



*Planning with*



*Land Use*

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**Table of Contents**

Land Use Decisions Can Affect Natural Resources and Water Quality ..... 1

Lands Providing and Supporting Natural Resources ..... 1

Threats to Lands Supporting Wildlife Habitat ..... 2

Increased Runoff ..... 3

Increased Pollution ..... 4

What Can You Do About It ..... 5

Natural Resource-Based Planning ..... 5

Not All Growth Pays ..... 6

Appropriate Site Design and Best Management Practices ..... 7

Remediation and Maintenance Practices ..... 8

Planning with POWER Can Help You .. 10

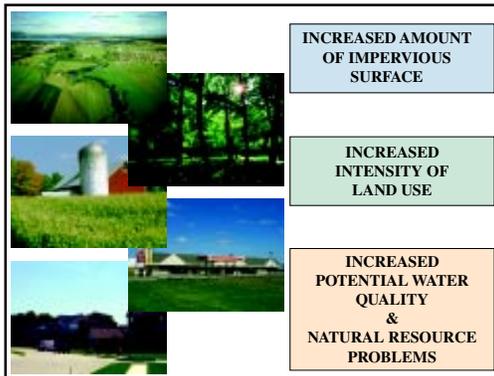
Additional Information ..... 10-11

**The Relationship Between Land Use Decisions and the Impacts on Our Water and Natural Resources**

Communities throughout the state of Indiana are growing and changing. The changes that growth brings can have both positive and negative impacts. A community’s natural resources are one asset that can be negatively impacted by growth if careful planning and proactive steps are not taken. This publication describes the relationship between land use decisions and natural resources and explains how the Planning with POWER program can help communities “Protect Our Water and Environmental Resources” as they grow.

**Land Use Decisions Can Affect Natural Resources and Water Quality**

Land use decisions are having significant impacts on our water and other natural resources in communities across the country. The potential negative impacts to our water and natural resources increase as the intensity of land use increases.



Intensity of land use can be categorized as low intensity (open space including farmland, wild lands, and managed green space) or high intensity (industrial, commercial, and urban centers). More intensively developed areas have a greater level of impervious surfaces, including roads, parking lots, sidewalks, rooftops, etc., than low intensity areas. Impervious surfaces prevent natural infiltration of water and increase storm water runoff.

As the intensity of land use increases, infiltration and the ability to recharge ground water decreases because percolation of surface water into the aquifer is inhibited. The increased runoff that results can also lead to increased water pollution and physical damage to our aquatic systems. Lands providing natural resources are often removed from this purpose and developed. Remaining wild lands adjacent to intensive land use are negatively affected, and some of the natural functions they provide (habitat and travel corridors) can be impaired.

**Lands Providing and Supporting Natural Resources**

Open space includes farmlands, managed green space (golf courses, parks, recreation areas), and wild lands (forest lands, unmanaged habitats, field corners, fence rows, abandoned pastures, etc.).

## Examples of Open Space



### What is open space?

These areas perform many vital and important functions such as collecting and filtering our water, filtering our air, providing critical habitat for wildlife, providing places for recreational opportunities, and providing food and fiber for the world.

Unfortunately, this open space is rapidly disappearing. From 1926 to 1997, the rate of development in the United States doubled to a level of three million acres per year. Indiana currently ranks second in the nation in total acreage of prime farmland, of which over 50,000 acres are lost each year. This is equal to 9 acres per hour – a trend in land use change that has a serious impact on the amount of prime farmland for future production needs.

### Threats to Lands Supporting Wildlife Habitat

#### Fragmentation and Habitat Loss



### What kind of threats?

Our natural resources – such as timber, wildlife, water, food, and plants from which we derive medications – are all produced in the “open space” on our landscapes. Land use changes permanently

impact lands providing our natural resources and can negatively impact the quality of the remaining lands that provide natural resources or perform natural functions.

