sites as rapidly as possible through the use of gutters, downspouts, pipes, curbs, catch basins and culverts. Some communities require developers to install detention ponds to temporarily store a portion of the excess runoff, then gradually release it after the peak natural runoff has occurred. Many hydrologists are concerned that mandating detention ponds on each site, while controlling runoff in the immediate vicinity, may work to collectively increase peak flows in the watershed, resulting in downstream flooding. Experts caution about reliance on one management practice to solve all drainage issues.

Linking

Land Use to

Water Quality



“Each site plan should contain a stormwater management plan addressing the impact the proposed land use will have on water quantity and quality.”

The Importance of Watershed Management Plans. Stormwater management begins with an understanding that every piece of land is part of a watershed. A watershed is defined as an area in which all drainage flows to a common outlet. Comprehensive land use planning and sound site design are necessary for effective stormwater management. Water resource experts strongly recommend that towns develop watershed management plans, so that management practices on individual sites can be coordinated as to location, size and function. Comprehensive watershed management plans include data from field inspections and inventories of existing drainage structures, mapping of watercourses, analysis of runoff rates and allowable capacities, and identification of existing and potential problem areas.

In addition to hydraulic and quantity impact analysis, watershed management plans should also address water quality issues. Things to be identified in the plan should include: priority water resources to be protected; known sources of contamination and existing pollutant levels; particular contaminants of concern; water quality goals; and overall watershed-level protection measures (such as use of buffer zones along waterways).

Within the context of a watershed plan, stormwater management should combine efforts to minimize impervious surfaces with efforts to maximize infiltration of clean runoff into the ground. Untreated stormwater should not be allowed to discharge directly into surface or subsurface waters. Site-specific runoff control measures should be based on their location within the watershed. Effective stormwater

management will maintain the natural patterns of runoff within the watershed. For instance, clean runoff from the lower portions of the watershed should be allowed to pass downstream without delay (as long as the downstream floodway is capable of handling these flows), while runoff from the central and upper sections of the watershed should be slowed or held back to prevent increasing peak flow rates.

The Contents of a Stormwater Management Plan

Developers are generally required to submit site plans to help local officials determine whether proposed development complies with municipal land use regulations. Each site plan should contain a stormwater management plan addressing the impact the proposed land use will have on water quantity and quality.

Site-level stormwater management plans are generally composed of maps and a narrative. The maps and associated construction drawings show existing site features and proposed alterations highlighting the location and type of proposed stormwater management system. The narrative consists of a written statement explaining the natural and proposed drainage system, a detailed description of projected runoff quantity and quality and an explanation of why certain management practices were chosen for pollution control. Highlighted should be a detailed description of the relationship of the proposed development to drainage and runoff within the entire watershed (with reference to a watershed management plan should one exist). Provisions for site safety and maintenance of approved management measures should also be included.

Also available:
NEMO Fact Sheet #1:
Project Brief
NEMO Fact Sheet #2:
Nonpoint Source Water Pollution
NEMO Fact Sheet #3:
Impacts of Development on Waterways
NEMO Fact Sheet #4:
Strategies for Coping with Polluted Runoff
NEMO Fact Sheet #5:
How to Get Started: Protecting Your Town from Polluted Runoff
NEMO Fact Sheet #6:
Asking the Right Questions: Raising the Issue of Polluted Runoff at a Public Meeting

Principles to Strive for in Stormwater Management

Stormwater management should include measures to control and convey runoff flow, and to collect and cleanse runoff on-site. These principles might be summarized as “The Four C’s” of stormwater management: control, conveyance, collection and cleansing. Measures do not fall neatly into an category in most cases; for instance, measures that control swales, may convey and clean runoff as well. These four principles, however, can provide a helpful framework for looking at stormwater plans.

1. Control. Control measures can be broken down into two categories: source control measures focus on pollution prevention. Their objective is to avoid or limit the generation of pollutants. Typical source control measures include lot sweeping, hazardous waste collection, and reduced usage of fertilizers and pesticides. Runoff control measures focus on slowing down runoff, in order to reduce the likelihood of erosion, downstream flooding, and pollutant transport. These measures include limiting impervious surfaces, directing flow over grass swales or other vegetated areas, storing runoff in ponds, and installing infiltration systems.

Conveyance. Conveyance systems are used to drain and direct the flow of runoff generated on a site. This is done with the pipes feeding into catch basins and storm sewers. More natural systems using vegetated depressions and swales, which look and function like the natural drainage system, should be used whenever possible. Existing systems can be adapted to reduce runoff; for example, perforated pipes can be used to promote infiltration. Particular attention should be given to system outlets, which commonly become restricted or blocked if poorly designed.

3. Collection. Capture and storage of runoff for more timely release is a vital component of most stormwater management systems. When runoff is collected in a vegetated storage area like a detention or retention pond, the site’s adverse impacts on water resources can be greatly reduced. For sites where total capture is infeasible, studies suggest that collecting the “first flush” of one-half to one inch of rainfall can capture a high percentage of contaminants. All collection systems require regular monitoring and maintenance to insure their continued effectiveness.

4. Cleansing. Control, conveyance, and collection of runoff mean little without provisions for cleansing. Cleansing is commonly accomplished through techniques that promote filtration and settling of pollutants and their natural processing by vegetation and soil. Filtering devices include engineered structures like catchment basins, and porous pavement, but also include more natural systems like stream buffers and vegetated filter strips. Depending on their design, many collection systems like ponds and wetlands also serve to cleanse water. Infiltration of stormwater into the ground, which allows pollutants to be cleansed by natural biological and chemical processes in the soil and helps to recharge groundwater, should be encouraged wherever soil type and groundwater systems can support it.

