

A Guide for Local Government

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Community Planning for Agriculture and Natural Resources



Community Planning for Agriculture and Natural Resources: A Guide for Local Government

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Introduction and Overview



GETTING STARTED

Kara Salazar, author

Land use planning decisions made by Indiana plan commissions, city and town councils, boards of zoning appeals (BZA) and municipalities are influenced by multiple factors such as federal, state and local regulations; community values and economic and environmental considerations. While state government provides the authority to city and county government units to pursue self-determined goals through comprehensive planning, it is up to each body to develop plans that achieve community goals. Additionally, municipal and county governments are responsible for protecting public health, safety and welfare within their jurisdiction through regulation of land use, spatial patterns and regulation of development, investment in infrastructure

for water resource management and conservation strategies for green space. Implementation of local plans and ordinances directly impacts the quality of Indiana's environment and community quality of life. This document is intended to serve local boards, commissions and their staffs as an educational resource for informed decision-making on current and emerging land use issues in Indiana.

Through the Land Use Team, Purdue Extension supports land use education, training and technical assistance for local government officials, citizen plan commissioners, board of zoning appeals members and residents. Indiana is the only state in the United States in which Extension Educators may be required to serve on Area and Advisory Plan Commissions by legislative mandate. Therefore, Purdue University is uniquely positioned to leverage this mandate to support Extension

programming that addresses current and emerging land use issues in Indiana. Similarly, the Indiana Land Resources Council collects information and provides educational assistance, technical assistance and advice to local governments regarding land use issues and policy across the state.

Purdue Extension and the Indiana Land Resources Council collaboratively developed this guidance document to support plan commission members and local government officials and staff with resources and examples to integrate agriculture and natural resources as part of community land use planning efforts for developing or updating comprehensive plans. Each document in the series provides an overview of the topic, economic development considerations, community examples and resources to make connections for local land use planning efforts.

This guidance document series is to be used for education purposes only and adapted to each community's local context as appropriate. The information included is not intended to provide specific recommendations for policies or decisions.

PUBLIC PARTICIPATION

Due to the technical nature of planning for agriculture and natural resources, residents and stakeholders bring varying degrees of knowledge, training and information to the planning process. Engaging residents and other stakeholders early in a process to provide input for a local agriculture or natural resources planning effort is important for building trust and communicating about how the community will look and function in the future. Public participation can be any process that directly engages the public in decision-making and gives consideration to public input in the final decision (International Association for Public Participation, 2017).

Indiana's Open Door Law (ODL) ensures the public can access meetings held by public agencies (Indiana Public Access Counselor, 2011). However, how a board or commission engages with the community beyond the statutorily required minimum number of meetings is up to the local leadership. There are several methods to increase public participation, ranging from simple information-sharing strategies to more complex workshop activities. The types of public participation selected for the planning activity depends on the

complexity of the project, the target audience and the types of decisions being made. The International Association of Public Participation (IAP2) designed the public participation spectrum to assist public agencies with communicating about the intent of public participation in a planning process. The stages include:

- Inform (information about the agency planning process),
- Consult (obtain and consider feedback),
- Involve (public has access to decision makers and the decision-making process),
- Collaborate (public is involved in decision-making and consensus building) and
- Empower (public has opportunity to make decisions though voting or ballots) (International Association for Public Participation, 2017).

Designing a local process for public participation takes into account the different levels of participation. Not all stages may be used in a public input series. Many public input activities fall within the consult, involve and collaborate stages. However, there are several tools and methods to use during each stage of a public participation process. Tools and strategies to share information may be used to inform residents and other stakeholders about a planning process and upcoming opportunities for public input. Outreach for comprehensive plans will always include publication or notice as outlined in IC 5-3-1. Additional outreach strategies to inform residents of a planning process and opportunities for participation may also include flyers, informational postcards, community signs, newsletters, newspaper articles or announcements, emails and postings on official websites and social media accounts, such as government Facebook, Twitter or NextDoor. Engagement tools and methods that generate feedback as part of a decision-making process include collaborative workshops, focus groups, interviews and study circles where residents have an opportunity to provide input on design preferences and brainstorm important assets and opportunities to build into their community vision. Additional input mechanisms such as online surveys and social media marketing campaigns provide the opportunity to reach larger populations. These methods can provide robust feedback. However, please keep in mind that surveys and marketing campaigns also require expertise and financial resources to effectively design, launch and analyze results.

Advisory boards that focus on seeking consensus and agreement provide the opportunity for collaboration and shared decision-making. This can also be the most time-intensive form of public participation. As with any public input process, specific focus should be given to reaching out as broadly as possible to provide equitable access for participation and to place emphasis on engaging underrepresented populations. Working in collaboration with local community groups, faith-based institutions and other social organizations will assist those designing the engagement process in tailoring efforts to the needs of the stakeholders. The references section below contains several options for designing a community engagement process appropriate for the scale of your planning process, target audiences, budget and timeframe.

Furthermore, private consulting planners and Purdue Extension staff working in collaboration with a plan commission and local staff can serve important functions as neutral parties to support communication, education, technical assistance and facilitation during a community engagement process. Working with a trained facilitator familiar with planning processes to co-design and lead community meetings, workshops and outreach strategies for public input can help to resolve conflicts, develop a shared community vision, formulate creative solutions and achieve objectives. The featured community engagement example to the right highlights how Bartholomew County utilized an advisory committee structure, engaged a trained facilitator to design and run meetings, and conducted community outreach and engagement practices as part of a countywide concentrated animal feeding operation (CAFO) regulation study.

Supporting a public participation process provides a pathway for direct dialogue with experts and local decision makers. When done well, outreach and engagement opportunities provide a platform for diverse groups to convene for decision-making and communication about important issues related to the environment and local planning.

COMMUNITY EXAMPLE: BARTHOLOMEW COUNTY – CAFO REGULATION STUDY COMMITTEE

Contributed by Kristine Medic, Purdue University Extension, Bartholomew County (former)

In 2014, the Bartholomew County Commissioners called for a study of local land use regulations as applied to CAFOs. Over the course of a year and a half, the CAFO Regulation Study Committee was charged with reviewing, evaluating and making recommendations for revisions to the standards within the Bartholomew County Zoning Ordinance.

The committee consisted of a County Commissioner, County Plan Commission members, representatives from departments of government (Surveyor, Soil and Water Conservation, Health) and county residents. The committee members represented a range of interests among residents. The county Purdue Extension ANR/Community Development Educator served as the facilitator in the process. The following are some important points relative to the committee's charge and process:

- *Keep options open*
 - The County Commissioners asked that the committee work to keep options open for farm families and landowners, consistent with the County's Comprehensive Plan.
 - The committee focused on the future to consider all types of CAFO operations that might be developed.
- *Focus on zoning only*
 - Zoning was the committee's only tool, to primarily focus on location.
 - Zoning does not regulate odor, emissions or discharges; nor does it regulate animal welfare or off-site manure application. Zoning guides the location of land uses to minimize conflicts.
 - The committee worked to understand the total regulatory environment so that zoning recommendations made by the committee were consistent with other rules.
 - Local zoning is just one set of regulations under which livestock operations must function.
 - The committee was asked by planning staff to bring current zoning language into alignment with existing state regulations.

- Because the focus was forward-looking, past applications to the BZA were not considered for discussion.
- *Clarify the role of Purdue Extension*
 - “ANR Educators do not serve on a plan commission as an advocate, nor should they be perceived as an advocate, for any one individual or interest group. . . . As a Purdue employee who has access to research-based information and facts, the Educator provides accurate information and resources to the commission as a part of the decision-making process,” according to Purdue Extension’s publication titled *The Role of the Extension Educator on the Plan Commission*.
 - As facilitator, the role in the process was to support the committee’s decision-making by finding research-based information and sources and fostering a process that finds solutions in the county’s best interest.
- *Open to the public*
 - Interested residents observed meetings from the audience and addressed the committee briefly at the end of meetings relative to the topic of the day.
 - The committee’s schedule, topics and meeting notes were posted on the Purdue Extension Bartholomew County’s website and communicated by local news media.
 - The drafts of committee recommendations to the Plan Commission were available for public review.

After more than 20 meetings, three field trips, an open house, a survey and additional work, the CAFO Regulation Study Committee forwarded its findings to the Columbus/Bartholomew Planning Department staff, which used the majority recommendations on setbacks and acreage to revise the zoning code. Revisions were then forwarded to the Plan Commission and, finally, to the County Commissioners for adoption.

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Economic Development Policy Tools for Local Government Land Use Planning



ECONOMIC DEVELOPMENT POLICY TOOLS FOR LOCAL GOVERNMENT LAND USE PLANNING

Michael Wilcox and Tamara Ogle, authors

Economic growth and economic development are two often-stated objectives for institutions (local Chambers of Commerce, economic development organizations, local governments, etc.) and politicians alike. While related, these objectives are different, and those differences impact the tools and policies communities elect to pursue. As discussed by Shaffer, Deller and Marcouiller (2006), economic growth seeks to increase a community's level of economic activity, while economic development is defined by sustained actions of decision makers that foster community and economic vitality. The key difference is that growth is focused on metrics

you can count (jobs, goods, sales, etc.) and development is more holistic and takes into account the community capitals (financial, political, cultural, social, natural, built and human, see **Figure 1**) and the actions of individuals and the policies determined by institutions (Beaulieu, 2016). This article provides an introduction to basic concepts of economic development and how they are related to land use planning.

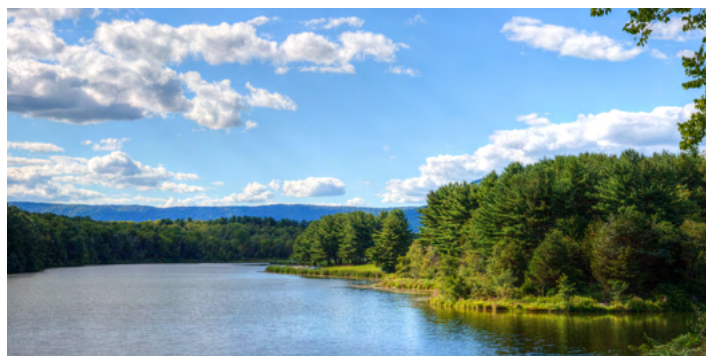


FIGURE 1: COMMUNITY CAPITALS FRAMEWORK



Source: Used with permission from <https://www.cdext.purdue.edu/signature-programs/quality-places/enhancing-the-value-of-public-spaces/>

At first glance, one can consider the current status of a community or region based on its “balance sheet.” Similar to a business, a community’s assets and liabilities can be examined and, in a sense, a community’s net worth ascertained. In this context, the back-of-the-envelope calculation of “community net worth” would point toward the level of community vitality or quality of life.

In community development circles, the consensus is that all development activities should be asset-based. While recognizing needs and constraints is important, assets are what the community will be able to leverage to accomplish goals. Assets can be grouped by community capital (**Figure 1**) or thought of in terms of actors and the community environment (**Figure 2**). The actors include individuals, institutions and associations. The community environment is the “quality of place.” The interplay amongst all four can have a profound effect on how adept a community is at promoting economic development while maintaining the ability to sustain the positive impacts on the “triple bottom line” of environmental, economic and social outcomes. This includes having the requisite capacity to collaborate across individuals, associations and institutions along with recognizing the environment in which decisions are being made and the potential effects on the environment once the decisions are enacted.

Liabilities are on the other side of the balance sheet. These can include issues that need to be addressed as well as constraints that can inhibit or limit the efficacy of certain strategies or tools the community wants to use to bolster economic development. Common community liabilities include poverty, crime, unemployment, environmental degradation, intolerance, low voter turnout, inadequate housing, limited infrastructure and acute/chronic health issues. Oftentimes, these liabilities are “wicked problems” that do not have an easy solution or are the result of medium/long-term trends. No matter the driving force, liabilities need to be recognized and dealt with as the community seeks to move economic development initiatives forward, especially regarding fundamental changes to local policies and regulation.

FIGURE 2: EXAMPLES OF COMMUNITY-BASED ASSETS



QUALITY OF PLACE

- Natural environment
- Recreational amenities
- Cultural assets
- Social capital
- Built environment

INSTITUTIONS

- Educational
- Non-profits
- Economic
- Governmental
- Civic

INDIVIDUALS

- Leadership
- Income
- Time
- Age/Experience
- Talent/Skills

ASSOCIATIONS

- Cultural
- Religions
- Neighborhood
- Business

While community assets in **Figures 1 and 2** and the community liabilities discussed above play a significant role in the success or failure of community-based initiatives, it is useful to also look at place-based assets in a land use context. **Table 1** provides an overview of such assets, the land use/economic development trends impacting the asset and the strategies that could be considered to preserve and strengthen the asset.

TABLE 1: COMMUNITY/REGIONAL ASSETS AND LAND USE

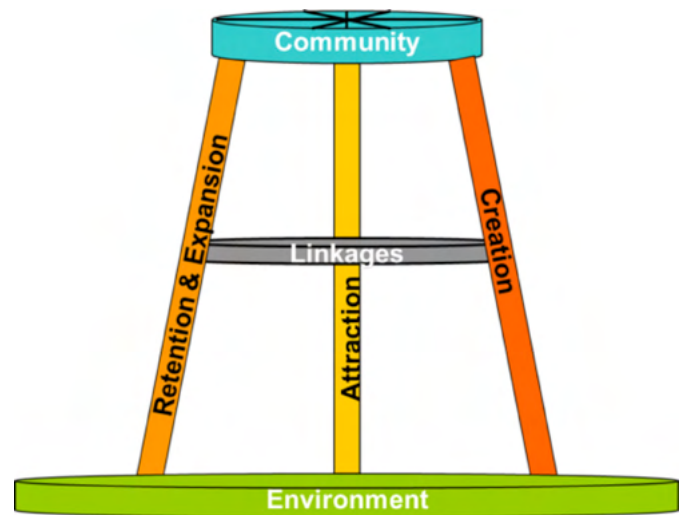
Asset	Land use/development-related trends impacting the asset	Land use/development decisions/ actions that could preserve & strengthen the asset
Agricultural and other resource-based activities	Dispersed development, decline of farming and resource-based economies, changing development needs of larger-scale production agriculture, conversion of land to development	Preservation of working lands, directing growth to designated areas, incentives to keep land in production
Natural and scenic amenities	Dispersed development, conversion of land to development	Preservation of natural lands, directing growth to designated areas, incentives for conservation, strengthening outdoor recreation/tourism
Historic buildings and historic/cultural sites	Declining downtowns, renewed interest in downtowns and historic buildings	Historic preservation designations, incentives for reuse of historic buildings, strengthening tourism of historic sites
Downtown/Main Street	Dispersed development, declining downtowns, renewed interest in downtowns	Main Street programs, incentives for redevelopment, marketing downtown sites, public infrastructure improvements
Housing stock	Rapid growth, population decline, changing demographics, fiscal challenges, dispersed development	Policies to promote housing renovation and repair, policies to promote a variety of housing types
Community facilities	Changing demographics, fiscal challenges, dispersed development	Policies to promote the repair and improvement of existing facilities, developing facilities in core areas close to the populations who use them
Talents and skills of individuals	Changing rural economies, rapid growth, population decline, changing demographics, health issues, dispersed development, longer commutes, renewed interest in downtowns	Downtown revitalization and other efforts to create vibrant places that are attractive to young people and knowledge workers, widespread community engagement in the planning process
Civic and volunteer organizations	Rapid growth, population decline, changing demographics, dispersed development, longer commutes, renewed interest in downtowns	Downtown revitalization and other efforts to create vibrant places that help grow the population, policies to provide public spaces and facilities in accessible locations
Institutions (educational, medical, financial, cultural, religious, governmental)	Changing rural economies, rapid growth, population decline, changing demographics, health issues, fiscal challenges, dispersed development, reduced access to destinations	Policies to encourage the provision of institutions in places that are accessible to the population/ development around existing institutions
Public services and infrastructure	Increased demand for broadband and other cutting-edge technology, Changing rural economies, dispersed development, rapid growth, population decline, changing demographics, health issues, fiscal challenges, renewed interest in downtowns	Policies to introduce new technology and infrastructure (including addressing missing markets), policies to repair and maintain existing infrastructure, efficient development patterns that are easily served
Leading regional employers	Changing rural economies, population decline, health issues, dispersed development, longer commutes	Downtown revitalization and other efforts to create vibrant places that help attract young people and workers, policies that ensure adequate infrastructure to serve businesses, policies that ensure that incompatible land uses do not encroach on operations, policies that provide housing for workers nearby and affordable transportation to work, policies to encourage employers to locate near their employees and other amenities
Low cost of doing business	Population decline, health issues, fiscal challenges, dispersed development, longer commutes	Efficient land use pattern that allows local governments to keep fees and taxes low, holistic land use policies that encourage or allow growth and development of complementary industries, streamlined land use permitting process

Adapted from Megan McConville and Lynn Desautels (2013) Strategies for Building New Economic Opportunities - Stronger Economies Together Supplemental Module: Land Use and Economic Development in Rural Areas. Available online at: http://srdc.msstate.edu/set/sites/default/files/curriculum/phase-vi/land_use/part1-handouts.pdf.

Once the assets of the community/region are delineated (using the Community Capitals framework, the community-based asset framework or the categories listed in **Table 1**), it is worthwhile to begin thinking about economic development strategies that can be put in place to promote community vitality. Community vitality is a result of development that not only spurs economic growth but also – more importantly – harnesses the energies of the community/region to make positive impacts on the social capital, environmental health and economic performance of the community/region.

Traditionally, economic development strategies have been thought of as a three-legged stool (**Figure 3**). Essentially, the stool offers three avenues: retention and expansion of existing businesses, attraction of businesses from elsewhere and the creation of new businesses from within the community/region. Since post-World War II, communities in the United States have given a disproportionate amount of attention to attracting businesses from other parts of the country or elsewhere. Attraction strategies typically employ government-funded subsidies and tax breaks along with investments in infrastructure (such as industrial parks). From the standpoint of land use, attraction strategies have the potential to place existing businesses and land use patterns in direct conflict with the requirements of the firm that is being courted by the community. In contrast, existing businesses are already in place and seeking opportunities to continue operations or to expand and increase their impact on the community as an employer and community advocate (through philanthropy and other community-focused initiatives). Community-led business retention and expansion strategies typically seek to address issues that the firms may be facing concerning workforce development, business climate, infrastructure, etc. Lastly, business creation is focused on the entrepreneurial pursuits of individuals who are interested in anchoring their new businesses in a specific community. This strategy depends on the ecosystem of support in the community. This support is wide-ranging, but often hinges on the necessary support, technical assistance and networking needed to see the business through the initial stages of the business life cycle.

FIGURE 3: THE THREE-LEGGED STOOL OF ECONOMIC DEVELOPMENT



These three legs of economic development are intrinsically tied together by three critical elements: community, strategy linkages and the environment. The community plays a key role as it serves as consumers, the workforce and decision makers who impact the prevailing business climate. The linkages serve notice to communities that whatever tactics they choose to use in support of one leg of the stool should be considered for the other legs as well. This is part of what determines the “length” of the stool legs. Disproportionate attention to one leg (via allocated resources) results in an unstable stool and an unbalanced approach. Building linkages and equal attention to all three strategies offers a stable economic development environment. This brings us to the last element, the environment. As mentioned previously, this model considers the environment in terms of all of the community capitals and community-based assets. For example, the natural environment is directly related to land use, as well as impact on air and water. The financial environment will determine the local availability of financial resources for investment in economic development and the built environment will impact the ability of firms to move goods, acquire services and connect with customers.

While the three-legged stool offers an easily accessible framework to consider economic development, a growing body of literature has taken these concepts

a step further and made a direct connection between economic development and land use. One such contribution is from Megan McConville and Lynn Desautels (2013) through their curriculum “Strategies for Building New Economic Opportunities - Land Use and Economic Development in Rural Areas,” a supplemental module supporting the highly successful regional development program Stronger Economies Together. The curriculum draws heavily from the publication “Putting Smart Growth to Work in Rural Communities,” a product of a collaboration between the United States Environmental Protection Agency and the International City/County Management Association (ICMA). It

provides communities with in-depth information on eleven tools, across three goals, that directly connect economic development with land use.

In the tables that follow, the three main goals are highlighted, and the eleven tools are linked directly to publications that explore each tool and empower communities to consider each for themselves. As such, the remainder of the document is meant to serve as a source of information as communities weigh the alternatives and consequences before them and consider how to spur economic development while weighing potential impacts on land use.

TABLE 2: GOALS, STRATEGIES AND POLICY TOOLS FOR LAND USE-RELATED ECONOMIC DEVELOPMENT

Goal 1: Support the Landscape Create an economic climate that enhances the viability of working lands and conserves natural lands.	Goal 2: Help Existing Places Thrive Take care of assets and investments such as downtowns, Main Streets, existing infrastructure and places that the community values.	Goal 3: Create Great New Places Build vibrant, enduring neighborhoods and communities that people, especially young people, don't want to leave.
1.a. Ensure the viability of the resource economy in the community/region	2.a. Invest public and private funds in existing places	3.a. Update strategic and policy documents to accommodate new growth through compact and contiguous development
1.b. Cultivate economic development strategies that rely on a variety of landscapes	2.b. Encourage private sector investment	3.b. Reform policies to make it easy for developers to build compact, walkable, mixed-use places
1.c. Promote rural products in urban areas and support other urban-rural links	2.c. Build on past community investments	3.c. Recognize and reward developers that build great places using smart growth
1.d. Link rural land preservation strategies to great neighborhoods	2.d. Foster economic development in existing downtowns	

Adapted from Megan McConville and Lynn Desautels (2013) Strategies for Building New Economic Opportunities - Stronger Economies Together Supplemental Module: Land Use and Economic Development in Rural Areas available online at: http://srdc.msstate.edu/set/sites/default/files/curriculum/phase-vi/land_use/part1-handouts.pdf.

TABLE 3: GOAL 1: SUPPORT THE LANDSCAPE: POTENTIAL STRATEGIES, TOOLS AND POLICIES

Strategy	Tools and Policies	
1.a. Ensure the viability of the resource economy in the region	<ul style="list-style-type: none"> • Market Value-In-Use taxation (State-level policy in Indiana) • Tax credits for conservation (State level policy in Indiana) • Right to farm policies (e.g., Notice of Agricultural Activity for rural development) or other policies supporting resource-related industries. 	<ul style="list-style-type: none"> • Renewable energy development • Value-added farm and forest products processing • Ecosystem services markets
1.b. Cultivate economic development strategies that rely on traditional rural landscapes	<ul style="list-style-type: none"> • Purchase of development rights (TDR/PDR program not currently in Indiana) • Conservation easements • Policies supporting resource-related industries 	<ul style="list-style-type: none"> • Fee simple acquisition (May not be available in Indiana) • Agritourism and ecotourism
1.c. Promote rural products in urban areas and support other urban-rural links	<ul style="list-style-type: none"> • Direct marketing to consumers • Government purchase of local products 	<ul style="list-style-type: none"> • “Buy local” campaigns
1.d. Link rural land preservation strategies to great neighborhoods	<ul style="list-style-type: none"> • Transfer of development rights (Not currently available in Indiana) • Priority funding areas • Conservation easements 	<ul style="list-style-type: none"> • Agricultural and/or forestry zoning • Rural home clustering

Adapted from Megan McConville and Lynn Desautels (2013) Strategies for Building New Economic Opportunities - Stronger Economies Together Supplemental Module: Land Use and Economic Development in Rural Areas available online at: http://srdc.msstate.edu/set/sites/default/files/curriculum/phase-vi/land_use/part1-handouts.pdf.

TABLE 4: GOAL 2: HELP EXISTING PLACES THRIVE – POTENTIAL STRATEGIES, TOOLS AND POLICIES

Strategy	Tools and Policies	
2.a. Invest public and private funds in existing places	<ul style="list-style-type: none"> • Fix-it-first • Historic preservation and the Main Street approach • Parks and natural resource areas as destinations 	<ul style="list-style-type: none"> • Streets and streetscape improvements • Targeted new development • Tax increment financing for redevelopment areas
2.b. Encourage private sector investment	<ul style="list-style-type: none"> • Infill development incentives • Overcoming barriers to infill 	<ul style="list-style-type: none"> • Redevelopment readiness certification • Split-rate tax (Not currently available in Indiana)
2.c. Build on past community investments	<ul style="list-style-type: none"> • Adaptive reuse 	<ul style="list-style-type: none"> • School rehabilitation
2.d. Foster economic development in existing downtowns	<ul style="list-style-type: none"> • Local business survey 	<ul style="list-style-type: none"> • Business recognition program

Adapted from Megan McConville and Lynn Desautels (2013) Strategies for Building New Economic Opportunities - Stronger Economies Together Supplemental Module: Land Use and Economic Development in Rural Areas available online at: http://srdc.msstate.edu/set/sites/default/files/curriculum/phase-vi/land_use/part1-handouts.pdf.

TABLE 5: GOAL 3: CREATE NEW PLACES – POTENTIAL STRATEGIES, TOOLS AND POLICIES

Strategy	Tools and Policies	
3.a. Update strategic and policy documents to accommodate new growth through compact and contiguous development	<ul style="list-style-type: none"> • Visioning • Places worth preserving • Designated growth areas 	<ul style="list-style-type: none"> • Infrastructure grid and transportation options • Distinctive local character • Overlay districts
3.b. Reform policies to make it easy for developers to build compact, walkable, mixed-use places	<ul style="list-style-type: none"> • Policy alignment • Walkability • Parks and open space • Traditional neighborhood development • Form-Based Codes 	<ul style="list-style-type: none"> • Context-sensitive design • Green street design • Low-impact development • Planned Unit Developments
3.c. Recognize and reward developers that build great places using smart growth and green building approaches	<ul style="list-style-type: none"> • Smart growth recognition programs • Conservation subdivisions • Green building 	

Adapted from Megan McConville and Lynn Desautels (2013) Strategies for Building New Economic Opportunities - Stronger Economies Together Supplemental Module: Land Use and Economic Development in Rural Areas available online at: http://srdc.msstate.edu/set/sites/default/files/curriculum/phase-vi/land_use/part1-handouts.pdf.

When communities consider a thoughtful and holistic approach to economic development, they can increase their community and region’s vitality. To do this, communities can work to leverage the assets they have in place and create an environment with policies and regulations that bolster the social capital, environmental health and economic performance of the community/region. This environment provides a solid foundation to support the communities’ economic development efforts. With a solid foundation, communities can make the most out of their efforts to retain and grow existing businesses, attract new businesses and encourage the creation of businesses.

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Built Environment and Natural Resources



NATURAL RESOURCES AND COMMUNITY HEALTH

Daniel Walker, author

In the early 1900s, urban planning policy responded to major concerns in large cities, such as overcrowding, pollution and disease. These concerns were addressed with tools including comprehensive plans, zoning and other development regulations (Wilcox et al., 2018). Today, planning is focused on solutions to the equally challenging issues of reducing physical inactivity and poor nutrition. However, community health is far too broad a field to address holistically through the natural resources element of a comprehensive plan, so we will examine how planning can contribute toward creating spaces for active living, or physical activity in one's daily life.

From a planning perspective, physical activity and natural resources are most directly connected through leisure activities in public spaces, including parks and multi-use trails. Therefore, this section focuses on how the comprehensive plan can be used to provide opportunities for active living through deliberate parks, trails and open space planning policy and regulatory tools. By identifying and planning for natural resource assets in your community, you can also create economic development benefits. In this context, we consider natural resources to include public and private undeveloped land that could be used or acquired by a parks system/municipality, community group or developer. The land should also be accessible to the public so that benefits of active living can be shared. When considering the use of open space, this document is referring to preserving or utilizing open space for

public use. Most open space in Indiana is privately owned and should not be used for recreation without the owner's consent.

Research on the health benefits of recreational areas has shown that access to recreation areas, parks and quality public spaces is beneficial to individual health (Han, Cohen, McKenzie, 2013). These spaces provide low- or no-cost outdoor opportunities for moderate-to-vigorous physical activity such as running, hiking or playing basketball to all who are able to access them. A study was conducted on users of six Indiana trails in both urban and rural settings. It found that at least 70 percent of users reported more physical activity due to the trail's existence (Wolter, Lindsey, Drew, Hurst, & Galloway, 2001).

Communities can also reap economic benefits by providing active living opportunities that leverage natural resources. Accessible recreation and open space amenities contribute significantly to quality of life. It has been shown that communities that provide active living amenities increase quality of life, attract greater investment and are more competitive for a talented workforce (LaGro, 2008).

LAND USE PLANNING

Open space/natural resource planning serves many purposes beyond providing recreational opportunities. Several types of open space classifications may be required to adequately address concerns within a jurisdiction (Berke, Godschalk, Kaiser, & Rodriguez, 2006). Below are examples of different types of open space that you might find in your community:

- Agricultural fields
- Forests and woodlots
- Grasslands/grazing lands
- Riparian corridors
- Golf courses
- Bicycle/pedestrian trails
- Greenways
- Wetlands and floodplains
- Wildlife habitats
- Environmentally critical areas (high slope, high water table)
- Parks, playgrounds and ballparks

(Prokopy, McCormick, & Reimer, 2004)

In addition to providing places for outdoor recreation, open spaces can provide green infrastructure services that have measurable economic benefits to the community, including:

- Buffering from natural hazards such as floods.
- Protection of natural processes such as ground water recharge areas.
- Protection and management of economic production such as forestry, tourism and water supply.
- Protection and enhancement of natural and cultural amenities, such as historic assets.
- Shaping urban form. Dedicated open space can be used to encourage growth elsewhere in the community. Consider transfer or purchase of development rights programs to further guide development. Additional resources on these topics can be found in the resource section.

Bloomington, Indiana, has a land use district for parks and open space in the future land use map of its comprehensive plan. It provides a thorough example of the application of open space planning to achieve the benefits listed above. The district is described as follows:

The Parks/Open Space district includes neighborhood and community parks, natural areas, multi-use trails, golf courses and other recreational amenities. Parks/Open Space areas should provide opportunities for both active and passive recreation, as well as opportunities to produce local food through community gardening and the planting of fruit trees. These areas also provide natural habitat, conservation areas and other protection areas important for their environmental and/or cultural significance. For example, the Griffy Lake Nature Preserve is used for recreation, but much of this area is characterized by steep, forested hills, bluffs and cliffs; it offers many other benefits for conservation and natural habitat. The intent of this district is to maintain and expand the inventory of public/private parks and open spaces for the residents of Bloomington.

Consider the active living or economic development opportunities that could be implemented or encouraged within an area designated for these purposes.

COMPREHENSIVE PLAN: ANALYSIS, GOALS AND OBJECTIVES

In Indiana, the comprehensive plan is an advisory document. The terms found in it (goal, policy, vision, principle, objective, strategy) are similar in meaning but used differently among comprehensive plans. In general, policies, principles, vision and goals are broadly reaching ideas to which the community aspires through the implementation of objectives and strategies (which are also used interchangeably). Yet none of these policies for the community’s future has the force of law. The zoning ordinance and subdivision control ordinance are the laws that are created to gradually implement the plan as development or contraction occurs. If your community is interested in using natural resource assets to increase active living and economic development, it

should review these regulatory tools to identify barriers or additional needs. Consider the following:

- Are regulatory tools such as overlay districts/zones in place to allow protection of biological or culturally sensitive natural resource assets?
- Are underutilized areas such as flood plains permitted to be used for activities that support active living?
- Are land conservation strategies included or incentivized in development regulations?

Review the examples of principles, policies and strategies below from a range of Indiana jurisdictions: Anderson (adopted in 2005), Bloomington (updated in 2018) and Madison County (2001).

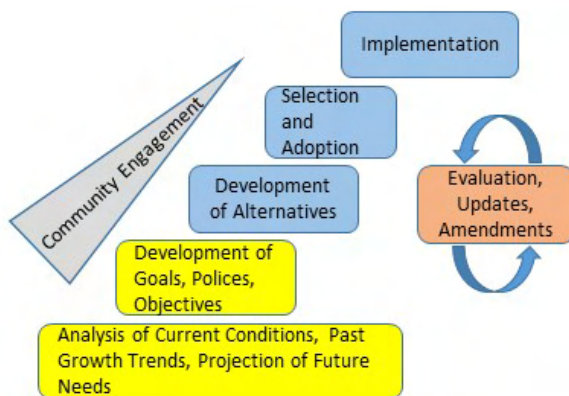
EXAMPLE COMPREHENSIVE PLAN POLICIES THAT BENEFIT ACTIVE LIVING AND ECONOMIC DEVELOPMENT

Benefit	Jurisdiction (adoption)	Comprehensive Plan Organizational Structuring	Example from Plan
Active Living	City of Bloomington (updated 2018)	Principle	Encourage healthy lifestyles by providing high-quality public places, greenspaces, and parks and an array of recreational activities and events.
Active Living	City of Anderson (2005)	Policy	Ensure access to open space: Provide convenient access to parks and open space amenities for all new residences in Anderson. This may include provision of open space within new subdivision developments.
Active Living	City of Anderson (2005)	Policy	Support development of a greenways trail system: Greenways trails can provide a unique recreational experience for a community, help to protect key natural areas and features and enhance transportation options for residents. Trails through existing parts of the community as well as within new developments should be considered as part of an overall system.
Economic Development	Madison County (2001)	Strategy	Support the development of amenities that would retain and attract businesses and residents to the County. Amenities that are attractive to both employee and employer could include: recreational opportunities (parks and trails) [etc.].
Economic Development	Hendricks County (2006)	Goal	Promote the development of amenities such as appropriately located shopping and recreation opportunities as economic development tools to encourage business relocation.

The first step to leveraging natural resources for the goals of active living and economic development is figuring out what exists and what is important to your community. Natural resource assets are identified through public engagement and analysis by professional planners during preliminary stages of the comprehensive planning process. Population projection and public feedback will assist planners in determining whether the current recreational facilities in the community will meet the future needs of its residents.

The highlighted steps in the graphic below show how identifying assets through analysis of current conditions and development of goals, policies and objectives that contribute to active living and economic development fit within the planning process.

THE COMPREHENSIVE PLANNING PROCESS



Determining future needs is a complex process due to the variety of recreation options, site options, natural assets and population changes over time and space. Natural assets are not always rurally situated or located at the fringe of the urbanized area; they can be surprisingly central. Undeveloped, vacant or remediated property can make ideal urban settings for recreational opportunities that promote active living. All such locations should be inventoried prior to developing goals and objectives so that all opportunities are apparent to decision makers. Berke et al recommend distinguishing between use-based recreation, which is organized activity such as sports fields, and resource-based recreation, which is valued due to its natural character or setting. Use-based recreation such as basketball courts might benefit in terms of the number of users by being near to some remarkable natural

feature, but ultimately it can be implemented anywhere there is suitable available land, while keeping in mind the principles listed below. An example of resource-based recreation is cycling through several miles of rural Indiana countryside on the Cardinal Greenway. The resources being utilized in this example are unbroken agricultural viewsheds, open space and perhaps the occasional stream or forest.

Consider these principles to aid in determining the “active living” benefit of a site or improvement:

- **Accessibility:** The more accessible a park or trail is, the more benefits it can provide a community. Urban or urban fringe opportunities may be rare, complex to develop and expensive to implement, but a greater number of people can conveniently use such a place more often. Sites that are on existing public transit routes are most accessible. A quick way to determine the accessibility of an urban site is to use a website like www.walkscore.com. It provides information on accessibility for all common forms of transit.
- **Connectivity:** Connectivity is a function of the natural space. Some locations can serve as links between other assets in a recreation system such as parks or forests. Identifying key gaps in the system will help the community be prepared when a parcel becomes available. Linking parks to one another or linking employment centers to residential areas through trails are ways to remove barriers to active living.
- **Shared use:** Natural resource assets that have more than one use for more than one particular user should be a priority.

These concepts have added importance when considering locations for use-based recreation. Consider these active living/recreational activities, the locations where they take place, whether they are use-based or resource-based and how the settings they require would influence how natural resource assets within your community are prioritized:

- Walking the dog
- Commuting
- Hunting
- Taking kids to a playground
- Bird watching
- Hiking
- Swimming
- Biking
- Softball
- Skiing

Once natural assets are identified and future need assessed, the plan's policies for open space/natural resources can be developed to conserve unique or biologically significant areas that contribute to resource-based recreation activities. For example, Monroe County, Indiana, identified Karst areas*, wetlands, soils, floodplains, waterbodies, watersheds, contiguous forest canopy, steep slopes and endangered species as part of its existing conditions inventory and created a future land use district to advise zoning regulations where such conditions exist. The resource-based activities above may be integrated into the different types of areas where appropriate.

According to Chapter 9 of the *Indiana Citizen Planner's Guide*, communities can include standards for open space and recreation areas within their subdivision control ordinance. "Conservation subdivisions" are one method for balancing preservation and use of natural assets with residential development. The layout of a conservation subdivision requires compact clustering of dwellings on relatively small lots, while the larger parent tract remains undeveloped. The subdivision ordinance may require these spaces to remain undeveloped or minimally disturbed. Building sites should minimize infrastructure requirements and maximize the amount of open space. During design, environmentally sensitive areas such as wetlands are prioritized for preservation. Low-impact development standards are applied to street design, lighting and other infrastructure. Some development-related improvements include trails and parks. Depending on the arrangement between the developer and governing body, management of common areas is either transferred to government or paid for through local homeowner or property owner association fees.

CONCLUSION

Natural resource assets present Indiana communities with the opportunity to leverage natural resources for economic development and provide better options for active living. A well-developed set of goals and objectives incorporated into your community's comprehensive plan will inform the development of regulatory tools that develop and preserve natural resources. Open spaces can provide additional economic development opportunities through use-based or resource-based recreation as well as a place



for recreational active living. For more information about opportunities to use the comprehensive plan to enhance these quality-of-life issues, consider engaging the *Enhancing the Value of Public Spaces: Creating Healthy Communities* program available through Purdue University Extension.

*Karst areas are areas where water infiltrates into the ground rapidly due to subsurface cavities in limestone bedrock. This has implications for groundwater quality and surface soil stability.