Unwise land use decisions can negatively impact wildlife populations in several ways. Critical habitat is lost each time wetlands, forestlands, grass lands, or agricultural lands are converted to other uses. The quality of the remaining wildlife habitat can also be affected by the adjoining land use. Predation on nests and wildlife is increased by the growing population of dogs and cats in the area. Increased levels of human activity and shrinking habitat size can further reduce the use of habitats as travel corridors or nesting areas by many species sensitive to this disturbance.

#### Loss of Open Space



Land use decisions often result in parcelization, which breaks large areas of habitat into smaller parcels. This process fragments a landscape and can negatively impact wildlife populations by inhibiting their dispersal or migratory patterns, preventing them from moving from feeding areas to places providing cover, and can make animals vulnerable to predation as they move greater distances from one area of suitable habitat to another.

Fragmentation and parcelization of farmland, forestland, green space, and wildlife habitat has three major impacts:

- It reduces the acreage of natural wildlife habitats and farmland.

*Each year, over 50,000 acres of farmland is converted to development in Indiana (according to the National Resources Inventory).*

*Indiana ranks second in acreage of prime farmland in the country, behind Illinois.*

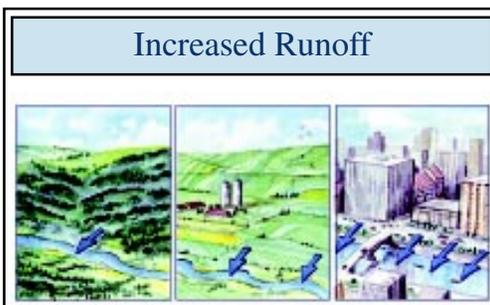
*As the intensity of land use increases, there is a corresponding increase in the amount of impervious surfaces such as roads, parking lots, sidewalks, and rooftops.*

- It increases contact between lands providing natural functions and potentially conflicting uses. For example, increased development near wildlife habitats increases the conflicts between people and wildlife. This may result in wildlife damage or increased predation and disturbance to wild animals by house pets and people.
- It increases isolation of wildlife and plants, which can inhibit their dispersal and genetic mixing and can lead to a species' decline or even extinction in an area.

In the last 16 years, the number of private forest owners tripled, but the number of acres in forest remained about the same. This increased parcelization facilitates fragmentation due to the diversity of management and use of individual tracts of land.

*Planning with POWER* encourages the protection of large tracts of farmland, forestland, other open spaces, and wildlife habitat in areas of your community most suited to this purpose. These valuable natural resource areas can then thrive and function as a cohesive unit for generations to come, thus maintaining a critical natural resource base for the community.

### Increased Runoff



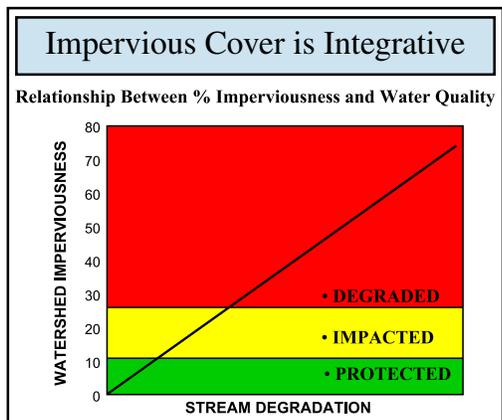
*From 1979 to 1994, the number of private forest owners in Indiana tripled, but the number of acres in forest remained approximately the same.*

*What causes runoff? How can runoff impact natural resources?*

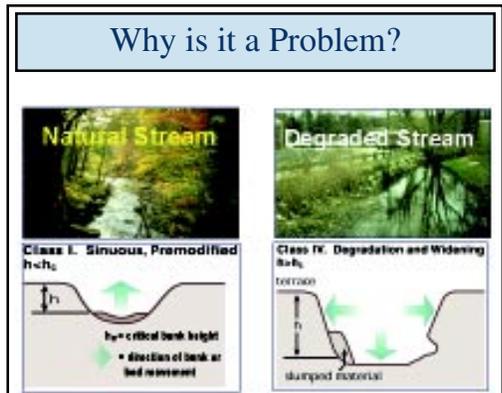
Scientific studies show a corresponding increase in the amount of impervious surfaces such as roads, parking lots, sidewalks, and rooftops as the intensity of land use increases. An increase in impervious surfaces causes the volume

and velocity of storm water runoff to increase significantly. The results can be increased flooding, severe erosion, and physical degradation of stream and river habitats that adversely impact the entire watershed and our valuable water supply.