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Summary Planning Guidelines for Stormwater Management

Site-by-site evaluation of stormwater plans can be greatly improved and facilitated by having a set of guidelines clearly stating the key management principles that the commission wants each applicant to address in a site plan. As part of site plan review, commissioners should require assurances that any stormwater management plan complies with these general guidelines. The detailed engineering formulas and designs used to attain compliance with the guidelines are

best handled by referring engineers and developers to commonly accepted manuals. Review of engineering design should be left to trained staff or consultants experienced in the field of water resources. Below is a suggested list of guidelines that applicants should address when designing a stormwater management plan. Commissions should consider using these when reviewing submitted plans. Municipalities might also consider including these guidelines in their subdivision and zoning regulations, and referencing them in watershed management plans.

The Storm Management System shall:

- 1. Consider the total environmental impact of the proposed system.*
- 2. Consider water quality as well as water quantity.*
- 3. Be consistent with the local Plan of Development, and any existing watershed management plan.*
- 4. Coordinate with erosion control measures and aquifer protection.*
- 5. Minimize disturbance of natural grades and vegetation, and utilize existing topography for natural drainage systems.*
- 6. Preserve natural vegetated buffers along water resources and wetlands.*
- 7. Minimize impervious surfaces and maximize infiltration of cleansed runoff to appropriate soils.*
- 8. Direct runoff to minimize off-site volume.*
- 9. Reduce peak flow to minimize the likelihood of soil erosion, stream channel instability, flooding and habitat destruction.*
- 10. Use wetlands and water bodies to receive or treat runoff only when it is assured that these natural systems will not be overloaded or degraded.*
- 11. Provide a maintenance schedule for management practices, including designation of maintenance responsibilities.*

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They Can't Do That (Can They?!!)

A Quiz About How Land Use is Decided in Your Alabama Town

Take this quick quiz and see how you score. The answers are provided directly after the questions, so don't peek!

Linking Land Use to Water Quality

Did you ever drive by a new development and wonder how and why that particular subdivision/office complex/industrial park is being put there? The answers may surprise you, since myths abound about how land use is decided.

1. Land use planning and regulation is primarily determined by:

- (a) federal laws. (c) local regulations.
- (b) state laws. (d) developers.

The correct answer is (c). Local land use regulations are the primary mechanism guiding land use. The state passes on the right to regulate land use through legislation that enables municipalities to zone. Zoning allows local governments to determine what type of development is appropriate for various areas of the town, for the good of all town citizens. Federal and state regulation is largely restricted to federal and state lands. Developers must conform to local zoning laws.

2. Local land use planning and regulation is done by the:

- (a) Planning Commission.
- (b) City or Town Council.
- (c) County Commission.
- (d) Zoning Board of Adjustment
- (e) All of the above.

The correct answer is (e), all of the above. The Planning Commission develops your town's Comprehensive Plan, which lays out the town's vision for future growth. In addition, the Planning Commission sets subdivision regulations, which specify how and when land can be subdivided for development. The City or Town Councils are responsible for the zoning regulations that set the rules for what kind of development is allowed in each area of town. The Town Council receives input from the Planning Commission on zoning, based on the comprehensive plan. In a few counties in Alabama, county commissions and county planning commissions enforce planning and zoning laws in unincorporated areas. Zoning Boards of Adjustment

approve or disapprove variances or special acceptance to the zoning ordinance of a city or town.

3. Members of local planning commissions and boards are:

- (a) appointed by the Mayor.
- (b) elected by the town's population.
- (c) appointed by the city or town council

The correct answer is (a) and (c). Planning commissions are usually appointed by the city or town council. In some cases Boards or members of Boards are appointed by the mayor

4. Members of local commissions and boards are:

- (a) paid for their time.
- (b) volunteers.

The correct answer is generally (b). Your neighbors are for the most part volunteering their time. You don't have to be a professional planner, engineer, or scientist to serve on these boards, either, which highlights the critical need for training and education of new board members.



Also available:
NEMO Fact Sheet #1:
Project Brief
NEMO Fact Sheet #2:
Nonpoint Source Water Pollution
NEMO Fact Sheet #3:
Impacts of Development on Waterways
NEMO Fact Sheet #4:
Strategies for Coping with Polluted Runoff
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How to Get Started: Protecting Your Town from Polluted Runoff
NEMO Fact Sheet #6:
Asking the Right Questions: Raising the Issue of Polluted Runoff at a Public Meeting
NEMO Fact Sheet #7:
Reviewing Site Plans for Stormwater Management

5. A controversial development proposal in town can be denied:

- (a) if public opinion is running against the proposal.
- (b) by a town referendum on the proposal.
- (c) only if town land use regulations are changed.
- (d) only if the proposal fails to meet the land use regulations in force at the time of submission.

The correct answer is (d). Once a proposal is submitted, it can only be denied if it fails to meet the current regulations in place. Of course, negative public opinion and the accompanying adverse publicity can result in an application being revised or withdrawn, but legally neither a town-wide rally nor a referendum can halt a proposal. Conversely, the blessing of each and every resident in town cannot save a proposal that doesn't meet land use regulations.