RESOURCES

Hendricks County Indiana Conservation Subdivision Development Guidebook: This resource is Hendricks County's Conservation Subdivision standards. Available here: http://www.co.hendricks.in.us/egov/documents/1437573385_31303.pdf

Indiana Citizen Planner's Guide, Chapter 9:

Subdivision Control: This resource discusses the subdivision control ordinance in Indiana and includes further information on conservation design subdivisions. Available here: <https://www.indianaplanning.org/wp-content/uploads/2012/12/FINAL-CitizenPlannersGuide-3.20.17-Ch.9-SubdivisionControl.pdf>

Indiana Citizen Planners Guide, Chapter 12: Planning for Public Health: This resource discusses health in terms of physical activity, healthy eating and safety. It discusses many different types of plans, policies and programs and how they can be used to benefit public health. It also discusses challenges for adopting such policies in the state of Indiana. Additionally, it provides a list of further resources related to health and planning that can be used to integrate policies beneficial to health across a variety of plans. Available here: <https://www.indianaplanning.org/wp-content/uploads/2012/12/Chapter-12-Planning-for-Public-Health-FINAL-09-05-18.pdf>

Purdue Extension Agricultural Land Protection in Indiana: This resource discusses the development of agricultural land and several land use tools for its regulation, such as Purchase or Transfer of Development Rights. Available here: <https://www.extension.purdue.edu/extmedia/ID/ID-225.pdf>

Purdue Extension Enhancing the Value of Public Spaces program: This website presents an overview of the Enhancing the Value of Public Spaces program and how it can assist in both comprehensive and parks and recreation planning efforts. Available here: <https://www.cdext.purdue.edu/signature-programs/quality-places/enhancing-the-value-of-public-spaces/>

Purdue Extension/Illinois-Indiana Sea Grant Conservation through Community Leadership program: This curriculum and planning process assists communities in planning natural resource elements for comprehensive plans and other community-planning initiatives. Available here: <https://www.purdue.edu/fnr/extension/scep/programs/conservation-through-community-leadership/>

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RENEWABLE ENERGY INTEGRATION FOR SUSTAINABLE COMMUNITIES

Chad Martin, author

Renewable energy installation has seen a significant increase, especially with a movement from small-scale individual-owned projects to utility-scale projects that feed into the main transmission grid. Renewable energy, such as wind, solar and biomass, is installed for many reasons, including:

- Diversify the type of electricity in both urban and rural communities
- Reduce individual reliance on an electric utility providing electricity
- Provide electricity where connection to the grid is difficult or expensive
- Improve economic sustainability of a community
- Meet consumer preference to reduce environmental impacts from energy production
- Enhance grid reliability by providing energy in areas where increases are needed
- Reduced cost of technology, making it more competitive with other sources of electricity

DISTRIBUTED ENERGY GENERATION

Electrical generation, distribution and/or storage can be provided on a small scale by a variety of small-grid connected systems (wind, solar, methane turbines) to serve individual needs or on the local community level. These projects are defined by nameplate capacity of not more than one megawatt (MW) or less than the customer's average annual electricity consumption (in Indiana). This includes individual solar units and small wind or biogas generation facilities, to name a few, that are located on a customer's property and owned by a customer. To be grid-connected, an agreement with the utility company is needed to ensure electricity can be sent back out to the electrical distribution system so that ample safety oversight is in place as well as compensation to the system owner for supplying electricity to the grid. The future of distributed generation could include micro-grids, which are self-sustaining, or even battery storage for using those electrons at a future time. Before an investment is made, the consideration stage of a project should include careful calculations of return on investment, policy changes with the utility and early communication with the utility company.

COMMUNITY RENEWABLE ENERGY PROJECTS

There are examples of renewable energy projects where ownership can be shared among community members and/or a combination of a utility or businesses within a community. These projects can help overcome barriers, lock in price certainty and provide resiliency to power grids that might be susceptible to electricity loss due to long-distance transmission issues. There have been several projects involving wind and solar where a community cooperatively invests to meet their energy needs and initiates sustainability investments within community businesses. An organization named Windustry has created a set of tools for community wind projects that can be accessed at http://www.windustry.org/community_wind. The solar industry has also seen considerable growth of community solar installations across the country. Indiana's Tipmont REMC community solar project is an example of a utility-initiated solar project that allows member-owners of the cooperative to "subscribe" to a panel and receive credits for their share of energy production. You can learn more about the Tipmont project model at www.tipmont.org/solar.



For additional tools on implementing community solar projects, we suggest referring to the following resources:

- Community Solar Hub: www.communitysolarhub.com
- Ohio-Kentucky-Indiana (OKI) Regional Council of Governments guidelines, methods and best practices for integrating solar: www.oki.org/portfolio-items/solar-ready/

UTILITY SCALE ENERGY GENERATION

If a renewable energy project generates more than 1 megawatt (MW) of nameplate capacity and more than the annual average electricity consumption, the project will need a Power Purchase Agreement (PPA) to enter into a contractual supply to a utility company. Large-scale wind and solar projects require approval by local government ordinances and zoning (in counties with local zoning). These projects require large investments and often are located on leased land, where resource availability is ample and where access to large-scale interconnection to the grid is available to reach large-scale markets.

PREPARING FOR RENEWABLE ENERGY PROJECTS IN YOUR COMMUNITY

When integrating renewable energy, there are approaches to be considered for both the distributed and utility scale investments in the community. It is helpful to begin by contacting counties that have already adopted energy-specific ordinances when you being the ordinance development or revision process. It will help you understand how the process (which is often controversial) needs to be managed as well as the conditions that need to be addressed in an ordinance. Given the highly technical and evolving nature of renewable energy production, it is advisable to reach out to renewable energy project developers, installers and utilities for current information.

It is always good for counties to be proactive in having a renewable energy ordinance in place before developers approach them to propose projects. This alleviates many of the concerns that arise from ordinances being debated as specific projects are also discussed. It shows whether a community is prepared and willing to accept renewable energy and at what scale.

Keep in mind that time is required to move through the ordinance development process and prepare for construction. Benton County, the first county in Indiana to investigate and adopt a wind energy development plan, began the ordinance process in 2004, but wind farm development in the county did not begin until July of 2007.

WIND ENERGY ORDINANCE DEVELOPMENT

The development of wind energy in Indiana counties offers an opportunity to diversify economic development in rural areas where wind resources exist. Developers have approached landowners with ample wind resource capacity in many areas of Indiana with the hopes of leasing their properties for utility-scale wind production. Landowners and developers alike seek out local ordinances for the implementation of wind energy, approved by a local governing body (typically a planning board, board of commissioners or other local government entity). Counties equipped with wind energy ordinances and permitting processes offer a proactive approach to development for their residents. A library of ordinances can be found at the Purdue Extension Renewable Energy, <https://ag.purdue.edu/extension/renewable-energy/Pages/Wind-Energy-Ordinance-Library.aspx>.

A wind energy ordinance will address most of, but is not limited to, the following topics relating to wind energy development within a local community: economic benefits, application for a permit, design and installation



guidelines, setback guidelines (or distance from designated property), use of public roads, operations, liability insurance and decommissioning of wind-energy equipment (Constanti & Beltron, 2006). Several of the wind energy ordinances currently in Indiana counties also account for the installation of small-scale wind turbines for residential use, businesses and other institutions, such as schools.

The wind energy development process for local government and landowners to consider follows the seven “Ps,” which are:

- **Potential:** Investigating what the wind resource is within the county and learning the basics of wind energy development
- **Promotion:** Allowing access and active promotion of the county’s wind energy resource potential to local constituents and wind energy developers
- **Public outreach:** Providing educational information to the general public about wind energy and its potential benefits and impacts
- **Planning:** Creating an effective and comprehensive plan to facilitate the development of wind energy in the county
- **Permitting:** Creating and implementing effective permitting, zoning and siting processes for new wind energy developments within the county
- **Project construction**
- **Project operations and maintenance (O&M):** Keeping things going once the development has been constructed and the wind company oversees the wind farm

Source: Constanti & Beltron, 2006

CONSIDERATIONS FOR A WIND ENERGY ORDINANCE

There are several components to a comprehensive county wind energy ordinance. They often include, but are not limited to:

- A required distance for setbacks or distance of the wind towers from buildings or residential property. This will depend upon the scale and the speed of the wind turbines within a proposed development.
- A method for determining compensation to land owners and farmers due to crop or property damage resulting from transportation and/or construction. Transportation of large equipment and turbine



components during construction may require the development company to include road expansions and repairs to roads, bridges and culverts damaged by the construction phase.

- A requirement that developers maintain adequate drainage in farm fields or other land affected by construction due to damage or interference with drainage infrastructure.
- A contractual arrangement describing how payments will be allocated to landowners from wind energy developers for use of the land for wind energy development.
- An evaluation and understanding of current infrastructure and construction needs before the development process begins.
- Noise standards for utility-scale wind turbines to properly integrate turbines with residential property.
- Decommissioning arrangements for the structures that will come into play once the wind turbines are no longer usable.
- Security and safety inspection measures to protect the area surrounding turbines and other infrastructure involving transmission, etc. to protect landowners and others using the property.
- Indemnification provisions should also be considered for individuals and businesses. These provisions should define which party agrees to pay for liabilities associated with the project.

The U.S. Department of Energy's National Renewable Energy Laboratory has created a resource guidebook titled Wind Energy Guide for County Commissioners, which can be accessed online at <https://www.nrel.gov/docs/fy07osti/40403.pdf>. It is a comprehensive resource for county planning commissions and other agencies to utilize while developing a local ordinance for wind energy development.

SOLAR ENERGY

Solar-generated electricity has become more affordable recently due to the reliability and efficiency of power production from advanced low-cost photovoltaic cells. There are two general types of solar energy collection methods. Photovoltaics, or PV systems, consist of cells connected in an array to create electricity for utility companies, or in distributed generation scenarios that involve individual homes, farms and businesses. The second type of solar system uses a concave solar collector to concentrate solar energy for heat generation as steam, which is used to run a turbine for electricity generation.

SOLAR ENERGY ORDINANCES

While wind energy production and ordinance development is becoming a mature process in Indiana, relatively few counties have ordinances in place to specifically address solar energy production. In some cases, counties are relying upon their utility siting requirements. However, they often fail to include considerations that are applicable to a several hundred

or two-thousand acre solar farm. In those cases, the lack of specificity can create an additional set of challenges in seeking approval to site a solar farm. Because few counties in the Midwest have addressed the issue of solar siting, there are few examples to point to for direction, leading counties to start a process largely from scratch. However, this provides the opportunity to receive lots of input and technical information to develop an ordinance that specifically meets the needs of the local community.

CONSIDERATIONS FOR SOLAR ENERGY ORDINANCES

While there are few solar energy specific ordinances, an obvious list of considerations that need to be addressed has appeared. The ordinance may address these as well as other provisions:

- Site plans to identify location of the panels, electric and communication lines and site characteristics
- Setback requirements from property lines and structures
- Visibility from neighboring property
- Ground cover and buffers
- Decommissioning plans in the event the solar farm is no longer used for energy production
- Indemnification provisions
- Evaluation of infrastructure requirements (especially for sites that propose to generate electricity as they will need an appropriate connection to the grid for that purpose)



ANAEROBIC DIGESTION FOR ENERGY AND WASTE MANAGEMENT

Anaerobic digestion (AD) of livestock manure and other organic products is an alternative pathway for managing large organic waste loads. Livestock manure from confined feeding operations can be a source of energy production that not only provides an alternative energy source for on-farm use but can also mitigate the odor from livestock farms and create a byproduct that is easier to transport and land apply as a nutrient for crop production.

Biogas generated from manure can be used directly in a gas-fired combustion engine or a microturbine to create electricity. Some Indiana farms are using the cleaned and compressed biogas to power compressed natural gas (CNG) fuel vehicle fleets, such as those found at Fair Oaks Farms in Northwest Indiana. Additional energy in the form of waste heat from turbine operations can be used to provide heat or hot water for on-farm use, as well as maintain the temperature of a digester during a cold winter. When planned correctly, AD can result in revenue from energy sales or savings in on-farm energy generation. Even though AD is not a new technology, its practice on Indiana farms requires careful planning and implementation in order to reap its benefits.

BIOMASS DIGESTER REGULATION IN INDIANA

Digesters might only use biomass (such as agricultural crops or manure), or they might combine biomass with other appropriate feedstocks (such as food waste and cooking oil). These two types of digester facilities are regulated by the state through the confined feeding program (327 IAC 19) when the facility is at the site of a confined feeding operation (CFO) or by the Biomass Registration program (329 IAC 11.5) when the facility is not at the site of a CFO. A third category of digester, one that can commingle biomass, appropriate feedstock and solid waste, must obtain a solid waste processing permit (329 IAC 11.5).

In addition to these permits/registrations, some digesters burn digester gas releases. In these situations, state air permits may also be required.



CONSIDERATIONS FOR BIOMASS DIGESTER ORDINANCES

Digesters on the site of a confined feeding operation are part of that operation's manure handling/storage system. Local zoning requirements already in place for confined feeding operations may be adequate for these facilities. Special consideration should be made for zoning requirements when the energy production system is not part of a livestock production area, while also keeping in mind that the state, as discussed above, already regulates many of the environmental aspects of these facilities. Factors that might be addressed in an ordinance include:

- Setback requirements from property lines and structures
- Decommissioning arrangements
- Appropriate planning for truck traffic in and out of the facility
- Indemnification
- County drainage considerations (Lefeld, 2008)

BENEFITS OF ANAEROBIC DIGESTION

In a study commissioned by the Great Lakes Regional Biomass Energy Program, the following benefits were documented for dairy operations (Kramer, 2004):

- Revenue from annual electricity sales or cost offsets generated \$32–\$78 per head.*
- Annual bedding costs were reduced by using digested manure instead of other bedding materials.
- After digestion, manure has improved nutrient availability, reduced acidity and reduced odor. By avoiding fertilizer purchases, producers saved \$41–\$60 per head (from dairy cattle).
- Odor control is a key factor in being a good neighbor. It increased quality of life on and off the farm, helped producers avoid complaints and lawsuits, allowed continuation of the operation or the ability to site new facilities and increased operational flexibility.
- Anaerobic digestion reduced pathogens associated with manure discharges (Mosier, 1998).

* Resale of electricity depends on state and utility policies.

More resources about anaerobic digestion projects can be found online <https://ag.purdue.edu/extension/renewable-energy/Pages/Bioenergy.aspx>.

For more information on the adoption of renewable energy for both distributed and utility-scale energy projects, visit www.extension.purdue.edu/renewable-energy.

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IMPORTANCE OF INDIANA AGRICULTURE

INTRODUCTION

Tanya Hall, author

Indiana's agriculture industry has a treasured heritage. This industry has simultaneously remained true to its roots and adopted innovative practices to address current challenges and needs. As fewer individuals interact with the daily efforts associated with raising or growing agricultural products, appreciation of its place within the larger Hoosier economy and landscape becomes diminished. Likewise, grasping the breadth and importance of the agriculture industry can seem elusive due to the complexities associated with gathering data on all agricultural enterprises, big and small. Any assessment of the scope of urban agriculture

is mostly anecdotal, as little data exists to fully capture the breadth of activity occurring in urban areas. This introduction to the Food and Agriculture section will provide a big-picture view of Indiana's flourishing agriculture industry – in both rural and urban settings.

INDIANA'S LANDSCAPE: PAST AND PRESENT

In 2017, Indiana had 56,800 farms and 14.7 million acres devoted to agriculture production, comprising 63.1 percent of the state's land (State Agriculture Overview, 2017). While still sizable, between 1925 and 2017, the state saw a 71 percent drop in number of farms and a 26.2 percent drop in acreage (United States Census of Agriculture, 1925). Individuals might not realize that Indiana is one of three states with more than 50 percent of its land (12.9 million acres) classified as prime farmland (Hall, 2010).

As the quantity of farms and farmland downsized, the share of individuals residing on farms dropped and the size of the farm evolved greatly since 1925 (Hall, 2015). As of 2012, 46.7 percent of farms were less than 50 acres, 40.5 percent were between 50 and 500 acres and the remaining 12.8 percent were more than 500 acres. Therefore, in Indiana, large and mid-scale agriculture production exists, yet there has been a tremendous growth since 1925 (19 percentage points) in small farm production (less than 50 acres). The importance of agriculture is not solely relegated to the rural areas of the state, as smaller farms can and do exist in urbanized areas.

Researcher Arthur Nelson (1990) noted that most of the United States’ prime farmland is located within the suburban and exurban counties of metropolitan areas. Thus, land most suitable for agricultural production is often equally desirable for development (Solomon, 1984). Between 1982 and 2012, Indiana saw 563,700 acres converted to developed uses (Farmland Information Center, 2018), which will likely never be reconverted to agricultural uses.

Today, most farms are not engaged in subsistence farming; rather, they produce a few commodities and take all, or a large share, of their output to the market. Therefore, manufacturing and wholesale operations play a large part in adding value to the raw outputs from the farm.* At present, Indiana is experiencing a resurgence of interest in local foods and urban agriculture, with consumers yearning to produce agricultural products, understand food production practices and have a relationship with the farmer. The local foods movement has extended beyond farmers’ markets as restaurants source foods locally, institutions prefer purchasing local foods, communities are growing community gardens and consumers engage in farm tours, community-supported agriculture memberships and support local foods initiatives. Likewise, concerns about the prevalence of Indiana’s more than 200 food deserts, or areas lacking access to healthful whole foods, have increased interest in urban agriculture.

INDIANA AGRICULTURE PRODUCTION AND ITS VALUE

Given Indiana’s landscape, it is no surprise that, according to 2017 rankings, the state was a top 10 producer of 12 commodities (see **Table 1**). This production is possible because of the state’s prolific production ability and livestock-friendly practices. National and international demand for the agricultural products produced in Indiana has driven growth in addition to increased efficiencies in the production process.

TABLE 1: INDIANA’S RANK IN AGRICULTURAL PRODUCTION

Commodity	Rank
*Ducks	1
Eggs produced	2
Spearmint	3
Tomatoes	3
Peppermint	4
Pumpkins	4
Turkeys raised	4
Watermelon	5
Corn for grain	5
Pigs	5
Soybeans	5
Cantaloupe	6

Sources: NASS 2017 State Agriculture Overview; Duck data* from Indiana State Board of Animal Health

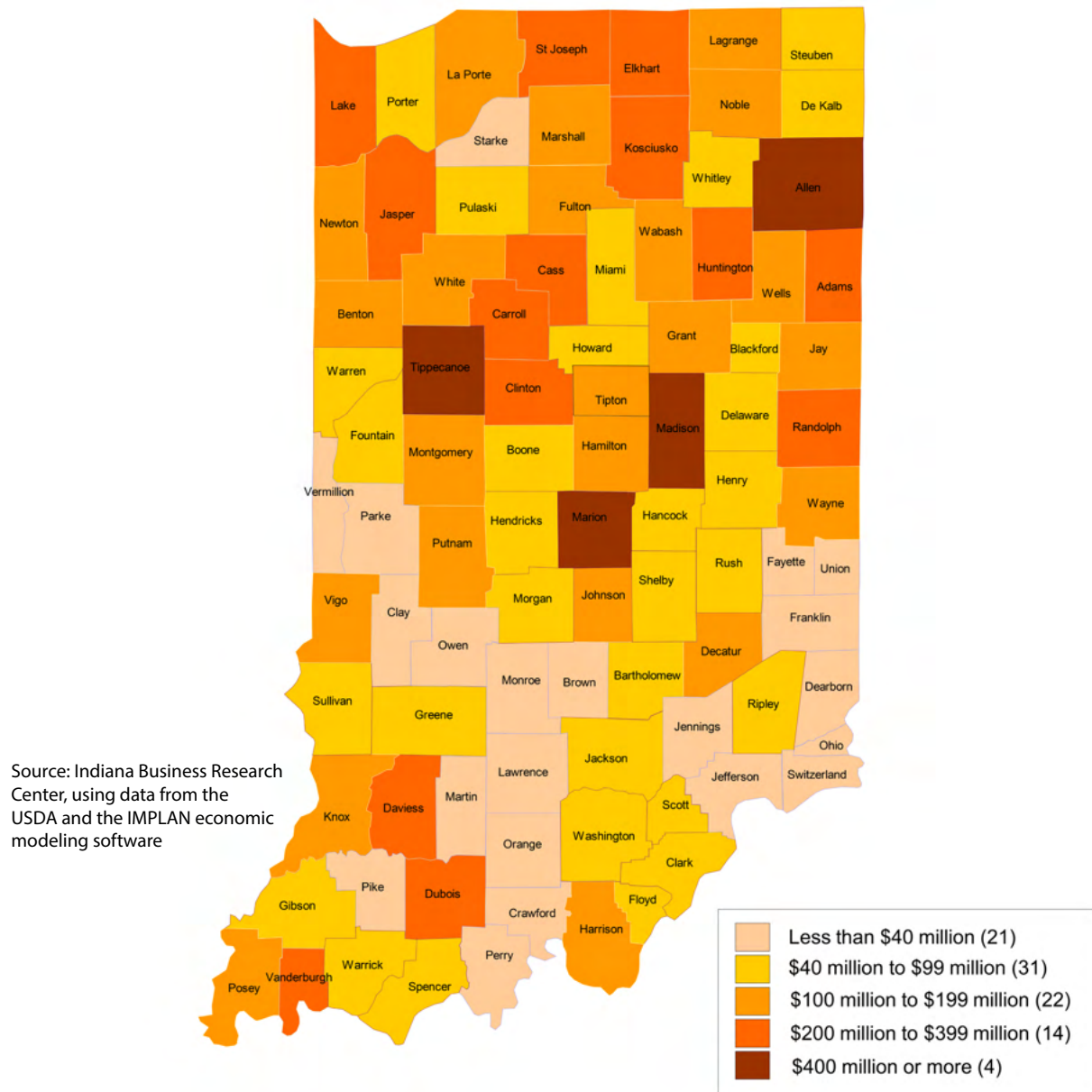
Production of these commodities (and more) led to Indiana farmers receiving \$10.6 billion in cash receipts from farm marketings in 2017. More than one-third of the cash receipts came from animals and products (35.1 percent) with the remainder coming from crops (64.9 percent), namely corn and soybeans (31.5 and 29 percent, respectively). All other crops, vegetables, melons, fruits and nuts comprised 3.6 percent of the cash receipts, but are likely higher as fruit production data is suppressed (NASS, 2018).

ECONOMIC IMPACT OF THE INDIANA AGRICULTURE INDUSTRY

As of 2012, the Indiana agriculture industry's impact on sales was estimated at \$44.1 billion. The value added created by the agriculture industry (GDP) accounts for nearly 5 percent of the state's economy (\$14.9 billion) and every dollar of GDP generated another \$0.88 in economic activity within other industries in Indiana. Despite agricultural production comprising more than 70 percent of the economic impact on sales, it only accounted for half of the total GDP contribution (\$7.44

billion) as the remainder went to agriculture-related manufacturing (IBRC, 2015a). Due to the prevalence of agriculture-related processing and manufacturing activities, often within more urbanized counties' borders, several of Indiana's more urbanized counties made the largest contributions to the agriculture industry. Much of this was driven by grain and soybean processing, causing Marion, Madison, Allen and Tippecanoe counties to have the largest share of total agricultural GDP effect amongst all counties (see **Figure 1**) (IBRC, 2015b).

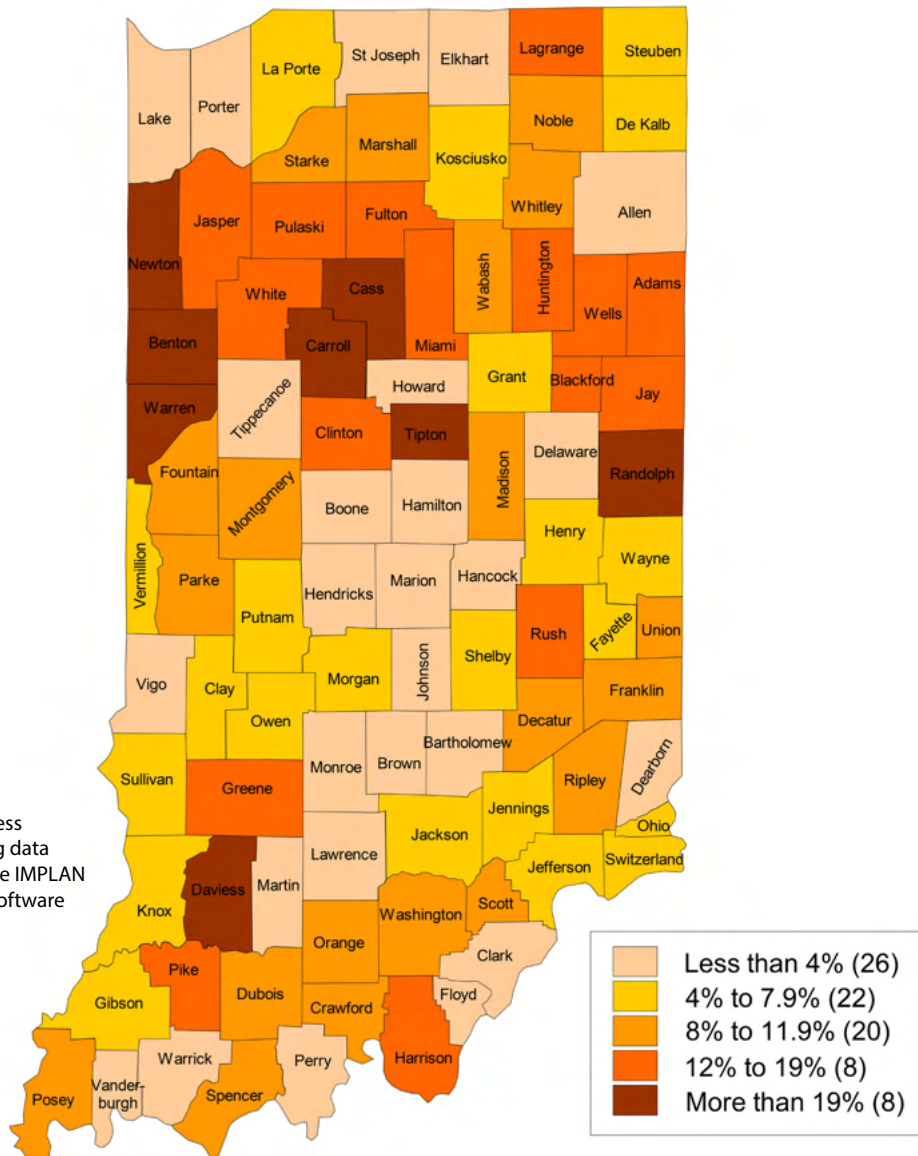
FIGURE 1: INDIANA AGRICULTURE'S TOTAL GDP EFFECTS BY COUNTY, 2012



Indiana's agriculture industry also employs a significant amount of individuals – more than 107,600 workers. As can be expected, agriculture plays a more critical role in the smaller or midsized counties around the state versus urbanized areas with a heavier presence of additional industries (IBRC, 2015b). In fact, the distribution of the quantity of individuals employed within the agriculture

industry mimics the dispersal evident in **Figure 1**. This is again because of the presence of agricultural-related manufacturing and other supply chain firms that employ large quantities of workers. **Figure 2** shows the agriculture employment effects as a share of the total employment by county in 2012.

FIGURE 2: AGRICULTURE EMPLOYMENT EFFECTS AS A SHARE OF TOTAL EMPLOYMENT BY COUNTY, 2012



Source: Indiana Business Research Center, using data from the USDA and the IMPLAN economic modeling software

CONCLUSION

In summary, agriculture is big business in Indiana (economically and in land use consumption) and is not relegated only to the more rural areas of the state. The state has very rich farmland and attractive terrain, which has led to its national prominence in grain and livestock production. In recent years, there has been a great resurgence in interest and concern about wholesome food access (mainly fruits and vegetables) in urban markets. Therefore, Indiana has become a state where commercial agriculture, small farms and urban farming co-exist. This co-existence can only occur if careful consideration is made toward sustainable development and mindful land use – regardless of whether the land in question is in a rural, suburban or urban setting.

This careful consideration ought to include local government incorporating goals and policies concerning agriculture in their comprehensive plans. Local government and planning officials should take the time to familiarize themselves with the local agrarian landscape as well as topics and issues surrounding agricultural land use. Given the breadth of the agriculture industry, it would be prudent to include the agricultural community, local food advocates and agricultural firms in the planning process. The following sections dive into specific agricultural topics and possible land use policies.

* Likewise, one could see how it can be difficult to discern where the agriculture industry “ends” within the valued-added process. Some researchers argue that it should include manufacturing and wholesale outlets, whereas others only include industries with a sizeable share of raw agricultural input.

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URBAN AGRICULTURE

Emily Toner and Paul Ebner, authors

WHAT IS URBAN AGRICULTURE?

In Indiana and across the country, urban agriculture is receiving greater interest and attention. Urban agriculture is the growing and raising of crops and livestock within the boundaries of a city. Often these crops and livestock are intended for consumption by the local community, sometimes by the person producing the food, but many times it is at a scale where the food is shared or sold as well. Urban agriculture can take multiple forms. It can be a one-acre parcel within city boundaries that is transformed into a for-profit market farm. It can be a church converting a large strip of their property into a community garden. It can be a neighbor raising a few chickens for egg production in their backyard. All of these are examples of growing or raising food within the boundaries of a city.

WHY ARE PEOPLE PURSUING URBAN AGRICULTURE?

Although growing or raising food is an outcome of urban agriculture, it is rarely the only motivation for urban farmers and gardeners. Many urban residents engage in food production because they want to build community, educate youth, improve urban sustainability or lessen the burden of those who struggle to access fresh food, among many other reasons. McClintock and Simpson (2018) were able to distill these motivations into six categories:

- Entrepreneurial – motivated by capitalistic economic development and environmental concerns, but may downplay social concerns
- Sustainable Development – motivated by food security, food quality, public health/nutrition, sustainability, self-sufficiency and community building
- Educational – motivated by education of youth and adults
- Eco-centric – motivated by environmental and agro-ecological sustainability
- DIY Secessionist – motivated by severing ties with the dominant food system, creating an alternative system of food production
- Radical – motivated by social justice, food justice, food sovereignty and anti-capitalist interests

BENEFITS AND CHALLENGES OF URBAN AGRICULTURE: WHY AND HOW TO ADDRESS AGRICULTURE AT THE MUNICIPAL LEVEL

Research shows a wide range of benefits from urban agriculture (Golden, 2013) including:

- Improved access to fresh food
- Increased fruit and vegetable consumption and more healthful food consumption overall
- Reduced blight in neighborhoods
- Increased biodiversity and habitat
- Increased youth development opportunities
- Creation of job and training opportunities
- Small business growth and development

However, it can seem oxymoronic to support “urban” “agriculture,” two areas that are often mutually exclusive and between which a stark geographic divide often exists. The aesthetics, noises, smells and possible health risks posed by raising crops and animals in the city are among the reasons that clear separations between agriculture and urban development often exist. Today, this separation is reinforced by other uses for urban land that enable denser development and higher economic returns. These issues might become central challenges in the urban agriculture conversation in your community, and there is research along with planning and zoning suggestions to help planners navigate this area. As Indianapolis community investor Tedd Grain notes, though urban agriculture might not be directly profitable, it has great potential to enhance the value of real estate and a neighborhood. You can listen to Mr. Grain’s case for urban agriculture’s value as an economic development tool in this short video (excerpted from the Purdue Extension Urban Agriculture Certificate): https://mediaspace.itap.purdue.edu/media/PU-UAC-PM_Communicating-the-Value.mp4/1_idhdll1e1.

Ultimately, the choice to welcome urban agriculture is up to each community. Though it might depart from the suburban image of a neighborhood and forego a more economically profitable use, keep in mind the dynamic social, economic and environmental benefits that urban agriculture can provide.

If you seek to encourage urban agriculture, helping these food producers overcome some primary challenges will be important. Urban food growers face limited and non-traditional land access, use of reclaimed

and sometimes contaminated soils, restrictive legal and political environments, low levels of agricultural expertise, unskilled laborers and the challenge of sustaining social missions in addition to producing food (Pfeiffer, 2014; Reynolds, 2011). Many of these challenges can be directly addressed by creating supportive municipal policies and raising awareness about local resources, such as soil testing assistance.

An important dynamic to consider is that often these projects arise in areas with vacant properties. These properties are likely vacant due to economic depression in the area and thus the population living nearby might be a vulnerable one. In light of resident displacement and other unintended consequences that increased investment in this type of urban area can create, it is important to consider the following recommendations, which are excerpted from the article “The Intersection of Planning, Urban Agriculture, and Food Justice: A Review of the Literature”:

Planners can play a stronger role in the movement for food justice by explicitly considering whether the urban agriculture efforts they plan and promote really do benefit disadvantaged communities. First, planners can embed urban agriculture into long-term planning efforts so that urban agriculture is viewed as a priority, not just a placeholder for future developments on the land. Second, planners can develop mutually respectful relationships with food justice organizations to better understand their constraints and needs. A third strategy is to target outreach, programming, funding, and infrastructure for urban agriculture to organizations led by and benefitting members of historically disadvantaged communities. Fourth, planners can increase the amount of land permanently available for urban agriculture. Finally, planners must confront and counter urban agriculture’s contributions to displacement.” (Horst, 2017)

URBAN AGRICULTURE POLICIES AND ORDINANCES

In the following two sections, considerations for urban agriculture regulation and policy are separated by type of activity. The two types of activity are: 1) growing crops; and 2) raising livestock.

GROWING CROPS

Major areas to consider regarding urban tracts of land under use for growing crops are:

- Use standards that maximize possibilities for urban farmers while also minimizing conflict with neighboring land uses;
- Mechanisms that provide urban farmers with sustained land access; and
- Assisting with access to a water source.

USE STANDARDS THAT MAXIMIZE POSSIBILITIES FOR URBAN FARMERS WHILE ALSO MINIMIZING CONFLICT WITH NEIGHBORING LAND USES

Indianapolis established new use standards around “[Gardens] as a Primary Use” after significant research and public input. Those use standards are included in **Table 1** and can be used to illustrate language that might be used to address certain concerns.

MECHANISMS THAT PROVIDE URBAN FARMERS WITH SUSTAINED LAND ACCESS

Long-term access to urban land is a limiting factor for many urban agriculture projects. If producers do not own the land, they often cannot count on its availability from one year to another given the competing land uses they are up against. In this state of uncertainty, it becomes difficult to make the investments of time and capital that could maximize the potential benefits of an urban farm or garden. In order to facilitate sustained land tenure for urban agricultural use, consider these following policy ideas:

- *Policies that provide urban farmers access and/or ownership options for vacant lands that return to the city’s ownership.*
 - If owning the land is not ideal for an urban agriculture project, consider long-term, low-cost leases to community gardens and urban farms. Multi-year leases help ease the risk and uncertainty in a project’s startup phase.
 - If the sale of a property for agricultural use is ideal, consider re-assessing the property at its agricultural value to lower the tax burden for its owner.

TABLE 1: USE STANDARDS FOR GARDENS AS PRIMARY USE IN THE CITY OF INDIANAPOLIS CONSOLIDATED ZONING/SUBDIVISION ORDINANCE

Concern	Standard
Defining various categories of uses to ensure small-scale personal uses are distinguished from large urban farming or community gardening efforts.	<p>Personal Garden: A private facility or area for the cultivation of vegetables, grasses, fruits, flowers, shrubs, vines, trees and domesticated bees as an accessory use by a resident or occupant of the site whether it be for purposes of producing food or materials. This definition includes the composting of on-site materials. This definition does not include high weeds and grass, nor does it include farming or beekeeping for commercial purposes.</p> <p>Garden as a Primary Use: An area of land managed and maintained by a group of individuals to cultivate fruits, flowers, vegetables or ornamental plants, for personal or group use, consumption or donation. Garden as a Primary Use may be divided into separate plots for cultivation by one or more individuals or collectively. Garden as a Primary Use may include bee-keeping (apiculture) and may include common areas maintained and used by group members.</p>
Allowing for structures that enable storage, gathering space and year-round growing efforts while establishing reasonable guidelines for height and setbacks.	Garden structures, such as greenhouses, hoop houses, storage sheds, gazebos, shelters and cold frames, are limited to a maximum height of 15 feet and shall meet the setback requirements of the district.
Allowing beekeeping while acknowledging public perception of risk related to hives.	<p>Personal beekeeping of domesticated honeybees is permitted in all districts. Without a personal livestock license, the number of beehives on a site shall be limited to eight hives. No beehive shall be larger than 16 cubic feet.</p> <p>Beehives may be located on the ground or on the roof of a building with a permanent foundation.</p> <p>If the opening of any beehive located on the ground opens toward an area on-site or another lot that is an activity area, such as a walkway, play area or patio, then a barrier must be provided to cause the bee flight path to be directed at least six feet above the area.</p>
Allowing composting while encouraging proper waste management	<p>Composting shall be located or designed and constructed to prevent the composting material and compost from sitting in ponded surface water.</p> <p>Refuse must be removed from the site at least once a week.</p>
Desire of many urban agriculture projects to sell products on-site	Sales of products grown on the site is permitted on the site, provided that any structure used for sales is no larger than 100 square feet, not on a permanent foundation and is not located in a required yard area.
Risk of soil contamination in an urban setting and encouraging soil testing and site research prior to growing crops	<p>Food products may be grown in soil native to the site if:</p> <ol style="list-style-type: none"> a. A composite sample of the native soil, consisting of no less than five individual samples, has been tested for lead content and the lead content in the soil is determined to be at or below the Indiana direct-contact standards for lead; and either: <ol style="list-style-type: none"> 1. The City determines through maps, deeds, prior permits or a combination of those sources that the site has only been put to residential or agricultural use in the past; or 2. A composite sample of the soil native to the site, consisting of no less than five individual samples, has been tested for metal content using the US EPA 3050B, 3051 or a comparable method and that (i) the metals arsenic, cadmium, mercury, molybdenum, Nickel, selenium and zinc are determined to be at or below the identified thresholds, as amended, food products may only be grown in raised beds filled with clean top soils. b. As an alternative to meeting the standards in subsection a.1 or a.2 above, food products may be grown in clean soil six inches deep brought to the site without completing a soil test of the native soil.
Possible use and storage of chemicals on-site	Herbicides, pesticides, fertilizer or other chemicals shall not be kept outside and shall be locked when not in use. The site drainage and maintenance must prevent water, herbicides, pesticides or fertilizer from draining onto adjacent property or into a right-of-way.
Activities in a residential area that are noisy	Operation of power equipment or generators may occur between sunrise, but no earlier than 7 a.m., and sunset, but no later than 10 p.m.

City of Indianapolis, 2018

- *Policies that incentivize property owners to make land available for multi-year urban agricultural use.* An example of this type of policy is the Urban Agriculture Incentive Zone enacted in California in 2013. It “allows cities and counties to provide landowners with a property tax deduction in exchange for committing their land to urban agricultural use for at least five years.” (Zigas, 2017)

ASSISTING WITH ACCESS TO A WATER SOURCE

Another key limiting factor for urban agriculture to thrive is access to a convenient, high-pressure water source. Policies to consider:

- Allowing use of hydrants where appropriate
- Subsidizing the reopening of dormant water connections on a vacant property
- Charging agriculture water use rates rather than standard municipal rates

RAISING LIVESTOCK

There is growing interest among city residents in small-scale livestock production, driven by practitioners’ desire to better understand the origin of their food (McClintock et al., 2014). This a national trend, but raising livestock and poultry in urban settings can be more controversial than growing crops under the same conditions. Well-supported, one-size-fits-all zoning or use standards for urban livestock production are not available, but examples of regulatory language exist, including the personal livestock standards in the City of Indianapolis Consolidated Zoning/Subdivision Ordinance. While residents wishing to engage in urban agriculture “must accept restrictions in their choices of enterprises to accommodate the preferred lifestyles of nearby residents” (Ikerd, 2010), this is especially true for livestock and poultry production. Because of the nature of livestock production (e.g., odors, manure accumulation, noises, zoonosis, etc.), residents should know that livestock production may simply not be feasible under some conditions commonly found in urban settings.

Nevertheless, there are numerous factors planners may wish to consider when developing use standards that could allow for livestock ownership while minimizing potential conflict with other uses. Such factors range from quantity and species of animals allowed, animal

housing standards, manure and odor management and inclusion of measures to reduce risks to public health.