Studies have shown that streams in watersheds with greater than 10 percent of their land area in impervious cover begin to show signs of ecological impairment. As the impervious cover in a watershed approaches 25 percent, streams become degraded and the water quality, habitat quality, and biological diversity occurring in watershed streams are all greatly reduced.



Flooding can have disastrous impacts on the local community, both in terms of private property damage and use of public tax dollars for clean up and removal of debris and sediment when floodwaters recede. Erosion of our valuable topsoil resource can result in decreased agricultural productivity and increased sediment runoff. Sediment runoff often contains pollutants such as nutrients and pesticides, which degrade water.



Physical degradation of natural streambeds, such as channelization and scouring, is also caused by increased runoff. Such degradation is detrimental to aquatic life and can result in the destruction of aquatic ecosystems in rivers and streams.

*Planning with POWER* encourages the slowing of storm water runoff and increasing infiltration through the use of vegetated swales, retention/detention ponds, buffers, pervious paving methods, and other Best Management Practices (BMPs) to protect water and other natural resources. By doing so, the overall integrity of our streams, rivers, and other waterways are maintained and improved.

### Increased Pollution



Where does the pollution come from?

As storm water runoff increases in volume and velocity, the types and amounts of pollutants detrimental to water quality and aquatic life may also increase. Very little infiltration of storm water occurs. This lack of infiltration eliminates the natural breakdown and filtering processes of the soil profile that normally cleanses and filters water as part of the natural water cycle.

Pollutants – such as sediment, nutrients, pathogens, and toxic contaminants – pose a threat to our drinking water supply and can reduce or destroy fish populations and aquatic life. Pollutants may also render water resources unfit for recreational uses such as swimming and fishing.

Polluted runoff is the number one water quality problem in the United States today. There are four main sources of polluted runoff: farmland, managed green space, commercial and industrial lands, and residential areas. The types of pollutants from each of these sources vary, but some common pollutants are shared by several of these sources. See table below.

*Polluted runoff is the number one water quality problem in the United States today.*

*Pollutants – such as sediment, nutrients, pathogens, and toxic contaminants – pose a threat to our drinking water.*

### Sources and Types of Polluted Runoff

	Farmland	Managed Greenspace (golf courses, lawns, parks)	Commercial & Industrial	Residential
<b>Nutrients</b>	Fertilizers	Fertilizers	Acid rain, automotive exhaust	Fertilizers, septic system effluent
<b>Pathogens</b>	Domestic & wild animal waste	Domestic & wild animal waste	Malfunctioning/overloaded septic systems and lagoons	Malfunctioning septic systems, pet waste
<b>Sediments</b>	Erosion from fields, stream bank erosion from animals	Erosion from fields, stream bank erosion from animals	Construction sites, roadside erosion, road sand	Construction sites, road sand, erosion from lawns and gardens
<b>Toxic Contaminants</b>	Pesticides	Pesticides	Industrial pollutants, automotive emissions & fluids	Household products, pesticides
<b>Debris</b>	Litter, illegal dumping	Litter, illegal dumping	Litter, illegal dumping	Litter, illegal dumping
<b>Thermal</b>	Removal of streamside vegetation	Shallow water impoundments, removal of streamside vegetation	Heated runoff, removal of streamside vegetation, impoundments	Heated runoff, removal of streamside vegetation, impoundments

## What Can You Do About It



### What can I do?

There are three main strategies in the *Planning with POWER* message for communities to use as they plan their future use and protection of vital and critical drinking water, farmlands, forests, and recreation areas. They are:

- 1) *Plan* to protect critical natural resources in your community while still accommodating growth through natural resource-based planning.
- 2) *Minimize* the impact to initial natural resources resulting from land use change through appropriate site designs and use of best management practices.
- 3) *Mitigate* the negative impacts to critical natural resources or loss of open space providing these functions through remediation and maintenance measures.