6. No one is ever allowed to build:

- (a) in a wetland.
- (b) on a floodplain.
- (c) on prime agricultural soils.
- (d) none of the above.

The answer is (d). Although there are federal, state, and local regulations that govern activities in and near wetlands, there may be occasions when limited development is permitted. On occasion, as a condition for approval, a developer may be required to create new wetlands. Building on a floodplain may be permitted in some towns, but is rarely a good idea. And finally, there are no prohibitions against building on prime agricultural soils. In fact, the site characteristics that make these areas good for farming also make them prime building sites, so a town interested in protecting its agricultural heritage should include farmland preservation in its plans and regulations.

7. Citizens can voice their concerns or ask questions about proposed development by:

- (a) attending regular commission meetings, which have "public comment" periods, or writing to the commission(s).
- (b) attending and participating in commission informational meetings.
- (c) attending and participating in public hearings, which are convened to gather public input on a specific proposal or issue.
- (d) joining a planning commission.
- (e) all of the above.

The right answer is (e). There are many opportunities to learn about



land conservation and development in your town, and to make your concerns heard to your fellow citizens serving on land use boards. If you have an interest in guiding the future of your town, consider joining a commission — whether elected or appointed.

8. Residential development:

- (a) increases the tax base of the town.
- (b) is an economic cost to the town.
- (c) is a “break even” proposition for the town.

The correct answer is (b). Economic studies show that most residential development usually creates increased needs for community services such as fire, police, education and public works that are not covered by the tax revenue from new homes. Recent studies find that, for every dollar of revenue raised from the residential sector, towns spend more than a dollar on services.

9. One and Two-Acre residential development can be chief contributors to:

- (a) rural character.
- (b) natural resource protection.
- (c) suburban/urban sprawl.

The surprising answer is often (c). Contrary to common belief, one and two acre zoning can pose a major threat to rural character and natural resources like clean water, open space and wildlife. Very high density subdivisions use up local landscapes to the point where every town looks the same. Effective community planning should incorporate natural resource and open space protection up front, and promote less consumptive land development as options including traditional villages (“neotraditional” development and “cluster” subdivisions).

10. Open space planning and protection:

- (a) is important for town character.
- (b) is important for natural resource protection.
- (c) is an economic plus for the town.
- (d) must be primarily a local initiative.
- (e) all of the above.

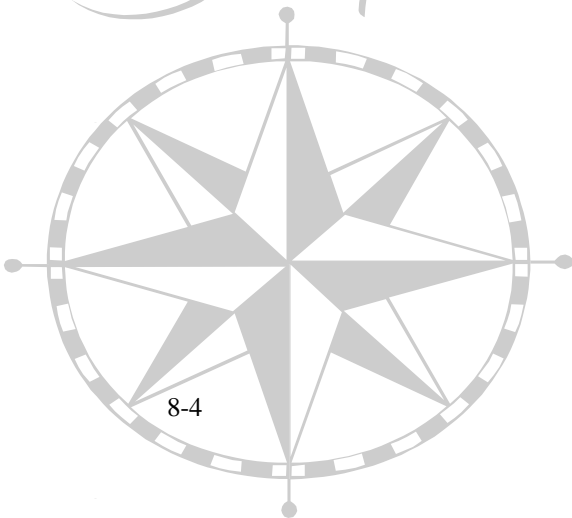
Yes, the answer is (e). As noted, preserving open space is a key to preserving your town’s character and protecting your water, land, and wildlife resources (see NEMO fact sheet #9: Open Space Developments). In addition, many studies show that open space is actually a money maker for the town, bringing in more money in taxes than the cost of what little services it requires. For

all these reasons, open space protection is an important local issue. It is increasingly falling to towns and private local groups like land trusts to preserve open space.

11. Land use planning is:

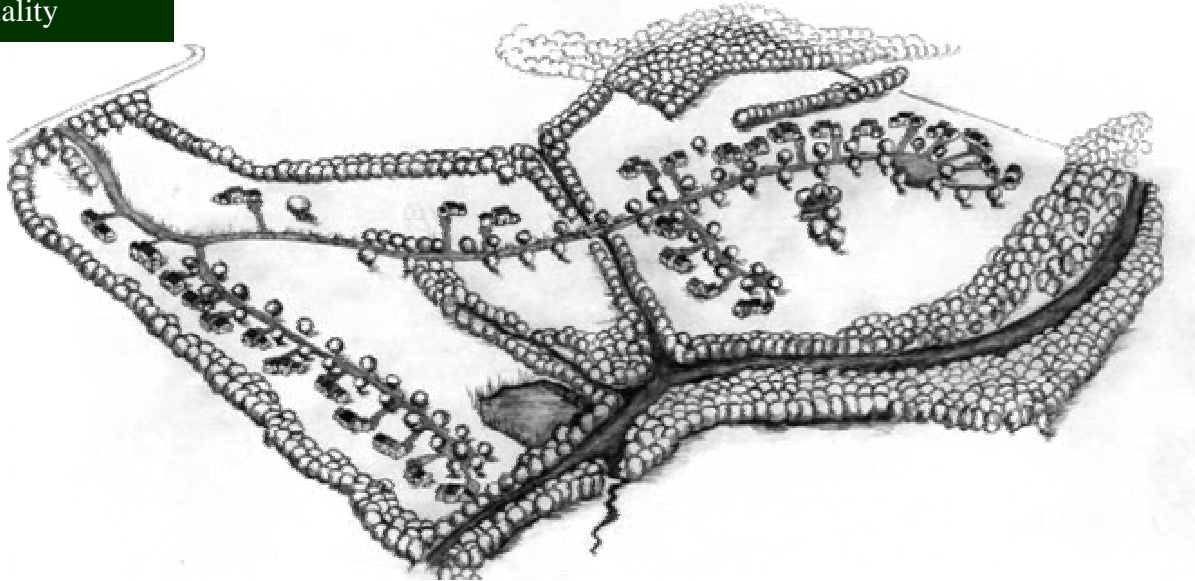
- (a) anti-community.
- (b) anti-American
- (c) an effective way for a town to protect its economic, social, and environmental well-being