SPACE

Often, planners consider allowable animal maximums when developing urban livestock use standards. It is tempting to create these standards based on space requirements of different livestock species. Doing so, however, can be problematic as an animal’s space requirements are influenced by a variety of factors, including, but not limited to, flooring (paved vs. dirt); age of animals (e.g., piglet vs. breeding sow); housing facility (e.g., open-floor vs. aviary; pasture vs. indoor); manure collection system; feeding systems and bunker space; pasture quality; purpose of animal (e.g., breeding vs. growing, meat vs. dairy goat/poultry), among many others. As a result, planners are likely to find wide ranges



of space requirements in the literature that differ based on whether these factors are considered and, if so, to what extent (see references). Thus, creating animal maximums based on generalized space requirements that do not take into account these different factors may be unnecessarily restrictive in some contexts while allowing animal overcrowding in others. This is especially true as new production systems are developed that may allow intensification, even in urban settings (Chitnis and Ebner 2018).

Ultimately, the Board of Animal Health sets animal care standards in Indiana under Indiana Administrative Code 345 Article 14. This code does not set forth animal maximums, but requires that “a person responsible for caring for livestock or poultry must provide the animals

with an environment that can reasonably be expected to maintain the health of animals of that species, breed, sex and age, raised using the applicable production method” (345 IAC 14, 2016). Purdue Extension can offer assistance in interpreting how these standards might apply in different contexts. The Purdue University Department of Animal Sciences has faculty Extension Specialists with expertise in housing and animal welfare across all livestock and poultry species. Equally resourceful are county Extension Educators, including 4-H Extension Educators who often work with livestock and poultry producers operating on similar scales found in many urban livestock and poultry operations.

NOISE, ODOR AND PUBLIC HEALTH

There are several potential land-use conflicts inherent in raising livestock and poultry in urban settings. Perhaps foremost among these conflicts are odor, public health and noise. In many cases, odors can be mitigated or reduced with diligent manure management. Effective manure management is also necessary to limit public health risks that can be associated with housing animals in close proximity to dense human populations. Thus, it is critical that urban livestock and poultry producers have adequate and consistently available means to collect and properly dispose of manure and litter in manners that reduce odor and public health concerns. This includes adequate access to water for cleaning and disinfection protocols. Note that all livestock producers with operations generating greater than 10 cubic yards of manure per year must comply with Indiana’s Fertilizer Material Use, Distribution and Recordkeeping Rule (355 IAC Article 8) regardless of their location (see <https://ag.purdue.edu/cfo/Pages/manure-rules.aspx>).

Likewise, planners should consider noises associated with livestock and poultry production. Such noises may come from the animals themselves or from animal handling and equipment use. The amount of noise often depends on the species of livestock, and even the sex of the animal, and there are examples of use standards that prohibit certain types of animals, such as roosters (although new poultry producers should not be surprised if their hens sometimes crow, too).

TOOLS

Table 2 includes use standards employed by the City of Indianapolis that address many of the issues highlighted above. Additionally, Butler (2012) compared zoning ordinances for urban livestock production across 22 U.S. municipalities and the study offers planners examples of different tools available or in use to guide urban livestock and poultry production.

Finally, in many rural counties throughout Indiana, new livestock facilities are required to submit a site-plan prior to siting (Ebner et al., 2016). In these cases, livestock production may be an accepted or approved use within the zoning district, but potential producers



must still submit a site-plan to the county detailing some aspects of their specific operation. Because livestock and poultry production within city limits can be highly nuanced in terms of practices or resources available that could reduce potential conflict with other uses, namely residential uses, it may be helpful to require those interested in producing livestock and poultry (beyond a small number of backyard chickens) in an urban setting to submit a site plan prior to populating their operation. Such site plans could detail the proposed housing system (with space allotment justification), odor and/or noise abatement strategies and manure management/containment protocols, among other requirements of interest. This practice could allow a review of potential operations that takes into account site-specific factors and resources. Again, the numerous Purdue Extension Specialists and Educators with expertise in livestock production, housing, welfare and odor can be resources.

TABLE 2: USE STANDARDS FOR LIVESTOCK AND POULTRY PRODUCTION IN THE CITY OF INDIANAPOLIS CONSOLIDATED ZONING/SUBDIVISION ORDINANCE

Concern	Indianapolis zoning language (City of Indianapolis, 2018)
Identifying which animals are allowed and considered livestock	Personal Livestock: Accessory activity of raising domesticated poultry, rabbits, sheep, donkeys, mules, alpacas, llamas, horses and goats, of which may be standard-sized or miniature, pygmy or dwarf for use by the resident or occupant of the property. This definition does not include domestic dogs or cats, and does not include animals associated with a business activity, such as an agricultural use (farm) or boarding.
Noise issues associated with roosters	Roosters are limited to one per lot and between dusk to dawn the rooster must be kept inside an enclosed coop or similar fully enclosed structure.
Preventing animals from wandering outside owner's property and limiting site of animal housing	Outside exercise area and pasture must be fenced and must not be located in the front yard. Pen, shelter, coop, roost, hutch or other shelter for animals must not be located in a front yard and must meet setbacks required in the district. Animals must at all times be confined to the lot.
Unpleasant odors	Odors from the animals or from animal waste must not be discernible at any property line.
Animal slaughter	Slaughter must be limited to personal livestock, must not be conducted in the front yard, and must be conducted within a completely screened area. Remains must be disposed of and removed from the site within 24 hours.
Manure management	Waste must be collected and removed or composted regularly.

City of Indianapolis, 2018

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LIVESTOCK PRODUCTION AND PLANNING: CONFINED FEEDING OPERATIONS

Paul Ebner, author

SUMMARY

In this section, we offer some background on how livestock production has changed over the last few decades but continues to play a large role in Indiana, both from economic and traditional standpoints. We address confined feeding operations (CFOs) specifically, including their benefits and the challenges sometimes associated with integrating livestock production into community planning. Finally, we describe several tools and resources available to planners and communities wishing to address CFOs specifically in their planning processes. The discussion below focuses on CFOs as defined and regulated by the Indiana Department of Environmental Management (IDEM). This might be an important distinction for some counties as IDEM defines CFOs based on a uniform set of characteristics of the farm, while some counties might use slightly different definitions (e.g., higher or lower animal numbers). Thus, there are cases throughout Indiana where an IDEM-regulated CFO does not meet the definition of CFO by the county. The converse is also true when a county definition of CFO in an ordinance does not meet the definition set by IDEM. These discrepancies, of course, have impact on which farms are actually impacted by ordinances at the county level. For the sake of clarity, we are defining CFOs as those farms regulated by IDEM as CFOs.

WHAT IS IT?

Livestock production has always played a large role in Indiana agriculture, both in its traditions and its outputs. Livestock production systems, however, have undergone significant changes over the past four decades, and this is true for Indiana livestock production. Animals are much more efficient, producing more meat, milk or eggs per unit of feed. Like other types of farming, the number of farms producing livestock has decreased over time, while the number of animals (or pounds of milk, etc.) produced per farm has increased (USDA-ERS 2013).

At the same time, livestock production has largely moved indoors for a variety of reasons. In general, indoor systems can afford a producer greater control



of numerous factors that affect the animal's health and, in turn, the animal's efficiency. For example, indoor systems might allow a producer to better ensure animals receive the proper nutrition required at different stages of their lives. Indoor production systems can also allow a producer to manage climate and better protect animals from heat/cold stress, predators and some diseases.

As a result, the overwhelming majority of food animals produced in Indiana, by weight and number, are produced in indoor systems or on lots. The State of Indiana defines such farms as CFOs when the number of animals on the farm reaches a defined number (see **Table 1**). Concentrated Animal Feeding Operations (CAFOs) are a subset of CFOs and are defined by a greater number of animals (see Ebner and Hong 2017a for more detailed definitions).

CFOs in Indiana are regulated by numerous offices and agencies at the state level, both directly and indirectly (see Ebner and Hong 2017b for review). Briefly, all CFOs must be issued a permit through the IDEM prior to construction. IDEM definitions of CFOs and CAFOs are provided in **Table 1**. In general, obtaining a CFO permit requires the CFO operator to provide plot/farmstead maps, structure designs, a manure (nutrient) management plan, detailed management plans and water monitoring plans (among other requirements). This is all in an effort to minimize potential environmental impact (a detailed description of the CFO permitting process can be found in IDEM 2014). The Office of the Indiana State Chemist regulates the sale, transport and application of manure as fertilizer across all size livestock farms with objectives similar to those of IDEM, and some specific requirements for handling manure generated from CFOs.

TABLE 1: INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (IDEM) CONFINED FEEDING OPERATION (CFO) AND CONCENTRATED ANIMAL FEEDING OPERATION (CAFO) DEFINITIONS BY NUMBER OF ANIMALS

Animal and/or Operation System	CFO (Animal Numbers)	CAFO
Swine: Growers, Finishers, Sows (> 55 lbs.)	≥600	≥2,500
Swine: Nursery Pigs (< 55 lbs.)	≥600	≥10,000
Beef: Cattle	≥300	≥1,000
Beef: Cow/Calf Pairs	≥300	≥1,000
Dairy: Mature Dairy Cows	≥300	≥700
Dairy: Other than Mature Dairy Cows (Dairy Heifers and Calves, Veal Calves)	≥300	≥1,000
Chickens: Non-layers (Non-Liquid Manure System)	≥30,000	≥125,000
Chickens: Layers/Broilers (Liquid Manure System)	≥30,000	≥30,000
Chickens: Layers (Non-Liquid Manure System)	≥30,000	≥82,000
Ducks: Liquid Manure System	≥30,000	≥5,000
Ducks: Non-Liquid Manure Systems	≥30,000	≥30,000
Turkeys	≥30,000	≥55,000
Horses	≥500	≥500
Sheep/Lambs	≥600	≥10,000

Adapted from IDEM, 2014

WHY ARE PEOPLE INTERESTED?

As a state, Indiana ranks fifth in swine production, fourteenth in milk production, second in egg production and first in duck production (USDA-NASS 2017). Numerous recent studies are available quantifying the contributions these different livestock sectors make to Indiana’s economy (IBRC 2017; Wilcox et al. 2013; Ayres et al. 2009; Mayen & McNamara 2007). CFOs in particular are businesses with often-large inputs (labor, feed, construction, etc.). Sourcing these inputs can have a multiplier effect on employment, effectively creating jobs in allied industries that provide materials or services. Most recently, the Indiana Business Research Center (IBRC 2017) provided estimates on employment multipliers, or the number of jobs created outside of the farm for every employee on the farm, for different livestock species in Indiana. Some of those data are summarized in **Table 2**.

TABLE 2: EMPLOYMENT MULTIPLIER EFFECTS BY LIVESTOCK SPECIES IN INDIANA

Species	Multiplier
Beef Cattle	2.04
Dairy	2.27
Hogs	1.41
Poultry and Eggs	7.39

Adapted from IBRC, 2017

Using “Beef Cattle” as an example, for every 100 individual employees working directly with the farms, 104 jobs are created in allied industries for a total of 204 jobs.

As noted previously, livestock production has a long history in Indiana. CFOs may also provide avenues for families or individuals to remain in or begin farming due to the relatively smaller initial costs and integrated structure of the different industries that can alleviate risk (Harper 2009). This notion is supported by data indicating that the average age of CFO owner/operators in Indiana is lower than the average age of farmers in general (Ayres et al., 2009).

WHY WOULD YOU ADDRESS IT IN A COMPREHENSIVE PLAN?

Over the past three decades, and as farm sizes grew and production practices changed, more Indiana counties began to include specific language in both their comprehensive plans and zoning ordinances regarding CFOs. At the time of this writing, 64 of Indiana's 92 counties operate under zoning ordinances containing standards specifically for CFOs (Ebner et al., 2016).

Some counties wishing to attract or retain livestock production, and recognizing that modern livestock production includes CFOs, have included language stating these goals clearly in their plans (e.g., Benton County 2018; Decatur County 2017). Similar to countless other approved uses, CFOs might be incompatible with some other approved uses and vice versa. A goal of planning and zoning is to minimize land use conflict, and county plans may also provide guidance on the best locations or zones for CFOs so different uses can co-exist and multiple goals of the county can be met.

WHAT ARE CHALLENGES?

The goals of a community are always multi-factorial. In an effort to reduce conflict between those goals, many communities have sought to foster livestock production, specifically CFOs, by creating defined areas or zones where such uses are approved, or requiring distance separations between CFOs and other uses (Ebner et al., 2016). The major challenge is in defining appropriate separation distances, i.e., distances that reduce potential conflict, but are not excessive or overly burdensome to the parties involved. Most potential issues associated with CFOs are not monolithic and impacted by various factors including, but not limited to, production system, animal species and land topography. Likewise, an increasing number of management practices are available to livestock producers that can mitigate potential impact of CFOs on neighboring uses. Thus, operators of CFOs located downwind from other uses, employing odor abatement strategies and injecting manure might expect to have potentially less conflict in the long run with neighbors than those operating CFOs not employing similar practices. This, of course, does not account for the pre-operation objections the operator might face.

It is also important to note that with many concerns related to CFOs, there is yet little research that affords the ability to quantify the true risk or potential impact. While issues related to public health are often raised (e.g., impact of antibiotic use and emissions, etc. on neighbors) and that risk should be acknowledged, to date, the treatment of CFOs as uniform public health hazards is not supported by a large body of scientific literature or scientific consensus (O'Connor et al., 2017; Nachman et al., 2017). Similarly, risks to nearby property values (also often voiced as a concern) are difficult to quantify without taking a multitude of factors into consideration (e.g., size, location, county characteristics, housing price, species, etc.; see references).

From a planning perspective, there remains some controversy over home rule and the types of standards that counties may require of CFOs. Specifically, there is lack of clarity in what a county may require beyond siting requirements, and whether those requirements could conflict with existing state regulations or jurisdictions. For example, IDEM's Confined Feeding Program does not regulate odor and requirements for CFOs to employ odor abatement practices are not uncommon in Indiana zoning ordinances. However, can a county require that manure be injected versus sprayed (specifically to reduce odor) when manure storage, handling and application is regulated by IDEM and/or OISC?

Finally, regardless of community decisions in planning and/or zoning, in no case can local standards remove regulations required at the state level. Thus, even if a community does not address CFOs explicitly, all CFOs are still required to comply with all IDEM, OISC and other state requirements and regulations. At the same time, counties may employ same, different or additional zoning or siting standards to livestock farms that are not permitted CFOs (i.e., livestock farms of any size) if they choose. Thus, siting standards for livestock production do not have to be CFO-exclusive.

WHAT DOES IT LOOK LIKE?

Numerous resources are available to planners, producers and counties wishing to address CFOs in their plans or zoning ordinances. Two examples of counties (Benton and Decatur) with recently updated comprehensive plans containing language specific to CFOs are included in the references.

The Indiana Land Resource Council provides guidance on how to incorporate CFOs into development or zoning plans (ILRC 2014). The document contains three suggested example ordinances, each containing a large set of tools available to planners that could be used to reduce land use conflict associated with CFOs. The three examples represent three different approaches to regulation, but, as noted by ILRC, the three examples are not mutually exclusive and could be combined in different manners most appropriate for a specific community.

Finally, many issues related to CFOs center on odor. CFOs in Indiana, however, are not regulated based on odor. Currently, there are numerous tools available to individuals involved in CFO siting that are designed to aid in identifying sites where the CFO might have lowest impact on neighbors, specifically when it comes to odor (Jacobson et al., 2017; PAAQL 2017). In many cases, producers and others might reduce community

conflict by employing such tools at the onset of their site identification process. The Purdue Agricultural Air Quality Laboratory (PAAQL) has developed an odor setback model (PAAQL 2017) that incorporates facility size, types of animals, amount of manure generated, prevailing winds/weather patterns and odor abatement practices, among other factors, to recommend setback distances and predict best locations for CFOs. Producers and others have used this model throughout the state.

Finally, Purdue University Extension recently completed a comprehensive analysis of all Indiana county zoning ordinances to begin to compare how CFOs are regulated across counties. In the report, zoning standards of 64 Indiana counties identified as having CFO ordinances were catalogued and compared (Ebner et al, 2016). The research allows planners to quickly compare standards across counties with similar or dissimilar land uses, population and housing densities, and animal densities, among other factors (Ebner et al, 2017).



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AQUACULTURE

Kwamena Quagrainie, author

WHAT IS IT?

Aquaculture/aquaponics

Indiana's agricultural economy includes aquaculture (fish farming), hydroponics (growing plants in water with nutrients) and aquaponics (integrated fish and hydroponics farming). These enterprises produce fish for human consumption, recreational fishing and ornamental display. There are diverse species of fish produced in Indiana, and the interest in aquaculture and aquaponics results from the availability of resources such as vacant farm buildings, large open ponds and water bodies. On the demand side, there is strong consumer preference for sustainably produced foods, local foods and fresh foods, which can lead to improvements in quality of environment and healthy local communities.

WHY ARE PEOPLE INTERESTED?

Indiana agriculture is undergoing a transition in the types of crops and livestock produced. One such animal production is aquaculture (fish farming), a specialty animal production and a small but growing industry. Aquaponics, another form of integrated farming, combines aquaculture and hydroponics in a sustainable integrated production of specialty crops utilizing waste

water from fish production, resulting in production of two crops. These production systems represent the diversity present in Indiana's agriculture economy.

Indiana has a number of aquaculture and aquaponics farms that produce food fish, sport fish, ornamental fish, crustaceans and miscellaneous fish species. Fish are grown for human consumption, recreational fishing and ornamental display. Culture methods include low-density pond production, intensive cage culture and high-tech intensive indoor re-circulating systems. Much of the emphasis in aquaculture and aquaponics is on food production, though other farms specialize in the production of sport fish such as bass, bluegill and catfish for private stocking, minnows for baitfish and ornamental fish. A number of food fish production facilities mainly producing largemouth bass, hybrid striped bass, yellow perch and tilapia, as well as crustaceans (e.g., saltwater shrimp and freshwater prawn), have been established in Indiana, increasing the production capacity of the state's agriculture economy.

CHALLENGES

The main challenge to aquaculture growth is competitiveness from imported seafood.

RELEVANCE TO ECONOMIC DEVELOPMENT/ BENEFITS

Economic importance

Economic analysis of the industry in 2012 showed that it supports 280 jobs within the aquaculture industry and other supporting industries in Indiana, 169 of which are direct jobs in the aquaculture industry. The industry generates \$3,731,842 worth of labor income and \$19,484,193 of added value. The value of output generated within the aquaculture industry is \$23,599,676 and a total value of \$37,892,895 with other supporting industries. A \$1.00 sale by the aquaculture industry results in additional local output of \$0.61, and for every direct job in the aquaculture industry, there is an additional 0.66 job in the local economy. For a \$1.00 increase in added value from the aquaculture industry, there is an additional \$0.62 increase in added value in the local economy.



POLICIES AND ORDINANCES

Permitting and regulations

Indiana Department of Natural Resources (DNR)

Indiana has 38 approved fish species that can be produced, transported, imported, released and/or sold live in the state. To engage in any of these activities involving the approved species list, a person must obtain a Fish Haulers and Suppliers Permit from the DNR. To produce, import, transport and/or sell live a fish not on the approved species list, a person needs an approved Aquaculture Permit from DNR. Fish involved in aquarium or pet trade, or used solely for exhibit purposes, are exempt from both permits.

To import into Indiana a species of fish listed on the USDA-APHIS website from another Great Lakes state, a person must submit an application for an Aquaculture Pre-Entry Permit to the Indiana Board of Animal Health (BOAH). The appropriate fish health certification documents must accompany this permit application.

Indiana Board of Animal Health (BOAH)

BOAH needs to approve an Aquaculture Pre-Entry Permit before any viral hemorrhagic septicemia (VHS) disease-susceptible fish (see USDA-APHIS website) is imported from Great Lakes states or provinces. The permit application must be submitted with fish health documentation. Permits are valid for six to twelve months from date of fish testing, depending on protocol followed.

The following fish diseases are Reportable in Indiana: viral hemorrhagic septicemia (VHS), spring viremia of carp, infectious hematopoietic necrosis, epizootic hematopoietic necrosis and *Oncorhynchus masou* virus disease.

National Pollution Discharge Elimination Standard (NPDES) permit

Aquaculture facilities fall into one of three categories:

- No NPDES permit required,
- NPDES permit required with no Effluent Limitation Guidelines (ELG) or
- NPDES permit with ELG requirements (ELGs are national standards for wastewater discharges).

An NPDES Permit for Concentrated Aquatic Animal Production (CAAP) is required only if an aquaculture facility discharges water continuously for 30 days or more per year. Aquaculture facilities that fall under this definition are either flow-through, recirculating or net pen systems. Most Indiana pond, cage and recirculating aquaculture production facilities do not require permits because water is not discharged continuously for 30 days per year.

ELGs are placed on CAAP facilities that discharge continuously for more than 30 days and produce at least 100,000 pounds a year in flow-through systems and recirculating (primarily to raise trout, salmon, hybrid striped bass and tilapia). ELGs are required for facilities that produce at least 100,000 pounds a year in net pens or submerged cage systems (used primarily to raise salmon).

CONSTRUCTION IN WETLANDS/FLOODWAYS

Permits are required from the DNR, Indiana Department of Environmental Management (IDEM) and the Army Corps of Engineers. A permit is required from the DNR (Division of Water) for:

- New construction or improving existing structures in a floodway with more than one square mile of drainage area above that point, and
- Constructing a dam meeting one of the following three criteria: 20 feet or taller, 100 acre feet of water, greater than one square mile of drainage (640 acres).

An IDEM permit is required for excavating and constructing a pond in an isolated wetland.

FDA CENTER FOR FOOD SAFETY

Fish processing facilities must be registered with the U.S. Food and Drug Administration (FDA), regardless of whether processed fish products from the facility enter interstate commerce. The FDA regulates fish and seafood, canned foods and live food animals. Fish farms and fishing vessels not engaged in processing are exempt.

EXAMPLES OF PRACTICES IN INDIANA

Major fish species grown in Indiana

Largemouth Bass (*Micropterus salmoides*)

Largemouth bass are raised mainly in ponds and marketed to the live market for sport fishing as well as for food fish. Fingerlings, yearlings and adult fish are sold to the sport fishing industry for stocking into lakes for non-commercial sport fishing. Very large bass are sold as trophy fish at a premium price. Adult largemouth bass for the food market are sold live to ethnic stores and Asian communities in cities such as New York, Chicago, Philadelphia, Toronto, etc. Very few largemouth bass are sold in the food-fish industry in the form of a frozen or iced product.

Hybrid Striped Bass (HSB)

The hybrid striped bass is a cross between the anadromous striped bass *Morone saxatilis* and the freshwater white bass *M. chrysops*. The hybrids grow faster in the first two years of life, readily adapt to formulated feeds and are more resistant to diseases than the parents. HSB is raised mainly from cage and pond culture operations. Cage operations are used because it is very feasible in most farm ponds and private lakes. There is an active live market for HSB in the Asian communities in Chicago, New York City, Toronto and other north central region municipalities.



Tilapia

Tilapia is a warm-water fish and non-native to the U.S. As such, there are some state restrictions on culture systems. In Indiana, production is mainly indoors in water recirculating systems. Indoor systems are expensive to build and operate because of the high initial cost of components as well as operating costs. Several strains of the tilapia are raised in the region. This includes the Nile tilapia (*Oreochromis niloticus*), blue tilapia (*O. aureus*), Mossambique tilapia (*O. mossambicus*) and various hybrids among these. Tilapia are currently sold to the live market for food in New York, Chicago, Philadelphia, Toronto, St. Louis, Kansas City and other relatively large Midwestern cities. Asians and Hispanics are the target or primary consumer markets at this time. There is no processing as processed products from the region cannot compete with imported tilapia products.



Yellow Perch (*Perca flavescens*)

Traditionally, the entire supply of yellow perch came from capture fisheries in the Great Lakes. There has been a steady decline in supply, but the demand for yellow perch has remained high, especially in the Great Lakes region. It is estimated that about 70 percent of the yellow perch sales in the U.S. occur within 50 miles of the Great Lakes. The decline in capture fisheries has allowed aquaculture production of yellow perch to increase. Wisconsin and Ohio are the major producers of

yellow perch from aquaculture, mainly in pond culture system as well as indoor recirculating aquaculture system. Yellow perch is sold to both the sport fishing industry for stocking and to the food market. The food market does not handle live fish; instead they are processed and sold as scaled fillets to restaurants, grocers, social clubs, etc.



Salmonids (e.g., rainbow trout)

Salmonids require large amounts of high-quality water. Therefore, access to high volumes of good quality water such as springs, streams and wells usually dictates where salmonid aquaculture facilities are located. Missouri, Wisconsin and Michigan are major Midwestern states that produce trout. Idaho is the leader in food-size trout production in the U.S. Trout production utilizes indoor rearing facilities and outdoor raceways and ponds for grow out. In the Midwest, trout is sold to fee/recreational fishing operations (stocker trout) and to the food market. The food market is for processed products such as fillets and sold to restaurants, grocers, social clubs, etc.

Pacific White Shrimp (*Litopenaeus vannamei*)

The main method of rearing marine shrimp is indoors in tanks using a recirculating biofloc water treatment system. A biofloc system removes metabolic wastes using bacteria that convert ammonia to nitrate. The bacteria form aggregates (bioflocs) suspended in the water column. There is increased interest in indoor marine shrimp production in Indiana stemming from their lower capital costs, variable scale of production and relatively high market price. Shrimp is mainly sold at the farm-gate.

RESOURCES

Economic Importance of Indiana's Aquaculture Industry www.extension.purdue.edu/extmedia/EC/EC-770-W.pdf

Purdue University www.purdue.edu/fnr/extension/area-of-interest/aquaculture-aquatics/

Indiana Aquaculture Association www.indianaaquaculture.com/

Indiana Department of Natural Resources www.in.gov/dnr/fishwild/3607.htm

Indiana Board of Animal Health www.in.gov/boah/2387.htm

Indiana Soybean Alliance/Corn Aquaculture Program www.indianasoybean.com/checkoff-investments/livestock-aquaculture

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Species regulated by title 9 CFR Parts 83.1 through 83.7, 93.900 and 93.910 through 93.916 (the Viral Hemorrhagic Septicemia (VHS) Interim Rule). 2008. United States Department of Agriculture Animal and Plant Health Inspection Service. Retrieved at www.aphis.usda.gov/animal_health/animal_dis_spec/aquaculture/downloads/vhs_regulated_spp.pdf

LOCAL FOOD SYSTEMS

Rhonda Phillips and Jodee Ellett, authors

INTRODUCTION

As a whole, the food production and distribution system in the United States is remarkably efficient. However, in recent years, efficiency as a top value of the food system has received some strong competition from environmental sustainability, public health and small business development. Some perspectives about sources of food are changing. Health concerns related to food quality and supply (such as rising rates of obesity and diabetes), methods of production (such as concentrated animal feeding operations), pollution and environmental issues arising from farming methods (pollinator die-off, water quality, etc.), and the continued loss of farms and farmland have prompted many to explore alternative options.



Communities interested in supporting local food infrastructure can include this support in their comprehensive and other local government planning efforts. Efforts to do this have been termed “local food system development.” This term refers to food that is produced in an area, whether it is a town, city or region. Acknowledging that all types of agriculture have value, a community can encourage additional development of local food-focused efforts through their policies, ordinances, zoning and related planning and regulatory tools. This includes both large-scale, commercial agricultural enterprises as well as small farms producing for local markets, whether this is via community supported agriculture (CSA) models or farmers markets, etc.

This chapter provides a look at how to incorporate food systems, including access and supporting environments, into planning and development efforts at the local and regional levels. This section begins with some definitions, followed by a look at why people are interested and then how food systems and economic development are related. The second section provides some context on including food systems in planning as well as some of the challenges and benefits faced by communities when doing so. The third section provides examples and short cases on how some communities have done this. The chapter concludes by listing some resources to aid you and your community’s efforts to embed food systems into planning and development policies and approaches.

WHAT IS A FOOD SYSTEM?

Food systems are basically all the elements that combine to provide people with food. It is unlikely that small, local food systems can replace existing large-scale commercial methods of growing and distribution, so that is not the question. Rather, it is how communities can ensure that local, fresh and affordable food infrastructure is provided to help improve access, quality and even livelihoods by including some focus on locally and regionally produced and distributed food. In other words, if a portion of food dollars spent in a community is used to help foster local food systems, it can positively influence a whole range of outcomes. A locally focused food system can impact health and economic circumstances at the level of individuals, families and even the whole community. One way it can do this is by encouraging more direct and healthier links between those who produce the food (farmers) and those who consume it (individuals, organizations or institutions).

One definition of a local food system is based on the flow of food, from production to consumption, within a defined area. It goes beyond considering just the food that is eaten and its impact on health as an end result to one that includes issues and dimensions of food production, processing, distribution and access. These food-related activities and purposes could be described as a food system, and “local” when placed in geographic context, whether at the community or regional level.

WHY ARE PEOPLE INTERESTED?

In some ways, it is simple – by including food in planning and development efforts, communities can help ensure that members have access to quality, affordable and safe food supplies. Food is a critical component of both individual health and the overall health of communities, regions and counties. Supporting food systems can also provide support for small and mid-sized food-based enterprises and farms in the area. Another reason? Preserving land for growing food is an issue in many places as development pressures sometimes push out agricultural land uses. Having access to and preserving land resources makes sense on many levels, not the least of which is to help ensure access to fresh and local food supplies. Similarly, communities can incorporate zoning and policies, such



as ordinances to support a local food infrastructure. More attention has recently been placed on “urban agriculture,” for example. This is where growing food is part of the landscape of the built environment, from fruit and nut trees planted on public property to vertical gardens included on buildings and even green roof installations for beekeeping and growing food. And one only has to look as far as the debates around whether or not city and town dwellers can keep chickens and other barnyard animals in their backyards to see how passionate and interested many have become about local food.

RELEVANCE FOR ECONOMIC DEVELOPMENT

Growing local livelihoods via food-based businesses and farms can be a way to encourage more economic resilience at the local level. If even a small portion of food consumed within any given community can be grown and supplied from the local area, economic development benefits will be realized. This might include expanded capacity in a community to both produce and process foods, or new ways to distribute, such as a regional food hub or local community supported agriculture (CSA) models. It could include new businesses generated from adding value to agriculture products, as is the case with several rural communities that have started food-based business incubator programs. These help farmer entrepreneurs generate marketable products for their own areas and beyond. It can include supporting larger agriculture production in the regional context, such as packers in Indiana that buy from numerous farms (such as Red Gold, for example). It might include programs to help provide training for youth to develop skills transferrable to the broader marketplace, such as cultivating or culinary work experiences.

There are opportunities within food systems to bridge the gaps between production and consumption in ways that help foster economic development for communities as well as broader community development outcomes, such as improved well-being. Economic development is basically a way to try to increase quality of life by increasing people’s income and creating wealth (whatever is said, income is still the most efficient indicator of individual health and well-being) and standards of living, through methods such as encouraging quality and quantity of employment opportunities and other economic outcomes (Phillips & Pitman, 2015). Food systems in particular represent a way to help spur enterprise in local and regional areas because they combine both elements of economic development (food cluster to promote specialty food businesses, for example) as well as community development (for example, community gardens, farm-to-school programs, etc.). Local food systems can help make a contribution to economies and well-being, leading to more durable, resilient communities. See information from the Indiana State Department of Agriculture provided in this guide for checklists on site selection and food processing considerations.

BACKGROUND

There are several aspects to consider when linking food systems to comprehensive and related planning efforts. The first is how it is done, which is the topic of the following section. A few of the benefits as well as challenges of doing so are then considered.

INCLUDING FOOD SYSTEMS IN LOCAL PLANNING

While not all communities include food systems in their comprehensive plans, it is increasingly becoming more common to partner long-term planning and policy initiatives with fostering healthy food environments and a strong food system infrastructure. One can see why – food systems could touch on just about every aspect of the typical elements in a comprehensive plan. Food



systems influence the economic and environmental health and well-being of communities, and are directly tied to other systems – energy, housing, land use, transportation and resources. Food systems are also tied to the waste stream and supporting infrastructure as well, with an estimated 25 percent of all food produced ending up in landfills and food overall as the largest component of waste. Beyond that, some estimates state that a quarter of the nation’s water ends up supporting food that ultimately ends up in landfills as waste. Persistent food insecurity for many U.S. residents must also be considered. Because local and regional governments manage resource allocation and determine who participates in decision-making for these systems, it is important that food systems be included. Further, infrastructure needs for larger

producers can be impacted by attention from local and regional governments to needs around transportation and water, for example. The issues discussed in this section can be readily addressed at the local and regional levels to create visible, immediately impactful results.

BENEFITS

As noted, food systems have a role in many dimensions of community and regional planning and development. The benefits seem both inherent and explicit because supporting healthy food choices and accessibility creates positive outcomes for members of a community. In the Minnesota Food Charter’s Food Access Planning Guide, the benefits of including food systems in planning are noted as efforts that can,

“...go a long way in reducing rates of preventable diseases, fostering community and economic development, and achieving equity for everyone. For example, many communities need to make specific improvements to ensure people have reliable access to affordable, healthy food, while also nurturing a robust infrastructure for the growing, aggregating, and processing of this food. Planners can assess existing food access disparities, shape the food environment of communities, and facilitate healthy eating.”
(Minnesota Food Charter, n.d.).

Prioritizing healthy food access in a community, and including it in comprehensive planning, along with policy to support this, can make a difference. Including goals such as local food retail and enabling urban agriculture uses can make a difference in a community. Other benefits of including food systems in comprehensive plans, zoning codes and other public policies such as design regulations include or can more significantly allow for the provision of:

- Affordable, safe and reliable transportation to food sources
- Support for small and mid-sized food and farm enterprises as well as farm-focused enterprise zones and commercial shared kitchens
- Zoning that supports a healthy food infrastructure such as proximity of food outlets to schools and residential areas
- Access to and preservation of land for food production

- Development of community food assets such as community gardens, pollinator-friendly habitats, food hubs and farmers markets (Minnesota Food Charter, n.d.).

There are other approaches that communities can support or include in their public policy beyond zoning regulations or comprehensive plans. They can be embedded within other local or regional regulations or plans, or may function separately. These can include designing a food charter, developing school food policies, collaborating with the civic and private sectors on joint initiatives for food-based business development or increasing cultural and social assets in the community. Community and regional health plans, created from local and regional healthcare providers and local health departments, are another potential point of intersection for food systems and planning. Supporting or establishing a food policy council is an effective way to start initiatives and build interest in a community or region. There are hundreds of food councils in the US now, and many are connected to government. The areas of focus for food councils typically are on supporting healthy food access and economic development. The Food Policy Network at Johns Hopkins University Center for a Livable Future provides resources and tools for those interested in supporting food councils in their areas (Food Policy Networks, 2018).

CHALLENGES

As noted earlier, food systems need to be included in decision-making at the local and regional government levels; however, there are inherent challenges that might prevent integration. For one, it might be difficult to have local government buy-in to include plans, policies and regulations to support food systems, or they might not yet see the benefits of doing so. If included, existing policy and regulations might need to be strengthened in order to have any meaningful adoption or implementation.

EXAMPLES

There are numerous examples of communities integrating food systems into local planning and development plans, policies and efforts. A few have been provided for gaining insight as well as inspiration for developing ideas feasible at the community level. The following section includes examples of how

communities have been able to overcome challenges and pursue opportunities to foster a healthier, stronger local food system.

MODEL POLICIES AND ORDINANCES

There are many various local ordinances and regulatory tools to support healthy food systems, ranging from zoning ordinances to inclusion of food system elements in comprehensive plans at the local or regional level. From large cities to small towns and entire regions, there is now more inclusion of overlay districts and permitted uses for small farms in most zoning districts, community gardens, urban agriculture uses, green roof installations, use of vacant publicly owned lots for community gardening, allowance for sale of fresh foods grown on site in districts or areas zoned for agricultural uses and greenhouses, plant nurseries and related uses in most commercial and manufacturing districts.



Ordinances can vary, from extremes of declaring food sovereignty, such as the case with several communities in Maine (irrespective of state and federal food-related laws). You can view those examples at <http://localfoodrules.org/ordinance-template/>. Another example is the healthy food zone ordinances in a small town in Texas that have received national attention. In the latter case, Hutto, Texas, with a population of 27,000, has designed a form-based Smart Code that incorporates many types of food production in five of its six zones. (View those ordinances at [http://www.huttotx.gov/document_center/government/public%20hearings%20&%20notices/development%20codes/UDC\(02-2017\)CURRENT-Ch3_201703021558526787.pdf](http://www.huttotx.gov/document_center/government/public%20hearings%20&%20notices/development%20codes/UDC(02-2017)CURRENT-Ch3_201703021558526787.pdf).) These types of food production include farms, vegetable gardens, urban farms, community gardens, vertical axis gardening, green roofs and agricultural plots; there is also code to support opportunities for composting and recycling solutions.

Since economic development is often the focus of interest in communities, some sample language regarding food systems and economic development has been included:

“We will pursue activities that both improve healthy food access and advance economic development.

- Review and refine ordinances to allow for new food, beverage and farm-related enterprises.
- Highlight a community or region’s food culture as a community branding strategy.
- Support agritourism efforts as a means of enhancing income streams for small farmers and producers.
- Purchase healthy foods from local food businesses when catering events, meetings and other gatherings.
- Review local ordinances to ensure that they don’t unduly restrict sidewalk and rooftop dining.
- Establish a Food Policy Council with a strong focus on improving the food economy.
- Partner with local education and training institutions to develop workforce skills and to promote workforce training.
- Partner with neighboring communities to pursue a regional food marketing strategy.
- Support the development of living-wage jobs so that community members can afford to purchase healthy food and support local businesses”
(Minnesota Food Charter, n.d.).

For additional information related to economic development in Indiana, see the resources provided by the Indiana State Department of Agriculture. Some ordinances now are more issue oriented, such as the aforementioned model offered to communities with the intent of discouraging or disallowing fast food restaurants near schools to improve the nutritional quality and choice of foods provided to children. These types of changes in planning and development planning represent a significant departure from many existing regulations. In the past, agriculture activities may have been prohibited within city limits, for example, in the interest of protecting public health, and there might have been little restriction on where a restaurant could be located. Changes such as the discouragement or disallowing of fast food restaurants near schools is a different direction that some communities are taking when considering public health issues.



Another example is from Orange County, North Carolina where a district for agricultural uses was added to existing zoning regulations. You can learn more here. This example is provided by the Center for Environmental Farming Systems in North Carolina. They have quite a few resources and links to information sources that are very useful to local governments seeking information about including food systems in planning and development regulations. You can learn more at <https://www.orangecountync.gov/792/Planning-Inspections> and <https://cefs.ncsu.edu/>. Likewise, the American Planning Association provides an archive of information on local comprehensive and sustainability plans for incorporating food access via comprehensive planning, ordinances and supporting regulations and policies. There are many examples of planning practices at the local and regional levels for moving forward (Haines 2018; Hodgson 2012; Phillips & Wharton 2016). The International City/County Management Association in conjunction with Michigan State University’s Center for Regional Food Systems provides a report profiling four communities from small in size (less than 10,000 in population) to a larger regional area at the county level of over 350,000 in population – Catawba County, North Carolina; Decatur, Georgia; Topsham, Maine; and Washtenaw County, Michigan. These cases illustrate how food systems are included and supported by local and regional government efforts (Goddeeris et al., 2015). Incorporating food systems at all levels of communities, whether small, mid-sized, or large and regional seems a focus for many local and regional government efforts now more than ever.