*Planning with POWER* provides education, resources, and technical assistance to local communities as they address land use decisions impacting water quality and environmental resources.

### Natural Resource-Based Planning

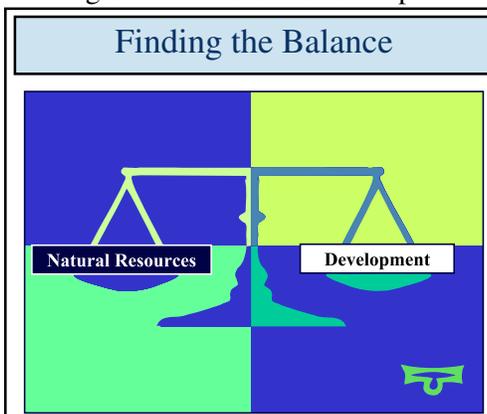


Photos courtesy of Cindy Salazar and Renee Gunn, Purdue University

## How do we want to use our land?

Natural resource-based planning is a process that identifies critical natural resources, evaluates potential impacts to these resources from proposed land use changes, and identifies practical strategies that can reduce the impacts on natural resources from land use change. Through this process, communities can effectively protect their valuable natural resources, such as farmland, forests, open spaces, and wildlife habitat, and reduce the fragmentation of lands while still accommodating growth in their community.

One of the most important elements in land use decision-making is the comprehensive land use plan for the community. The comprehensive plan answers three key questions for the community: What kind of growth? How much growth? Where should we put it?



Comprehensive planning is a process where the local community develops a long-term vision of what kind and how much development it wants, then finds the balance between protection of natural resources and economic growth and development. The comprehensive planning process has to involve all segments of the public. Without public support and involvement, the planning process will not represent the entire community.

A community that does not have a comprehensive plan, or a recently revised plan, is vulnerable to special interest groups. Development could occur in the community with little thought or concern for the resources that are unique and

valuable to the area. Without a plan, severe degradation and loss of valuable natural resources will occur.

Natural resources are part of the plan

A comprehensive plan should have the protection of a community's water and natural resources as one of its goals. The plan's objective is to find the balance between the protection of natural resources and growth or development.

To effectively protect the natural resources of a community, several key steps must be taken:

- 1) Inventory the natural resources in the community.
- 2) Prioritize areas for protection.
- 3) Target development to the most appropriate areas.
- 4) Incorporate open space planning.
- 5) Develop a plan of action and revise zoning and subdivision regulations.



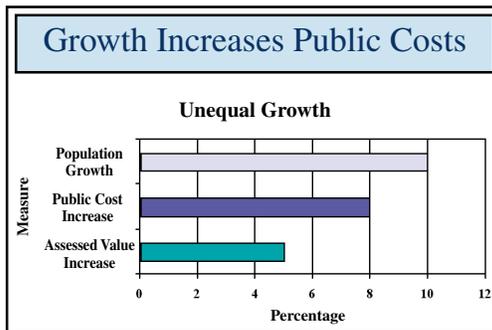
The Purdue Extension Land Use Team, made up of Extension educators from across the state, can assist local communities with land use planning and the comprehensive planning process. Contact *Planning with POWER* to locate your nearest Land Use Extension Team member.