The answer is (c) because there’s nothing anti- about self-determination for communities. The fact remains that land use planning is one way to help keep your town a nice place to live. Land use planning is nothing if not local. So, it’s up to you and your neighbors serving on town planning boards to determine the future of your town, and how it’s going to develop and secure for the next generation.



**Linking Land
Use to Water
Quality**

A better way to protect water quality, retain wildlife, and preserve rural character.



Conservation Subdivisions

A better way to protect water quality, retain wildlife, and preserve rural character.

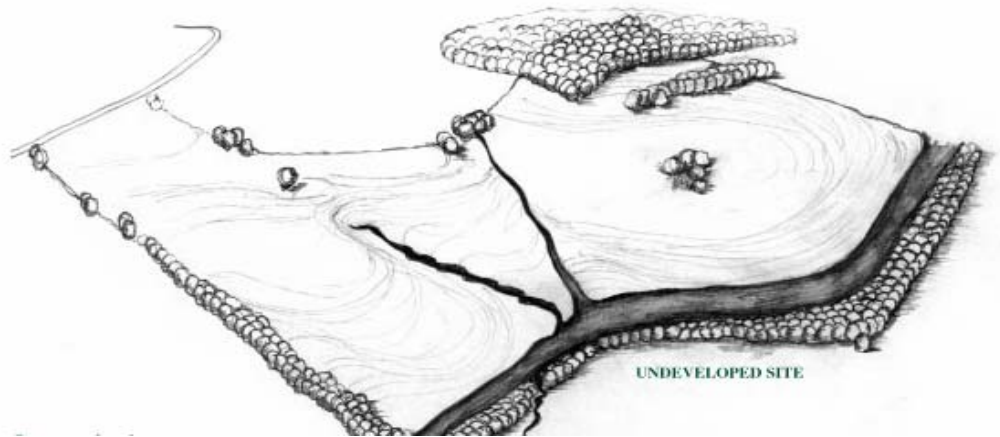
KEY FINDING

Attitudinal surveys show that many people value their community's rural character, but few realize this cherished character is programmed to disappear. That's right, programmed. Local zoning and subdivision ordinances serve as blueprints for converting undeveloped forest and fields into residential, commercial and industrial lots. Except for permanently protected open space, sooner or later those beloved woods and meadows are almost certain to disappear.

In other words, every acre of unpaved and buildable land is typically zoned for some type of development. Maybe it won't happen tomorrow, but in the future your town probably will look very different. Not only will rural character suffer, but wildlife habitat and water quality will diminish as well. Pollutants wash off developed areas into streams and ponds, harming fish and wildlife. While development isn't inherently bad, we must question whether current patterns of sprawl are what we really want, or whether there is a better way.

ARE LARGER LOTS THE ANSWER?

Typical subdivisions are often designed with cookie-cutter sameness. Development with structures evenly distributed on large lawns served by wide, straight roads is expensive to build and maintain, and does a disservice to the people living there and the wildlife that once roamed the woods and swam the streams. It is ironic that developments designed to conserve open space and protect water quality are often rejected in favor of more costly and harmful arrangements, especially since conservation designs are based on traditional, New England small town and village layouts. Large lot zoning (e.g., 2, 3, or 4 acres) is *not* the answer to retaining rural character and protecting wildlife and water quality, as it promotes leapfrog development that paves land and fragments natural areas.



SO WHAT’S THE SOLUTION?

A large part of the answer lies in “conservation subdivision” design. Using this tool, developers can design subdivisions that maximize open space protection without reducing the number of homes to be built. This is achieved by locating the structures on half (or less) of the property with the remainder permanently protected through conservation easements. It is important to note there is **no reduction** in the total number of structures - they are simply carefully situated to protect land and water resources, in direct contrast to the adverse impacts of aimlessly scattered lots that fragment the landscape and obliterate underlying resources.

Open space location should be the first thing the landowner or developer designs, not the last...

HOW CONSERVATION SUBDIVISIONS HELP PROTECT WATER QUALITY

When neighborhoods are developed with conservation in mind, roads can be shorter and narrower than in conventional developments. Less pavement reduces the amount of impervious surface and consequently the potential for polluted storm water runoff. (See also NEMO Fact Sheets 17). Pavement can be further reduced where development is designed to resemble traditional villages, with homes close to streets, thereby reducing driveway lengths. In addition to protecting water quality, street widths that are scaled to actual neighborhood traffic volumes reduce driving speeds, calm traffic and create safer pedestrian conditions. Where appropriate, open space may be used to treat contaminated stormwater associated with development. For example, instead of directing road runoff to the nearest stream, it might flow to common open areas containing naturalistic drainage facilities, such as swales or wet ponds that help filter pollutants and recharge local aquifers.