PURDUE EXTENSION PROGRAMS AND RESOURCES

Programming and Technical Assistance	Diversified Farming and Food Systems	Community Development
Food Production and Processing	Beginning Farmer Signature Program	Beginners Guide to Grant Writing
	Urban Agriculture Certificate	
	Safe Produce IN	
	Shared-Use Kitchen Development Toolkit	
Coordination	Community or Local Food Summit	
	Technical assistance for Food Hubs	
Markets	Farm to School Training for Action Committees	Enhancing the Value of Public Spaces
	Market Basket 360	
	Annual Farmers Market Forum	
Consumers	FoodLink	Enhancing the Value of Public Spaces for Health
	Market Basket 360	
Community	Local Foods Indiana Data	Community Leadership Development
	Support for Food Policy Councils online Professional Development Course	Facilitative Leadership
	Indiana Food Policy Council Network	
	Community Wellness Coordination through the SNAP Ed Program	

PURDUE RESOURCES

The Purdue University Extension Local Food Program and Community Development programs provide a wealth of programmatic, technical assistance and facilitative skills critical for the implementation of planning and policy documents. Working from farm to plate, these programs offer education to re-localize the food system for many stakeholders, including beginning farmers, farmers markets, public school systems, food processors, food entrepreneurs and consumers. Visit www.purdue.edu/dffs and www.cdext.purdue.edu to learn more.

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INDIANA SITE CERTIFIED PROGRAM

Developed by the Indiana Office of Community and Rural Affairs

The Indiana Office of Community and Rural Affairs (OCRA) administers the Indiana Site Certified program, which designates sites that are well positioned for economic development. Indiana recognizes three tiers

of readiness: Silver, Gold and Prime. Certified sites are featured on Indiana's Site Selector Database and are included in Indiana Economic Development Corporation (IEDC) marketing materials. Communities of any size are eligible to apply for this certification and applications are accepted on a rolling basis. More information can be found on OCRA's website (in.gov/ocra/sitecertified.htm) and in the following information sheet.

Indiana Site Certified



The Indiana Site Certified program certifies sites that are ready for economic development. Communities of any size apply for the designation through the Indiana Office of Community and Rural Affairs (OCRA).

The Indiana Site Certified Program has three main goals:

1. Mitigate risks
2. Marketing tool
3. Illustrate the community's commitment to economic development

Indiana Site Certified Silver Bottom Tier



- No size limit
- No proximity to state highway
- Support from LUG-CEO
- Clear Title-50 YR Title Search
- Zoning not required
- ALTA Survey
- Topo map using LIDAR
- Aerial Map
- Phase 1
- Wetland Delineation
- Letter from INDOT addressing appropriate use of site
- Utility Service capacity and distance defined

Indiana Site Certified Gold Middle Tier



- 20 contiguous acres
- At least 5 miles from a State Highway
- Zoning required
- Geo tech study
- Seismic hazard map
- Be free of recognized environmental concerns
- Desktop archaeological investigation
- Utility to property line or future build located in public right of way

Indiana Site Certified Prime Top Tier



- 30 contiguous acres
- At least 2.5 miles from a State Highway
- Zoning required
- Geo tech study
- No recs or site clear
- Archaeological investigation
- Utility to property line or future build located in public right of way
- LUG, LEDO, or REDO must own property or have agreement with property owner

Indiana Site Certified Glossary



Aerial Map: Map of the site using photographs showing layout and location from an elevated position.

Archaeological Investigation: Archaeological records checks including a thorough investigation of documentary records, historical maps and plans of the area, photograph evidence, geological information as well as all relevant data from the IDNR DHPA along with a Phase 1a Reconnaissance Report.

ALTA Map: Survey map including boundary lines, location of the main building with improvements, location of ancillary buildings, identification of easements (access rights by service companies such as water, gas, telephone, railways, and other utilities).

Clear Title: The fifty-year title search found no liens, mortgages, judgments, encumbrances, or unpaid taxes.

Contiguous Acres: All acreage must be uninterrupted, touching or connected throughout in an unbroken sequence.

Current Documents: Completion of annual updates ensuring the status and information on the Site and Building Database is accurate.

Desktop Archaeological Investigation: Desk-top assessment will include a thorough investigation of documentary records, historical maps and plans of the area, photograph evidence, geological information as well as all relevant data from IDNR.

Established Price: Letter from the property owner includes a sale and/or lease price.

Support from LUG-CEO: The chief elected official from the local unit of government has submitted a letter of support for the project.

Five miles from two-lane highway transportation: The site must be a minimum of five miles from an INDOT designated state or federal highway.

Infrastructure to the property line or on the property: The site must have water, wastewater, electric, natural gas and high speed communications to the property line or located on the property.

Letter from INDOT addressing appropriate use of site: Letter from INDOT district office discussing transportation access points for the site.

Free of environmental concerns: The Phase I Environmental Assessment returned without any Recognized Environmental Conditions (REC) or documentation demonstrates all contaminants have been cleaned up.

Phase I Environmental Assessment: Report identifying potential or existing environmental contamination liabilities. Includes examination of potential soil contamination, groundwater quality, and surface water quality. Must be based on ASTM standards E 1527-00 or 1527-05.

Phase II Environmental Assessment: Report following the identification of a Recognized Environmental Condition (REC) during the Phase I Environmental Assessment. Includes collection of soil samples and/or ground- water and surface water. Only required if the Phase I Environmental Assessment identified REC (s).

Proper Zoning: Site is located in a jurisdiction that has a planning department established in compliance with IC 36-7-4 and the selected industry profile (s) is/are consistent with the local zoning ordinance.

Public Right of Way: an easement granted or resected over the land for transportation purposes. This could be a highway, public footpath canal, or pipelines.

Seismic Hazard Map: Inclusion of mapping of the site to verify seismic hazard %g for 2% in 50 years peak ground acceleration (PGA).

Geo tech survey: Study investigating sample soil borings taken at site to obtain information on the physical properties of the site's soil and rock to determine the strength and properties of a required building foundation. Report will determine any known risk factors including seismic vibration/activity, fault lines, sink holes and past under- mining. Must meet the requirements of one soil boring for every ten acres of land and each soil boring must be a minimum of 20 feet in depth.

Topographical Map using LIDAR: LIDAR mapping is a technological form of mapping that uses high-resolution to project deep set imagery that collects data via LIDAR and provides a detailed image.

Utility capacity and distance defined: Letters from utility providers identify the site's capacity and distance for water, wastewater, electric, natural gas and high speed communications to the property line or located on the property or the community has demonstrated the ability to construct and pay for the infrastructure up to the property line.

Wetland Delineation: Report performed by a certified professional determining wetland boundaries or locations on the property.

Last updated 12.16.15

SITE CONSIDERATIONS FOR THE RURAL ECONOMIC DEVELOPMENT MODEL

Developed by the Indiana Economic Development Association's Rural Economic Development Affinity Group - a partnership with the Indiana State Department of Agriculture, Purdue Center for Regional Development, Indiana Farm Bureau, Indiana Corn Marketing Council/Indiana Soybean Alliance, Indiana Office of Community and Rural Affairs, and the Indiana Economic Development Association

Agriculture and ag-based business might require a different infrastructure footprint than other industry. Water, waste-water capacity, road surface and capacity, rail service, bridge width and structure might all be unique, depending on the agribusiness targets for a community and region. Connecting infrastructure requirements to a community's ag-based economic development targets up front will be critical. Relying on available resources can be a significant advantage.

The planning and identification of specific industry needs should come together in each community with the development of sites that meet the unique needs for the ag industry targets. Knowing how an "ag park" has different specifications from a typical industrial park will be critical and working with local elected officials and leaders to differentiate the community and develop sites that are "shovel ready" for the targeted ag businesses will position communities to succeed.

Development of an appropriate site should be the culmination of the research and prioritization of assets, the facilitation of appropriate policies, the leveraging of existing resources and the implementation of infrastructure plans.

We need to stop thinking about farmland and crops as commodities, and look at them as raw material for value-added processing. Any land-use and zoning discussion needs to occur early in the process to ensure the use is compatible with the community's land use plan, that the environment is right and that the project is socially acceptable. The development of a food

processing facility needs to be broken down to include a discussion on the quantity, quality and content of the process for all infrastructure needs.

Food processing site and facility needs will vary, dependent on the type of input and processing, such as:

- Dairy
- Grain
- Meat
- Produce
- Poultry
- Other

SITE CONSIDERATIONS FOR FOOD PROCESSING

SITE REQUIREMENTS

Existing facility

- Food grade
- USDA clean environment
- Review by regulatory agencies

Bare land

- Developable land
 - USDA clean environment
- Shovel-ready site
 - Utilities in place
 - Environmental permits obtained
- Fast track site
 - Utilities in place
 - Environmental needed

Future development in the area

- Existing food processing facilities may limit which other types of industry can be in close proximity

LAND USE/ZONING

Land use - local

- Compatible with community's plan
- Compatible with community's target sectors

Zoning - local

- Acceptable use
 - No additional permits required
- Special use permit
- Access to the facility's raw material
 - Confined feeding operations

LOCATION

- Proximity to raw material
- Proximity to markets

LOGISTICS

- Highway access (two-lane/four-lane/interstate)
- Rail service
- Air service
- Ports
- Motor carrier services

UTILITIES

Electric power

- Capacity
- Reliability
- Redundancy
- Location of substations
- Cost

Natural gas

- Availability
- Size of pipeline
- Cost

Water supply

- Process water versus domestic use
- Volume per minute
- Treatment capacity
- Cost

Wastewater

- Treatment capacity
- Distance to treatment

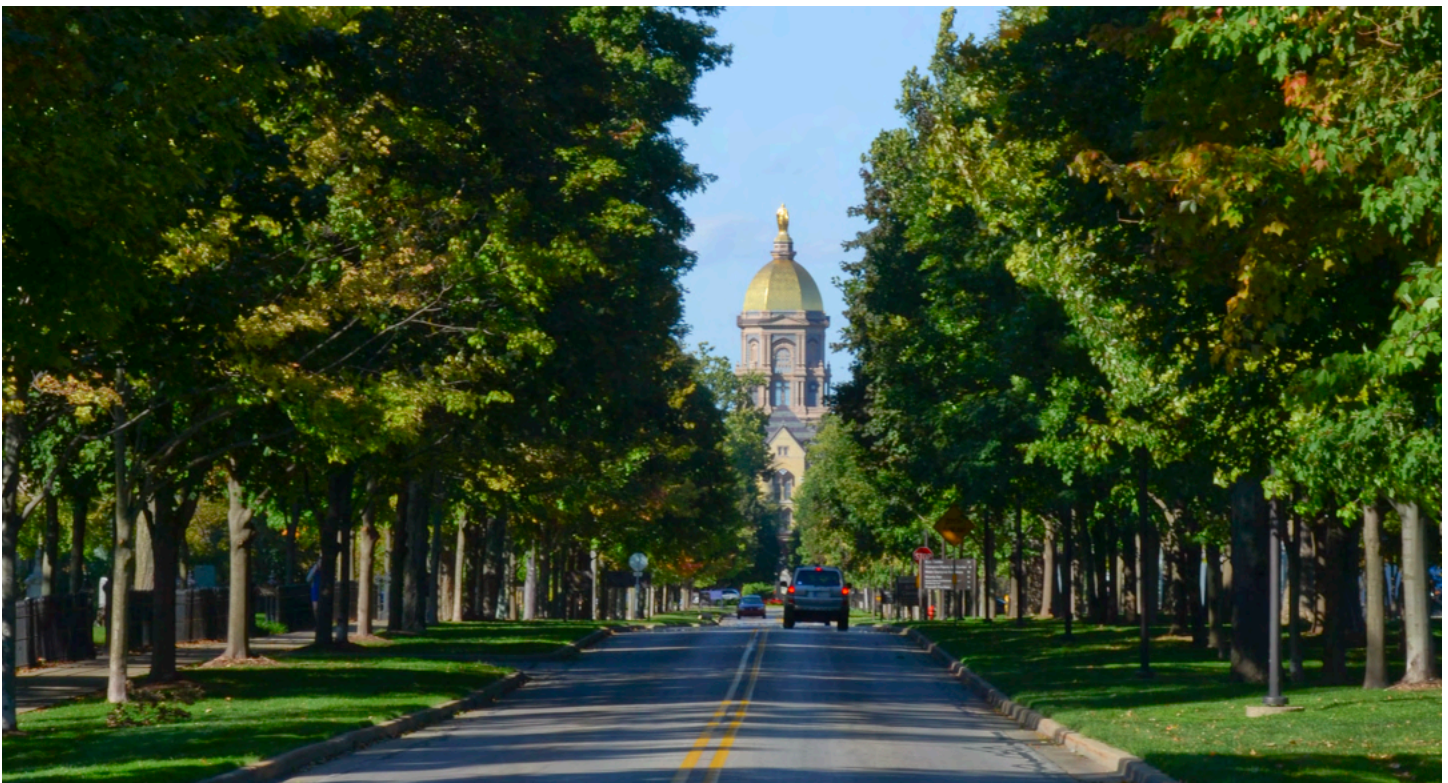
- Size of pipeline
- Location of lift stations
- Cost and surcharges
- Quality
 - Basic oxygen demand (BOD)
 - Total suspended solids
 - Nutrient loading (e.g., nitrogen phosphorus compounds)

TELECOMMUNICATIONS

- Land lines
- Mobile service
- Broadband/high-speed Internet/fiber

PERMITTING

- Air quality
- Soil
- Water
- Wastewater and discharge
- Environmental
- Geotechnical compatibility
- Construction and occupancy
- USDA standards
- Costs for all permits



LAND USE TOOLS FOR PRESERVING FARMLAND

Tamara Ogle, author

In communities across Indiana, open space contributes to the look and feel of the community and provides for amenities and resources. Open space is simply land that is not developed. Open space can include amenities such as parks and golf courses, fields and pastures utilized for production agriculture or natural areas such as woodlands and wetlands. Open space can be public or private land. Private open space like private woodlands, fields and pastures provide important resources to the community such as rural scenery, watershed services and natural habitats even though access is restricted. Planning with open space in mind helps communities preserve these resources. This section will focus on farmland preservation although additional resources for open space planning can be found in the references (Prokopy, McCormick & Reimer, 2005).



Agriculture is an important part of Indiana's economy with \$11.2 billion in sales of unprocessed agricultural commodities (National Agricultural Statistics Service, 2018). Additionally, production agriculture, along with supporting industries such as fertilizer services and food processing, are estimated to provide around 188,640 jobs to Hoosiers (Kinghorn, 2015). Agriculture also is the primary land use in the state, with 14.7 million acres (64 percent of the state's total land area) dedicated to farmland in 2017. While agriculture remains the most significant use of land, the number of farmland acres has decreased by 14 percent since

1975 (National Agricultural Statistics Service, 2018). Oftentimes in rural communities, agriculture is the default use of land, with community planning policies geared more toward development than open space preservation. While farmland is preserved when there is a lack of development, under this system it can be lost quickly when the demand for development is high. This is a particular issue in growing metropolitan and micropolitan areas where the demand for land for development is high, but it can also be an issue in rural communities. People looking for a rural lifestyle may lead to sprawling residential development across rural areas. As communities look to grow, a goal of farmland preservation as a part of their comprehensive plan can help them put into place the policies needed to encourage smart growth while maintaining prime farmland resources. Ultimately, planning to preserve agriculture land can:

- Reduce land use conflict,
- Protect valuable natural resources,
- Preserve rural character,
- Encourage development in key areas,
- Condense needed infrastructure and
- Maintain land for food production.

Preserving farmland and open space is one of the principles of Smart Growth (McCormick & Dorworth, 2009). By encouraging development and growth around existing infrastructure, communities can provide services more readily and efficiently and maintain their rural character outside of their towns and cities. Once land is developed, regardless of the purpose, it is difficult to convert back to fields and pastures. When a community has identified farmland preservation as goal, they first need to inventory the farmland resources. Not all farmland is equal, and by looking at soil types, tract size and geographical location a community can start to assess the value of their agricultural resources (Carver & Yahner, n.d.). Communities will want to prioritize protecting their most productive farmland in terms of soil productivity, accessibility and efficiency. Community planners will also be able to identify areas where they would most like to see future development, such as along transportation corridors, with access to needed infrastructure, close to services or existing development. Once a community has identified prime agricultural land and other areas of interest, there are a number of tools that can be employed.

ZONING

The use of different zoning districts is the most obvious tool. Communities frequently have agricultural, residential, commercial and industrial zones. However, zoning ordinances can be expanded to include differentiated agricultural zones. For example, if Hoosier County wanted to create two agricultural zoning districts, protected agricultural and agricultural, development standards can be more restrictive in the protected agricultural zone than the agricultural zone. If Hoosier County wanted, they could include a third zone for rural residential. In this zone, residential development would be expected.

Some intensive agricultural uses or agricultural industries may seem to be a good fit in a protected agricultural district because of the need to buffer from residential and commercial land uses. A community may want to consider some of these as a permitted use or special exception while keeping in mind the goal of preserving open farmland. Once land is developed, regardless of the type of development, it is costly and difficult to restore this prime agricultural land resource. Related uses also may impact the land differently, such as increased traffic on rural roads or impact on drainage. If any developed use is allowed, communities can place additional standards such as buffers and setbacks on that use.

EXAMPLE 1

	Protected Agricultural District	Agricultural District	Rural Residential District
Goal	Preserve open farmland resources for production agriculture	Provide land for production agriculture, farmsteads and agribusinesses	Provide space for large lot residential development in a rural setting while maintaining non-intensive agricultural production
Minimum lot size	40 acres	10 acres	2 acres
Residential as a permitted use	Special exception	Special exception	Permitted
Residential subdivision (from the subdivision control ordinance)	Not permitted	Not permitted	Permitted

The above zones and standards are intended to serve as an example. Communities can create these differentiated rural zoning districts and their various development standards to provide appropriate space for different types of rural land uses (Washington County, 2005). Whatever zoning tools are implemented should support the goals of the county's comprehensive plan. The county may also want to consider looking at their subdivision control ordinances and limiting splits in the agricultural districts to support these goals.

without limiting the development. With a scoring system, a potential residence would be awarded points based on meeting certain criteria spelled out in the zoning ordinance. A set minimum score would have to be reached for the residence to be permitted at the proposed location. Some criteria might include points for being a farmstead, existing land use, private or municipal water, road type or density of the section. By awarding points, the community can encourage new houses in a residential district to build in places that limit sprawl and conserve farmland.

RESIDENTIAL SCORING SYSTEM

In the example, residential use in the agricultural district was listed as a special exception. This means it would need to go through an additional process to be permitted where the board of zoning appeals could look at each individual case. Another way of evaluating whether or not a specific residential project is a good fit for the zoning district would be through a scoring system. Scoring systems are sometimes used for confined feed operations (see ILRC's model ordinance), but can be used for any sort of development when a community wants to encourage certain practices

MINIMUM LOT SIZE

Many communities use a large minimum lot size in rural districts in hopes of preventing residential buildup in rural areas. However, this can have an adverse effect. If each home in the county's agricultural district is required to have 10 acres, then residential development will naturally be more spread out. Five homes would require 50 acres. If the county were to reduce the minimum lot size to two acres, those same five homes could only take up 10 acres in the agricultural district. Maintaining an appropriate minimum lot size in rural

areas not serviced by a central sewage system is still important. Plan commissions should work with the county health department to better understand what that minimum lot size and appropriate density should be to maintain septic systems well into the future. It may be better for rural communities with goals of both increasing or maintaining their population and preserving farmland to consider where they would like to see rural residences built and craft policies to bolster both goals.

THE LIMITATIONS OF ZONING TOOLS

While zoning provides a great opportunity for communities to plan for current and future land use, it also has its downfalls. The zoning of a particular parcel can be amended or rezoned. Variances can be given. Developmental standards can be changed. Additionally, privately owned land where a community would like to encourage development may not be readily available for purchase. Zoning tools such as differentiated agricultural districts, development standards and scoring systems will not preserve farmland in perpetuity, but they can help communities guide development and land use in the present (Chase, 1999). Zoning tools are most effective when the community leaders, plan commission and board zoning appeals members and the community at large have been engaged in the planning process and understand and uphold the community's goals.

AGRICULTURAL CONSERVATION EASEMENT

Although not a land use planning tool, agricultural conservation easements can provide protection of farmland in perpetuity. An agricultural conservation easement is a legal agreement by a landowner to restrict development of a piece of property. This agreement or restriction attaches to the deed of the property and stays with it even when transferred to a new owner. Agricultural conservation easements can be gifted or sold to a private land trust with the mission of preserving open land or public agencies. When conservation easements are gifted, there can be tax benefits to the landowner. Agricultural conservation easements provide permanent protection of farmland; however, purchase programs can be costly for local or state governments. To learn more about conservation easements see the publication "Conservation Easements in Indiana" (ID-231).

CONCLUSION

Farmland preservation is not about limiting development in Indiana's rural communities, but protecting valuable natural resources, preserving rural aesthetics while reducing potential land use conflicts. Planning and zoning tools, while subject to change, can help communities balance development and agricultural activities and interests. Involving stakeholders in the planning process, identifying clear community goals and crafting land use policies to support those goals can help communities intentionally plan for and conserve prime agricultural resources.

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Planning for Agritourism



A GUIDE FOR LOCAL GOVERNMENTS AND INDIANA FARMERS

Developed by the Indiana State Department of Agriculture

INTRODUCTION AND OVERVIEW

Agritourism is a business model that is growing in popularity as Indiana farmers recognize a need to diversify their operations and supplement their farm incomes. In addition, there is a growing public desire to engage in rural experiences and outdoor recreational activities. By combining agriculture and tourism, agritourism offers rural experiences to urban residents and economic diversification to farmers. Planning for agritourism requires a forward-thinking, locally driven process. Planners must acknowledge agriculture as a land use as well as a business. The Indiana Land

Resource Council (ILRC) designed this planning guide for agritourism operators, community leaders, extension agents and rural economic development and tourism professionals.

WHAT IS AGRITOURISM?

There is no universal definition of agritourism. It is frequently used interchangeably with “agri-tourism,” “agrotourism,” “farm tourism,” “agricultural tourism” or “agritainment.” It is also generally understood to be a business model that links agricultural production/processing with tourism to attract visitors to a farm, forest, or other agricultural business for the purposes of entertaining and/or educating the visitors and generating income for the farm, forest or business owner. Purdue University defines agritourism as “any business conducted by a farmer or processor for the

enjoyment or education of the public, to promote the products of the farm and to generate additional farm income” (Purdue University, 2005). In comparison, Lancaster County, Pennsylvania, defines agritourism as “visiting a working farm or any agricultural, horticultural or agri-business operation for the purpose of enjoyment, education or active participation and involvement in the activities of the farm or enterprise” (Lancaster County Planning Commission, 2009).

*In 2011, the Indiana General Assembly defined an **agritourism activity** as: (1) an activity at an agricultural, horticultural or agribusiness operation where the general public is allowed or invited to participate in, view or enjoy the activities for recreational, entertainment or educational purposes, including farming, ranching, historic and cultural agricultural activities, self-pick farms or farmers’ markets; (2) an activity involving an animal exhibition at an agricultural fair; or (3) natural resource-based activities and attractions, including hunting, fishing, hiking and trail riding.*

EXAMPLES OF AGRITOURISM

Indiana is home to a wide variety of agritourism operations. Common examples include:

- Pumpkin picking patches
- Corn mazes/crop art
- Educational and demonstrative tours
- On-farm farmers’ markets and roadside stands
- U-Pick operations
- Petting and feeding zoos
- Hay rides
- Cut-your-own Christmas tree farms
- Agricultural museums
- Living history farms
- Processing demonstrations
- Winery tours and wine tasting
- Breweries
- Horseback riding
- Rural bed and breakfasts
- Garden tours
- Other commercial activities in conjunction with farm, forest or agribusiness use

For more information on Indiana agritourism experiences, please visit the agritourism page at VisitIndiana.com/agritourism. For agritourism operator resources, please see the ISDA agritourism website, www.in.gov/isda/3434.htm. The Indiana State Department of Agriculture (ISDA), in partnership with the Indiana Office of Tourism Development, developed these resources to help Hoosiers and visitors find agritourism destinations across the state.

IMPORTANCE OF AGRITOURISM

Agritourism provides a number of economic, educational and social benefits to producers, consumers, tourists and communities. Furthermore, agritourism provides incentives for producers to remain in agriculture.

The agriculture industry is facing a growing number of challenges, such as market competition, rising land and input costs, encroachment from urban sprawl and a complex regulatory environment. In order to stay in business, some operations have had to look for ways to add value to their products and create dependable revenue sources. Because of their proximity to a number of large and diverse metropolitan areas of the Midwest, Indiana farmers have tremendous opportunity to diversify their list of product and service offerings and supplement farm incomes.

Agritourism enterprises provide numerous economic benefits to the surrounding community. Operations create jobs and support the local economy through their purchases of goods and services. Other “spillover” economic development opportunities occur when agricultural tourists shop, eat and lodge in the surrounding communities. Agritourism also provides rural communities with the potential to increase their local tax bases because farmland generally requires fewer community services and generates more local tax revenue than it costs in services (DeBoer, 2010). More importantly, agritourism operations are unique, local businesses that cannot later be “outsourced” to other communities.

Lancaster County, Pennsylvania, is nationally recognized for its agritourism enterprises. In 2009, the local plan commission and tourism development council developed a comprehensive plan and agritourism guidelines to maximize their economic development opportunities. The publication identified several benefits that could be directly attributed to the development of a successfully managed and regulated agritourism program. These benefits include:

- *Enhancing the economic viability of the farm and providing on-site employment opportunities*
- *Generating additional income or off-season income for the farmer*
- *Interacting with and educating locals and visitors about the importance of farming in Lancaster County*
- *Increasing awareness of local agricultural products*
- *Developing a new consumer market niche*

Agritourism provides educational experiences that connect visitors to scenic landscapes and the local community heritage. Such operations can also be used to educate the public about the industry's contribution to the local quality of life. For example, agritourism can provide sustainable ways to care for rural working lands and scenic areas. Agritourism can also preserve the agricultural heritage of a community. Farmland and forestland preservation ensure that future generations will have the opportunity to visit local farms and timber operations, learn more about agriculture, participate in recreational activities and enjoy a local food supply. In short, agritourism has the potential to turn urban residents into strong allies for farms, forests and other agricultural enterprises.

To promote agritourism enterprises in Indiana, the General Assembly enacted a limitation of liability for agritourism providers who provide a statutory warning to participants and meet other specific requirements. Essentially, the law limits liability that may arise from the "inherent risks of agritourism activities." Inherent risks are defined as "those conditions, dangers or hazards that are an integral part of an agritourism activity" (Ind. Code Section 34-31-9-4). If all of the statutory requirements are met, then a participant or his/her representative cannot make a claim for injury, loss, damage or death caused by the inherent risks of an agritourism activity.

There are some exceptions and exclusions. For example, this law does not limit liability for injuries caused by improperly trained employees or due to a known dangerous condition on the land which is unknown by the participant.

POTENTIAL OBSTACLES

Although it is very likely that agritourism development can be successfully integrated into local communities without great disruption, there are some potential challenges. Planning for agritourism requires attention to possible neighborhood impacts and competing interests within the agricultural community.

Residents often have concerns about potential noise, traffic and trespassers because these impacts have the potential to change the overall character of the community. When farmers take proactive actions to maintain good relationships with neighboring landowners, local decision makers and the community, many of these concerns can be resolved informally. There are also several tools available that can be used to minimize potential obstacles.

Noise levels can potentially diminish the quality of life for neighboring landowners. In general, the noise level in rural and agricultural areas is lower than urban areas. These peaceful surroundings are a part of the character of rural areas. However, agricultural operations can also be very noisy. Machinery, equipment, trucks and animals produce various noises. When considering approval of an agritourism operation, local decision



makers should determine whether the noise of the agritourism operation is similar or different from the noise that normally occurs in rural and agricultural areas. If the noise is not typical to the surrounding area, local decision makers should consider whether activity would be daily, seasonal or event-based. Noise concerns can be addressed through buffers or noise ordinances. The noise ordinances should not be more restrictive for agritourism operations than for other businesses.

Increased traffic can also be a concern for neighboring landowners. Local governments could utilize a traffic management plan that identifies the projected number



of vehicles and any anticipated use of public roads to determine potential traffic impacts. To minimize additional traffic hazards, agritourism operations need to provide adequate off-street parking.

Trespassing is a concern for both agritourism providers and neighboring landowners. Operators should regularly check restricted areas for trespassers. If trespassers are found, such persons need to be escorted back to the proper locations. To limit trespassing onto neighboring landowners, agritourism providers could post “No Trespassing” signs at property boundaries. Posting such signs demonstrates a reasonable and prudent effort to protect neighboring landowners from increased liability.

Local decision makers must also recognize differing perspectives and competing interests within the agricultural community. While some farmers feel that planning is an opportunity to influence the future of the community, others feel anger and uncertainty toward the planning process. In addition, farmers have multiple interests in their property that can conflict with each other. As simultaneous landowners, business owners, taxpayers and community members, a farmer’s interests might vary depending on the issue. For example, a farmer who is actively transitioning operations to a younger generation might support policies that limit non-agricultural development. On the other hand, farmers who plan to exit the industry in the near future might be more likely to emphasize their interest as landowners in order to maximize property values. Different types of farms may also have different priorities. Communities must consider the local diversity in agriculture to ensure that all interests are taken into consideration.

THE PLANNING PROCESS

Communities interested in diversifying their local economy and maintaining rural character recognize the need to support agricultural operations and plan for agritourism. This agritourism planning should be part of a community’s comprehensive planning process (see Ind. Code Section 36-7- 4-500 through 599), which would provide a foundation for agritourism efforts along with associated goals for the future. If a community already has an adopted comprehensive plan, it would be amended to include agritourism. Due to the distinct characteristics, attitudes and values between communities, a comprehensive plan that works for one will not necessarily work for another. A good comprehensive plan reflects the local agricultural culture and helps achieve a unique community identity while ensuring that the needs and desires of all residents have been considered.

Farmers, planners, interested citizens and elected officials must work together to create a vision for the community and develop plans and implementation tools (i.e., zoning, permitting, etc.). During the planning process, it is important to ensure that financial and regulatory benefits and burdens are allocated equitably. Each community will need to strike its own balance in accordance with its characteristics, attitudes and values.

With a shared vision of protecting agricultural lands and promoting agritourism, farmers, planners, citizens and local officials can be strong partners in planning. Public-private partnerships can also provide support for the planning process.

Federal, state and local laws and other decisions can directly impact local agricultural uses. For example, the Indiana Right to Farm Act provides agricultural operations protections that supersede local ordinances. Furthermore, expenditures by federal and state programs for roads, water, sewer and other kinds of development can have significant impacts on agriculture in a community. To the extent possible, integration of local, state and federal policies is essential.



Each community must determine the appropriate balance of planning regulations and incentives. The balance must be based on the overall cost of the various tools in relation to the available resources. The cost effectiveness of various approaches should be analyzed over the long term to determine which strategies make sense for agritourism in a given community. For example, several local governments in the Shenandoah Valley of Virginia worked together to incentivize agritourism through collective marketing, tracking and capacity-building initiatives. They leveraged local resources to promote the economic development of agritourism. Other local governments may choose to incentivize agritourism through favorable tax structures for permanent agritourism structures.

Strategies for increasing participation from the agricultural community

- Engage local farmers early in the planning process
- Hold focus groups and meetings at times and locations convenient for farmers
- Establish an agricultural advisory committee
- Invite local farm organizations to participate in the planning process
- Identify key farm leaders and encourage them to solicit feedback from the agricultural community
- Advise farmers on how to participate most effectively in the planning process

Strategies for how farmers can participate in the planning process

- Contact the planning department to cultivate relationships with the staff and evaluate the community's plan
- Explain to local officials how the municipality or county could better support agricultural enterprises
- Seek appointments to plan commissions, board of zoning appeals or advisory committees

(Farmland Information Center, 2018)

ZONING

While promoting agritourism development, the community must not lose sight of the balance between the legitimate public health, safety and welfare concerns of local government; the preservation of the rural character of the county and the provision of opportunities for growing a sustainable tourism industry in rural areas. Zoning ordinances are the primary implementation tool of a comprehensive plan and are a vital tool for maintaining this balance. Zoning can support community goals by regulating land use, intensity of use and development standards (i.e. parking, screening and signage).

Home rule, or local control, is the foundation of Indiana land use planning. In 1980, the General Assembly enacted the home rule statute, which gave counties the power to exercise any powers not specifically denied to them or reserved by the State of Indiana. The statute granted Indiana counties "all the powers that they need for the effective operation of government as to local

affairs.” Local units of government have the authority to engage in comprehensive (land use) planning and enact zoning ordinances; almost all Indiana counties exercise these powers. Just like with comprehensive plans, the nature of Indiana zoning ordinances will vary greatly with each locality.

It is generally recognized that there are different levels of intensity associated with different agritourism activities. Local governments can utilize various zoning models to manage these uses. Some communities have more than one Agricultural Zoning District, so certain agritourism uses might be permitted in all, some or none of those districts. Generally, the lower the intensity of the agritourism use, the lower the amount of review required. Lower-intensity uses are typically allowed by right within an agricultural or rural district. Uses that have moderate-scale impacts may be allowed by right but subject to established development standards. Quantified development standards can help mitigate anticipated impacts of agritourism activities. Development standards may include criteria to specifically address potential impacts, such as noise, traffic or dust. High-impact uses can be approved through a discretionary process, such as a special exception through the board of zoning appeals or development plan approval through the plan commission. High-impact uses should require public review of the proposed agritourism operation. For example, Hancock County, Indiana, passed a zoning ordinance that makes distinctions between the types of agribusinesses based on their intensity of use.



ZONING ORDINANCE DRAFTING TIPS

- **Zoning district purpose statement.** If you have a specific zoning district for agritourism, ensure that the purpose statement reflects the county’s vision for agritourism (which should be part of the comprehensive plan). An example from Troup County, Georgia, is below.

Purpose. *The purpose of this ordinance is to allow Agritourism uses in Troup County, Georgia, while maintaining the rural character and preserving farmland of the area and protecting the health, safety and welfare of the citizens. Agritourism presents a unique opportunity to combine aspects of tourism and agriculture to provide a number of financial, educational and social benefits to tourists, producers and communities.*

Agritourism gives producers an opportunity to generate additional income and an avenue for direct marketing to consumers. It enhances the tourism industry by increasing the volume of visitors to an area and the length of their stay. Agritourism also provides communities with the potential to increase their local tax bases and new employment opportunities. In addition, agritourism provides educational opportunities to the public, helps preserve agricultural lands and allows the development of businesses that cannot later be outsourced to other countries.

Allowing agritourism uses in the Agricultural and Agricultural/Residential Districts of Troup County provides:

- *Enhancement of the economic viability of the farm and provides on-site employment opportunities*
- *Additional income and/or off-season income for the farmer*
- *Interaction with and education of local citizens and visitors about the importance of farming in Troup County*
- *Increased awareness of local agricultural products*
- *A new consumer market*

- **Define and use the term.** Define agritourism in the definitions section of your zoning ordinance and reference it as a use in the list of permitted uses and use table. It may be necessary to add more definitions of specific agritourism uses (U-Pick, etc.) if all uses are not allowed in all agricultural zoning districts.

Regardless of the exact definition or terminology, The National Agricultural Law Center suggests that any definition of agritourism should include the following four factors:

- *Combines the essential elements of the tourism and agriculture industries*
- *Attracts members of the public to visit agricultural operations*
- *Increases farm income*
- *Provides recreation, entertainment and/or educational experiences to visitors*

- **Develop standards.** Draft an agritourism ordinance that reflects intensity of use and includes it in standards for parking, screening, lighting, signage, etc.

Include agritourism uses in the by-right or as special exception or development plan uses within ag zones

- *Examples can enhance agritourism uses and broaden the public's understanding of what to expect and promote within certain areas of the county*
- *Uses should be based on impacts rather than agricultural definitions because such definitions can be vague and they are subject to misinterpretation*

Agritourism operations must:

- *Be an existing and operating working farm*
- *Be incidental to and directly supportive of the agricultural use of the property*
- *Not have significant impacts on the agricultural viability or rural character of neighboring properties*

Permanent agritourism structures should be required to meet the requirements for similar businesses in the zoning district

ADDITIONAL RESOURCES

Please see njsustainingfarms.rutgers.edu/Agritourism/wp/agritourismplannerpolicyactions.html for a list of specific actions that support agritourism enterprises.

Please see njsustainingfarms.rutgers.edu/townfarmfriendly.html for a checklist regarding protection of a community's agricultural base. This checklist evaluates three major categories: Practical Land Use Ordinances and Regulations, Fair Enforcement of Local Regulations and Understanding and Encouraging Farming. Towns that encourage agricultural activity retain the benefits inherent in local farms of open space, food security, energy independence and healthy communities.

Please see planning.woodfordcountky.org/documents/AARCDDecisionTree.htm for a tool on evaluating agritourism proposals.

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Forestry and Natural Resources



INTRODUCTION TO URBAN FORESTRY

Urban forestry is a program that invests in the future of the community. Considerations for planning and protecting trees should consider biological, management and community needs to establish the best policies and practices. This section will provide a survey of the basic tools and concepts to help your community with protecting and enhancing urban trees. Topics and examples will include creating and implementing a management plan, low-impact design strategies, ordinance administration and establishing minimum canopy coverage.

URBAN FORESTRY COMPREHENSIVE PLANNING GUIDE

Lindsey Purcell, author

Urban forestry is a program that invests in the future of the community. Your final plan should consider the biological, management and community needs in order to establish the best policies.

Trees provide many benefits to communities. These can include aesthetic qualities, such as the beauty of flowers

and fall colors, or functional benefits, including shade, storm water management and filtering pollution for cleaner air and water. All of these qualities combined are called ecosystem services.

Unfortunately, Indiana ranks low in air and water quality compared to other states, *but trees can help reverse this situation*. They serve many vital functions important to us, including air cleaners, water purifiers, woodland resources, social assets and economic generators.

Scientific understanding of how urban trees benefit people has increased significantly in recent years. One important benefit that is often overlooked is the economic values trees provide. Businesses are more competitive with consumer demand when trees help create an improved environment that is more attractive and welcoming to customers. Surveys indicate that the public prefers to patronize establishments where trees and landscaping are established. Consumers both stay longer and spend more money in business districts with green areas. Research also indicates that consumers are willing to pay more in these tree-lined shopping areas.

A process for strategic planning is needed in order to protect and expand the urban forest. In this section, we will provide a helpful list of considerations, examples of urban forest management and resources for creating a customized plan for your community. Future generations rely on informed decision-making today to improve the canopy and influence the ecosystem services provided by the urban forest.