For help in watershed planning and incorporating protection of critical natural resources in your community, you can contact the Conservation Partnership in Indiana (composed of the Indiana Department of Natural Resources (IDNR), the Natural Resource Conservation Service (NRCS), Purdue Cooperative Extension Service (CES), and the Soil and Water Conservation Districts (SWCD)). Your local office of the U.S. Department of Agriculture (USDA), including the Natural Resource Conservation Service (NRCS), the Farm Service Agency (FSA), and your local Soil and Water Conservation District (SWCD), is a starting point for Conservation Partnership assistance (see local listing).



**Not All Growth Pays . . .**



*What kind of growth do we need to achieve our economic goals?*

Local decision-makers are often faced with the dilemma of how much and what kind of growth will be optimal in terms of economic benefits for their community. In addition, they must balance environmental goals and regulations with economic and growth goals of the community.

***Planning with POWER Project Partners***

- Purdue Cooperative Extension Service
- Illinois-Indiana Sea Grant College Program
- Indiana Department of Environmental Management (IDEM)
- Indiana Land Resources Council (ILRC)
- Indiana Department of Natural Resources (IDNR)
- Natural Resources Conservation Service (NRCS)
- Soil and Water Conservation Districts (SWCD)

***Planning with POWER is funded by:***

- Purdue Cooperative Extension Service
- Illinois-Indiana Sea Grant College Program
- Indiana Department of Environmental Management (Sec. 319 Grant)
- NOAA Coastal Services Center

*Designs that reduce grading and filling and retain natural features are often less expensive and more pleasing to the eye.*

*Jobs must grow at above normal rates to provide other tax revenues to cover the cost of growth.*

*Property tax rates must rise to provide more total tax revenues to cover the cost of growth.*

Growth in single-family housing is often assumed to have a positive economic benefit for the local community. In reality, increases in population and housing growth generally increases community costs for public services such as schools, roads, and police and fire protection. A recent study in Indiana found that “a 10 percent increase in population increased county government costs approximately 8 percent while only increasing county assessed value approximately 5 percent” (Larry DeBoer, Purdue University, Agricultural Economist). To make up the difference, a tax increase is required.



Photo courtesy of Robert McCormick, Purdue University

The process of development has tended to raise tax rates because the positive fiscal impacts of added business have not been enough to offset the negative fiscal impacts of additional housing. Studies from across the country illustrate the fact that commercial and industrial developments tend to have positive fiscal impacts for a community, while residential development tends to have negative fiscal impacts. Agriculture ranks between commercial/industrial and residential, but tends to be positive in its fiscal impacts.

In order to support and balance increased residential growth and the increased public services required, the community must increase employment and keep jobs above the present rate or increase tax revenues to cover the shortfall in providing public services.

When business and residential growth is combined, counties must see 7 new jobs for every 10 new people in order to break even. Currently in Indiana, there are around five existing jobs for every ten people.



Photo courtesy of Renee Gunn, Purdue University

The type of growth and development in your community can greatly influence fiscal impacts, either positively or negatively, which in turn affects the cost of providing public services. Ultimately, this affects tax rates and revenues.

Incorporating open space (agricultural and forest lands) into a community’s plan may help achieve the positive fiscal goals a community desires while protecting natural resources vital to the community.

### **Appropriate Site Design and Best Management Practices**

Site Design and BMP’s for Natural Resources	
<ul style="list-style-type: none"><li>• Implement setback distances from critical resources</li><li>• Riparian buffer zones for streams</li><li>• Watershed approach</li></ul>	

*How do we decide what to build and where to build it?*

Natural resource-based planning sets a course to reduce negative impacts to natural resources that your community wants to protect. You can minimize impacts through appropriate site design and Best Management Practices (BMPs).

By incorporating improved site design and use of BMPs to slow storm water flow and increase its infiltration, communities can reduce and, in some cases, eliminate toxic pollutants carried throughout waterways and natural resource areas.

Minimize, whenever possible, impervious surfaces such as roads, parking lots, structures, etc. and increase the amount of open space and pervious pavement alternatives. Doing so will promote and encourage infiltration of storm water. This is also a critical strategy for reducing pollutants entering waterways and impairing drinking water and degrading natural wildlife habitat.