IT MATTERS WHERE THE OPEN SPACE IS LOCATED

Designated open space should be located to protect environmentally sensitive features. In most cases, it can also provide nearby residents benefits such as scenic vistas and recreation areas which add value and increase marketability. The location and functions of neighborhood conservation areas should be the *first* thing the developer designs, not the last. If the property is blessed with a good fishing stream or notable wildlife habitat, the conservation areas should be configured to protect these resources. While recreational use of the open area is often appropriate, locating a ballfield on the banks of a trout stream, where soil and fertilizer might wash to the water, should be avoided. Ultimately, to retain rural character and protect habitat, conservation areas need to be viewed in a regional perspective and possibly linked to form greenways. (See NEMO Fact Sheet #10)

WHAT HOMEOWNERS FIND VALUABLE

Locating homes to protect open space addresses a need that people have expressed in attitudinal surveys. Real estate market researchers have found that people want to live in small towns providing a sense of community, as opposed to cookie-cutter developments offering nothing more than house lots and streets. In addition, people value available open space and informal trails and will pay more to live near them. In fact, surveys show that 40-80% of people living in golf course developments are *not* golfers –they choose to live there because of the open space visible from their windows.

FREQUENTLY ASKED QUESTIONS ABOUT CONSERVATION SUBDIVISIONS

How can we be guaranteed we will receive quality open space? A new generation of conservation subdivision regulations empower commissions to require submission of two subdivision plans: a sketch showing the number of lots achievable in a conventional layout, and a conservation design for the same lot yield. In the conventional plan, a certain percentage of the land, often 10%, may be dedicated as open space. Under conservation subdivision, anywhere from 40 to 70 percent of the land, *in addition* to wet, flood prone or steep areas, is set aside as permanent conservation land. The planning commission decides which design is best for the community. The provision of quality open space should be a key consideration when deciding which design most benefits the community.

Don't these developments always result in high density apartment and condominium complexes?

Zoning generally requires that the housing types and densities permitted in conservation subdivisions be the same as are normally permitted within the zoning district. Conservation subdivisions do not give developers any special right to build attached units or at densities greater than generally permitted. Many concerns regarding density and housing type are based on developments built under poorly worded "cluster zoning" adopted thirty or forty years ago. Many of these developments allowed attached units at densities greater than permitted by conventional zoning. The result was tightly packed attached units with little common open space. The modern conservation subdivision regulations are a world apart from these early provisions, in that they are designed to protect the municipality and the environment while providing developers design flexibility to produce better layouts. As such, if the community wishes to preserve 50% of land in addition to areas deemed unbuildable, or limit conservation subdivisions to single family

detached dwellings, they may include these provisions in their regulations. Some communities choose to offer modest density bonuses when developers agree to conserve more than the required minimum open space.

Who will own, maintain, be liable for and pay property taxes on the conservation land?

Whoever owns the conservation land is responsible for all the above. Generally there are four basic ownership options: individual landowners, homeowners' associations, land trusts and the municipality.



Municipalities generally prefer not to hold title to the common open space within subdivisions unless the land would help complete a town trail system or provide active recreation areas. In most instances, homeowners' associations own and manage conservation lands and have typically encountered few problems when a few basic management principles are followed.

*Surveys show that 40-80% of people living in golf course developments are **not** golfers - they choose to live there because of open space visible from their windows.*

This fact sheet is a collaboration of the NEMO Project and The Natural Lands Trust. It was written by Rosemary Monahan, Jim Gibbons and Chester Arnold is based on the work of Randall Arendt, Vice President for Conservation Planning at the Natural Lands Trust.

WHAT YOU CAN DO

Whether you're a local land use official, resident or business owner, you can ask whether your town has an updated plan of conservation and development. You can discuss with your neighbors the role conservation subdivision design might play in meeting neighborhood and community goals. You might review your local land use regulations to see if they encourage development protective of your town's character and valuable natural resources or

whether your town has programmed itself for more sprawl, in which all lands are eventually converted to house lots and streets. You might consider serving on a local land use board to insure local plans and regulations include provisions for conservation subdivision design. In any case, do not rely on someone else to take the initiative. You can help place your town in the driver's seat regarding its future, or you can leave it to someone else with interests quite different from yours.

The Natural Lands Trust

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ADVANTAGES OF CONSERVATION SUBDIVISIONS

Compared with conventional layouts, conservation subdivisions offer the following advantages:

Economic advantages

For the municipality:

Open space enhances the municipality's quality of life, one of its chief assets in attracting quality businesses and in encouraging economic growth.

Municipal service provision is cheaper when homes are not widely scattered.

Open space dedications may provide public parkland, reducing public land acquisition costs.

For the developer:

Site plan review is smoother when development plans conform with local planning objectives.

Development costs are reduced as utility lines, streets, driveways and sidewalks are shorter.

Conservation subdivisions have marketing and sales advantages, as buyers prefer lots close to or facing protected open space.

Homes in conservation subdivisions tend to appreciate faster than counterparts in conventional developments.

Where zoning permits, a variety of housing types, ranging from single family detached to attached units, may be more easily accommodated.

Environmental Advantages

For water quality:

Common open space can be designated as buffers to protect wetlands, streams and ponds.

Water quality is enhanced when impervious surfaces such as streets, driveways and pipes are minimized.

Where appropriate, stormwater and sewage treatment facilities can be located within the open space.

