

# The Green Buildings and Environmental Sustainability Element of the Master Plan

Lawrence Township, Mercer County, New Jersey



Adopted by the Planning Board May 3, 2010





## Sustainability Element Work Group

Chris Altomari  
Stacy McCormack  
Nathaniel Moorman  
Anthony Cermele,  
Municipal Constuction Official  
Andrew Link, Municipal Planner  
James Parvesse, Municipal Enginner  
Elizabeth McManus, Municipal Planning Consultant  
Philip Caton, Municipal Planning Consultant

## Sustainability Element Project Team

Robert Bostock, Councilman  
Ralph Copleman  
Philip Duran  
Brian Friedlich  
James Kownacki  
Pamela Mount, Councilwoman  
Paul A. Penna

## Planning Board Members

Nathaniel Moorman, Chairman  
Paul A. Penna, Vice-chairman  
Michael S. Powers, Mayor  
Richard S. Krawczun, Municipal Manager  
James S. Kownacki, Councilman  
Keith Dewey  
Philip B. Duran  
Dr. David Maffei  
Stacy McCormack  
Kim Y. Taylor (Alternate #1)  
Michael Horan (Alternate #2)

James F. Parvesse, P.E. (Lawrence Township) – Municipal Engineer and Board Secretary  
David M. Roskos, Esq. (Sterns & Weinroth) –Board Attorney  
Philip B. Caton, PP, FAICP (Clarke Caton Hintz) – Board Planning Consultant  
James L. Kochenour (Arora & Associates)– Board Traffic Consultant  
John H. Rea (McDonough & Rea) – Board Special Traffic Consultant  
Eric M. Zwerling (The Noise Consultancy, LLC) – Board Noise Consultant  
Sara A. Summiel (Lawrence Township)– Board Recording Secretary

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Adopted by the Planning Board May 3, 2010

In accordance with the Municipal Land Use Law (N.J.S.A. 40:55D et al)

Prepared for Lawrence Township by:



Philip B. Caton, PP, FAICP  
Clarke Caton Hintz  
PP License # 1829



Elizabeth K. McManus, PP, AICP, LEED AP  
Clarke Caton Hintz  
PP License # 5915



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## Introduction

This Green Buildings and Environmental Sustainability Element of the Master Plan has been prepared in accordance with the Municipal Land Use Law, N.J.S.A. 40:55D-28 and has been adopted by the Planning Board as part of the Lawrence Township Master Plan. In August 2008, the Municipal Land Use Law was amended to include the Green Buildings and Environmental Sustainability Element in the list of permitted Master Plan Elements. It describes the Element as the following:

*“A green buildings and environmental sustainability plan element, which shall provide for, encourage, and promote the efficient use of natural resources and the installation and usage of renewable energy systems; consider the impact of buildings on the local, regional and global environment; allow ecosystems to function naturally; conserve and reuse water; treat storm water on-site; and optimize climatic conditions through site orientation and design.”*

This Element, like all Master Plan Elements, is intended to guide land use decisions and provide the basis for ordinances addressing sustainability and land use issues. It is important to note that a Master Plan cannot include requirements or mandatory actions; instead it provides support for ordinances that fulfill that role in municipal planning. Additionally, a Master Plan Element cannot dictate the operations of a business or institution.

While sustainability is a broadly supported principle, there is no universal definition for it. However, the United Nations World Commission on Environment and Development (Brundtland Commission) in 1987, created a definition for sustainable development that has been widely accepted:

*“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”*

The development of this Element has generally been guided by this UN definition. The overarching intent of the Element is to ensure that planning and development, both public and private, in Lawrence Township is done such that future generations enjoy the same or more opportunities in terms of housing options, access to open space and the local ecology, vibrant community life and environmental health. To provide further guidance in developing the Element, a number of sustainability principles were referred to. These principles, while not specific to one organization or philosophy, are consistent with those of the sustainability principles of the American Planning Association as well as the Natural Step framework for sustainability.