### Site Design

The site planning stage offers the best chance for local officials, designers, and builders to work together to reduce polluted runoff and negative environmental impacts from a potential building site.

Common steps in implementing site design practices that protect natural resources include:

- Evaluate site plans to minimize both impervious areas and disruption of natural drainage and vegetation.
- Consider cluster development areas that reduce the amount of paved surfaces and increase open space.
- Use brick, crushed stone, or pervious pavements as a viable alternative in low traffic areas.
- Reduce proposed sidewalks, roads, and parking lot sizes as much as possible.
- Utilize vegetated swales or filter strips instead of curbing and piping, when possible.

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

### Best Management Practices (BMPs)

#### Improving Site Design and Best Management Practices (BMPs)

- Encourage natural and vegetated storm water controls—swales vs. curbs.
- Emphasize on-site drainage of storm water—percolation vs. detention.
- Target and protect open space, prime farm land, and critical wildlife habitat—retain natural landscape and minimize impervious surfaces.
- Encourage agricultural BMPs.
- Require proper septic systems placement, design, maintenance. Use cluster systems when possible.



Best Management Practices (BMPs) include a range of methods designed to prevent, reduce, or treat storm water runoff. Choosing the correct BMP is often highly site-specific. *Planning with POWER* project partners can provide assistance and guidance. Here are some basic BMP concepts to keep in mind:

- 1) Encourage natural and vegetated storm water controls—swales vs. curbs when possible.
- 2) Emphasize on-site drainage of storm water to increase percolation and infiltration. Use of porous paving materials and percolation basins are two strategies that could be used.
- 3) Target and protect open space, farmland, and critical wildlife habitat. Retain natural landscapes and minimize impervious surfaces.
- 4) Encourage urban and agricultural BMPs. Use of buffer strips along waterways and creation of wildlife habitats in undeveloped areas are examples of BMPs.
- 5) Require proper septic system placement, design, and maintenance. Use cluster systems when possible. Regular cleaning and maintenance is a requirement for long-term septic operation.

#### **Remediation and Maintenance Practices**

*Is there a right way to lower impacts on natural resources?*

Remediation measures are practices designed to mitigate unavoidable impacts to natural resources caused by

*The proper maintenance of on-site septic systems by homeowners is crucial to the protection of our natural resources.*

development. Most remediation measures are designed to slow or reduce storm water runoff, and associated sediment and pollutants that result from increased development.



Photo courtesy of Shawnee County Conservation District, Kansas

*Wetlands support natural processes that facilitate the deposition of sediment, reduction of nutrients, and deposition and reduction of some pollutants.*

Remediation measures are often most effective when used in combination with BMPs. Both remediation measures and BMPs allow pollutant removal to take place through the settling of particles and through chemical and biological interactions in the standing water or soil.

As with any management practice, remediation measures 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.



Photo courtesy of Robert McCormick, Purdue University

The following are some examples of constructed and natural remediation practices:

**Detention/Retention Basins.** Detention basins are shallow depressions that are designed to slow and hold storm water before releasing it, whereas retention basins are designed to hold water permanently until it infiltrates into the ground.



Photo courtesy of Brian Miller, Purdue University

**Wetlands.** Wetlands – natural and constructed – serve as nature’s sponges, soaking up rain and storing excess flood water runoff and then slowly releasing it back into streams, lakes, and groundwater. Wetlands also support natural processes that facilitate the deposition of sediment, reduction of nutrients, and deposition and reduction of some pollutants.

Constructed wetlands are often designed as part of a system of remediation measures to reduce the impacts of development by reducing storm water runoff and improving the quality of water leaving the site. Wetlands can also be designed to improve aesthetics and wildlife habitat on a site and may cost less than some other remediation alternatives.