An Urban Forestry Management Plan (UFMP) is a roadmap that creates a shared vision for the future of the tree canopy. It's a tailored plan that guides urban forestry professionals to proactively and effectively manage and provide for maximum long-term benefits to the community. The UFMP provides recommendations based on the analysis of detailed inventories and includes additional components or documents, such as budgets, implementation schedules, policy and procedure manuals, standards and specifications, public education and monitoring plans and existing ordinances. Annual work plans and budgets can then be developed based on the long-term UFMP.

In general, an effective UFMP will include:

- A **shared vision** for the urban forest
- Inventories and assessments of the current status of the urban forest
- A **strategic plan** that includes goals, objectives and actions based on identified needs
- An **implementation plan** with specific dates and assigned responsibilities of care
- A **monitoring and evaluation** plan with a system or matrix to check effectiveness and revise the UFMP as needed

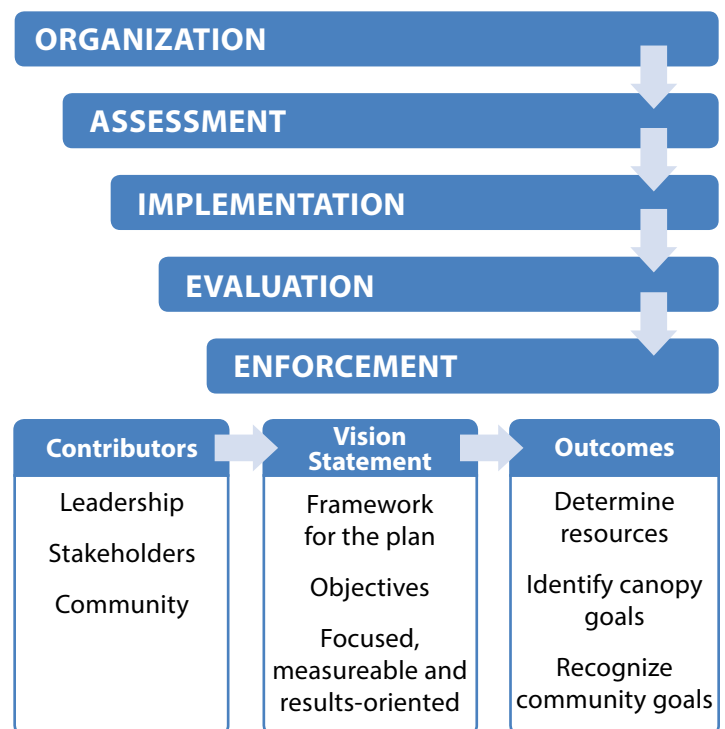
FIGURE 1: URBAN FOREST REQUIREMENTS



The basic requirements for a healthy, sustainable urban forest are an inventory, management plan and an ordinance. These are critical attributes to the overall urban forestry management plan. It's as simple as measuring existing trees, creating a plan to manage those trees and an ordinance to protect those assets.

- A **means of enforcement** of the plan to protect the urban forest and maintain canopy goals

FIVE STEPS FOR CREATING A UFMP



STEP ONE: ORGANIZATION

Contributors

Establish a broad-based community working group or team. A neutral meeting facilitator is often needed to ensure that everyone is heard and that all concerns are identified. The group should meet periodically and consistently to maintain cohesiveness and effectiveness. The working group could consist of, but is not limited to, the participants listed below:

- Tree care professionals
- Representatives of DMD, DPW and DPR
- Emergency management services
- Public Information Officers (PIOs)
- Local utility service providers
- Local NPOs and NGOs, including neighborhood organizations
- Business, health care and other civic leadership

There will likely be trade-offs related to tree care, emergency management, fiscal issues and other considerations. These need to be assessed by the more specialized members of the working group (e.g., tree care specialists) then reviewed and accepted by the community.

Vision statement

To be effective, the vision statement and well-defined goals and objectives should be a community activity. Some ways of increasing community participation include discussing the plan with friends and neighbors, organizing outreach activities such as news releases and public meetings and developing educational programs for schools and other community groups.

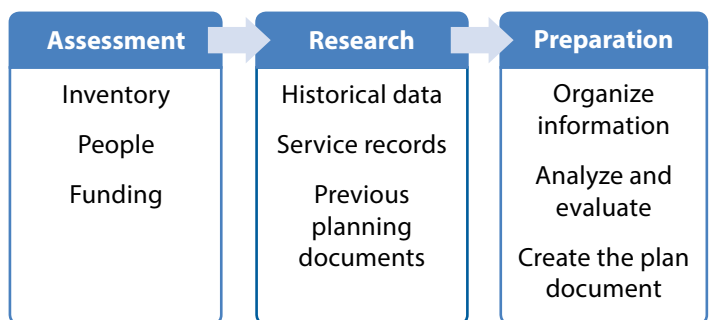
When there is participation, the UFMP has the potential for greater success. It will help identify and develop alternative management options. The team will discover new information relevant to the community and urban forest and have a better understanding of challenges and opportunities. Be sure to demonstrate fairness across community demographics by representing environmental justice in the process.

The following should be accomplished during step one:

- Organize existing resources and determine the value to the planning process

- Get the issues recorded so they can be used to gather support and be critiqued within the community
- Create the vision statement and a broad list of goals and objectives
- Identify the stakeholders, planning team, scale of the project and partnerships
- Recognize the financial obligations and identify funding sources

STEP TWO: ASSESSMENT AND PREPARATION



Most communities will need information to help develop the vision, goals and objectives into a management plan. Some key questions this information should answer include what the urban forest should provide for community, what funding is available to help move the plan forward and whether the community has the necessary resources available to set the plan in action.

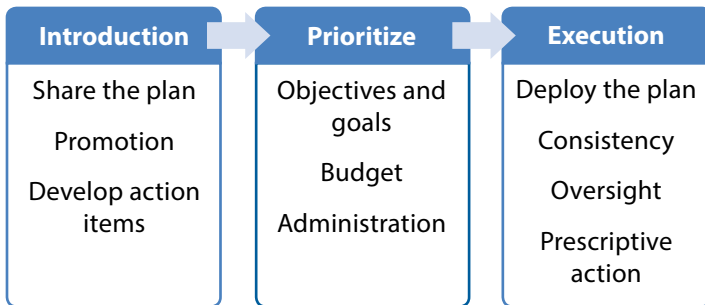
A resource analysis is critical to determine people, funding and inventory, including a reliable tree inventory for all streets and public spaces. The information needed for your plan can come from several sources. A systematic tree inventory is particularly useful for assessing your tree resource and establishing and measuring your goals and objectives.

Keep in mind that data collection is expensive and measure only what is needed, based on previously determined objectives. Reviewing current practices (such as tree planting, pruning and removal) and plans (such as street tree management, emergency response plans, ordinances, etc.) can also identify common objectives and explore ways to plan effectively. If funding is a critical issue, the team might want to apply for an urban community forestry grant to help offset costs. Similarly, if personnel are a critical issue, the team may want to hire a consulting firm specializing in urban forestry to do the inventory and data synthesis.

The following should be accomplished during step two:

- Community consensus of goals and objectives
- The scope of work and the project timeline for the plan
- Identify potential funding opportunities to support the plan
- Data from your resource analysis that supports goals and objectives in the form of:
 - Maps
 - Planting sites and their attributes (location, size, utility conflicts, soil volume, etc.)
 - Stocking levels
 - Risk trees present
 - Trees requiring plant health care, such as pruning
 - List of potential resources (community volunteers, government and private technical assistance, grants, etc.)
- Prepare and create the plan

STEP THREE: IMPLEMENTATION

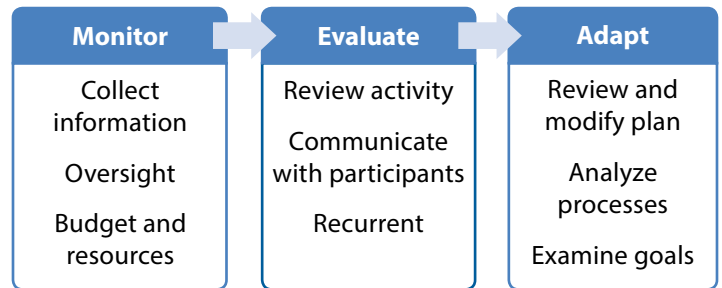


Once the plan is complete, share the excitement with stakeholders, community and staff. Transparency is important. Provide details of the scope and intent of the plan. Prioritize objectives and develop action items that support the established goals and outcomes. Be realistic with the action items, prioritizing based on needs and risk management protocols. Some objectives can be achieved easily and quickly, but budget is an important consideration. Be certain financial support is consistent with both short-term and long-term objectives. Working with the financial principal will be critical to implementation.

Be sure to consider how the community and staff might respond to these changes. All of the planning and building of consensus up to this point will help to ensure that the UFMP will run as smoothly as possible. However, you should approach this step as a learning experience and anticipate the need for contingency

planning. Some objectives can be achieved within a certain timeline, but this process needs to be updated regularly because your community, environment, resources and urban forest will change over time. Updates are important for keeping your planning team and staff aware of priorities and progress.

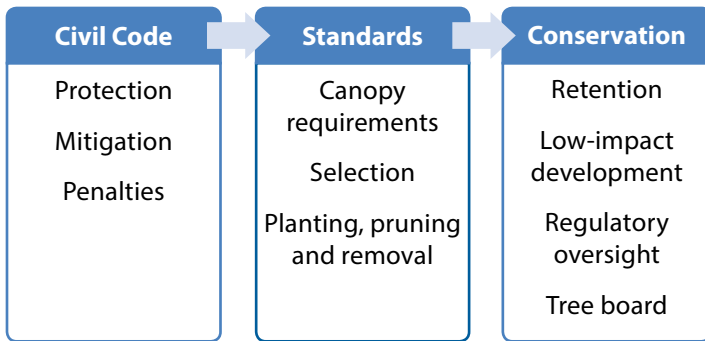
STEP FOUR: MONITOR AND EVALUATE



In most existing management scenarios, monitoring and evaluating the impact of the plan is the most neglected step. Yet, it is one of the most critical elements of any plan because it will determine if the plan's goals and objectives are realistic and actually being met. Monitor and evaluate the impact information as a team, learn from other team members and modify or improve goals if necessary. The culture, politics, budgets and constraints of every community are different and balancing the community's needs with urban forest management is challenging and complex. However, changing and adapting your objectives should serve as learning experiences and not as failures. Consistent evaluation will also provide feedback on how to improve your plan.

A plan and its vision should not have a shelf life; they should be dynamic, flexible management instruments. If the ecological, economic or social assumptions that directed the initial plan change or become questionable, then the plan needs to be adjusted to meet the new realities. In the aftermath of a weather event, the impact on the urban forest is about the last thing on anyone's mind. Trees will be secondary to ensuring public safety, mitigating risk to people and property, cleaning debris and restoring public services and utilities. In fair weather, however, the urban forest should be a primary community concern. Careful planning for the allocation of resources to the urban forest will provide a community with a healthy, strong, resistant forest.

STEP FIVE: ENFORCEMENT



Tree ordinances are among the tools used by communities striving to attain a healthy, vigorous and well-managed community forest. By themselves, however, tree ordinances cannot ensure that the trees will be improved or even maintained. Tree ordinances provide authorization and standards for present and future management activities. If these activities are not integrated into an overall management strategy, problems might arise.

TYPES OF TREE ORDINANCES

Tree ordinances fall into one of three basic categories.

- *Street tree ordinances* primarily cover the planting and removal of trees within public rights-of-way. Recommended species, locations and permits are a part of the ordinance. They often contain provisions governing maintenance or removal of private trees that pose a hazard to the public. Also included in this category are ordinances with tree planting requirements, such as those requiring tree planting in parking lots.
- *Tree protection ordinances* are primarily directed at providing protection for native trees or trees with historical significance. They usually require that a permit be obtained before protected trees can be removed, encroached upon or, in some cases, pruned. They can also include specific protocols related to construction activities near trees.
- *Ordinances* can be a combination of any or all of the above examples. It is entirely dependent on the UFMP goals and objectives.

A clear vision, community participation, monitoring and the ability to adapt your plan to adversity will ensure the sustainability of the urban forest and its services. Conservation and planning is not a discrete event, but a long-term process. Success will require all individuals of a community to cooperate.

SIMPLIFIED URBAN FOREST MANAGEMENT PLAN

These are suggestions for creating a management plan for your community. The statements listed below would require details and features that reflect the needs of the community and results from the inventory.

Vision: To sustain a healthy, safe and appealing public street and park tree population in the community.

Goal: To effectively manage the urban and community forest in an effective manner through sound fiscal, personnel and operational management, utilizing internal and contracted services and building a team of effective proponents for the trees in the community.

SHORT-TERM ACTION ITEMS

- Remove risk trees on rights-of-way and green spaces that could threaten the public.
- Properly prune trees to improve safety and sight lines for key areas such as traffic signals and signs, street lights, pedestrian and vehicular traffic and buildings.
- Perform timely, systematic tree inspections, looking for defects and initiating the proper mitigation strategy.
- Install new street trees to maintain designated canopy goals. This includes replacing those damaged by weather events or in decline from subsequent maintenance operations due to necessary improvements.
- Planning with trees to improve species diversity to better protect the urban forest from pest issues.
- Establish a routine, systematic pruning cycles for all trees along the community rights-of-way, parks and public green spaces.
- Identify potential partners for urban and community forestry programs and initiatives in the community.
- Inform the public of ongoing efforts and long-term strategies to improve engagement and inclusion.

LONG-TERM ACTION ITEMS

- Development of a Street Tree Ordinance for the community.
- Increase public education and involvement in the planning, care and maintenance of the community trees and urban forest.

- Development of a community Tree Board to help provide guidance and recommendations to the community for care and maintenance of the community forest.
- Create a fiscal budget that matches the needs of urban and community forestry operations.
- Develop working partnerships with local and regional utilities, agencies and non-profit organizations to improve effectiveness and efficiency of urban and community forestry operations.
- Plan responsibly to increase the number of trees planted on public lands and along the streets.
- Develop and maintain a current inventory of all street and park trees.
- Develop a comprehensive set of specifications for plant health care applying to internal and contracted service professionals.
- Develop and implement training to internal personnel on all aspects of urban and community tree care.
- Maintain communication and collaboration with all community departments, state highway and transportation agencies on developing standards and criteria for care of trees growing on state roadways.

RESOURCES

City of Indianapolis Municipal Forest Resource Analysis
www.fs.fed.us/psw/topics/urban_forestry/products/psw_cufr738_IND_MFRA.pdf

Indiana Department of Natural Resources Community and Urban Forestry Publications
www.in.gov/dnr/forestry/8337.htm

Indiana Street Tree Benefits Summary
www.in.gov/dnr/forestry/files/fo-benefits.pdf

Purdue Education Store
mdc.itap.purdue.edu/newsearch.asp?subCatID=323%20&CatID=14

Purdue University Department of Forestry and Natural Resources, Urban Forestry
ag.purdue.edu/fnr/Pages/UrbanForestry.aspx

Tree City USA
www.arboday.org/programs/treecityusa/

USDA US Forest Service Urban and Community Forestry
www.fs.fed.us/managing-land/urban-forests/ucf



WHAT DO WE HAVE?

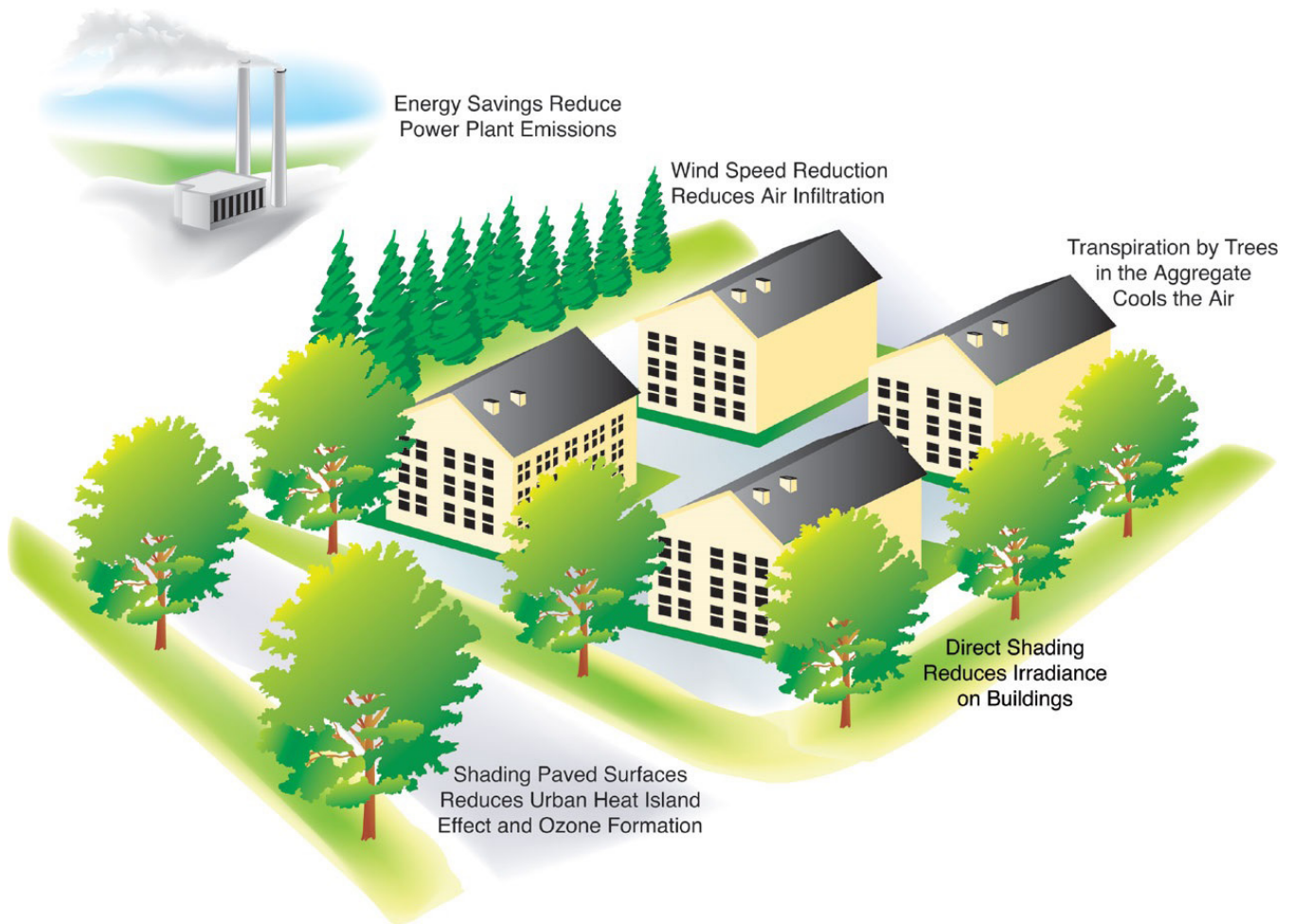
Indicators of a Sustainable Community Forest		Assessed Conditions or Performance		
		Low	Moderate	Good
The Trees	Urban Tree Canopy Level (All Trees)			
	Canopy Location/Distribution (All Trees)			
	Condition (Public Trees)			
	Size/Age Distribution (Public Trees)			
	Species Diversity (Public Trees)			
	Species Suitability (Public Trees)			
Stakeholders	Public Awareness			
	City Department/Agency Cooperation			
	Neighborhood Action			
	Large Private Landholder Involvement			
	Utility Engagement			
	Green Industry Involvement			
	Regional Collaboration			
	Funder Engagement			
The Management Approach	Tree Inventory Data			
	Overall Canopy Data			
	Management Plan			
	Risk Management Program			
	Maintenance Program – Public Trees			
	Planting Program			
	Tree Protection Policy			
	City Staffing and Equipment			
	Funding			
Totals				

The following resources will give you more information on assessing the sustainability of your community forest and forest management program:

- Sustainable Urban Forest Management Planning Using Criteria and Indicators
 - digitalcommons.lmu.edu/cgi/viewcontent.cgi?article=1047&context=cate
- The Sustainable Urban Forest Guide – A Step-By-Step Approach
 - www.itreetools.org/resources/content/Sustainable_Urban_Forest_Guide_14Nov2016.pdf



TREE VALUATION: WHAT'S MY TREE WORTH?



Trees and other living plants are valuable. They beautify our surroundings, purify our air, manufacture precious oxygen, act as sound barriers and help us save energy through their cooling shade in summer and their wind reduction in winter.

Many people don't realize, however, that plants have a dollar value of their own that can be measured by skilled plant appraisers. If your trees are damaged or destroyed, you may be able to recapture your loss through an insurance claim or as a deduction from your federal income tax.

Street trees and urban woodlands provide a number of environmental and social benefits, including contributing to climate change adaptation and mitigation and providing urban green space.

However, measuring the benefits or ecosystem services that trees provide to a community is equally as important. Benefit-based tree valuation provides alternative estimates of the fair and reasonable value of trees while illustrating the relative contribution of different benefit types. This is an important tool for enhancing urban forestry programs by providing monetary value on natural resources as a capital asset. Today, we are able to put a dollar value on many of the ecosystem services that trees provide, such as stormwater management, carbon storage, cooling effects and many others.

This website can help you calculate tree values:
mytree.itreetools.org

TREE ORDINANCE AND CANOPY COVERAGE POLICY

A tree ordinance is a tool to help protect and manage a community's trees. It can be designed to regulate various aspects of tree planting, removal and maintenance on public and private property within a municipality. By protecting trees, a well-planned, written and implemented ordinance can enhance a community's beauty, reduce air pollution, lower air conditioning costs and increase biodiversity.

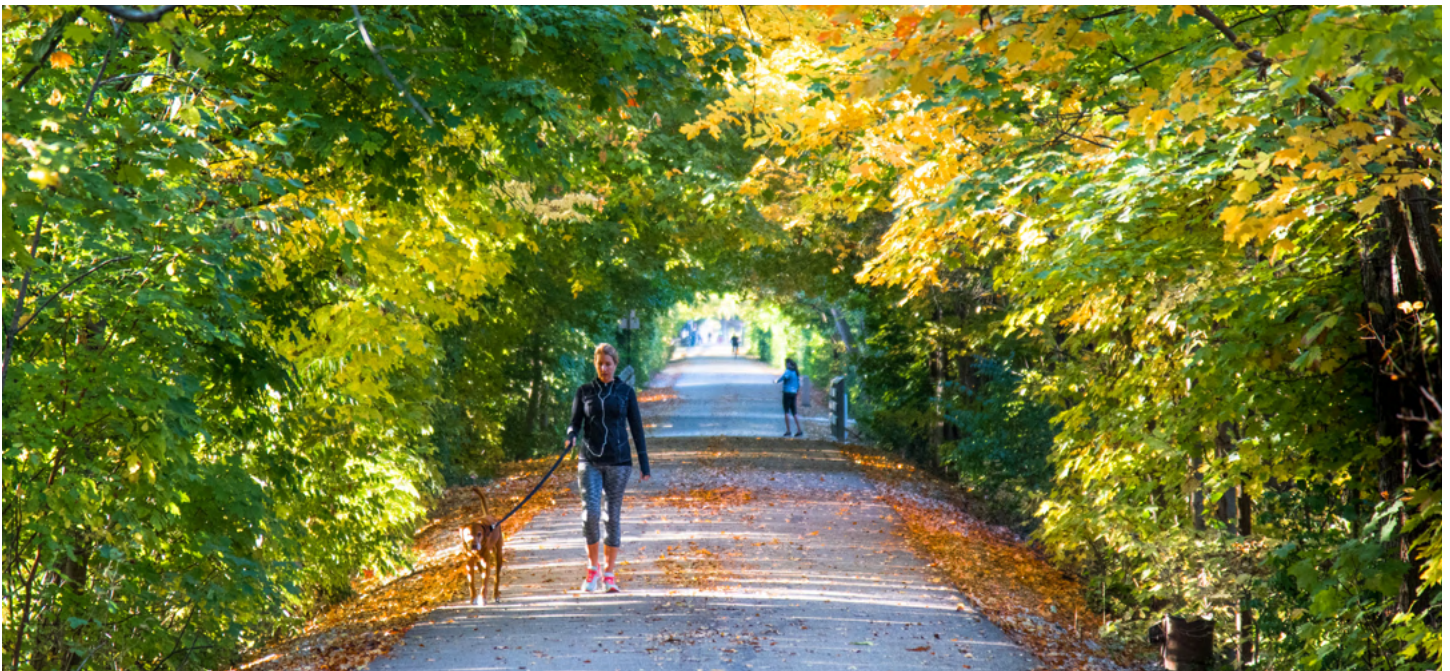
To evaluate the necessity and feasibility of an ordinance, a community should create a working group to assess the municipality's needs and wants, resources and existing ordinances. In the beginning, the group should develop rules governing information sharing, decision making and conflict resolution.

An ideal group is composed of people who mirror the demographics of the community. It should include experts on relevant topics such as forestry and public works, as well as people from other fields. A sample group could include a realtor, developer, garden club member, arborist, planner, environmental group representative, landscape architect, forest landowner, public works official, business owner, lawyer and interested citizen.

The International Society of Arboriculture categorizes arboriculture-focused tree ordinances, which relate to maintaining trees for aesthetic and environmental benefits, into three main categories:

- *Street and public tree ordinances* regulate the planting, removal and maintenance of trees in parks or along public rights-of-way, including private trees that could endanger the public. These ordinances can include tree planting specifications (e.g., requiring tree planting in parking lots) and tree care standards (e.g., standards for pruning and removal).
- *Tree and woodlot protection ordinances* protect specific tree species, trees of a certain circumference or height or trees with historical significance on public and private property. These ordinances usually stipulate that permits are required to remove, encroach upon or prune such trees. They also provide for the replacement of removed trees.

As part of the ordinance, conservation strategies may be imposed to protect and maintain desired canopy levels and goals. Researchers estimate that tree canopy cover in urban and metropolitan areas across the U.S. averages only 27 percent and 33 percent, respectively (Dwyer and Nowak, 2000). Additionally, the trees that are present are subject to a wide variety of stressors, which significantly shortens their lifespan. As such, it is important for urban communities to take steps to protect and enhance their urban forests through urban tree canopy (UTC) goal setting processes.





In order to set UTC goals, communities must first have an idea of how much current canopy is present. The process for conducting UTC assessments and goal setting generally includes the following steps:

1. *Measure current UTC*

- Remote sensing or inventories to measure existing urban tree canopy.
- Identify the different types of forest in the community, including public (street trees, riparian corridors, parks, etc.) and private (residential, commercial, industrial areas, etc.).

2. *Estimate potential UTC*

- Use remote sensing imagery and geographic information systems analyses to identify locations with potential for reforestation to improve UTC.
- Identify priority locations where UTC increases will support identified community needs (e.g., water quality, air quality, stormwater management).

3. *Adopt a UTC goal*

- Determine a goal based on the results of the assessments and specify a timeframe.
- Formal adoption of the goal is preferable to ensure that the goal comes to fruition (e.g., institutionalize UTC goals in local ordinance, regulations and comprehensive planning efforts).
- Create a metric to measure inputs and manage the goal.

Once the assessment and goal-setting process is complete, the next logical step is to develop a plan. In general, a UTC plan identifies the UTC goal and

timeline, describes the relationship of canopy goals to local ordinances, regulations, and the community's comprehensive plan and outlines the specific strategies for achieving UTC goals, including identifying a timeline and responsible party. Each community must develop an approach to achieve UTC goals that considers their internal capacity and resources, political climate and stakeholder needs. The range of strategies to achieve UTC goals includes:

- Permanently protect priority forest tracts through acquisition, conservation easements or another method.
- Prevent forest loss during development by adopting or amending site development regulations (e.g., forest conservation regulations, open space design, low-impact design and zoning).
- Maintain existing forest canopy by adopting regulations that restrict tree removal.
- Increase tree planting during development by adopting or revising site development regulations such as landscaping and parking lot shading.
- Reforest public lands, beginning with priority sites.
- Encourage reforestation of private land by developing education, stewardship and incentive programs.

An example might be:

In order to balance environmental goals and planned density goals, the community has shifted its approach of tree retention from regulating individual trees to the conservation of the overall urban forest canopy. Recognizing the functional importance of a mixed-age, mixed-species urban tree canopy, regulations are adopted to treat urban residential sites without tree canopy the same as urban residential sites with tree canopy.

TREE CANOPY AND SIGNIFICANT TREES

Tree canopy shall include all evergreen and deciduous trees six feet in height or greater, excluding invasive species or noxious weeds as designated in the tree ordinance. Significant tree means a tree with a caliper of at least 10 inches. Dogwoods and other small, understory trees are significant trees if they have a caliper of at least six inches. For multiple-stem trees, such as serviceberry, the caliper of the individual stems shall be added together to determine if a tree meets the minimum caliper for a significant tree.

Exemptions to tree canopy requirements

- Removal of any hazardous, dead or diseased trees, and as necessary to remedy an immediate threat to person, property or activity as determined by an arborist.
- Construction of a single-family dwelling, duplex, accessory or non-accessory storage structure on an individual lot created prior to implementation date.
- Construction or maintenance of public or private road network elements and public or private utilities including utility easements not related to development.
- Construction or maintenance of public parks and trails when located within an urban residential zone.

Tree canopy coverage requirements

A minimum healthy tree canopy cover shall be preserved or established on each lot subject to these requirements. Tree canopy cover shall be calculated based on the trees’ expected mature canopy in the urban environment.

Table A lists the mature tree canopy to be credited for a newly planted or immature tree of the indicated size category. The size category shall be as indicated on the Approved Tree Species List.

TABLE A

Mature Canopy Cover	
Size Category of Tree	Expected Mature Canopy Cover (square feet)
Large	1,600
Medium	900
Small	400
Very small	150

Table B lists the minimum required tree canopy coverage by zoning district.

TABLE B

Required Tree Canopy	
Zoning District	Minimum Tree Canopy Coverage
Residential	30% for a subdivision; 20% per residential lot
Central Business District	15%
Commercial	20%
Light Industrial	15%
Planned Redevelopment Area (PRA)	Use canopy requirement for the zoning designation assigned by the administration based on approved use.
Planned Unit Development	40% for the development; 20% per residential lot
Planned Business Development	30% for the development; 15% per lot

Calculation of tree cover

The following areas shall not be included in the site area for purposes of calculating minimum required canopy coverage: water bodies and public street rights-of-way owned by a government agency.

- All healthy trees on the development site may be included in the tree canopy coverage for purposes of meeting the minimum requirement, including but not limited to trees planted or retained to meet landscaping, buffer yard and forest conservation.
- Evergreen trees and tree species identified as very small by the Tree Species List shall generally not be used to meet canopy requirements. They may be used if site characteristics render deciduous or larger trees impractical.
- The canopy of a preserved tree or group of trees may be calculated by measuring the actual canopy, using recent surveys, aerial photographs, satellite images or other means, or may be estimated by multiplying the diameter of the crown at its widest point by the diameter of the crown perpendicular to the first measurement.
- An existing tree determined by the Zoning Administrator to be in poor condition shall not be credited toward required canopy coverage. The Zoning Administrator may rely upon the advice of an ISA certified arborist retained by the community.

Canopy cover calculations for preserved trees
The canopy of preserved trees shall be calculated as indicated in **Table C**.

TABLE C

Canopy Credit for Healthy Preserved Trees	
Tree Location	Canopy Cover Credit
Trunk entirely on development site and at least 6 inches' DBH	1.5 times the current, measured canopy cover or 1.5 times the canopy cover area assigned in Table A
Trunk entirely on development site and smaller than 6 inches' DBH	The current, measured canopy cover or the canopy cover area assigned in Table A for the tree species
Adjacent trees with overlapping crowns, trunks entirely on development site	1.5 times the current, measured canopy that they collectively project onto the development site
Trunk directly on property line	The current, measured canopy cover that falls onto the development site or half the canopy cover area assigned in Table A
Street trees, trunk on adjacent street right-of-way on the same side of the street as the development site	The current, measured canopy cover that falls onto the development site or half the canopy cover area assigned in Table A
Trunk on adjacent lot or parcel	No credit for canopy cover, even if branches overhang the development site

The Planning and Zoning Commission shall consider the following guidelines when reviewing site plans and subdivision plans requiring tree canopy:

- To the extent possible, required canopy shall be provided through protection of existing trees utilizing the guidelines provided by the Tree Board.
- Where applicable, trees shall be planted and protected where they will be most beneficial in the enhancement of water quality and preservation of environmentally sensitive areas.

LOW-IMPACT DEVELOPMENT (LID) STRATEGIES FOR STORMWATER MANAGEMENT AND LAND CONSERVATION

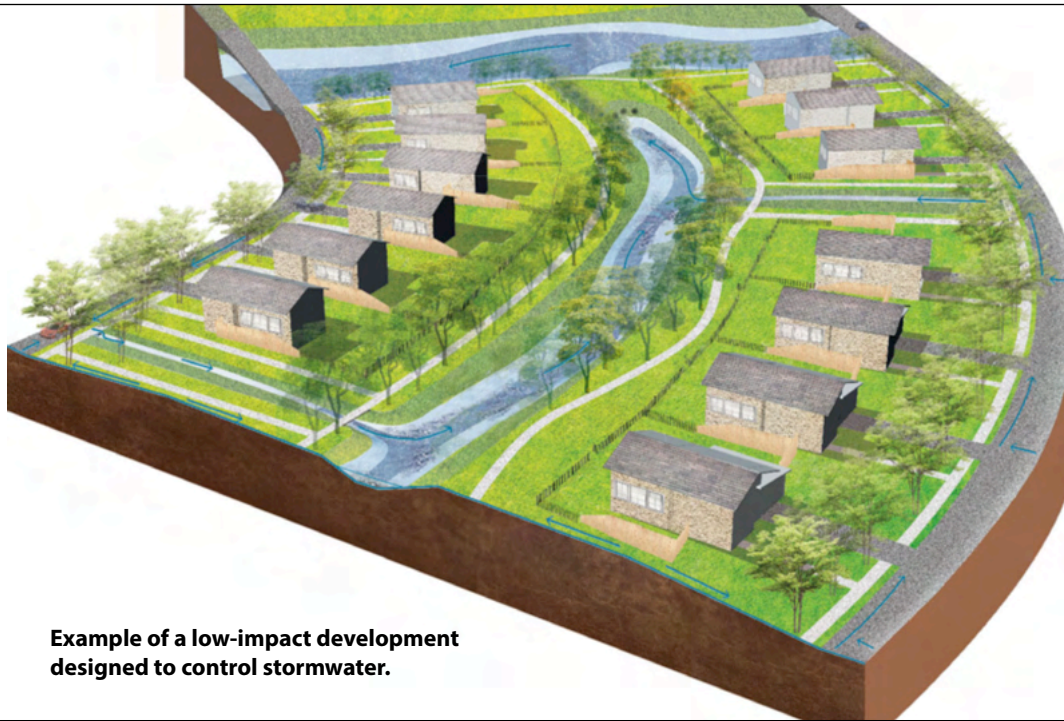
Building and development significantly alters the natural features and hydrology of a landscape, typically by creating impervious surfaces such as parking lots, sidewalks, roadways and commercial and residential buildings. Compaction, caused by heavy equipment and construction activity, destroys soil texture. This reduces tree canopy, affects urban forest health and prevents rain from soaking into the ground, allowing stormwater to sheet across parking lots and streets, collecting used motor oil, pesticides, fertilizers and other pollutants, moving them into riparian areas.

In most cities, a complex system of piping usually feeds contaminated stormwater flows directly into streams and coastal waters. More recently, stormwater control structures such as retention ponds have been installed, mainly in new developments, to intercept stormwater on its way to surface waters. Historically, the goal of stormwater planning has been to prevent localized flooding by moving large amounts of water offsite as quickly as possible. However, experience has shown that traditional stormwater management has many limitations and it is very expensive to install and maintain.

Efforts to address stormwater problems resulting from traditional development methods have produced a number of innovative alternatives. One such method reduces stormwater runoff by conserving forests and green spaces and protecting stream buffers. Yet another technique diminishes impervious surfaces, narrows road and sidewalk widths, reduces parking lot sizes, minimizes or removes cul-de-sacs and replaces traditional paving materials with pervious hard surfaces.

Development strategies like low-impact development (LID) seek to control stormwater at its source. Rather than moving stormwater offsite through a conveyance system, the goal of LID is to restore the natural ability of an urban site to absorb stormwater. Green spaces, sustainable landscaping and a variety of innovative bioretention techniques capture and manage stormwater on-site. LID reduces peak runoff by allowing rainwater to soak into the ground, evaporate into the air or collect in storage containers for irrigation

CONCEPTUAL DESIGN FOR RESIDENTIAL STORMWATER



Example of a low-impact development designed to control stormwater.

and other beneficial uses. In areas with slow drainage or infiltration, LID captures the first flush before excess stormwater is diverted into traditional storm conveyance systems.

The result is development that more closely maintains pre-development hydrology. Furthermore, LID has been shown to be cost effective and, in many cases, cheaper than using traditional stormwater management systems.

Similar to LID strategies, conservation development tries to mitigate the effects of urbanization, but it places additional emphasis on protecting aquatic habitat and other natural resources. Better site design to reduce impervious cover and capture stormwater on-site should be the goal of any new development. Conservation development subdivisions are characterized by compact, clustered lots surrounding a common open space. Conservation development's goal is to disturb as little land area as possible while simultaneously allowing for the maximum number of residences permitted under zoning laws.

Prior to new construction, conservation developers evaluate natural topography, natural drainage patterns, soils and vegetation. They deploy stormwater best management practices to help prevent flooding and

protect natural hydrology. By maintaining natural hydrological processes, Conservation Development creates conditions that slow, absorb and filter stormwater runoff on-site. Because future development threatens valuable natural ecosystems, conservation development provides specific provisions for long-term and permanent resource protection. Conservation easements, transfer of development rights and other "in perpetuity" mechanisms ensure that protective measures are more than just temporary.

The damaging effects of stormwater runoff can be mitigated if urban planners use development plans that reduce the "footprint" of impervious structures. Traditional stormwater approaches, with their emphasis on collection, conveyance, storage and discharge, cannot address the environmental problems caused by urban sprawl. Furthermore, with rapid development occurring beyond metropolitan regions, urban stormwater is jeopardizing water quality. New land and stormwater management strategies take a more holistic approach. Communities employing conservation development techniques have found that natural features such as undeveloped land, vegetation and buffer zones effectively reduce and filter stormwater flow. There are also other benefits, such as recreation, wildlife habitat, and increased property values.



Commercial Greenhouse and Nursery Production

Alternative Options for Invasive Landscape Plants

Rosie Lerner and Kyle Daniel, Purdue Horticulture and Landscape Architecture

Lindsey Purcell, Purdue Forestry and Natural Resources

Purdue Horticulture and Landscape Architecture
www.ag.purdue.edu/HLA

Purdue Forestry and Natural Resources

www.ag.purdue.edu/FNR

Indiana Invasive Species Council
www.entm.purdue.edu/iisc

Ornamental plants provide many environmental and ecological benefits to landscapes and urban areas. They can be aesthetically pleasing, reduce stormwater runoff, lower carbon dioxide and pollutants, alleviate the urban “heat island” effect, and provide habitats to pollinators, birds, and mammals. And in the last 20 years, consumers and the general public have become much more aware of these benefits.