1. Reduce the community's dependence on substances extracted from the Earth's crust, especially fossil fuels and rare minerals.
2. Reduce dependence on manufactured substances whose production and accumulation in nature may be harmful to the environment and citizens of the Township.
3. Reduce harm to the local, regional and global ecosystems.
4. Meet all fundamental human needs fairly and efficiently.

Sustainability addresses a broad range of topics – some of which are particularly relevant to the people, civic life and environment of Lawrence Township. In order for the this Master Plan Element to reflect the needs and concerns of Township residents, the Environmental Commission conducted a survey to determine which sustainability topics should be a priority. This survey, which had approximately 100 respondents, was conducted during the 2009 Community Day (October 4, 2009).

As shown on the right, energy, land use and waste and recycling were the highest priorities among respondents. While green building ranked toward the bottom, at 8 out of 10, many components of green building, such as water and energy, ranked toward the top. It is also noteworthy, that the rankings reflected the feelings of the Project Team, the subcommittee established by the Planning Board to guide the preparation of the Element. Table 1, Lawrence Sustainability Survey Results, and Chart 1, Lawrence Sustainability Survey Results (on the following page), provides the ranking results from the survey.

Rank	Topic Area
1	Energy
2	Land Use
3	Waste and Recycling
4	Water Resources
5	Local Economy
6	Transportation
7	Municipal Facilities
8	Green Building
9	Equity Considerations
10	Brownfields

Table 1. Lawrence Sustainability Survey Results

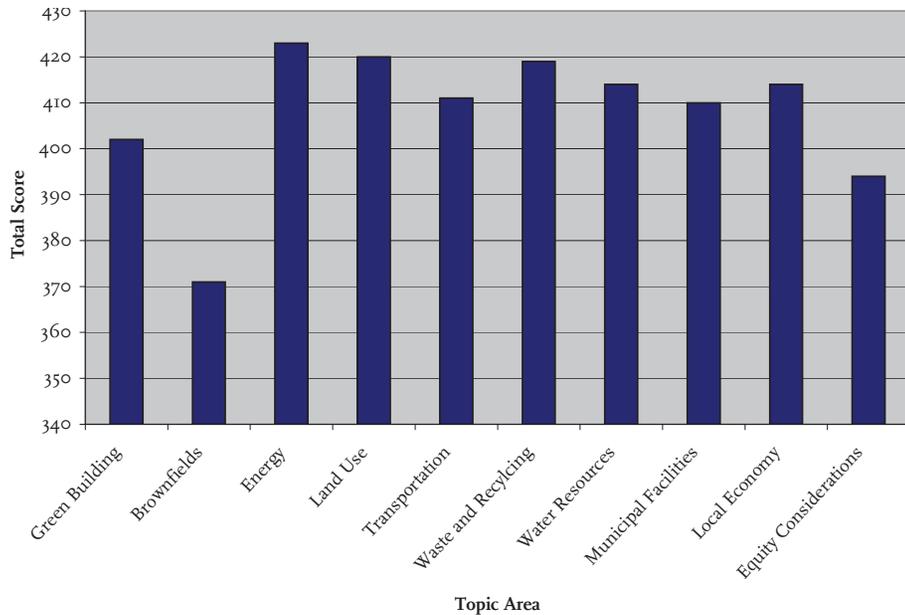


Chart 1. Lawrence Sustainability Survey Results (Above)

Lawrence Township is a very diverse community in that the southern part of the Township has compact building patterns and is well served by infrastructure, such as streets, transit and public sewer and water, while the northern part of the Township consists of large residential lots, typically on well and septic, and institutional properties, as well as expansive agricultural lands and open space. It is this diversity that makes Lawrence Township unique and expands the range of tools that are available and appropriate for reducing the Township’s environmental footprint.

Lawrence Township has been active in sustainability efforts for some time. Several years ago residents joined together and formed Sustainable Lawrence, which is today one of the most well known and active local sustainability-focused organizations in the State. Additionally, Lawrence Township was certified in the Sustainable Jersey program in fall of 2009. The Township was one of 34 New Jersey municipalities to be certified in the first round of the program.