For wildlife:

Common open space, if properly sited and managed can provide wildlife habitat with the three basic requirements of shelter, food and water.

When linked to other existing open areas, the common open spaces can serve as wildlife corridors and unfragmented wildlife preserves.

Common open space can be used to protect "unique or fragile" habitat as identified by local, regional or state natural resource surveys.

Social and Recreational Advantages

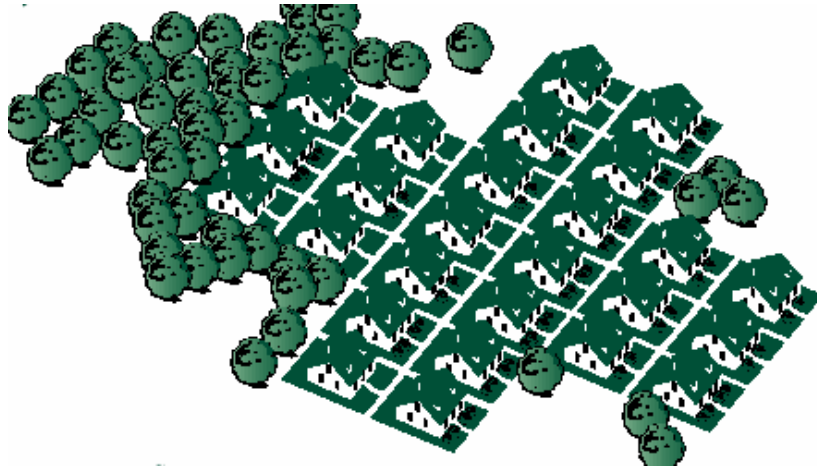
Common open space provides attractive areas for neighbors to meet informally and socialize.

Common open space may be designated for recreational uses such as biking, walking or ball playing all of which promote social interaction.

Smaller yards to tend can provide residents with more leisure time.

Carving up the Landscape

Habitat Fragmentation and What to Do About It



SUMMARY

The rise of suburban sprawl as the prevalent development pattern in America has resulted in extensive disruption, or fragmentation, of the landscape. Fragmentation reduces the diversity of wildlife, contributes to the degradation of water resources, and impacts community character. Retaining the environmental, social and economic benefits of unfragmented open land requires a strategy that combines natural resource-based community planning and design, land conservation, and wise management of both developed and natural areas.

WHAT IS FRAGMENTATION?

As development occurs, elements like roads, houses, railways, parking lots and utility lines divide the natural landscape into ever-smaller pieces, or fragments. Natural habitat areas are reduced in size and quality, and native populations of plants and animals decline. Some of the more sensitive species disappear. Compared to the obvious damage of a filled wetland or a clear-cut forest, the effects of fragmentation are subtle. However, we have begun to realize that “everyday” development can disrupt and degrade ecosystems even where substantial natural lands remain.

Every type of animal or plant has certain requirements to “make a living” — key elements like food, water, and shelter needed for survival. The minimum area required to provide these needs and the amount of human disturbance that can be tolerated within this area vary widely by species, and are subject to much scientific scrutiny. As research continues, it is becoming clear that for many types of wildlife, it’s not the total acreage of habitat that counts, but how much of that habitat exists in large, undisturbed tracts.

SO WHAT?

FRAGMENTATION IMPACTS

- ◆ *habitat destruction*
- ◆ *critical changes to vegetation and hydrology*
- ◆ *increased predation by domestic animals*
- ◆ *increased access for other predators*
- ◆ *barriers to wildlife movement*
- ◆ *road kill*
- ◆ *health effects caused by pesticides and other pollutants*
- ◆ *behavioral effects caused by noise, lights, and other disturbances*

Does it really matter if you haven't seen a warbler in your neighborhood lately, or if there are no more otter or bobcats in the woods? The answer is yes. Biological diversity is a measure of both our natural wealth and health, and a certain level of it is essential for our environment to function. If too much diversity is lost, the food web breaks down and an ecosystem becomes unable to renew itself: its species, its soils, and its habitats. Natural processes like decomposition and nutrient cycling, upon which we all depend, begin to break down.

Fragmentation also impacts water resources. Nonpoint source pollution, carried by runoff from developed areas into watercourses and wetlands, is now the number one water quality problem in the country. As development occurs, pavement and other impervious surfaces disrupt the water cycle, channel pollutants into waterways, and otherwise contribute to the degradation of our water resources (*NEMO fact sheet #2 and #3*). Suburban sprawl, the post-World War II pattern of development founded on automobile transportation, creates more impervious surfaces and eats up more open space than more compact styles of development (*NEMO fact sheet #9*).

Natural resources are not the only thing affected as the landscape is transformed from green to gray. The homogenizing effects of sprawl wreak havoc on community character, as strip malls replace traditional village or urban centers. Furthermore, studies from around the country indicate that sprawl is costly, while other studies show that open space is important both to the economic and social health of a community. Public opinion surveys consistently highlight the importance of natural lands, clean drinking water and healthy waterways to citizens.

HOW DOES FRAGMENTATION WORK?

Fragmentation can have many different impacts on native species (see box). For instance, as wooded areas shrink, forest birds which build nests on or near the ground, become susceptible to housecats and other suburban predators. Similarly, amphibian populations decline as ponds and vernal pools become surrounded by developed areas. Research suggests that to survive, frogs and salamanders need undisturbed woodland contiguous to their aquatic habitat. For these small species even minor aspects of development can have a major impact — road curbs, for example, can serve as barriers preventing movement to and from vernal pools (*See Figure 1*).