The urban environment is different than most locations in a plant’s native range. It is an ecosystem unlike any other due to extreme environmental pressures. So landscapers and homeowners must use a wide range of plant material that will survive in these unique and often harsh environments. Horticulturalists have continued to discover and introduce plants to broaden the plant palette. Unfortunately, a few of these landscape species can escape into wild areas and create ecological problems in unintended areas such as forests and woodlands. In Indiana, a few frequently used landscape plant species have invaded these natural areas and are displacing native species.

For these reasons, the green industry must begin to produce and use different landscape plants that can replace the invasive species. This publication lists potential alternatives to some of the most notorious and damaging invasive plants in Indiana.

Unlike the many lists available from many resources, we have included native and non-native species. This is an important difference for several reasons, but the two main reasons are:



Figure 1. Many callery pears can produce abundant fruit that are widely distributed by birds.



Figure 2. After their seeds are disseminated, callery pears can invade natural and disturbed areas. The callery pear’s ability to grow in a wide range of conditions and their fast growth rate enable them to effectively compete with other vegetation.



Invasive plant brochure sample

Continued on page 4.

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Table 1. Common ornamental plants that are at high-risk of becoming invasive or are currently invasive and their potential replacements¹.

Indiana Invasive Species				
Scientific Name	Common Name	Invasive Rank ²	Size Group	Growth Rate ³
<i>Acer platanoides</i>	Norway maple	high	large tree: >30-50 feet	fast
<i>Alnus glutinosa</i>	black alder			
<i>Phellodendron amurense</i>	amur cork tree			
Potential Replacement Species				
Scientific Name	Common Name	Native (Y or N)	Special Characteristics	Growth Rate ³
<i>Acer rubrum</i>	red maple	Y	Susceptible to manganese deficiency. Has vibrant fall color.	fast
<i>Acer saccharum</i>	sugar maple	Y	Not good for compacted, confined soils. Has vibrant fall color	medium
<i>Acer x Fremanii</i>	freeman maple	N	Numerous cultivars vary in fall color and performance.	fast
<i>Aesculus glabra</i>	Ohio buckeye	Y	Prefers moist, deep soils.	slow
<i>Betula nigra</i>	river birch	Y	Prefers wet soils. Generally weak-wooded, Susceptible to bronze birch borer	fast
<i>Cladrastis kentuckea</i>	yellowwood	Y	pH-tolerant, prefers well-drained soils. Has white fragrant flowers.	medium
<i>Diospyros virginiana</i>	persimmon	Y	pH-tolerant, prefers moist, well-drained soils. Difficult to transplant.	slow
<i>Fagus grandifolia</i>	American beech	Y	Prefers moist, well-drained acid soils. Does not tolerate compacted soils.	slow
<i>Fagus sylvatica</i>	European beech	N	More tolerant of alkaline soil than <i>Fagus grandifolia</i> . Numerous cultivars available.	slow/ medium
<i>Ginkgo biloba</i>	ginkgo	N	Suitable for urban/poor soils. Widely adaptable.	medium
<i>Gymnocladus dioicus</i>	Kentucky coffee tree	Y	Widely adaptable. Can be messy — drops pods, leaves.	medium
<i>Quercus bicolor</i>	swamp white oak	Y	Tolerates urban conditions. Prefers wet soils.	medium
<i>Quercus macrocarpa</i>	bur oak	Y	Drought-tolerant. Tolerates clay soils.	slow
<i>Quercus robur</i>	English oak,	N	pH-tolerant. Prefers well-drained soils.	fast
<i>Quercus rubra</i>	red oak	Y	Prefers sandy, well-drained soils, but is adaptable.	fast
<i>Quercus shumardii</i>	Shumard oak	Y	pH- and drought-adaptable.	fast
<i>Sassafras albidum</i>	sassafras	Y	Difficult to transplant. Prefers moist, well-drained soils.	medium
<i>Styphnolobium japonicum</i>	Japanese pagoda	N	Suitable in urban/poor soils. Flowers in summer. Can be messy.	medium/fast
<i>Tilia cordata</i>	littleleaf linden	N	Widely adaptable. Has fragrant flowers in early summer.	medium
<i>Tilia tomentosa</i>	silver linden	N	Tolerates urban conditions.	medium
<i>Ulmus parvifolia</i>	lacebark elm	N	Suitable in urban/poor soils. Has beautiful mottled bark. Do not confuse with Siberian elm, <i>U. pumila</i> .	medium
<i>Ulmus spp.</i>	many cultivars	N	Suitable in urban/poor soils.	fast
<i>Zelkova serrata</i>	zelkova	N	Suitable in urban/poor soils.	medium

Continued on page 3.

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Table 1. Continued from page 2.

Indiana Invasive Species				
Scientific Name	Common Name	Invasive Rank ²	Size Group	Growth Rate ³
<i>Pyrus calleryana</i>	callery pear	high	medium tree: >15-30 feet.	fast
Potential Replacement Species				
Scientific Name	Common Name	Native (Y or N)	Special Characteristics	Growth Rate ³
<i>Acer griseum</i>	paperbark maple	N	Suitable in urban/poor soils. Has outstanding cinnamon-brown, peeling bark.	slow
<i>Acer japonicum</i> , <i>A. palmatum</i>	Japanese maple	N	There are many cultivars, some with excellent fall color. Grows best in light shade.	slow
<i>Amelanchier</i> spp.	serviceberry	Y	Prefers moist, well-drained, acid soils. Not good in high-stress environments.	medium
<i>Carpinus betulus</i>	European hornbeam	N	pH-tolerant. Prefers well-drained soils.	slow
<i>Carpinus caroliniana</i>	American hornbeam	Y	Prefers slightly acidic, rich, moist soils.	slow
<i>Cercidiphyllum japonicum</i>	katsura tree	N	pH adaptable. Prefers, moist, well-drained soils.	medium
<i>Cercis canadensis</i>	redbud	Y	pH adaptable. Prefers, moist, well-drained soils.	medium
<i>Chionanthus virginicus</i>	fringetree	Y	Adaptable, but prefers moist, acidic soils. May be susceptible to emerald ash borer.	medium
<i>Cornus alternifolia</i>	pagoda dogwood	N	Prefers moist, well-drained, acidic soils and partial shade. Self seeds.	slow
<i>Cornus kousa</i>	kousa dogwood	N	Prefers moist, well-drained, acidic soils.	Slow
<i>Cornus mas</i>	corneliancherry	N	pH adaptable. Prefers, moist, well-drained soils.	medium
<i>Cotinus coggygria</i>	common smoketree	N	Widely adaptable but prefers well-drained soils.	medium
<i>Cotinus obovatus</i>	American smoketree	Y	Widely adaptable, but is particularly good on alkaline soils.	medium
<i>Crataegus phaenopyrum</i>	Washington hawthorn	Y	Has outstanding fruit display.	medium
<i>Crataegus viridis</i>	green hawthorn	Y	'Winter King' has larger fruits. Is somewhat resistant to rust. Has compact habit.	medium
<i>Halesia carolina</i>	silverbell	Y	Prefers moist, well-drained, acidic soils. Best grown as container rather than balled and bundled.	medium
<i>Maackia amurensis</i>	amur maackia	N	pH-tolerant. Prefers well-drained soils.	slow
<i>Malus</i> sp.	crabapple	N	Widely adaptable, but intolerant of poor drainage. There are numerous cultivars.	fast
<i>Ostrya virginiana</i>	hophornbeam	Y	Prefers moist, well-drained soils, sun or partial shade.	slow
<i>Stewartia</i> spp.	stewartia	Y	Prefers moist, well-drained, acid soils. Afternoon sun is ideal.	slow
<i>Syringa reticulata</i>	Japanese tree lilac	N	Widely adaptable. Flowers best in full sun. Has white flowers in summer.	fast
<i>Ulmus</i> spp.	many cultivars		Suitable in urban/poor soils.	fast

Continued on page 4.

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Table 1. Continued from page 3.

Indiana Invasive Species				
Scientific Name	Common Name	Invasive Rank ²	Size Group	
<i>Euonymus fortunei</i>	wintercreeper	high	GC	fast
Potential Replacement Species				
Scientific Name	Common Name	Native (Y or N)	Special Characteristics	Growth Rate ³
<i>Asarum canadense</i>	wild ginger	Y	ph adaptable but prefers moist, well-drained, acidic soils Shade-tolerant.	medium
<i>Cotoneaster apiculatus</i>	cranberry cotoneaster	N	pH adaptable. Salt-tolerant.	slow
<i>Cotoneaster horizontalis</i>	rockspray cotoneaster	N	pH adaptable. Prefers full sun or light shade. Good in poor soils.	medium
<i>Parthenocissus quinquefolia</i>	virginia creeper	Y	Widely adaptable. Shade- and salt-tolerant. Adheres to walls. Can be difficult to remove.	fast
<i>Carex</i> spp.	sedge	Y	Low growing. Numerous species and varieties. Suitable for wet, dry, or shady areas. Has attractive seed heads.	medium

¹Table sources:

Alvey, A.A. 2013. *Finding alternatives to invasive ornamental plants in New York*. Cornell University Cooperative Extension. 134 pgs.

Dirr, M.A. 1998. *Manual of woody landscape plants*. Stipes Publishing. 1187 pgs.

Gilman, E.F. 1997. *Trees for urban and suburban landscapes*. Delmar Publishers. 662 pgs.

²Indiana Invasive Species Council (www.entm.purdue.edu/iisc/plants.php) ratings.

³The growth rates listed are general. A plant's growth rate is environmentally sensitive relative to urban, suburban, and rural growth conditions. Rates are faster and sizes larger in areas with less stress and disturbed soils.

Find Out More

To see other publications in the *Commercial Greenhouse and Nursery Production* series are available from the Purdue Extension Education Store, www.edustore.purdue.edu.

Continued from page 1.

1. In some situations, a native plant is not the best choice due to environmental conditions, size, fruit characteristics, etc.
2. Some native plants are more difficult to cultivate than a similar non-native.

This publication was reviewed by representatives from Purdue University, Indiana Nursery and Landscape Association, Indiana Arborist Association, The Nature Conservancy of Indiana, Indiana Department of Natural Resources, and Indiana Native Plant and Wildflower Society.

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INVASIVE SPECIES CONSIDERATIONS IN COMMUNITY PLANS

Liz Jackson, author

WHAT ARE INVASIVE SPECIES?

Invasive species are plants, animals or pathogens that are non-native (or alien) to the local ecosystem and whose introduction causes or is likely to cause harm (National Invasive Species Information Center, 2018). Invasive species present significant economic, ecological and in some cases health-related challenges to communities.

Examples of invasive species that are affecting Indiana include Emerald Ash Borer (EAB), an invasive insect that is killing all ash trees, Asian carp, an invasive fish that forces out native fish in our rivers and lakes and Asian bush honeysuckle, an invasive terrestrial plant that invades natural areas and prevents native plants from growing.



WHERE ARE INVASIVE SPECIES COMING FROM?

Invasive terrestrial plants

Invasive plants can come from a variety of sources, but several of our most problematic plant species have been intentionally planted for landscaping or for purposes such as erosion control or wildlife habitat conservation. Once the plants are established and producing seed, they may spread into native forests, wildlife habitats and parks or disturbed sites including ditch banks, abandoned lots or roadsides. Many invasive plants are still planted for landscaping (burning bush and Callery pear are examples) and continue to spread as they produce seed or expand as a colony of plants.

Some plants have been introduced accidentally when seed is present in packing materials, soil or gravel fill, feed or other items that could contain plant seeds or parts. Evidence is growing that high deer populations may also facilitate the expansion of invasive species. White-tailed deer may over-browse their habitats and this disturbance can create growing space for invasive species to invade and spread.

As they mature and spread seed, invasive populations can grow quickly and spread to new areas. Birds and other wildlife can spread seed long distances, as can wind and water. People may also unwittingly spread invasive plants by accidentally moving seed or plants in soil, shoes, tools and equipment such as mowers and excavators, debris, vehicles and boats.

Aquatic invasive species

Aquatic invasive species may include aquatic plants such as Hydrilla that grow and choke waterways, or aquatic animals such as zebra mussels, which attach to water supply systems and power plants. Aquatic invasive species may be introduced intentionally, such as by people dumping their aquariums in a lake, or accidentally, by organisms transferred in ballast water or attached to boats or other recreational equipment.

Invasive animals, insects and diseases

Other invasive species come from humans causing an accidental and/or intentional introduction, release or spread of that species beyond its native range. Due to their potentially massive economic and health impacts, these species are generally monitored and controlled under the jurisdiction of federal and state agencies, including USDA Animal and Plant Health



Inspection Services (APHIS), U.S. Fish and Wildlife Service, Indiana State Board of Animal Health and the Indiana Department of Natural Resources' Division of Entomology and Plant Pathology, among others.

ECONOMIC IMPACTS OF INVASIVE SPECIES

The annual cost of terrestrial invasive plants alone to the United States economy is estimated at \$120 billion a year, which includes economic losses, harm to the environment and control costs (Pimentel, Zuniga, & Morrison, 2005). Invasive species are a global problem, with the annual cost of impacts and control efforts equaling five percent of the world's economy (The Nature Conservancy, 2005).

A 2012 informal survey conducted by the Indiana Invasive Plant Advisory Committee found that landowners and managers in Indiana spent \$5.85 million to manage terrestrial invasive plants (Invasive Plant Advisory Committee, 2013).

Aquatic invasive species can also be very expensive or impossible to control and the resulting damage to sport fisheries, recreation and commercial resources can be serious. Lake residents in Indiana spend an estimated \$800,000 per year in public waters to chemically control nuisance Eurasian watermilfoil, an exotic water plant that can shade out native species and interferes with boating and fishing. The annual national control costs for purple loosestrife are estimated to be \$45 million per year (Indiana Department of Natural Resources, n.d.). In the United States as a whole, an estimated total of more than \$800 million is spent on the damages and control costs of aquatic weed species (Pimentel, Zuniga, & Morrison, 2005).

These are just a few examples of the costs of monitoring, control and management of invasive species. Because there is no one agency that has jurisdiction over the many species and types of invasions, economic costs are difficult to determine.

ENVIRONMENTAL IMPACTS OF INVASIVE SPECIES

One of the single largest threats to our nation's natural resources, invasive species:

- *Reduce agricultural production and property values.* A study by the Department of Plant Biology at Ohio University found that in woodlands with an understory dominated by bush honeysuckle, there was a reduction of hardwood tree annual volume growth of up to 53 percent, with a subsequent reduction in timber sale value and income. Agricultural losses may occur from invasive insects and weeds reducing crop yields or the increased expenses from control of weeds and pests. According to the U.S. Forest Service, the invasive vine Kudzu has overrun more than 200,000 acres and is increasing by about 2,500 acres per year. Kudzu is an alternate host for soybean rust, resulting in potential agricultural losses.
- *Displace native plants that wildlife and fish depend on for food.* Critical pollinators and other native insects are also impacted by a reduction in native plants.
- *Put endangered and threatened wildlife species at further risk.* Invasive species are the second-leading cause of animal population decline and extinction worldwide. More than 400 of the over 1,300 species currently protected under the Endangered Species Act, and more than 180 candidate species for listing, are considered to be at risk at least partly due to displacement by, competition with and predation by invasive species (U.S. Fish & Wildlife Service, 2012). (Center for Invasive Species Management, www.weedcenter.org/inv_plant_info/impacts.html)

HUMAN HEALTH IMPACTS

Municipalities, power plants and some industries rely on access to water to operate. Invasive species may clog and damage intake pipes, increasing maintenance and operational costs. Toxic invasive plants like giant hogweed and poison hemlock present a threat of dermal and oral toxicity to those entering infested areas.

Evidence is building that the presence of invasive plant species may be raising the risks of tick-borne disease transmission to humans. Research reported in the *Proceedings of the National Academy of Sciences of the United States of America* shows that the presence of bush honeysuckle increases the density of nymph life-stage ticks infected with bacteria that cause human disease tenfold in areas infested with bush honeysuckle when compared to areas without honeysuckle (Sakai, 2010). A study published in the journal *Environmental Entomology* in 2009 revealed that larger black-legged tick (deer tick) populations correspond with a greater abundance of dense Japanese barberry patches. The study concludes that managing Japanese barberry will effectively reduce the number of deer ticks that commonly feed on humans and carry Lyme disease (Fahrner, 2012).



RECREATION AND LIFESTYLE IMPACTS

Changes in vegetation cover due to invasive plant species can decrease the aesthetic qualities of landscapes, which may have impacts on tourism. Invasive plant species can lessen the enjoyment of recreational activities. Unmanaged and unchecked plant invasions can inhibit access for hiking or horseback riding, limit access to hunting lands, reduce wildlife populations and can eliminate views. Invasive aquatic species can limit swimming and watersports opportunities and harm water quality. Depending on the lake, invasive species in the Great Lakes have reduced commercial fishing from 13 to 33 percent, sport fishing 11 to 35 percent and wildlife watching 0.8 percent (Lodge, 2008).

RELEVANCE TO ECONOMIC DEVELOPMENT

Natural areas support a strong tourism and recreation industry. Natural resources support productive agriculture and forestry industries. Water resources are critical to our municipal and rural water supplies and to the tourism industry. Invasive species impact the quality and quantity of these natural resources and our economy. High-quality natural resources create a higher quality of life for citizens and can lead to increased economic development.



HOW AND WHY WOULD YOU ADDRESS IT IN A COMPREHENSIVE PLAN?

The economic and environmental impacts on communities are dependent on the species and extent of invasives present and the areas they infest or threaten. As the extent and density of invaded areas increase, often related to increasing development, the costs of lost values and benefits to the community and the costs of control and site restoration can greatly increase. Invasive species' impacts may be mitigated by prevention and careful consideration before disturbing natural areas. Considering the current and future impacts of invasive species in a comprehensive plan could lead to improved natural areas, better recreation opportunities and reduced costs to a community.

WHAT ARE THE BENEFITS?

Invasive plants commonly colonize edge areas, unmaintained land or disturbed sites. Awareness and inventory of invasive plants in public and private landscaping, parks, streets, roadsides and natural areas can help communities prioritize the work of managing their impacts. Detecting and controlling invasive species before they cover large areas or reach high densities provides an opportunity to maintain land in good condition at a much lower cost in terms of both money and effort. Several information sources and tools for identification and reporting of invasive species are provided in the resources section at the end of this chapter.

Being aware of the presence of invasive species and the means by which they spread can help slow or stop their spread. Halting the planting of known invasive plants and replacing existing invasive landscaping with native or non-invasive plants can yield greater success in efforts to control the damage invasive plants cause.

WHAT ARE THE CHALLENGES?

Resources to monitor, report and control invasive species are in high demand and funding is not readily available. Public and private landowners must recognize the problem and prioritize resources for invasive species. Another challenge is recognizing and responding to an invasion before control costs become prohibitive. Invasions are often not recognized until the population has exploded and control is much more difficult.

Taking action on invasive species can also be challenging because it often involves a change in behavior and priorities. Switching from known invasive landscaping plants to native or non-invasive plants can be a good starting point to limit future infestation sources.

Finally, invasions don't recognize boundaries and easily spread and inhabit space across the entire landscape. No one jurisdiction or landowner has the ability to manage invasions across the landscape and management requires cooperation among all levels of government and all land ownerships, both public and private.

COMPREHENSIVE PLANNING FOR INVASIVE SPECIES CONCERNS

Federal laws

Federal invasive species laws are limited, and are generally related to organisms that would have substantial economic impacts on agriculture or devastating impacts on the ecosystem. A list of federal laws is available at <https://www.animallaw.info/article/detailed-discussion-laws-concerning-invasive-species#id-7>.



State rules and statutes

Indiana has very limited regulations and ability to further regulate invasive species at this time. The state lists Canada thistle, purple loosestrife, multiflora rose, burcucumber, Columbus grass, shattercane and johnsongrass as noxious weeds and subject to state law, see <http://iga.in.gov/legislative/laws/2017/ic/titles/015/#15-7> for the state code. These plants are specifically prohibited from sale, planting and distribution in state code (IC14-24-12). Note that existing plants are not regulated under this statute. A list of all state laws related to invasive species can be found at <https://nationalplantboard.org/laws-and-regulations/>.

The Indiana Natural Resources Commission (NRC) establishes standards for declaration and control of pests and pathogens and regulation of nurseries. The Indiana Division of Entomology and Plant Pathology Director has the authority to implement and carry out these rules.

In 2019, The Indiana Natural Resources Commission adopted a rule that declares 44 invasive terrestrial plants as prohibited in the state and preventing the sale or distribution and transport of those plants. Prohibited plants could be monitored, inspected and removed per the rule. This rule provides no legal means of controlling existing plants on the restricted list. (See full rule language at the end of this section.)

Another Indiana statute regulates the possession or distribution of aquatic invasive animals and plants. See www.in.gov/dnr/fishwild/files/fw-AIS_PossessionRules.pdf for a complete list of the prohibited aquatic invasives.



The Indiana Invasive Species Council (IISC) was created with several roles, one of which is to make recommendations regarding invasive species to governmental agencies and legislative committees (IC 15-16-10). The IISC has no regulatory authority but has begun exploring potential statutes or rules to regulate invasive species. They have also been instrumental in creating the list of Indiana invasive plants, found here with their regulatory status: www.entm.purdue.edu/iisc/invasiveplants.php.

Local regulation and ordinances

One method a local jurisdiction can use to manage plant pests is through a weed control board, whose operation is in statute (IC-16-16-7). Unfortunately, at this time the list of noxious weeds under control of a local weed board includes five weeds, none of which are considered invasive woodland plants. In other states, local weed control boards are used to regulate a number of invasive plants that are determined through state statute. This is an area that could be explored for creating regulations at the local level, but would require state legislation.

Zoning ordinances are another avenue to address local concerns. Dearborn County has a list of plants that are considered “Unacceptable Plants” in the Landscaping portion of its Zoning Ordinance. The plants listed in Section 2280 are identified using both their scientific and common names, along with the reasons for their inclusion as unacceptable plants (invasive species, susceptibility to pests, maintenance issues). The Ordinance states: “The plants listed within this section are not entirely prohibited; however, the use of these species should be limited to agricultural or residential areas where they can be properly installed, monitored and maintained in accordance with this Ordinance” (Dearborn County, n.d.)

Knox County Commissioners passed an ordinance in August 2018 preventing the sale, trade or import of listed invasive plants into the county, but it does not include existing plants or seed. The ordinance will take effect on January 1, 2020, leaving time for landscapers to clear inventory. The Knox County Natural Resource Specialist on behalf of the commissioners is the enforcing authority with the Knox County Invasive Species Board being the hearing authority. (See the Knox County ordinance at the end of this chapter.)

Should a community wish to pursue opportunities for regulation of invasive species, it is recommended that they contact the IISC or the Director of the Division of Entomology and Plant Pathology for guidance. Any new regulation may require either a rule approved by the Natural Resources Commission or a new statute approved by the state legislature. Since regulations are not widely used to address invasive species, guidelines or prevention and monitoring programs are commonly used to reduce invasive species impacts.

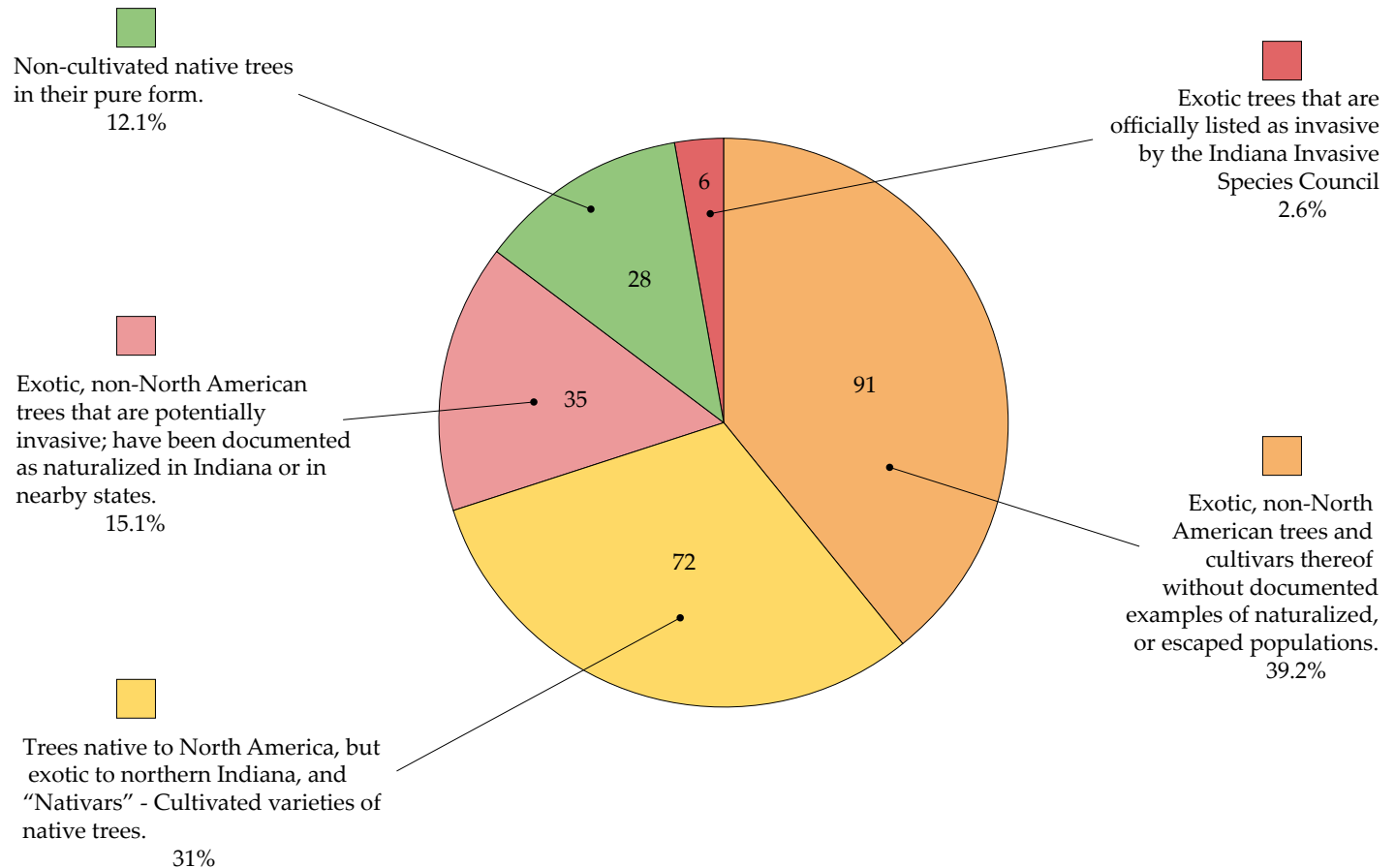
LOCAL POLICIES TO ADDRESS INVASIVE SPECIES

Planting guidelines

Establishing community planting guides for public property can facilitate moving away from invasive landscape plants and toward native plants and provide an example to private landowners. Some communities have adopted local guidelines or ordinances covering the planting and care of trees and shrubs, particularly on but not necessarily limited to public lands. Lists of invasive species that should be avoided in plantings should be included in these documents, such as those in Dearborn County (Dearborn County, n.d.). Promoting native plants and pollinators can be a positive program for the community.

The City of South Bend created a document titled “Trees Suitable for Planting in South Bend City Limits.” Of the trees that are endorsed as being considered suitable for planting, 56.9 percent are not native to North America. Only 12.1 percent are true native trees (in green on the chart below), which should be the goal of any planting program. This problem isn’t endemic to South Bend or even to Indiana, but is an example of the lack of knowledge about invasive species, and illustrates that care must be taken when developing planting guidelines.

SUMMARY OF THE DOCUMENT “STREET TREE MASTER PLANTING LIST 2017” CITY OF SOUTH BEND, IN



South Bend Street Tree Master Planting List 2017

(Source: Steve Sass, Ecological Advisory Committee Member, South Bend Department of Parks and Recreation, April 2018)

LAND DEVELOPMENT GUIDELINES

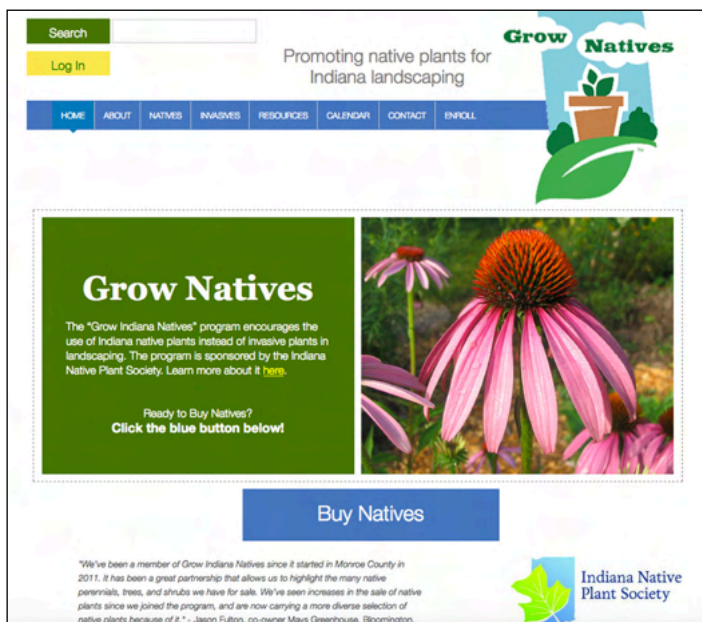
A common pathway for invasions to occur or spread is when land is disturbed, such as the development of housing, industry, roads, trails or utilities. Guidelines could be established prior to development through contracts, local zoning or subdivision control ordinances, or in economic development plans to minimize invasive species impacts. Those might include treating invasions on the land before beginning development, requiring equipment to be cleaned before entering and leaving the property, requiring the use of uncontaminated construction and landscape materials, requiring the use of best management practices (BMPs) or prohibiting the planting of new invasive plants. See the Resources section for a list of voluntary BMPs that might be considered on development sites.

BEST MANAGEMENT PRACTICES (BMPs)

There are a number of suggested steps to prevent and control further invasions of invasive species. Local communities should encourage government agencies and local landowners to use best management practices (BMPs). Invasive species BMPs are included below.

BUILDING AWARENESS

Working with local landscaping and nursery businesses to inform them about invasive plants still in trade and native or non-invasive options might help them provide alternatives to citizens looking for landscaping plants.



The screenshot shows the 'Grow Natives' website. At the top, there is a search bar and a 'Log In' button. The main heading reads 'Promoting native plants for Indiana landscaping'. Below this is a navigation menu with links for HOME, ABOUT, NATIVES, INVASIVES, RESOURCES, CALENDAR, CONTACT, and ENROLL. A large graphic features the text 'Grow Natives' and a description: 'The "Grow Indiana Natives" program encourages the use of Indiana native plants instead of invasive plants in landscaping. The program is sponsored by the Indiana Native Plant Society. Learn more about it [here](#).' Below the text is a blue button that says 'Buy Natives'. At the bottom, there is a testimonial from Jason Fulton, co-owner of Mays Greenhouse, and the logo for the Indiana Native Plant Society.

Some of these businesses might also be well positioned to assist with invasive species removal work and restoration with desirable plants. A statewide program, "Grow Indiana Natives," (<https://growindiananatives.org/>) has been developed to encourage the nursery industry to sell native plants through a voluntary certification program.

Communities can provide resources to increase local awareness of invasive species concerns. Signage and boot cleaning stations can be placed at public trailheads to avoid the spread of seed. Boat docks are good areas to place signage to recommend cleaning boats and emptying ballast water. See the Resources section for invasive species organizations that can assist with education and resources.

LOCAL ORGANIZATIONS

Developing a local organization to address invasive species may be a more successful approach for communities to consider. These groups, commonly known as Cooperative Invasive Species Management Areas (CISMAs) or Cooperative Weed Management Areas (CWMAs), organize community members, public lands agencies and private landowners to prevent, control and educate with the goal of reducing invasive species impact locally. Watershed groups and county Soil and Water Conservation Districts also address invasive species as part of their mission to improve the environment. A common goal of these organizations is to remove invasive species infestations from public lands. Grant programs and resources exist to assist the startup of local groups. The Southern Indiana Cooperative Invasives Management (SICIM) organization is working to develop local groups in at least 60 counties across Indiana. You can learn more about the group at www.sicim.info.

REPORTING AND MONITORING

To report by phone, for any type of suspected invasive species, call the Indiana DNR Invasive Species Hotline toll-free at 1-866 NO EXOTIC (1-866-663-9684). EddMaps provides an online reporting system and real-time tracking and distribution maps of invasive species in Indiana using a smartphone or computer. EddMaps is located at www.eddmaps.org/indiana/.

BEST MANAGEMENT PRACTICES (BMPs) FOR INVASIVE SPECIES

The Invasive Plant Advisory Committee of the Indiana Invasive Species Council has developed Best Management Practices (BMPs) to prevent the introduction and spread of invasive species. This information is also available at www.entm.purdue.edu/iisc/bmps.php.

1. *Develop an organizational Invasive Species Strategy:*

- Goals
- Objectives and Priorities
- Tactics: policies and procedures on:
 - Employee education and training
 - User education
 - Contracting and sourcing
 - Monitoring
 - Prevention
 - Control projects
- Schedule regular assessments to measure and celebrate your success

2. *Create and maintain an invasive species knowledge base:*

- Maps: where are current infestations?
- Reporting and mapping process for staff and users
- Documentation of control projects (exact location, treatment protocol, dates, herbicide concentrations, weather and soil conditions, etc.) and assessment of results initially and after additional growing seasons

3. *Think ahead. Pre-plan major land development or maintenance activities:*

- Avoid disturbing heavily infested areas when possible
- Pre-treat areas that must be disturbed well in advance
- If possible, conduct such activities when seeds are not easily movable
- If possible, use existing roads, trails, landings, staging areas and designated equipment cleaning areas

4. *Use native plants and seeds, and make sure they are from “weed-free” sources:*

- Use species that are appropriate to site and conditions
- Ensure that species received are as specified
- Ensure that new plants and seeds are not contaminated
- Use “trusted sources” whenever possible (reference the Indiana Native Plant Society Sources of



Native Indiana Plants list at <https://indiananativeplants.org/native-plants/>

- Ask for guarantees or make-good provisions in sourcing contracts
- ### 5. *Use uncontaminated construction/landscaping material (mulch, fill, gravel, straw, etc.):*
- Use trusted sources whenever possible
 - Ask for guarantees or make-good provisions in sourcing contracts
 - Look to create on-site sources if possible
 - Monitor stockpiles regularly
- ### 6. *Keep tools, equipment, vehicles and clothing clean:*
- Require contractors to bring clean vehicles and equipment to your site
 - Designate contained areas for cleaning and disposal
 - Educate and encourage users to inspect and clean clothing, equipment, pets, etc. before and after entry
- ### 7. *Have a long-term plan for managing invasives:*
- “An ounce of prevention...”
 - Prioritize locations and species, taking into account severity of infestation, degree of invasiveness, feasibility of control, “value” of habitat at risk, etc.
 - Optimize treatment timing and technique
 - Evaluate, measure and document success
- ### 8. *Monitor disturbed locations and high-risk areas:*
- Monitor regularly and frequently
 - This is especially important following natural disasters and major development or maintenance projects

9. *Require contractors to follow BMPs:*

- Incorporate BMP requirements into requests for proposal (RFPs) and contracts
- Inspect and document infestations before and after contractor activity
- Ask for guarantees or make-good provisions

10. *Educate recreational users (and neighbors) on invasive species BMPs:*

- Provide basic education when possible:
 - What are invasive species?
 - Why are they bad?
 - How to identify key species
- Offer a mechanism for reporting invasives
- Provide cleaning stations at key entry and exit points
- Regulate entry of infested material when possible (campfire wood, hay, bait, etc.)

And one to grow on: Actively look for funding opportunities, partnerships and volunteers to assist in preventing and reducing invasive species.

CASE STUDIES/EXAMPLES OF PRACTICES AND/OR IMPLEMENTATION

Monroe County Identify and Reduce Invasive Species Group (MC-IRIS): “Adopt a Kudzu Site”

The Department of Natural Resources’ Division of Entomology and Plant Pathology (DEPP) identifies more than 100 sites for the Kudzu vine in Indiana, with five of those sites in Monroe County. This invasive species is a concern because it carries soybean rust, a disease critical to soybean crops. MC-IRIS is collaborating with DEPP by adopting the five kudzu sites in the county. DEPP has already treated those five sites for two to three years, greatly reducing the size of each kudzu infestation. MC-IRIS now visits each site annually and continues treatments as needed, freeing up DEPP resources to take on kudzu in other counties. You can learn more at mc-iris.org/adopt-a-kudzu-site.html.

Monroe County Identify and Reduce Invasive Species (MC-IRIS): Grow Native Project

An estimated 86 percent of invasive woody species come from landscape plantings. MC-IRIS started the Grow Native project to promote the sale of native plants and reduce the sale of invasive plant species. In 2016, the Indiana Native Plant and Wildflower Society (INPS) took this program statewide. In an effort to help consumers make more ecological landscaping

choices, INPS provides local retailers selling native plants with Grow Native signs, plant stakes and stickers to identify the native species that they have for sale. In addition to selling native plants, some retailers are going “invasive free” and agreeing not to sell any of the invasive horticultural plants on the list created by the Indiana invasive plant list, see www.entm.purdue.edu/iisc/invasiveplants.php. Keep your eye out for the Grow Native logo at Monroe County plant retailers to ensure you are purchasing plants native to Indiana (MC IRIS, 2016).