#### Maintenance Measures

Most structural BMPs require regular maintenance to ensure peak pollutant-removal efficiency. Maintenance ranges from the frequent and simple (sweeping parking lots, cleaning storm drains) to the infrequent and complex (sediment removal from detention/retention ponds or catch basins). But, maintenance must be budgeted and planned for in all cases.

### Remediation and Maintenance

- Ensure maintenance of roads, lots, catch basins, and BMPs.
- Encourage proper installation and maintenance of onsite septic systems
- Clean storm drains
- Sweep Streets



In addition to maintenance of BMPs and remediation practices (cleaning storm drains, retention and detention ponds, etc.), the proper maintenance of onsite septic systems by homeowners is crucial to the protection of our natural resources. The on-site septic system should be cleaned approximately every three to five years, depending on water usage.

The Purdue Residential Onsite Wastewater Disposal (PROWD) Web site <<http://www.ces.purdue.edu/onsite/>> has many publications and technical resources to assist your community.



Photo courtesy of Robert McCormick, Purdue University

Communities should implement educational programs for their local officials and the general public on the importance and proper care of BMPs and on-site septic systems. This is a very important step in protecting our natural resources from non-point pollution and contaminated runoff that threatens the overall health and safety of citizens.

### Planning with POWER Can Help You

When making land use decisions, there is a lot to deal with – both regulatory and non-regulatory.

You can't make land use decisions in isolation.

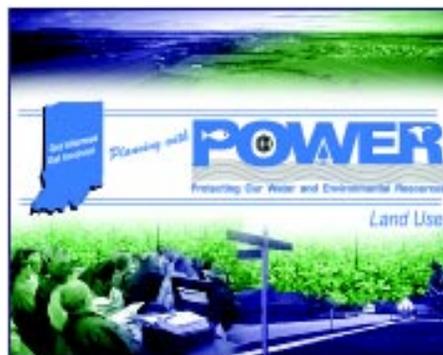
How can we help?

Communities are all in different stages with respect to the planning process. Some communities may not have a formal planning process initiated to guide development to the most appropriate areas, while other communities may be in the process of updating their comprehensive land use plan for the first time in many years. Still, other communities may be continually revising plans and ordinances due to tremendous growth pressures and population changes.

Regardless of where you are in the planning process, some basic *Planning with POWER* steps can help your community:

- 1) Evaluate where your community is in the planning process.
- 2) Identify the steps needed to incorporate natural resource protection into your community's long-term comprehensive plan.
- 3) Connect your community with the appropriate technical and educational resources needed to identify natural resources at risk in your community; evaluate management and policy options that can protect those resources, and select practices needed to balance natural resource objectives with economic objectives.
- 4) Regularly evaluate your community's progress toward natural resource-based planning and protection and identify additional steps that may need to be taken.

### Additional Information



Credits: Unless otherwise noted, all photo compilations are taken from the *Planning with POWER* multimedia presentation.

The *Planning with POWER* project is a statewide educational program that links land use and watershed planning at the local level.

The *Planning with POWER* program can assist you in learning more about how to start protecting your community from polluted runoff by providing educational programming and resources.

*Planning with POWER* has additional publications available to assist you as you start the planning process. These publications are available on the *Planning with POWER* Web site and from the project coordinator.

ID-255 Protecting Our Water and Environmental Resources

ID-256 Nonpoint Source Pollution: A Threat to Our Waters

ID-257 Impacts of Development on Waterways

ID-258 Strategies to Minimize Polluted Runoff

ID-259 How to Get Started: Protecting Your Community From Polluted Runoff

### **Additional Information**

For additional information, or to learn how your community can start *Planning with POWER*, please contact:

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## **NOTES**

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Illinois-Indiana Sea Grant College Program is 1 of 30 National Sea Grant College Programs. Created by Congress in 1966, Sea Grant combines university, government, business and industry expertise to address coastal and Great Lakes needs. Funding is provided by the National Oceanic Atmospheric Administration, U.S. Department of Commerce, Purdue University, West Lafayette, Indiana, and the University of Illinois at Urbana-Champaign.