This Green Buildings and Environmental Sustainability Element presents Goals and Objectives for both new development and building rehabilitation that will aid the Township in becoming more sustainable through reducing reliance on fossil fuels, water needs, waste generation, vehicle miles traveled and promoting use of green building principles. These goals and objectives reflect the results of the sustainability survey. This Master Plan Element provides guidance on municipal actions that should be considered by Lawrence Township Council to reduce the environmental footprint of the municipal government as well as that of local businesses, industry, schools and residents.

Development of this Master Plan Element is timely; not only have municipalities been recently authorized to adopt a Green Buildings and Environmental Sustainability Element, but the State of New Jersey has recently taken steps to reduce its greenhouse gas emissions. Executive Order 54, signed by Governor Corzine in February 2007, was the State Government’s first move toward setting a measurable reduction in greenhouse gasses. Specifically, the Executive Order called for the following, among other items:

1. “Stabilization of greenhouse gas emissions at 1990 levels by 2020; and
2. Reduction of greenhouse gas emissions to 80% below 2006 levels by 2050.”

Shortly afterward, in July 2007, the Governor signed the Global Warming Response Act which adopted the above statewide limits on greenhouse gasses. The Act, generally, required that State agencies work together to achieve these limits. New Jersey was the third state to sign greenhouse gas reduction goals into law. Since then, the State has taken additional steps, such as the 2008 Energy Master Plan, to reduce its environmental footprint, including its greenhouse gas emissions, and the Solar Energy Advancement and Fair Compensation Act, which implements the portions of the Energy Master Plan which call for solar energy in the State’s energy portfolio. Additionally, the International Code Council is drafting an International Green Construction Code (IGCC). This new building code will set standards for sustainability in construction of buildings, structures and systems, including alterations and additions.

Lawrence Township’s Green Building and Environmental Sustainability Element is in step with these State and national efforts by providing meaningful ways the Township can reduce its environmental footprint, including its greenhouse gas emissions.

## Sustainable Land Use Patterns

This section is related to and should be read in conjunction with the Land Use Element, Conservation Element, Housing Element and the Circulation Element of the Master Plan.

Sustainable land use patterns are very generally defined as 1) focusing development potential toward lands served or can be served by alternative forms of transportation (i.e. walking, biking and mass transit) and public sewer and water and 2) focusing preservation efforts toward environmentally sensitive and active agricultural lands. Much of Lawrence Township has already been developed or is undevelopable because it is environmentally sensitive or has been preserved as open space or farmland. However, scattered infill opportunities are located throughout the Township. Infill development has some inherent sustainability since it does not rely upon new streets or the extension of infrastructure. Notwithstanding these benefits, all infill development should be compatible with the neighborhood which it is located. The Township should continue its land preservation efforts and should focus these efforts on lands which are active agricultural and/or environmentally sensitive lands. It is important that networks of open space, also known as landscape linkages, are created in order to reduce habitat fragmentation, facilitate wildlife corridors and expanded recreation activities.

In line with preserving networks of open space, the ecosystem within the developed areas of the Township must also be nurtured. The Township can rely on principles of providing green infrastructure as a framework for this. Green infrastructure is defined as interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to the community; it includes, but is not limited to, parks, agricultural lands, many stormwater management devices and street tree networks. Many of the benefits and components of green infrastructure revolve around water resources; these aspects are addressed in more detail in the Sustainable Water Resources section of this Element.

The green infrastructure network in Lawrence Township provides valuable roles in water quality and infiltration as well as wildlife habitat, aesthetic enhancement and air quality. Even the smallest green areas, such as a tree lined street, can help achieve all of these goals. The Township is active in community forestry, creating a Shade Tree Advisory Committee and a Community Forestry Management Plan. Promoting shade trees along streets and other public rights-of-way will provide shade, which reduces ambient temperatures and ozone generation, water filtration and wildlife habitat, as well as other non-environmental goods such as neighborhood enhancement and pedestrian protection from vehicles when placed between the cartway and the sidewalk.