REFERENCES AND RESOURCES

- Purdue Extension publication listings
 - Commercial Greenhouse and Nursery Production: Alternative Options for Invasive Landscape Plants: <https://extension.purdue.edu/article/10027>
 - Invasive Plant Species in Hardwood Tree Plantings: www.extension.purdue.edu/extmedia/FNR/FNR-230-W.pdf
 - Mile-a-Minute Vine Fact Sheet: www.extension.purdue.edu/extmedia/FNR/FNR-481-W.pdf
 - Japanese Chaff Flower Fact Sheet: www.extension.purdue.edu/extmedia/FNR/FNR-477-W.pdf
 - Poison Hemlock Fact Sheet: www.extension.purdue.edu/extmedia/FNR/FNR-437-W.pdf
 - Palmer Amaranth Biology, Identification, and Management: www.extension.purdue.edu/extmedia/WS/WS-51-W.pdf
- Videos
 - Oriental bittersweet: www.youtube.com/watch?v=mtw5Gi3S09c
 - Wintercreeper: www.youtube.com/watch?v=rRxHICeBECg
 - Callery pear: www.youtube.com/watch?v=yvnd13TJUJc
 - Multiflora rose: www.youtube.com/watch?v=KMThwvYeFX0
 - Asian bush honeysuckle: www.youtube.com/watch?v=uYoRgE7xTQo
 - Burning bush: www.youtube.com/watch?v=tjHpmdOqztQ
 - Arrest that Pest! Emerald Ash Borer in Indiana: extension.entm.purdue.edu/arrestthatpest/

- Websites
 - ReportInvasives: ag.purdue.edu/reportinvasive/
 - Purdue Department of Forestry & Natural Resources Extension www.purdue.edu/fnr/extension/
 - Indiana Invasive Species Council: www.entm.purdue.edu/iisc/
 - Purdue Plant & Pest Diagnostic Laboratory: <https://ag.purdue.edu/btny/ppdl/Pages/default.aspx>
 - Indiana Department of Natural Resources Division of Entomology and Plant Pathology: www.in.gov/dnr/entomolo/
 - Southern Indiana Cooperative Invasives Management www.sicim.info/
 - Indiana Invasive Species Council Top Ten List of BMPs for Invasive Species: www.entm.purdue.edu/iisc/bmps.php
 - Midwest Invasive Plant Network (MIPN): www.mipn.org/
- Technical Assistance
 - Purdue Forestry and Natural Resources Extension Specialists: www.purdue.edu/fnr/extension/
 - Indiana Department of Natural Resources District Foresters provide assistance for Indiana landowners with forest management questions: www.in.gov/dnr/forestry/4750.htm
 - USDA Natural Resources Conservation Service (NRCS) provides a wide range of conservation technical assistance: <https://www.nrcs.usda.gov/wps/portal/nrcs/in/home/>
 - County Soil and Water Conservation District offices are often jointly located with the USDA NRCS and can provide information on local conservation issues and resources: iaswcd.org/
 - Indiana Department of Natural Resources Division of Entomology and Plant Pathology: www.in.gov/dnr/entomolo/

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INDIANA NATURAL RESOURCES COMMISSION INVASIVE TERRESTRIAL PLANT RULE

1 TITLE 312 NATURAL RESOURCES COMMISSION Proposed Rule LSA Document #18-316

Adds 312 IAC 18-3-25 to designate as pests or pathogens, certain invasive terrestrial plants and to prohibit and restrict the sale, distribution, and transport of these invasive terrestrial plants.

Effective 30 days after filing with the Publisher.

312 IAC 18-3-25 SECTION 1. 312 IAC 18-3-25 IS ADDED TO READ AS FOLLOWS: 312 IAC 18-3-25 Prohibited invasive terrestrial plants Authority: IC 14-10-2-4; IC 14-24-3 Affected: IC 14-24 Sec. 25.

(a) The following are prohibited invasive terrestrial plants and are declared pests or pathogens regulated under this section: (1) *Achyranthes japonica* (Japanese chaff flower). (2) *Ailanthus altissima* (tree of heaven). (3) *Alliaria petiolata* (garlic mustard). (4) *Alnus glutinosa* (black alder). (5) *Artemisia vulgaris* (mugwort). (6) *Arthraxon hispidus* (small carpgrass). (7) *Berberis thunbergii* (Japanese barberry). (8) *Carduus acanthoides* (spiny plumeless thistle). (9) *Carduus nutans* (musk thistle). (10) *Celastrus orbiculatus* (Asian bittersweet). (11) *Centaurea stoebe* (spotted knapweed). (12) *Cirsium vulgare* (bull thistle). (13) *Conium maculatum* (poison hemlock). (14) *Convolvulus arvensis* (field bindweed). (15) *Coronilla varia* (crown vetch). (16) *Dioscorea polystachya* (*oppositifolia*) (Chinese yam). (17) *Dipsacus fullonum* (common teasel). (18) *Dipsacus laciniatus* (cut-leaved teasel). (19) *Elaeagnus umbellata* (autumn olive). (20) *Euonymus fortunei* (wintercreeper). (21) *Euphorbia esula* (leafy spurge). (22) *Frangula alnus* (glossy buckthorn). (23) *Hesperis matronalis* (dame's rocket). (24) *Humulus japonicus* (Japanese hops). (25) *Lepidium latifolium* (pepperweed). (26) *Lespedeza cuneata* (*sericea* lespedeza). (27) *Ligustrum obtusifolium* (blunt leaved privet). (28) *Lonicera japonica* (Japanese honeysuckle). (29) *Lonicera maackii* (Amur honeysuckle). (30) *Lonicera morrowii* (Morrow's honeysuckle). (31) *Lonicera tatarica* (Tatarian honeysuckle). (32) *Lonicera x bella* (Bell's honeysuckle). (33) *Microstegium vimineum* (Japanese stiltgrass). (34) *Morus alba* (white mulberry). (35) *Phalaris arundinacea* (reed canarygrass). (36) *Phellodendron amurense* (Amur cork tree). (37) *Phragmites australis* subspecies *australis* (common reed). (38) *Polygonum perfoliatum* (mile-a-minute vine). (39) *Reynoutria japonica* (Japanese knotweed). (40) *Reynoutria sachalinensis* (giant knotweed). (41) *Reynoutria x bohemica* (Bohemian knotweed). (42) *Rhamnus cathartica* (common buckthorn). (43) *Vincetoxicum nigrum* (black swallow-wort). (44) *Vincetoxicum rossicum* (pale swallow-wort).

(b) This section applies to any part or life stage of the species identified in subsections (a).

(c) Except as provided in subsection (d), with respect to any species identified in subsection (a) a person must not: (1) Sell, offer or grow for sale, gift, barter, exchange, or distribute a species; (2) Transport or transfer a species; or (3) Introduce a species. (4) Subdivisions (1) and (2) of this subsection are effective one year after the effective date of this rule.

(d) Exempted from this section are the following: (1) A person who possesses a species identified in subsection (a) under a permit issued by the state entomologist. (2) A person engaged in a project approved by the state entomologist for the destruction of a species. 3

(e) A person who discovers a species identified in subsection (a) may do the following: (1) Report the discovery to the state entomologist or to the following address: Department of Natural Resources Division of Entomology and Plant Pathology 402 West Washington Street, Room W290 Indianapolis, IN 46204 (2) Include in the report provided under subdivision (1): (A) The location of the discovery, including the name of the county. (B) The date of the discovery. (C) Contact information for the person making the report, including telephone number and address.

KNOX COUNTY INVASIVE SPECIES ORDINANCE

KNOX COUNTY, INDIANA BOARD OF COMMISSIONERS

ORDINANCE NO. 11 - 2018

AN ORDINANCE PROHIBITING THE SALE AND PLANTING OF CERTAIN INVASIVE PLANT SPECIES (NOT SEEDS) IN KNOX COUNTY, INDIANA

BE IT ORDAINED by the Knox County Commissioners, Knox County, Indiana that:

WHEREAS, the Knox County Commissioners recognize the detrimental effect that invasive plant species have on Knox County agriculture, forests, natural habitats and to animal and human health in general; and

WHEREAS, the Indiana Invasive Species Council has warned that landowners are spending significant funds managing the impact of invasive species in Indiana; and

WHEREAS, the Knox County Commissioners desire to mitigate the impact of invasive plants by preventing their purposeful introduction into Knox County, Indiana; and

WHEREAS, invasive species are exotic plants that cause harm to human health, economic harm, and harm to our natural areas and ecosystems; and

WHEREAS, invasive species with a rating of medium or high on the Indiana Invasive Species Council list (located at www.indianainvasivespecies.org) are causing harm to the natural ecosystem of Knox County, Indiana; and

WHEREAS, the Indiana Invasive Plant Advisory Committee determines the ratings of the invasive plants and that listing, as may be amended from time to time, may be found at www.indianainvasivespecies.org; and

WHEREAS, the Knox County Commissioners find that the attached list of plants, not seeds (Exhibit A) as amended by the State of Indiana or the Hearing Authority created herein, with noted exceptions crossed out, should no longer be sold, traded or imported into Knox County; and

NOW, THEREFORE, IT IS HEREBY ORDAINED BY THE BOARD OF COMMISSIONERS OF KNOX COUNTY, INDIANA, as follows:

Section 1. INVASIVE SPECIES. Invasive species are non-native plants, animals or microbes that pose serious threats to human health and well-being, the environment, or our economy. Invasive plants are capable of rendering forests unrecognizable, by shading out native plants, saplings and wildflowers. Particular invasive plants are capable of hybridizing native plants and can negatively affect soil chemistry.

Section 2. PROHIBITION OF SALE OF PLANTS (not seeds). Invasive plant species identified on Exhibit A (with exceptions) shall not be sold in Knox County, Indiana by nurseries, retailers, grocery stores, chain stores or any other vendor (collectively "Vendor(s)") beginning January 1, 2020. Other potential invasive species identified in Exhibit B shall not be regulated at this time, but nurseries, retailers, etc. are encouraged to avoid selling them due to some invasive tendencies in the surrounding area. If the species in Exhibit B or other plant species become ranked Medium or High on the Indiana Invasive Plant list, they may be regulated by this ordinance.

Section 3. INVASIVE SPECIES ALREADY PLANTED. For those landowners who have invasive species already located on their property, this Ordinance does not require that they be removed as this Ordinance is not retroactively applied.

KNOX COUNTY INVASIVE SPECIES ORDINANCE *(continued)*

Section 3.1. Landowners are encouraged to remove invasive species and can contact the Cooperative Invasive Species Management Authority (CISMA), currently located at 604 South Quail Run Road, Vincennes, Indiana 47591, Phone Number 812-882-8210 for technical and advisory support.

Section 4. ENFORCING AUTHORITY. The Knox County Natural Resource Specialist, or another appointee of the Knox County Commissioners shall be the enforcing authority and shall be authorized to inspect points of sale to determine if any Vendors are operating in violation of this Ordinance. The Enforcing Authority shall be authorized to administer and to proceed under the provisions of the law in ordering the removal and disposal of any of the invasive species as specified herein.

Section 4.1. The Knox County Commissioners will address the compensation for the Enforcing Authority during the budget process in 2019 for the 2020 budget and for each year thereafter.

Section 5. CONTENTS OF ORDER AND NOTICE OF HEARING. The enforcement authority may issue an order requiring action relative to any violation of this Ordinance, including:

- (1) order to cease and desist of the sale of the invasive plants;
- (2) order the immediate disposal of the offending plants;
- (3) order the immediate surrender of the offending plants to Knox County for it to dispose of the same if the vendor does not have adequate disposal facilities;
- (4) notice that costs of enforcement and disposal will be assessed against the vendor;
- (5) notice of a hearing date to be held, no sooner than ten (10) days after the service of the Order on the Vendor and no more than sixty (60) days after the service of the order on the Vendor.

Section 6. HEARING AUTHORITY. The Knox County Commissioners shall appoint a five (5) member board to be known as the Knox County Invasive Species Board (KCISB). The KCISB shall be the Hearing Authority herein. The KCISB shall use the State Invasive Plant Species List (plants not seeds) as modified to address local Knox County requirements.

Section 6.1 Board Appointments. The initial terms of the five members will be staggered with one member serving one year, one member serving two years, one member serving three years, one member serving four years and one member serving five years. After the initial terms, all appointments are for five years or until a replacement is appointed. All appointments serve at the pleasure of the Knox County Commissioners. At all times, at least one member shall be associated with the agricultural industry and one member shall be associated with the horticulture industry.

The Hearing Authority shall meet in January of each year to organize and thereafter as needed based on Orders issued by the Enforcement Authority, or changes made by the State of Indiana to the invasive species plant list necessity meeting to discuss.

Section 6.2 Hearings, Penalties and Judicial Review. At the conclusion of any hearing at which a continuance is not granted, the Hearing Authority may make findings and take action to:

- (1) affirm the order;
- (2) rescind the order; or
- (3) modify the order, but unless the person to whom the order was issued, or counsel for that person, is present at the hearing, the hearing authority may modify the order in only a manner that makes its terms less stringent.
- (4) Impose penalties as follows:
 - (A) A fine not exceeding \$2,500 for the first violation; and
 - (B) A fine not exceeding \$7,500 for second and subsequent violations; and
 - (C) A separate violation shall be deemed committed upon each day during which a violation occurs or continues.

KNOX COUNTY INVASIVE SPECIES ORDINANCE *(continued)*

(D) The Hearing Authority has the sole discretion to determine if the violation(s) applies per plant or per location.

Judicial review of the hearing authority's order may be had by filing a complaint within ten (10) days of the action of the hearing authority. The Knox Superior Court II is the Court of judicial review for violation of this ordinance.

Upon the expiration of the above ten (10) days, the Enforcement Authority shall take the action contained in the Order.

Failure of the Vendor to pay the costs and/or fines associated with the violation of the Ordinance may result in a damages action being filed against the Vendor in the Knox County Superior Court II.

Section 7. EMERGENCY ACTION. The Enforcing Authority may take emergency action if the Enforcement Authority finds a Vendor's violation so egregious that emergency action must be taken in order to protect life, safety, or property. Emergency action may be taken without issuing an order or giving notice. However, this emergency action must be limited to removing plants in violation of this Ordinance to prevent further danger to Knox County's ecosystem.

Section 8. SEVERABILITY. Should any section, paragraph, sentence, clause, or any other portion of this Ordinance be declared by a court of competent jurisdiction to be invalid for any reason, the remaining provision or provisions shall be given the effect intended by Knox County in adopting this Ordinance. To this end, the provisions of this ordinance are severable.

Section 9. PUBLISHING. The Knox County Auditor shall cause this ordinance to be published within thirty (30) days of passage.

FORESTS AS A CONSIDERATION IN COMMUNITY PLANNING

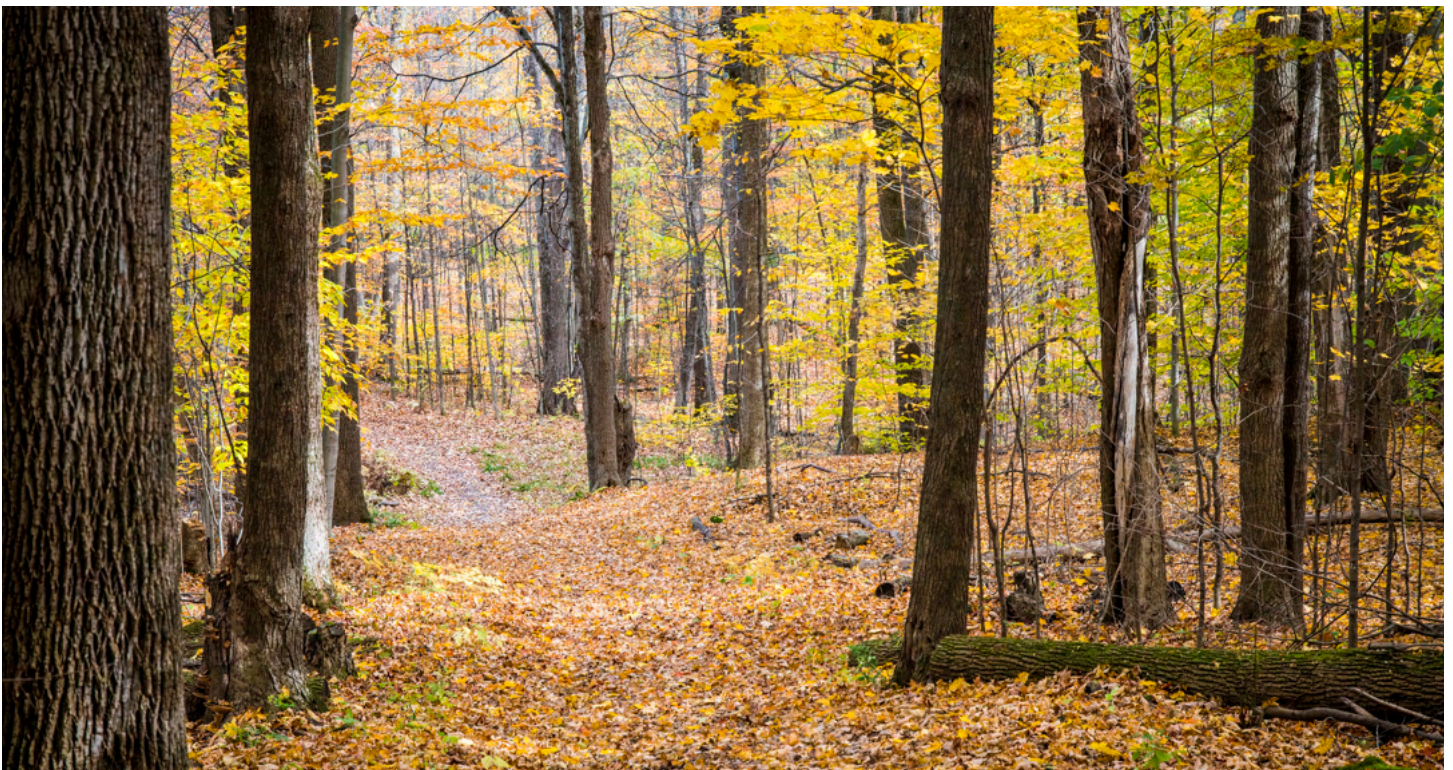
Lenny Farlee, author

AN OVERVIEW OF INDIANA FORESTS

Forestland occupies approximately one-fifth of the landscape in Indiana, nearly 4.9 million acres, and can be found in both rural and urban areas as well as the interface between the two. Forests represent an important resource in Indiana with significant ecologic, economic and societal benefits to individuals, communities and business. Forest cover is important to many species of Indiana wildlife and is critical habitat for some species, including federally endangered species such as the Indiana bat. Forests provide significant personal and public recreation value. They also provide additional environmental services including soil erosion control, soil building, windbreaks, shading, production of clean water vapor, buffering of stream courses and drainage areas, moderation of storm water discharge, reduction of noise, light, water and air pollution, visual screening and aesthetic value. Forests are a natural reservoir of biological diversity and sequester carbon dioxide in woody plants and forest soils. Flowering trees, shrubs and forbs in forests are an important resource for pollinators.

Forests contribute directly to economic growth through the forest products and outdoor recreation industries. Outdoor recreation in Indiana accounts for an estimated \$15.7 billion in consumer spending annually. Hiking, camping, boating, wildlife watching, fishing, hunting and other outdoor activities draw native Hoosiers and people from around the nation and world to Indiana localities. Those visitors in turn purchase supplies, equipment and services in those communities. Outdoor recreation opportunities such as bike, foot or horse trails, parks and public camping and fishing may provide an advantage when competing for new businesses and employees. The positive aesthetic qualities of trees and forests may also attract businesses and visitors to communities.

The forest products industry is a leader in employment and value-added in the agricultural sector and one of the top manufacturing industries in the state. Timber sales provide income to landowners from land that might not be well suited to other agricultural uses. That same timber may be transformed from the tree to a finished product, in a furniture or cabinet showroom for example, completely by Indiana companies, and might be shipped to a number of locations around the world. Indiana was approximately 85 percent forest cover just prior to European settlement, and reached a low ebb in



forest cover of perhaps 5 to 7 percent in the late 19th and early 20th centuries. Area of forest cover has grown since due to abandonment of marginal agricultural lands, including crop, hay and pasture lands, which has regrown to tree cover. Tree planting has added acres to Indiana forests as well.

Forests may also lose ground to land development such as housing, roads, utilities and conversion to crops, water bodies and other uses. Forests in urban areas and at the urban-rural interface are particularly vulnerable to conversion, reduction or fragmentation as land values and competing uses increase. The general trend across the state over the past few decades has been an increase in forest acres, but localities might see forest decline from the previously mentioned sources. Projections from the Indiana DNR Division of Forestry and the U.S. Forest Service suggest we can anticipate declines in Indiana forested area over the next four decades, with the quantity lost influenced by the level of population and economic growth.

Eighty-four percent of Indiana forestland is held by private interests, including families, farms and corporations. Family forest owners hold the majority of this land, an estimated 3.6 million acres. The balance is owned by corporations and other private groups including conservation organizations and Native American tribes. Public forests account for 16 percent of the total and include federal (8 percent), state (7.5 percent) and local (1 percent) government. Hoosier National Forest, U.S. Fish and Wildlife Service and Department of Defense properties are significant federal ownerships. Indiana Department of Natural Resources (DNR) properties including state forests, parks and fish and wildlife areas are representative state ownerships.

Forestland owned by private entities may be held and used for a wide range of goals. Many landowner surveys indicate quality-of-life objectives such as recreation, family legacy and passing property to the next generation are highly rated goals. Conservation objectives like wildlife habitat, biological diversity and forest health are also common goals. Owners may also value economic objectives such as land investment and timber harvesting to generate income. Leasing recreation opportunities has also emerged as an income source. Hunting rights are probably the most common recreation lease, but a variety of other activities may be

provided through leases. Some owners may use forests to produce products such as maple syrup or ginseng. Selling timber represents an important source of occasional income for forest owners and an important resource supply chain for the forest products industry.

FOREST MANAGEMENT

Appropriate forest management activities including vine control, thinning, invasive species control and timber harvesting have been demonstrated to improve forest health and wildlife habitat diversity, in addition to improving the production and quality of wood products, which are one of the most environmentally friendly building materials available. Providing landowners the opportunity to produce income from their forests creates incentives to retain forestland. Active forest management can help landowners accomplish their ownership goals. Active forest management also addresses significant threats to forest health from invasive plants, insects and diseases by managing the impact and spread of these forest health threats.

Forest and wildland fire risks should also be considered as a part of forest management. The large and fast-moving fires seen in the western U.S. are not common



occurrences in Indiana, but the wildfire experiences of communities like Gatlinburg and Pigeon Forge, Tennessee, in 2016 serve as a warning that weather conditions, forest fuels and building proximity to combustible vegetation can combine to produce dangers to life and property in the eastern U.S. as well. Homeowners and communities can access guidance

for making their properties and communities more wildfire-resistant through the National Fire Protection Association Firewise USA program and their local fire prevention authorities. The Indiana DNR Division of Forestry also offers assistance to rural and volunteer fire departments (see <https://www.in.gov/dnr/forestry/2874.htm>).

Forest landowners have access to professional forest management advice and assistance through professional foresters working for agencies including the Indiana DNR Division of Forestry and private sources such as consulting foresters and wood products industry foresters. DNR district foresters work with landowners to provide advice and assistance with forest management. Contact information for the local district foresters can be found at www.in.gov/dnr/forestry/4750.htm.

Private consulting foresters can provide a wide variety of services to landowners on a fee basis. Industrial foresters work for wood using industries and often buy timber from landowners for those industries. They may also offer additional forest management services. Consulting and industrial foresters can be located at www.findindianaforester.org. Landowners have good access to timber markets through professional foresters and a thriving primary wood products industry across the state. Several companies have also emerged to assist landowners with leasing recreation opportunities such as hunting, as well as buying and selling recreational properties.

Eligible landowners may have access to cost-sharing and technical service programs through the USDA Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA). Several programs, including the USDA Conservation Reserve Program and NRCS Environmental Quality Incentive Program, can assist landowners with costs to install practices such as wildlife habitat development and improvement, reforestation tree plantings, invasive plant control and soil erosion control practices. Most Indiana counties have a USDA Service Center office where details of the programs and application forms can be accessed. You can locate your local center at www.nrcs.usda.gov/wps/portal/nrcs/in/home/.

Managed forestland may receive some incentives in the property tax code. Forestland being managed

to produce timber products is normally considered agricultural land for tax assessment purposes, is referred to as woodland for land type and is generally assessed at 20 percent of the value of comparable cropland. Land may also be voluntarily entered into the Classified Forest and Wildlands Program, administered by the Indiana DNR Division of Forestry. Lands entered into the program are assessed at a much-reduced rate, providing incentives for landowners to retain and manage their forestland. Additional information on the Classified Forest and Wildlands Program can be obtained from the Indiana Division of Forestry at www.in.gov/dnr/forestry/.

Timber harvesting on public and private lands might upset some community members who consider this activity visually unpleasant or environmentally damaging. As stated previously, well-managed harvesting can improve long-term forest health and productivity, enhance habitat for some wildlife



and provide income for landowners and resources for businesses and industry. Using the services of a professional forester to manage the sale of timber can reduce the risk of unnecessary damage and improve forest conditions following the harvest. Indiana also requires buyers of standing timber to be licensed and bonded. The state maintains a list of licensed timber buyers to provide some protection to landowners from timber theft and dubious business practices. The forest products industry sponsored this law to prevent bad actors from damaging the ability to legally manage and harvest timber in the state. You can learn more about the Licensed Timber Buyers law and access the list of licensed buyers at www.in.gov/dnr/forestry/2846.htm.

Forests in Indiana have naturally regenerated on millions of acres abandoned from cropping, grazing and haying over the past several decades. Forests subject to harvesting or natural disasters like tornados, ice storms or fires also generally return to trees from the seed and seedlings found in forest soils. Replanting seedlings in current forest areas is normally not required to produce new tree growth, but planting and protection from damaging agents like deer browsing and aggressive weed growth can encourage quicker recovery of forest trees.

Protection from soil erosion and water quality degradation are important considerations when harvesting timber. Most erosion from a timber harvesting operation occurs from logging trails, roads, stream crossings and landings or loading areas. The Indiana DNR Division of Forestry has developed a set of best management practices designed to protect soil and water quality during and following timber-harvesting operations. These guidelines are voluntary on a statewide basis, but can be included as required in a timber sale contract. The guidelines are available at www.in.gov/dnr/forestry/2871.htm.

URBAN FOREST VALUES AND BENEFITS

Forest areas found in urban areas provide unique opportunities and benefits, but also some planning and management challenges. Urban forests contribute benefits similar in many respects to rural forest areas, but in close proximity to higher human population and developed landscapes. Purdue Forestry and Natural Resources Extension and the Indiana Division of Forestry provide several documents on urban forests, including their benefits to communities and resources for management and planning.

PURDUE EXTENSION PUBLICATIONS

Indiana's Urban Woodlots: https://mdc.itap.purdue.edu/item.asp?Item_Number=FNR-489-W

Lumber from Urban and Construction-Site Trees: https://www.edustore.purdue.edu/item.asp?Item_Number=FNR-93-W#.VrPCssArk3c

Urban Wood and Traditional Wood: A Comparison of Properties and Uses: https://mdc.itap.purdue.edu/item.asp?Item_Number=FNR-490-W

INDIANA DIVISION OF FORESTRY PUBLICATIONS

The Indiana Division of Forestry has a Community and Urban Forestry program providing assistance to communities including education, guidance and grants: www.in.gov/dnr/forestry/2854.htm

Publications on urban forest and tree planning, management and planning: www.in.gov/dnr/forestry/3605.htm

INDIANA'S FOREST PRODUCTS INDUSTRY

Production of forest products in Indiana is a highly sustainable activity, meaning the resource is being reproduced and growing, rather than declining, over time. Indiana has been gaining forest acreage over the last few decades. Statewide forest inventories indicate our forests are growing between 2 and 2.6 times more wood annually than is lost to mortality and removed in harvesting combined. The USDA report *Forests of Indiana, 2016* (see https://www.fs.fed.us/nrs/pubs/ru/ru_fs127.pdf) outlines trends in forest acreage and growth using a continuous forest inventory program conducted by the USDA Forest Service in cooperation with the Indiana DNR Division of Forestry. *Forests of Indiana, 2013* (see www.in.gov/dnr/forestry/files/fo-State_Private_lands_forest_inventory_update.pdf) provides a more detailed look at Indiana forest distribution and characteristics.

The growing forest acreage and increasing volume of wood available provides business opportunities for additional wood products harvesting and manufacturing in the state. An increase in tree mortality as our forest trees age suggests there may be additional opportunities to expand wood products manufacturing and employment by increased harvesting of trees to utilize the wood resource before it dies.

The wood products industry includes harvesting and primary manufacturing to produce dimensional lumber and veneer. Although no paper mills are currently located in the state, mills in neighboring states may purchase wood fiber from Indiana. Secondary industry uses primary wood products to produce industrial products such as pallets and crates, railroad ties, staves for wood barrels, wood mats for construction equipment and other construction materials. Secondary

industry also produces a wide array of consumer product such as hardwood furniture, flooring, cabinets, paneling, molding and trim, stair rails and treads, windows and doors. Wood can also be used as a primary or secondary fuel for homes and industry. Business opportunities related to wood products vary in size from a garage-based custom woodworking contractor to large production facilities producing lumber, veneer, furniture or flooring. The Indiana Forest Products Community website (www.indianaforestproducts.com/index.php) provides a directory and map of businesses in the wood products sector in Indiana.

The economic impact of forests and the wood products harvested from them is substantial statewide and crucial to many rural communities.

Total value of shipments of \$7 billion, 2.4 percent of Indiana's gross domestic product

- \$166 million was paid to landowners for timber
- For every \$1 paid to landowners for timber, \$41 of value was added in the production of final products

The hardwood industry employed 30,845 people

- An additional 64,908 jobs were generated in economic sectors supporting or supported by the hardwood industry



Annual wages of \$1.3 billion were paid, generating an estimated

- \$43 million in state payroll taxes
- \$20.1 million in local payroll taxes

Each acre of forest supports \$245 of hardwood wages paid annually.

Indiana is a leading producer of:

- Wood office furniture
- Manufactured homes
- Wood stock-line kitchen cabinets
- Wooden caskets and coffins
- Hardwood plywood-based products

Indiana Statutes Affecting Forestry

Forest management activities are protected, much like agricultural practices, from nuisance suits related to generally accepted forestry management practices or changes in operations, including:

- A change in the ownership or size of the forestry operation
- Enrollment in a government forestry conservation program
- Use of new forestry technology
- A visual change due to removal of timber or vegetation
- Normal noise from forestry equipment
- Removal of timber or vegetation from a forest adjoining the locality
- The proper application of pesticides and fertilizers

This protection is provided under what are commonly called "right to farm" or "right to practice forestry" statutes. Indiana Codes §§ 32-30-6-1 to 32-30-6-1.5, 32-30-6-9, 32-30-6-11 provide the details of this protected status.

Some additional laws and regulations that may impact forest management or timber harvesting include the previously mentioned Classified Forest Act (IC 6-1.1-6) and Licensed Timber Buyers Law (IC 25-36.5-1-18). The Indiana Flood Control Act governs activities and construction occurring in floodway areas. Stream crossings or leaving logging debris in regulated streams or floodways may fall under this act. Additional information on each of these acts can be found here. Wetland regulations may also impact forestlands that contain wetlands. One example is a list of best management practice requirements for building a road in wetlands for forest management purposes. Information on the requirement and the list of practices is located at www.in.gov/dnr/forestry/4704.htm.

Clearing forests or wetlands for agricultural production may have impacts on eligibility for USDA agriculture support programs. Consultation with the USDA Natural

Resources Conservation Service or Farm Service Agency in the county is recommended for those participating in USDA agriculture programs prior to conversion of wetlands or forestland.

FORESTS AND COMPREHENSIVE PLANNING

Forests are important parts of the natural, agricultural, commercial and societal landscape of Indiana. Retention and sustainable management of forests creates an opportunity to continually produce the many benefits forests provide. Unfortunately, forests are regarded by some people as underutilized areas best converted to other uses. The multiple benefits outlined here provide evidence of the value forests bring to communities and motivation to maintain and manage forests as part of the landscape. Because of their potential to produce multiple benefits for individuals and communities, forests may fit into several areas of planning, including natural and recreational areas, agriculture production



(timber), environmental benefits and services, sources for industrial production and aesthetic values, to name a few. For many communities around Indiana, forestlands are primarily private lands, so consideration of the private property rights and opportunities for forest landowners should be an important part of planning considerations. Other communities have significant public forest holdings in their areas, providing opportunities for communication and cooperation with the public agencies holding those forests. Recognizing and outlining the current contributions and future benefits related to forests in your community comprehensive planning can encourage leaders and citizens to value forests as a part of the community.

ADDITIONAL RESOURCES

Purdue University Department of Forestry and Natural Resources: [https:// ag.purdue.edu/fnr](https://ag.purdue.edu/fnr)

Indiana DNR Division of Forestry: www.in.gov/dnr/forestry/

Indiana USDA Natural Resources Conservation Service: www.nrcs.usda.gov/wps/portal/nrcs/in/home/

Federal requirements for forest roads in wetlands: www.in.gov/dnr/forestry/4704.htm

Forestry best management practices: www.in.gov/dnr/forestry/2871.htm

Licensed timber buyers: www.in.gov/dnr/forestry/2846.htm

DNR district foresters: www.in.gov/dnr/forestry/4750.htm

Directory of private professional foresters: <http://www.findindianaforester.org/>

Summary of state and local forestry regulations in Indiana affecting timber harvesting: www.in.gov/dnr/forestry/4591.htm

The Indiana Forest Products Community: www.indianaforestproducts.com/index.php

Indiana's Hardwood Industry: Its Economic Impact: www.in.gov/dnr/forestry/files/fo-Hrdwd_Imp_2016.pdf

State Comprehensive Outdoor Recreation Plan: www.in.gov/dnr/outdoor/files/or-2016_2020_SCORP.pdf

Economic Impact of Indiana Outdoor Recreation: <https://outdoorindustry.org/resource/indiana-outdoor-recreation-economy-report/>

Indiana Forests 2013 and Beyond: www.in.gov/dnr/forestry/files/fo-State_Private_lands_forest_inventory_update.pdf

National Fire Protection Association, Firewise USA <https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA>

WHAT IS POLLINATOR-FRIENDLY SOLAR?

Savanna Ploessl and Brock Harpur, authors

Pollinator-friendly solar sites take an alternative approach to site design and management by using low-growing seed mixtures that stabilize soil while also providing a meaningful amount of value to pollinators, project owners, and the community.



Enel Green Power's 150 MW Aurora Solar project
Credit: Jake Janski

WHY POLLINATOR-FRIENDLY SOLAR?

There are several reasons why communities, developers, energy buyers, and landowners may wish to pursue pollinator-friendly solar in Indiana. Of primary importance to all groups is the increased potential short and long-term conservation value of a pollinator-friendly site. Pollinating species (predominantly insects like butterflies, hover flies, and bees) need flowering plants for food and nesting sites. Charismatic pollinators like the Monarch Butterfly, for example, require nesting and feeding sites on milkweed plants and Indiana is a critical migration stop. Pollinator-friendly solar also provides additional habitat value to heritage birds like pheasant and quail, grassland songbirds, and small mammals. These spaces can also be used for agricultural insects such as honey bees.

Early evidence on solar acceptance suggests that residents are more likely to accept a neighboring solar installation if it is aesthetically more pleasing than the

previous land use. Pollinator-friendly solar may therefore provide a means to increase public acceptance. It also provides an opportunity for developers to advertise their commitment to green initiatives.

Pollinator plantings under and around solar panels can be less expensive to maintain in the long-term than traditional turfgrass. The long-term savings are made through reduced mowing frequency. Furthermore, the integration of grazing sheep can altogether eliminate the need to mow and provide additional financial benefits to landowners.

BENEFITS AND CHALLENGES

Pollinator-friendly solar can benefit developers, landowners, surrounding agriculture, the public and pollinators. Specific benefits include:

- Potential reduction in long-term maintenance costs
- Increased likelihood of public acceptance
- Potential increase in yield for pollinator-dependent crops in the surrounding area
- Creation of nectar and pollen food sources for native and local pollinator species
- Reduced water run-off and erosion
- Increased soil organic matter and soil health

Some developers experience challenges when doing their first pollinator-friendly solar projects. Specific challenges can include:

- Selecting an experienced landscape or ecological consultant
- Changing "status quo" of grass-only turf-type seed mixtures to incorporate clovers and/or other flowering species
- Perceptions associated with seed supply and cost
- Perceptions associated with sting risks or whether pollen will accumulate on solar panels
- Ensuring the planting is beneficial to the local landscape

To help find ways to offset extra costs some developers may perceive, incentives can be available through habitat-landowner assistance programs, and these programs should be looked into by developers for their areas.

On Costs

The cost of pollinator-friendly solar can vary based on the desired groundcover, the site layout, and the maintenance plan. Each of these should be considered when planning. The example seed mix provided below has an estimated retail cost of \$66.78/acre for 100+ acres. A comparable high-diversity seed mix with no panel-height restrictions can cost as much as \$300-\$600/acre. This range is well within the range expected of turfgrass. An additional benefit of pollinator-friendly seed mixes is the reduced mowing schedule. Substantial savings can be made in the long-term by reducing the number of annual site visits for mowing.

POLICY AND PLANNING CONSIDERATIONS

Planning

Large-scale solar development requires a team of consultants and contractors. When planning for a pollinator-friendly solar site it is essential to contact an expert on pollinator-friendly planting before beginning the process. This expert will develop site-appropriate seed mixes and a site-management plan. Indiana is home to several regional and national firms with applicable expertise.

Specific recommendations for plants species include:

- Ensuring species planted near-to and underneath panels do grow tall enough to shade the panels
- Selecting shade-tolerant species for spaces under panels
- Confirming with state regulators that there are no invasive plant species in the seed mix
- Ensuring a mix of plant species that will have blooms throughout the growing season
- Including native grasses and forbs in the seed mix
- Ensuring that seeds are untreated with pesticides and are purchased from a trusted provider
- Planning an effective buffer area composed of woody shrubs and other species

Planting experts should also consider how to eliminate previously-planted vegetation in the site and take measures to control weeds before seeding. The use of a cover crop seed mix (e.g. oats, winter wheat, etc) is highly recommended for soil stabilization. Soil testing and soil preparation before planting will vary based on specific site requirements. Soil testing is strongly encouraged.

No matter what kind of ground cover is used on a solar site, it will require management. For pollinator-friendly solar sites, a common goal is for the project to require just one annual mow or grazing after the vegetation is established. During the first 3-5 years, a landscaping contractor will visit the site three or more times per year. This should be included in budgeting and site planning. Broadcast herbicides or insecticides are strongly discouraged.

It is strongly recommended that a detailed site management plan is developed to ensure the long-term health of the site.

Pollinator-friendly ground cover in a solar facility should not be thought of as a native restoration. A native restoration might use local-ecotype seed mixtures that are only commercially available in very limited quantities. Pollinator-friendly ground cover in a solar facility is an improvement on the use of mono-crop of turf-type grasses and should be expected to include clovers and other regionally appropriate plant species.

Visible signage indicating that the site is pollinator-friendly can be encouraged and may increase public acceptance.

Panel height

Panel height is critically important to the long-term success of a pollinator-friendly solar site. When the lower edge of the photovoltaic (PV) solar panels is too close to the ground, a deep shadow is created and vegetation performance can suffer. Solar racking manufacturers and the National Renewable Energy Laboratory have made recommendations regarding the height of solar panels and associated costs and energy performance benefits. We encourage landowners to seek information about the long-term benefits, such as increased soil organic matter when deep-rooted plants are used as ground cover.

Vegetative buffer areas

Buffer areas provide screening around the solar site. Buffer areas can also be used to plant pollinator-friendly species. The buffer provides an area where one can plant flowering shrubs, trees, grasses and forbs. Buffer requirements will vary based on the specifics of the desired site.

Vegetation Management

Electricity and transportation right-of-way managers have been sharing best practices in vegetation management for more than a decade. Use of Integrated Vegetation Management (IVM) — the combination of trained staff, spot- and landscape mowing, targeted spot-use of herbicides, and manual extraction — is recognized as the approach that delivers the best outcomes at the least cost. Using IVM to manage pollinator-friendly solar is straightforward. During the establishment period, the site is mowed to knock-back fast-growing undesirable plant species. Annual mowing can also be performed on pollinator-friendly solar sites and ideally timed for late fall. Spot mowing (only mowing problem areas) can be performed when necessary. Contractors should be expected to ensure their equipment does not inadvertently move seeds from one site to another. Discussing IVM options with site managers and local biologists is highly recommended.