Fragmentation also affects large mammal and bird species. Large predators needing sizeable hunting ranges, like bears, bobcats, and owls, seem most affected. Some species are so adaptable to human landscapes that they make generalizations difficult; for instance, deer populations in southern New England are at record highs. Even this gain may be connected to fragmentation, since most experts believe that the deer explosion is due, in part, to the absence of large predators (including human hunters). Fragmentation can also directly affect human health; for instance, most experts believe that Lyme disease, carried by the “deer” (wood) tick, has spread as deer populations have grown. The toll of disappearing species is mounting. While our understanding is incomplete, it's generally true that the wildlife base dwindles as the average size of natural parcels decreases.



Figure 1: What constitutes fragmentation is highly species-dependent. A power line may be a barrier to forest birds, while a salamander's eye view of fragmentation might be a simple road curb.

WHAT CAN BE DONE?

It is possible that some species of wildlife can make a comeback, if given the opportunity in the form of suitable habitat. However, the landscape conversion now taking place — that of forest and field to developed land — entails more permanent changes from which recovery is unlikely, if not impossible.

Development will continue, but we can do a much better job guiding how and where development occurs. Minimizing fragmentation requires an approach that combines several overlapping strategies:

1. natural resource-based community planning and design;
2. land conservation;
3. wise management of both conservation land and developed land.

STRATEGY #1: NATURAL RESOURCE-BASED LAND USE PLANNING & DESIGN

Comprehensive, natural resource-based community planning is the most effective way to combat fragmentation. Natural resource-based planning typically involves these steps:

- ◆ conducting a natural resource inventory;
- ◆ reaching consensus on priority natural resources on which to focus protection efforts;
- ◆ directing development (through town plans and zoning regulations) to areas where it has the least impact on priority natural resources.

Unlike traditional development-driven planning, natural resource-based planning considers the long-term economic and environmental health of the community.

An open space plan identifying community goals, uses, and funding for open space preservation is a critical component of the natural resource-based planning approach. In Alabama, Planning Commissions and Conservation Commissions need to take the lead in municipal open space planning. Planning Commissions should see that the

town Plan of Conservation and Development includes or references an open space plan. The enabling legislation for Conservation Commissions charges them with conducting natural resource inventories and advising other land use boards in their towns on conservation of priority resources; this mandate makes Conservation Commissions the ideal group to provide leadership in open space planning, particularly in the context of a regional approach where inter-town cooperation is needed. Local land trusts can be key players as well. Although land trusts are private organizations, they can provide leadership and expertise to municipal open space planning efforts.

As noted, good natural-resource based planning addresses where development should occur and what type of development is desired. Zoning and subdivision regulations then implement plan goals, including design elements that can reduce fragmentation. At the neighborhood level, for instance, conservation or cluster subdivisions can help to conserve open and sensitive areas like wetlands, wildlife corridors, and agricultural fields (*NEMO fact sheet #9*). On the individual site level, design elements that reduce impervious surfaces, retain natural vegetation, protect riparian corridors, and make use of vegetated stormwater systems help to reduce fragmentation and support wildlife populations, while serving to protect water quality.

STRATEGY #2: LAND CONSERVATION

Permanent conservation of land — both private and public — constitutes a major portion of any strategy to preserve open space and minimize fragmentation. It's beyond the scope of this fact sheet to review conservation mechanisms. However, below are a few general concepts regarding open space and fragmentation that are important when considering conservation priorities.

Examining a map showing the mosaic of existing open space in your town or watershed, and how it relates to waterways, wetlands, ridgetops and other key areas, is one of the best ways to get a handle on implementing the conservation strategies listed above.

Conservation Objective #1: Protect a few large tracts of natural land.

For biodiversity, bigger is better. Ecologists tell us that we need to maintain relatively large areas of continuous, unfragmented natural lands with a diversity of habitat types — grassland, shrubland, and forest. This may seem like a tall order, but it's still achievable in many parts of the country. You might be surprised to learn how much conservation land already exists in your area.

To ensure the protection of sensitive species, you need a lot of unfragmented land. Research, for example, shows that forest interior birds seem to require a minimum of 1500 acres, while 5000 acres or more is ideal. This may be an extreme example, but even tracts this size may be possible to protect when you take a regional view, such as a watershed perspective. By building partnerships and combining forces with neighboring counties, towns, state and federal agencies, and non-profit organizations, it may well be possible to protect large land blocks in perpetuity.

Conservation Objective #2: Protect a network of smaller tracts.

Experts also suggest that we need a scattering of moderate size natural areas, in the 125 to 500 acre range. These "satellite" pre-serves can support species that don't need really large forests in which to breed, and may even support small populations of the more sensitive species. Wildlife from these satellite areas can repopulate the larger tracts should something catastrophic happen there. Ideally, these smaller tracts of land should be as close as possible to any larger tracts, contain a diversity of habitat/landscape types, and be connected to other natural areas. As tracts decrease in size, their shape can become an important factor. Most biologists agree that straight-line boundaries encourage harmful "edge effects" that include predation and competition from generalist species. Gradual, nonlinear transitional edges help to minimize these impacts.

Conservation Objective #3: Make connections.