Grazing

In addition to IVM practices, vegetation management in the facility can be completed through the use of sheep grazing. Recommended by the American Solar Grazing Association, rotational grazing (also called “conservation grazing”) practices should be used and have been shown to benefit overall biodiversity and is a compatible practice for pollinator-friendly ground cover. Continuous grazing, where the sheep are left on site all year with little supervision, has been shown to attract coyotes and Sheep work nicely for the grazing of solar sites as they are small enough to not disrupt the panels. The employment of sheep grazing at facilities in place of mowing provides for a more holistic approach to land use.

Unwanted species

Indiana Invasive Species Council Official Indiana Invasive Plant List

- <https://growindiananatives.org/invasive-plants/indiana-invasive-species-council-official-indiana-invasive-plant-list/>

Exotic & Invasive Plants

- <https://www.in.gov/dnr/3123.htm>

Pollinator-Friendly Solar Scorecard

Standards establishing what constitutes “pollinator-friendly” within the managed landscape of a large-scale solar farm have been published by agencies and leading universities in 13 states, including Purdue University. Scorecards help establish and build trust between the local community and the solar developer and provide a check against the temptation to make exaggerated marketing claims. Using a scorecard serves to look over the quality of seed mixes beneath the panels, the plant species in the site, and the plant species in the vegetative buffer areas. A scorecard will also assess site management and insecticide risk. A scorecard for Indiana was recently developed by Purdue University and can be used for sites across Indiana. The 2020 scorecard can be found at the end of this section. More recent scorecards for Indiana can be found online through Purdue Extension.

EXAMPLE OF LARGE-SCALE POLLINATOR-FRIENDLY SOLAR

The 1,200 acre, 150 MW Aurora Solar project owned meets the applicable pollinator-friendly solar scorecard standard. A diverse mixture of low-growing flowering plants and grasses is used throughout the project. Because of the fixed cost to mobilize equipment, doing pollinator-friendly ground cover on larger projects is more economically attractive than doing it on small projects.



Credit: Jake Janski/Minnesota Native Landscapes

A series of presentations at the Society of Soil and Water Conservation Symposium are recorded and available online. <https://youtu.be/r9DRNEs5-Co>

EXAMPLE SEED MIX

Seed mixes should be carefully crafted to be site-appropriate. They should consider exposure, panel height, soil conditions, local flora, and seed availability.

There is no generic seed mix that will be appropriate for all solar sites in Indiana. This seed mix was kindly developed by the Conservation Blueprint. It assumes a 30-inch maximum height for plants.

Species	Scientific Name	PLS lbs per acre	PLS seeds per sq ft	% PLS	Bloom Period
Alsike Clover	<i>Trifolium hybridum</i>	0.7	10.93	17.37	June - July
Blackeyed Susan	<i>Rudbeckia hirta</i>	0.25	9.04	14.37	June - July
Clasping Coneflower	<i>Rudbeckia amplexicaulis</i>	0.2	7.35	11.67	April - May
Crimson Clover	<i>Trifolium incarnatum</i>	1.8	6.19	9.83	June - July
Golden Alexander	<i>Zizia aurea</i>	0.08	0.32	0.51	April - May
Gray Goldenrod	<i>Solidago nemoralis</i>	0.008	0.19	0.29	August - October
Ladino or White Clover	<i>Trifolium repens</i>	0.3	4.9	7.79	June - July
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	0.25	1.27	2.02	June - July
Lemon Mint or Lemon Bee Balm	<i>Monarda citriodora</i>	0.08	2.64	4.2	June - July
Missouri Goldenrod, Native Source	<i>Solidago missouriensis</i>	0.008	1.16	1.84	June - July
Purple Coneflower	<i>Echinacea purpurea</i>	0.2	0.53	0.84	June - July
Red Clover	<i>Trifolium pratense</i>	0.5	3.12	4.96	June - July
Western Yarrow	<i>Achillea millefolium</i>	0.05	3.27	5.2	April - May
White Dutch Clover	<i>Trifolium repens</i>	0.6	12.01	19.08	June - July
Rice Hulls	N/A	3.5	0	17.37	--

Wildflower/Forb/Legume Total:	5.026	62.93	100
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Filler Total:	3.5	0	0
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Total Mixture:	8.526	62.93	100
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ADDITIONAL RESOURCES AND REFERENCES

- MACOG Technical Guide on Solar and Pollinator-Friendly Solar - http://macog.com/solar_energy.html
- EG Research Report Pollinator-Friendly in Indiana - <https://eq-research.com/eq-publications/pollinator-friendly-solar-in-indiana/>
- Illinois Solar Score Card - <https://www2.illinois.gov/dnr/conservation/PollinatorScoreCard/Pages/default.aspx>
- Indiana Solar Score Card - <https://mdc.itap.purdue.edu/item.asp?itemID=24467>
- Walston, Leroy J., et al. "Examining the potential for agricultural benefits from pollinator habitat at solar facilities in the United States." *Environmental science & technology* 52.13 (2018): 7566-7576.
- Hernandez, Rebecca R., et al. "Techno-ecological synergies of solar energy for global sustainability." *Nature Sustainability* 2.7 (2019): 560-568.



LOCAL GOVERNMENT FLOOD POLICY TOOL KIT

Kaitlyn McClain, author

What is localized flooding?

FEMA defines localized flooding as “smaller scale flooding that can occur anywhere in a community.” Localized flooding is most common in areas with high groundwater or poorly drained soils, where urbanization and impervious surfaces have increased runoff or in older sections of communities where original storm sewers were not designed with today’s standards. Localized flooding causes:

- Sheet flow into streets and low-lying areas
- Ponding in yards and on streets
- Sewer backups
- Basement or first floor flooding

Localized flooding is sometimes referred to as “nuisance flooding” or “urban flooding.” Localized flooding can occur outside of Special Flood Hazard Areas (SFHAs), or A Zones, as defined on a community’s Federal



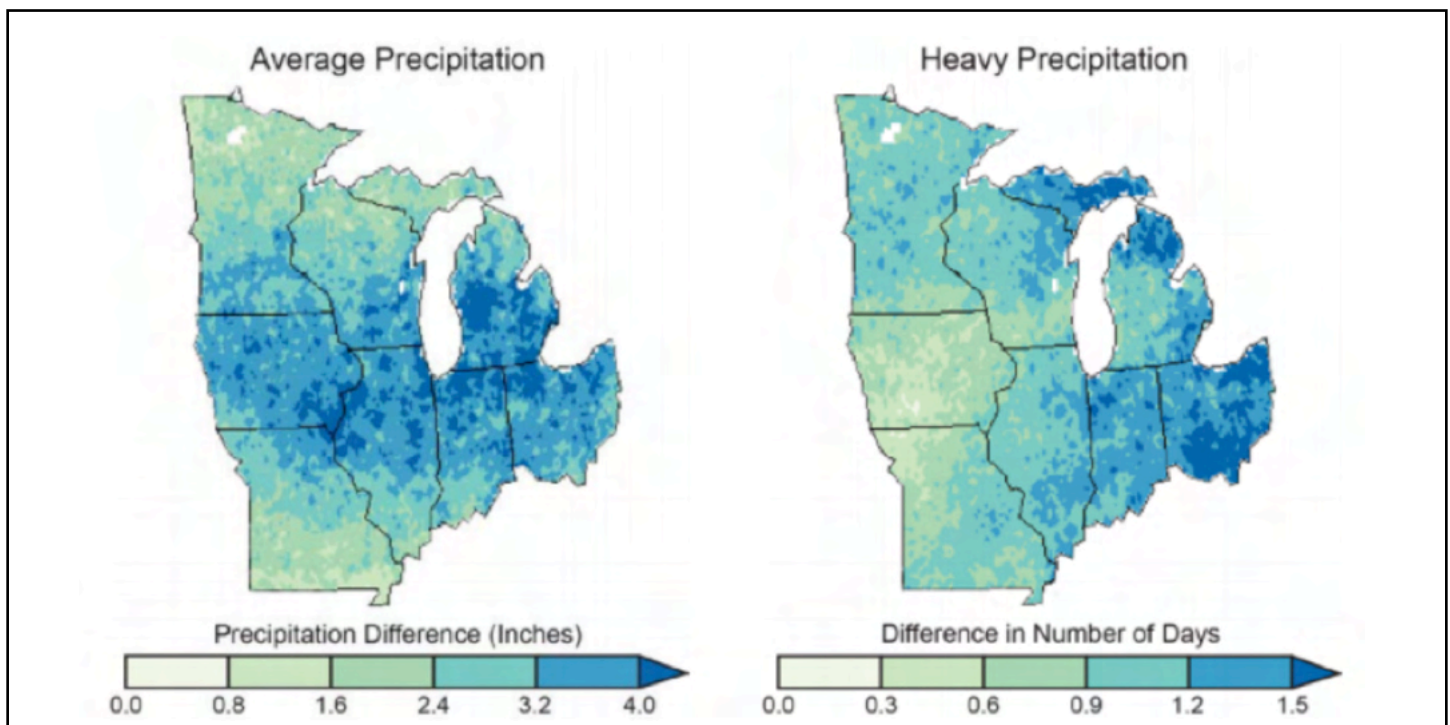
Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM). In fact, between 20 and 25 percent of all National Flood Insurance Program (NFIP) repetitive loss properties are rated as being in B, C and X Zones, outside of the 100-year floodplain (see **Table 1** for definitions). Flood insurance is not required for homes, commercial buildings and other development in these zones. As a result, these structures rarely meet the same development standards of those in SFHAs and are susceptible to damage from even small-scale flood events.

Localized flooding might become more of a problem in the future if communities do not incorporate stormwater management into planning and development decisions. According to the 2014 National Climate Assessment (NCA3), extreme rainfall events and flooding have increased during the last century, and these trends are expected to continue (**Figure 1**). The projected warmer temperatures mean that more precipitation will be falling as rain rather than as snow. Winter and spring will be wetter.

TABLE 1. FEMA FLOOD ZONE DESIGNATIONS

Zone	Risk Level	Description
A, AE, AH, A1-30, AO, A99	High	Areas with a 1 percent annual chance of flooding and a 26 percent chance of flooding over the life of a 30-year mortgage. Flood insurance required.
V, VE, V1-30	High	Coastal areas with a 1 percent or greater chance of flooding and the additional hazard of storm waves. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Flood insurance required.
B, X	Moderate	Usually the area between the limits of the 100-year and 500-year flood hazard zones. Zone B is the area of 0.2 percent annual chance flood (500-year). Zone X is the area of 1 percent annual chance flood (100-year) with depths of less than 1 foot or less than one square mile drainage area, or areas of 1% annual chance flood (100-year) protected by levees.
C, X	Low	Zone C may have ponding and local drainage problems that don't warrant designation as base floodplain. Zone X is the area determined to be outside the 500-year floodplain.
D	Undetermined	Areas in which no flood hazard analysis has been conducted.

FIGURE 1: POSSIBLE INCREASES IN PRECIPITATION FROM THE 1971-2000 BASE PERIOD TO THE PERIOD 2041-2070 BASED ON THE A2 HIGH EMISSION SCENARIO.



Source: National Climate Assessment, 2014

HOW IS LOCALIZED FLOODING RELEVANT TO ECONOMIC DEVELOPMENT?

The problems associated with localized flooding range from safety hazards and public health concerns, to property damage, to overall community impacts and costs to local governments.

As little as two feet of water can float most vehicles, and adults can be knocked down by as little as a few inches of moving water. Standing water is a breeding ground for mosquitos that can transmit disease. Health problems such as asthma, allergies and respiratory infections can develop or worsen from living in a home that has been flooded and now has mold and mildew. Repetitive flooding can cause great anxiety for individuals and families.

Property damage can be extensive even with small amounts of water. If carpet, walls, insulation and mattresses get wet, they will likely need to be replaced. Most property owners outside of SFHAs do not have flood insurance, and damage from flooding is not covered under standard homeowners' insurance policies. The cumulative damage of these flood events can be significant.



The community as a whole can suffer from localized flooding because areas that are repeatedly flooded are less desirable to live and work in. Property values may be negatively affected. Things like sidewalks, streets, fences and signs wear out sooner and are a cost to local government. Even temporarily flooded streets and damaged buildings can have ripple effects throughout the community and local economy.

In some areas, localized flooding is a chronic problem. While larger floods might cause greater destruction that is more immediate, the repetitive damage of localized flooding can add up over time. Despite the fact that localized flooding can be severely impactful to communities, the bulk of federal and state resources such as funding, technical help and disaster assistance goes to handling large flood events and mitigation. However, there are actions that local governments can take to mitigate the risk and damage caused by localized flooding.

ADDRESSING FLOODING THROUGH COMPREHENSIVE PLANNING

Comprehensive plans should be updated every five to ten years. As a community updates its comprehensive plan, it should incorporate the goals of existing watershed management plans (www.in.gov/idem/nps/3180.htm) and address stormwater management and localized flooding concerns. These concerns can be addressed in comprehensive plans through zoning that discourages sprawl, encourages alternative transportation options that reduce demand for streets and impervious surfaces and upholds No Adverse Impact floodplain management principles (see www.floods.org/index.asp?menuID=349&firstlevelmenuID=187&siteID=1). Developing or updating a comprehensive plan should be a holistic, inclusive process that reflects economic, environmental and societal conditions. What works for one community might not work for another.

No Adverse Impact (NAI) Floodplain Management is a managing principle that has been developed and promoted by the Association of State Floodplain Managers. It gives communities a way to promote responsible development through local decision making. Ideally, a community will develop a comprehensive plan that identifies acceptable levels of flood impacts, specifies appropriate measures to mitigate those adverse impacts and establishes an implementation plan. Under NAI management principles, the actions of one property owner are not allowed to adversely affect the rights of other property owners.

MODEL POLICIES AND TOOLS

The Indiana Department of Natural Resources Lake Michigan Coastal Program has created a web-based toolkit for Indiana communities seeking to address local flooding (see www.in.gov/dnr/lakemich/9609.htm). The toolkit contains a resource library, interactive maps via IndianaMAP and an overview of policy tools that local governments can use to address localized flooding. The resources are geared toward local government staff, elected officials and commissioners, nonprofit staff, planners, developers and interested citizens. The resources are meant to serve as a starting point for understanding a community's flood risk and steps that can be taken to address community needs.

The following policy tools can be incorporated into a community comprehensive plan, sub-area plans or ordinances. Regulatory tools such as ordinances might produce greater results, but they require administration, enforcement, time and resources to be effective. They might also discourage economic development under some circumstances. Incentive tools, including fee discounts and expedited development review processes, might not limit all development that negatively impacts hydrology, but they are often more palatable to developers and community members. For many communities, it is most effective to find a balance between competing economic, environmental and social forces and adopt a combination of regulatory and incentive-based policies, i.e., "carrots and sticks."

STORMWATER/LOCAL ORDINANCE AUDITS AND UPDATES

Summary

Ensuring that local zoning, building codes and ordinances allow green infrastructure and other stormwater management techniques while discouraging building in floodplains is a good start to minimizing localized flooding. A code audit will help identify regulations that prohibit or are silent on the implementation of green infrastructure, open space protection and low-impact development. Code updates could include on-site infiltration standards, wetland and waterbody protection buffers and native landscaping standards. Visit the links in the Further Resources section to find model ordinances.



City of Hobart has designated an area of the city as a Nature District.

Pros

- Potentially low cost
- Audits met with little public resistance
- Proactive measures

Cons

- Depending on the political climate, codes can be difficult to change
- Code changes could need to be phased in or adapted over time

Cost estimate

There is the potential for low cost associated with updating stormwater and building codes.

Further resources

- WI Sea Grant Tackling Barriers to Green Infrastructure: An Audit of Municipal Codes and Ordinances (<https://www.seagrant.wisc.edu/our-work/focus-areas/coastal-communities/green-infrastructure/>)
- U.S. EPA Water Quality Scorecard (<https://www.epa.gov/sites/production/files/2014-04/documents/water-quality-scorecard.pdf>)
- U.S. EPA Smart Growth Fixes for Climate Adaptation and Resilience (www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience)

GREEN STREETS/COMPLETE STREETS

Summary

Complete streets, sometimes also referred to as green streets, are streets that incorporate green infrastructure and alternative modes of transportation into street planning as a way to decrease impervious surfaces and increase environmental services. Complete streets help to control stormwater by reducing street width, planting trees, adding swales with native plantings and utilizing permeable pavement.

A good way to start a green streets program is to begin with a pilot program with a main thoroughfare. The pilot allows for the program to gain popularity with the public and for any user conflicts to be detected. The pilot can then be expanded to more streets and the adoption of street design standards for the community.



Bike lanes, green medians and native plantings were added during the Michigan City Wabash Street Improvements project.

Pros

- Reduces runoff and pollutant loading
- Improves street aesthetic
- Encourage alternative modes of transportation

Cons

- Time intensive
- Difficulty in coordinating timing of projects between local government and state agencies
- May need to be paired with community education

Cost estimate

Costs are dependent on which features are selected, but generally costs are moderate to high. Features such as permeable pavement and roadway retrofits can be quite expensive, but generally planting trees and native vegetation is not as costly as grey infrastructure.

Further resources

- Northwestern Indiana Regional Planning Commission (NIRPC) Complete Streets Planning & Design Guidelines (<http://nirpc.org/media/4171/completestreetsguidelinesfinal.pdf>)
- City of Chicago Complete Streets Design Guidelines (<http://chicagoCompletestreets.org/resources/design-guidelines/>)
- U.S. EPA Water Quality Scorecard (www.epa.gov/sites/production/files/2014-04/documents/water-quality-scorecard.pdf)
- U.S. EPA Managing Wet Weather with Green Infrastructure Green Streets (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_green_streets_0.pdf)

GREEN INFRASTRUCTURE BEST MANAGEMENT PRACTICES (BMPs)

Summary

Green infrastructure best management practices (BMPs) mitigate stormwater runoff through practices that use or mimic natural processes. Green infrastructure BMPs slow down runoff and provide storage and infiltration. Most often these practices look like rain gardens, bioswales, vegetated buffer strips and open-space corridors. Green infrastructure ranges in its storage capacity. Disconnecting a downspout from a residence and connecting it to a rain barrel is a low-cost, low-intensity method that is also extremely accessible for citizens. On the other end of the intensity spectrum are options like stormwater parks and permeable pavements.

Pros

- Less costly and time intensive to implement than grey infrastructure
- Improves the aesthetic of public spaces
- Improves water quality

Cons

- Requires coordination between departments
- Maintenance can be difficult to fund over time



Gary's Aetna neighborhood incorporates public art into stormwater management.

Cost estimate

Costs associated with implementing green infrastructure can vary depending on what the community chooses to do. For example, updating local guidelines to encourage residential rain gardens has virtually no cost, whereas installing municipal bioswales could cost between several hundred to thousands of dollars. Installing a rain barrel generally costs less than \$100 but retrofitting a road with permeable asphalt is expensive. All of the costs associated with implementing green infrastructure should be compared with the savings in managing stormwater runoff and the alternative grey infrastructure solutions.

Further resources

- MO DNR Guide to Green Infrastructure (<https://dnr.mo.gov/env/wpp/stormwater/mo-gi-guide.htm>)
- WI Sea Grant Tackling Barriers to Green Infrastructure: An Audit of Municipal Codes and Ordinances (www.seagrant.wisc.edu/our-work/focus-areas/coastal-communities/green-infrastructure/)
- U.S. EPA Green Infrastructure Municipal Handbook (www.epa.gov/green-infrastructure/green-infrastructure-municipal-handbook)

CRS POLICY TOOLS AND INSURANCE DISCOUNTS

Summary

The Community Rating System (CRS) is a program administered by FEMA. It recognizes communities that go above and beyond the minimum floodplain management requirements by offering reduced flood insurance premiums in the community. To participate in CRS, a community must do some combination of the 19 creditable activities. These activities fall under the categories of Public Information, Mapping and Regulations, Flood Damage Reduction and Flood Preparedness. Based on the amount of credits earned, property owners are eligible for a discount of between 5 and 45 percent.

Pros

- Discounted flood insurance for community members
- Many communities already doing some of the activities
- Flexibility in meeting community needs and goals

Cons

- Creditable activities might not be applicable or feasible for all communities
- Multiple activities are required to earn an insurance discount

Cost estimate

The cost is variable depending on which activities and policies a community chooses to adopt and the resources available to the community.

Further resources

- IDNR Division of Water Floodplain Management & Homeowner Information
- FEMA Community Rating System Local Official's Guide
- FEMA Community Rating System Coordinator's Manual

STORMWATER FEE DISCOUNTS FOR BMP IMPLEMENTATION

Summary

Incentivizing private and commercial property owners to adopt green infrastructure best management practices (BMPs) is one way to expand green infrastructure beyond lands in public ownership and reduce the burden put on public stormwater

management infrastructure. One way to do this and get more properties managing stormwater is to offer a discounted stormwater utility fee for BMP implementation. Common eligible BMPs include rain garden installation, use of permeable pavement and rainwater harvesting. To determine a discount schedule, a community should look at the utility revenue and what their projected reduced burden will be. The BMPs, to varying degrees, should offset the loss of revenue from the discounted utility fees.

Pros

- Private property contributes to stormwater management
- Not a regulation, so property owners can choose whether or not to participate

Cons

- Stormwater utilities are typically underfunded, so discounts might not be feasible
- Resource intensive to set up rate structure and verify BMP functionality

Cost estimate

The cost of implementation is dependent on current stormwater utility fees, if any, and the discounts offered. Program administration must be factored in too. A consultant may be needed to set the program up.

Further resources

- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Funding Options (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_funding.pdf)
- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_incentives.pdf)
- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms (https://www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_incentives.pdf)
- U.S. EPA Water Quality Scorecard (<https://www.epa.gov/sites/production/files/2014-04/documents/water-quality-scorecard.pdf>)
- MO DNR Guide to Green Infrastructure (<http://dnr.mo.gov/env/wpp/stormwater/mo-gi-guide.htm>)

DEVELOPMENT INCENTIVES FOR LOW-IMPACT DEVELOPMENT AND BEST MANAGEMENT PRACTICES

Summary

Low impact development (LID) refers to strategies that emphasize conservation and management of stormwater runoff on-site. Development incentives for LID and BMPs are a good way to incorporate stormwater management into new development and retrofits. These incentives can take many forms, such as a credit against open space requirements, subsidies or tax abatements in exchange for LID and BMP implementation, and expedited permitting and review processes. Common eligible activities include incorporating sustainable site design features, green infrastructure such as green roofs or rain gardens and stormwater management features that double as public recreational spaces.

Pros

- Relieve stress on public infrastructure
- Improve water quality
- Can improve aesthetics of developments

Cons

- Can be resource intensive to set up incentive program
- Might place extra pressure on staff to review development plans quickly. In rural areas, there may be minimal staffing or limited expertise to review plans.
- Might not have large impact on stormwater management because only applies to new or redevelopment, and is voluntary

Cost estimate

The cost of development incentives is dependent on which incentives are chosen. For example, if a community decides to reduce fees for developers that incorporate stormwater management into their development, then the cost would be the difference between the reduction in revenue from the reduced fee and the savings from the reduced stormwater management burden. In another example, if a community decided to offer an expedited development review period for projects implementing LID and/or BMPs, then the cost of the incentive would be low.

Further resources

- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_incentives.pdf)
- U.S. EPA Water Quality Scorecard (www.epa.gov/sites/production/files/2014-04/documents/water-quality-scorecard.pdf)
- MO DNR Guide to Green Infrastructure (<https://dnr.mo.gov/env/wpp/stormwater/mo-gi-guide.htm>)

GRANTS, REBATES AND INSTALLATION FINANCING FOR RETROFITS

Summary

Grants are attractive funding options for small-scale or pilot projects. Grant programs are administered through philanthropic organizations, nonprofits and federal and state government.

Another form of financing for retrofits and development is rebates and installation financing. These mechanisms provide incentives for property owners to install green infrastructure on their properties. They often target areas that have demonstrated the greatest need for green infrastructure through excessive runoff and flooding. Rain barrel distribution is a common example of this policy tool.

If a community is planning a larger project, they could also consider low-interest loans. The State Revolving Fund (SRF) loan program provides low-interest loans to Indiana communities for projects that improve water infrastructure and flood control.

Pros

- Good for pilot projects
- Creates incentives to implement BMPs
- Opportunities to leverage limited resources

Cons

- Grants and SRF loans are competitive
- Grant funding is not reliable or limited to specific regions
- Revenue is required; grants often require match funding and loans must be repaid over time

Cost estimate

The cost associated with grants, rebates and loans are dependent upon the size of the project. Generally, the cost will be less than doing nothing or administering the program without using these funding options.

Further resources

- IDNR Coastal Program Grant Referral Service (www.in.gov/dnr/lakemich/6044.htm)
- Indiana Department of Homeland Security Mitigation Grant Program (https://secure.in.gov/dhs/files/IDHS-Mitigation_Grant_Programs.pdf)
- Indiana Finance Authority State Revolving Loan Fund: Flood Control (www.in.gov/ifa/srf/2957.htm)
- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Funding Options (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_funding.pdf)
- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_incentives.pdf)

AWARDS AND RECOGNITION PROGRAMS

Summary

Awards and recognition programs highlight successful examples of green infrastructure as a means of stormwater management and flood mitigation in a community. Winners can be businesses, government agencies, schools, property owners, community organizations and non-profits. These awards can be good opportunities to receive press coverage and share information about effective programs with other groups.

Pros

- Raise awareness about stormwater and floodplain management
- Recognize exceptional organizations and individuals
- Create an incentive for groups to improve projects

Cons

- Low impact on stormwater management

Cost estimate

Awards and recognition have little to no cost associated with them.

Further resources

- Indiana Governor's Award for Environmental Excellence (www.in.gov/idem/prevention/2358.htm)
- INAFSM Stormwater Management Award (www.inafsm.net/inafsm-awards)
- Chicago Wilderness Force of Nature Awards (www.chicagowilderness.org/page/AwardAcres)
- U.S. EPA Managing Wet Weather with Green Infrastructure Municipal Handbook: Incentive Mechanisms (www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_incentives.pdf)

CITY OF GARY GREEN INFRASTRUCTURE PLAN

The City of Gary is currently implementing a number of programs across different departments to address environmental and economic issues within the city. With strong support from the mayor, the Division of Environmental Affairs and Green Urbanism and the Department of Planning and Development are leading these efforts.

In 2017, with a grant from the IDNR Lake Michigan Coastal Program, the city embarked upon the development of a citywide green infrastructure plan with the intent to create a strong guiding document and decision-support tools that will allow city staff to effectively prioritize green infrastructure installation and maintenance.

The city will use the plan and tools to tackle:

- Negative impacts from urban stormwater runoff on water quality, residential flooding and environmental health
- Negative social and economic impact of blighted properties and corridors
- Managing vacant land, given a weak redevelopment market
- Outdated zoning regulations that do not account for green infrastructure solutions
- Fragmentation of high-quality remnant dune and swale and wetland ecosystems

The City of Gary is using a number of the incentive-based and regulatory tools explained in the previous section to meet its stormwater management, localized flooding mitigation and community development goals. The city is considering changes to its zoning code, planting demonstration gardens and engaging the

community in the process to educate and build support. This approach can be replicated in any community across Indiana and modified to meet community-specific goals.



The City of Gary Division of Environmental Affairs and Green Urbanism's Vacant to Vibrant green infrastructure installation in Gary's Aetna neighborhood combines public art with stormwater management. This garden sits on a lot that previously held a home that had not been occupied for 15 to 20 years.

RESOURCES

Association of State Floodplain Managers CRS for Community Resilience Green Guide
www.floodsciencecenter.org/products/crs-community-resilience/green-guide/

Extension Disaster Education Network ag.purdue.edu/extension/eden

FEMA Reducing Damage from Localized Flooding: A Guide for Communities
www.fema.gov/media-library-data/20130726-1446-20490-0539/FEMA511-complete.pdf

Illinois-Indiana Sea Grant Flood Vulnerability Assessment for Critical Facilities mrcc.isws.illinois.edu/FVA/

Indiana DNR Lake Michigan Coastal Program Localized Flooding Planning Resources www.in.gov/dnr/lakemich/9609.htm

TOOL OVERVIEW: FLOOD VULNERABILITY ASSESSMENT FOR CRITICAL FACILITIES

Molly Woloszyn, author

mrcc.isws.illinois.edu/FVA

INTRODUCTION AND OVERVIEW

The Flood Vulnerability Assessment for Critical Facilities (FVA) tool is available online to help critical facilities—such as hospitals, fire and police departments and utility providers—evaluate their preparedness for when the next big rainstorm hits. The tool consists of a series of questions that will help communities in the Midwest determine a facility’s risk based on factors such as its proximity to a flood plain, past flooding issues, stormwater drainage structures and the location of backup generators, servers and other critical systems. Facilities are also able to use the tool to evaluate current emergency communication plans for heavy rainfall and determine whether improvements are necessary. After completing the assessment, users receive a report with specific recommendations and resources for steps they can take to reduce the facility’s vulnerability to riverine and/or urban flooding.

WHAT ARE THE GOALS OF THE FVA?

- Identify specific vulnerabilities of a particular critical facility to flooding by looking at factors such as proximity to a floodplain or other bodies of water, past flooding issues, emergency management plans and location of critical systems like primary and back-up power
- Provide recommendations and/or resources to critical facility managers for short- or long-term changes that could be made to reduce their facility’s risk to flooding
- Provide educational information to increase the awareness of critical facility managers to their facility’s risk of either riverine or urban flooding

WHO SHOULD TAKE THIS ASSESSMENT?

- A critical facility
 - According to FEMA, critical facilities include hospitals and other healthcare facilities, fire and police stations, emergency operations centers, communication and data centers, essential government buildings and other critical facilities and their contents, machinery and equipment therein that serve the community or affect the safety, health or welfare of the surrounding population. In some cases, the community may determine that wastewater treatment plants, water treatment plants, electrical substations, transportation facilities and buildings such as schools or community centers are critical or essential for their community.
- The FVA is designed to assess a one-building critical facility or a site of buildings (up to seven buildings) that function as one critical facility (e.g., a medical campus).

MY FACILITY IS NOT IN A FLOODPLAIN, SO DOES THIS ASSESSMENT APPLY TO ME?

- While flooding is most common for those in the floodplain, flooding also occurs outside of the floodplain and is referred to as stormwater and/or urban flooding.
- According to FEMA, properties outside of high-risk flood areas account for more than 20 percent of National Flood Insurance Program (NFIP) claims and one-third of disaster assistance for flooding.

WHAT DO I NEED TO HAVE PRIOR TO STARTING THE ASSESSMENT?

- Knowledge about the building and where critical systems are located
- Basic engineering knowledge about the building (preferred)
- Access to emergency response plans for weather (preferred)

HOW LONG WILL THIS ASSESSMENT TAKE ME?

- Approximately 45 minutes to an hour and a half
- It will depend on how many buildings are assessed and if the information needed is readily available

WHAT IS THE FORMAT OF THIS ASSESSMENT?

- Users need to complete the assessment on a computer. It is an online tool that only requires Internet access, it does not need to be downloaded onto the computer.
- The assessment is a set of online questions. The majority are yes/no or multiple choice, with a couple of open-ended questions as well.
- Each user will create a profile to log in to the assessment.

THE SECTIONS OF THE ASSESSMENT INCLUDE:

- Facility Siting Conditions
- Communication and Emergency Operations Planning
- Past Flooding Issues and Mitigation Efforts
- Importance and location of critical systems

WHAT WILL I RECEIVE AFTER TAKING THIS ASSESSMENT?

- After completing the FVA, you will receive a Facility Risk Summary and Recommendations Report. This will summarize the most important findings and provide a set of recommendations and/or resources as steps that could be taken to reduce the facility's risk to flooding events.
- You will also have the option to download the completed assessment for your records.

INDIANA EMBANKMENT DAM HAZARDS LARGELY UNKNOWN AND UNDER-APPRECIATED

Jeff Healy, author

Under current Indiana code for embankment dams (IC 14-27-7.5), dam owners are responsible for the operation, maintenance and safety of their dams. There are very few local ordinances, and no state codes, that address zoning, land use and permitting for lands within dam failure flood risk areas downstream from embankment dams that are typically larger than the 1 percent chance floodplain limits (regulatory floodplain, 312 IAC 10; also the flood insurance requirement zone). Those currently living within flood risk areas downstream of dams are overwhelmingly unaware of the risk that these dams pose to their lives and their properties.

In Indiana, state emergency planning and response are directed by the Indiana Department of Homeland Security (IDHS). In its 2008 Hazard Mitigation Plan, IDHS noted:

Dam and Levee Safety is an issue of growing national, regional and State importance. Dams are inherently hazardous structures because of energy that can be released by elevated/stored water. Many dams and levees in the State have deficiencies that will result in an emergency situation leading to a possible breach failure during an unusual loading condition such as a substantial rainfall event.

If dams or levees fail issues of primary concern include loss of human life/injury, downstream property damage, lifeline disruption (of concern would be transportation routes and utility lines required to maintain or protect life), loss of resource purpose and benefits, and environmental damage. Further, the threat of dam or levee failure requires substantial commitment of time, personnel, and resources.

Since dams and levees deteriorate with age, minor issues become larger compounding problems and the risk of failure increases. Further, the downstream areas become more populated and developed risking more lives and property, and escalating mitigation and rehabilitation costs. Like many critical infrastructure projects, dams and levees are also potential terrorist targets.

The failure of a dam or an important component of a dam may cause substantial flood damage. Depending on the size of an impoundment and the severity of a dam failure, the flood inundation area may be substantially deeper and larger than areas identified as 100-year flood plains for insurance purposes. The lack of the flood insurance flood plain maps to account for inundation due to dam failure is a problem common to all 75,000 (now known to exceed 90,500) plus regulated dams in the United States.

As the dam building era was more than 40 years ago, the inventory of dams is greatly aging and dams are deteriorating. Component and total failures of dams are becoming more common in the State. Additionally, with time residential development continues to increase near water resource features, thus increasing the number of individuals and property at risk due to dam failures. This development also is causing the hazard classification of existing dams to creep up. Dams that were designed and built to function as low hazard structures, because of uncontrolled downstream development now function as high hazard dams.

One can see where development activities downstream from a dam can increase the potential risk from impounding water in an embankment structure without knowledge or involvement of the respective dam owner. Hazard classification in Indiana is a rating of relative risk to life and property if a dam would fail suddenly.

IC 14-27-7.5-2 "Hazard classification" Sec. 2. As used in this chapter, "hazard classification" means a rating assigned to a structure by the department based on the potential consequences resulting from the uncontrolled release of its contents due to a failure or misoperation of the structure. As added by P.L.148-2002, SEC.15. [Note: "department" above refers to the Indiana Department of Natural Resources, Division of Water (IDNR).]

A development can quickly turn a low-hazard dam into a high-hazard dam. The expectation from IDNR then becomes that the dam must be rehabilitated by the owner, at the owner's expense. Along the same line, the construction of an embankment dam induces risk on downstream landowners, potentially without their knowledge, acknowledgement or consent.

The Indiana Flood Control Act (IC 14-28-1) regulates construction in an identified floodway. In fact, construction of residential structures is prohibited within floodways. By definition, a floodway is a portion of the overall floodplain. A floodplain is delineated by evaluating the effect of storms and events that have an annual risk of exceedance of 1 percent (in other words, a 100-year event). Most 1 percent floodplains are mapped in Indiana. However, potential dam failures are not considered a part of floodplain mapping. This creates a risk to landowners downstream of the embankment dam that is not routinely evaluated.

Risk areas downstream from dams are identified by calculating the area that would be flooded if a dam

were to suddenly fail, or breach. The area covered by floodwater in a dam breach situation might be much greater than the associated 1 percent chance floodplain. The risk is frequently unknown or unrecognized by residents in the risk area and sometimes even the owner of the dam.

Dams that fall under the jurisdiction of the state regulatory body (IDNR, Division of Water) meet any of the following size criteria:

- Greater than or equal to 20 feet high
- Greater than or equal to one square mile contributing drainage area
- Store greater than or equal to 100 acre-feet of water



Dams that do not meet the size-based criteria for jurisdiction might still become jurisdictional if a written petition is filed by a concerned individual and the dam is found by the DNR to be a high-hazard structure. Each dam must meet stringent design criteria for total spillway capacity. Low- and significant-hazard jurisdictional dams must have total spillway capacity that can safely pass a 50 percent probable maximum precipitation (PMP) storm event without uncontrolled overtopping of the dam embankment. Storms by which spillway capacities of dams are judged are two to four times that of a 1 percent chance event (AKA a 100-year event).

If an embankment dam is determined to pose a high risk to life and property downstream (see definitions in code), they must meet the high-hazard design criteria, which is much more stringent. A high-hazard dam must safely pass a 100 percent PMP storm event without uncontrolled overtopping of the embankment. Very few high-hazard dams in Indiana meet a PMP spillway capacity criterion. It can be quite expensive to upgrade or modify a dam to meet this criterion.

As the size-based jurisdictional limits have existed for several decades, many dams in Indiana have been constructed such that they are just short of the threshold height criteria (20 feet), yet they still pose risk of loss of life and property downstream. They are technically high-hazard dams but were not permitted and not inspected. As a result, many of these types of dams have been designed, constructed and maintained at a sub-standard condition, posing higher safety concerns than the dams that are regulated. Frequently, when found or reported as a “failing dam,” they are in very poor condition. The cost of rehabilitation would be high and the state and county have no authority to compel the owner to repair or remove the dam.

Many municipal government entities in Indiana have a multi-hazard mitigation plan in place. Most of those plans do not include accommodations or actions needed for an incident or emergency relating to dams in their communities, as the intent of the multi-hazard mitigation plan is for mitigation, rather than prevention or response actions. Grant-funded efforts by the Federal Emergency Management Agency (FEMA) through IDNR and by the Indiana Office of Community

and Rural Affairs (OCRA) through IDHS have recently been completed to develop Incident and Emergency Action Plans (IEAP) for about 100 high-hazard dams, but the effort is far from inclusive of all high-hazard dams in the state. Even after development of the IEAP, implementation and activation are largely in the hands of the dam owners (as is IEAP document updating and coordination of IEAP tabletop exercises with first responders and stakeholders).

What do we do with this information? Ordinance requirements can be added requiring considerations for dams and levees. Refer to the 2016 revisions of the Boone County, Indiana, Stormwater Technical Manual, Chapter 10, Sections E and F titled “Requirements Associated with Dams and Levees” and “Requirement Associated with Proposed Developments Downstream of Dams.” (www.boonecounty.in.gov/Offices/Surveyor/Drainage-Ordinances)

For additional Information on safety considerations relating to embankment dams, refer to: <https://damsafety.org> and www.in.gov/dnr/water/2458.htm.

Indiana code relating to dams can be found in Indiana Code 14-27-7.5 and 312 IAC Article 10.5.





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