Isolated pockets of natural lands are of value to the community, but to maximize ecological value it's important to connect open space wherever possible. Parcels contiguous to existing large and medium-sized tracts should be given high priority for conservation. Stream valleys and ridge tops also should be targeted — these areas often do "double duty," serving as both critical habitat and wildlife corridors. Riparian (streamside) corridors, for example, are used by almost 70% of all vertebrate species. Protected land in riparian corridors should include banks and floodplain areas, as well as contiguous upland forest on at least one side. The width of wildlife corridors is subject to debate, but some studies have suggested that corridors must be at least 100 meters in width to maintain at least some "interior" (as opposed to "edge") conditions. Small but strategic properties can often be protected through conservation easements or other creative techniques. At the community or regional scale, "greenway" initiatives are obviously good opportunities to make connections.

To make connections, it's invaluable to see it on a map. This gets back to the value of natural resource inventories, and knowing what you've got. Examining a map showing the mosaic of existing open space in your town or watershed, and how it relates to waterways, wetlands, ridgetops and other key areas, is one of the best ways to get a handle on implementing the conservation strategies listed above.

WISE LAND MANAGEMENT

Property owners (both public and private) can further protect natural resources and minimize fragmentation through management and design, whether their property is in a natural or developed state.

Management Objective #1: Manage conservation lands to provide diverse habitat.

Not only do we need to add to conservation land, but we also need to manage conservation lands and other property to support key species. Whether natural lands are publicly or privately owned, management usually means making some decisions about what constitutes a “key” species. For instance, birds that live in grassy or shrubby habitats, like the bobolink, eastern meadowlark, and blue-winged warbler, have declined dramatically over the past 30 years as farmland shrinks. To preserve these species, some conservation lands must be managed to create or maintain shrub and grasslands (i.e. clearing, mowing, burning, etc.). On the other hand, some forest species require extensive tracts of undisturbed forest. The need for a diversity of habitats further underscores the value of having large parcels that can accommodate different landscapes.

Management Objective #2: Manage individual properties to provide diverse habitat.

There are many species that don't need large forests in which to live. These are species that you may catch glimpses of as you walk through nearby woods, or that may come into your backyard to feed, even if they live in more secluded areas. For these species, such as woodpeckers, many song birds, small mammals and some larger ones, even narrow woodland corridors can provide critical travel routes. As noted, often such pathways are located on ridgetops or along waterways. Permanent conservation of these small but important areas is ideal, but wise management by private landowners can



The elusive bobcat near Wildcat Springs? Highly unlikely! How many ironically named subdivisions like this have you seen around your town?

also work. Streamside buffers of natural vegetation, and the use of naturalistic landscaping in these areas instead of lawns, are important contributions that individual homeowners can make. For owners of large forested properties, a forest stewardship plan can help enhance their property's value to wildlife while accommodating timber harvesting or other economic activities.

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BUT WHAT CAN I DO? GET SPECIFIC!

Reducing habitat fragmentation may seem a bit overwhelming for the individual. But there are many things you can do to help, based on the strategies listed above. Here are a few ideas:

- ◆ You can contribute time and/or money to land conservation in your area, whether it's accomplished through a local land trust, your town's land use boards, or nonprofit conservation organizations.
- ◆ You can ask whether these groups have open space plans. Many towns and local groups simply take any piece of property that comes their way, with no attempt to target critical areas like streamside corridors and areas contiguous to existing open space. Municipal open space plans should prioritize land to be acquired, and address funding mechanisms.
- ◆ You can check with your town's Conservation Commission — have they conducted a natural resource inventory, identified priority natural resources, or developed an open space plan? If the answer to these questions is "*we're too busy regulating wetlands to take on new responsibilities,*" suggest that the town consider separating their Inland Wetland and Conservation Commissions to allow for more proactive conservation. If you own farm or forest land and you wish to preserve it for future generations, you can investigate conservation easements, estate planning, and other tools that can make conservation an economically feasible option.
- ◆ You can manage your own property to improve wildlife habitat, employing naturalistic landscaping, stream buffers and other mechanisms. If you are a forest owner, you can implement a stewardship plan. Even if you live on a quarter acre lot in the middle of town, you can grow native, berry-producing shrubs and other plants that are food sources for local wildlife.

- ◆ You can ask your local land use boards to rethink their land use plans and regulations to ensure they protect critical natural resources and wildlife habitats. Does your town ask developers to propose open space or conservation subdivisions in key areas? If biodiversity doesn't move them, maybe the mounting list of studies showing the economic benefits of open space will!
- ◆ You can volunteer (or run) to serve on a land use board yourself, and have a direct hand in the decisions that shape the future of your town (*NEMO fact sheet #8*).
- ◆ You can support wildlife conservation and habitat management programs in local schools.

CONCLUSION

Fragmentation impoverishes both the natural and human landscapes. Researchers still have much to learn about the effects of habitat fragmentation, but the basic concept is simple — a parking lot can't support a bobcat, nor can a suburban lawn accommodate grassland bird species. Whenever a streamside forest is replaced by manicured lawn, a wildlife corridor is severed and fish habitat is degraded. When forest understory plants are removed to create a park-like appearance, certain plant and animal species may lose their last foothold for miles around. When a large forest is fragmented into house lots, rare songbirds and other deep woods species lose another place to reproduce and thrive. And, as habitat goes, so does water quality and community character. As individuals and communities, we can help to reduce the impacts of fragmentation through a combination of planning, design, conservation, and management.