*Great Meadows Park in Lawrence Township*  
Photo courtesy of <http://www.lawrencetwp.com/gallery-5.html>



*Colonial Lake in Lawrence Township*  
<http://www.lawrencetwp.com/gallery-5.html>

To further protect natural systems, including wildlife habitat and water infiltration, site disturbance during construction should be minimized to the area immediately surrounding the development. Limiting site disturbance during construction can reduce top soil loss and erosion, the unnecessary loss of trees and other vegetation and unnecessary compaction of soil.

The most significant source of development potential in the Township comes from redevelopment. The Brunswick Pike Redevelopment Area offers an opportunity for the Township to integrate the sustainability principles of this Element into a Redevelopment Plan which will be drafted in 2010. There are similar redevelopment opportunities throughout the Township, including but not limited to, the Route 1 business corridor, the Spruce Street corridor and along Route 206 near Eldridge Park.<sup>1</sup>

The most fundamental thing which a New Jersey municipality can do to reduce the energy demand and vehicle miles travelled of a municipality is to require, where appropriate, compact development which is served by alternative forms of transportation and in proximity to goods and services (additional policies regarding vehicle miles traveled can be found in the Sustainable Circulation Systems section of this Element). In other words, communities can reduce their environmental footprint by implementing smart growth principles and therefore providing residents an opportunity to drive less since destinations are closer and walking and biking options are available. Policies promoting compact development in appropriate areas – those served by existing infrastructure – which are coupled with policies promoting preservation of active agriculture and environmentally sensitive lands will allow for continued growth and enhancement in the Township without jeopardizing its environmental resources.

In addition to these environmental benefits from compact development, there are also health, economic and social advantages. Walkable neighborhoods, particularly those which are in or proximate to a mixed use area which offers destinations, can lead to improved public health through increased exercise rates as people walk (or bike) for enjoyment, employment and/or shopping. Additionally, neighborhoods with compact development patterns typically have a stronger sense of community since they typically have a human scale, which includes homes which are close to the street and, often times, porches – both of which further facilitate neighborly interaction.

Similar to the benefits of walkable neighborhoods – reduced vehicle miles traveled, increased exercise rates, etc. – a mix of uses should be considered for employment centers, such as office parks. Providing convenience uses, such as banks, dry cleaners, restaurants and childcare within employment centers will reduce vehicle miles traveled since employment and these uses will be in proximity to each other and will also reduce the occurrence of employees leaving the Township for these purposes, therefore additionally providing support for the local economy.

Diversity of housing stock, in terms of income and housing type, is also a component of sustainability. Diverse housing types are positive contributions to residential-commercial mixed use areas. Apartments and condominiums are well suited to the upper stories of buildings with commercial on the first floor. These upper story residences can not only provide the density necessary to support the commercial uses (customers and jobs) and mass transit, but they also provide modest priced and small housing opportunities. Additionally, they can help ensure a mix of ages since upper story residences are commonly occupied by young adults. Residences on small lots, such as but not limited to, townhouses, duplexes and modest sized multi-family homes, are appropriate in areas surrounding a mixed use core. These areas can serve as a transition area to lower density parts of the neighborhood. Coupling the densities associated with these housing types with complete streets (those with pedestrian, bicycle and mass transit facilities) is an important step toward creating a sustainable community. Lawrence Township has a number of these compact neighborhoods, such as but not limited to, Lawrenceville, the Slackwood neighborhood and the Edridge Park neighborhood. To further the Township's sustainability, these neighborhoods should be looked to as examples of how compact forms of development and mixed use can be used to create communities that are compatible with the character of the Township and provide opportunities for households of all incomes. These examples can be applied in both redevelopment as well as new development.

Traditional neighborhood development, including diverse housing types, is part of mixed-use centers. This development pattern provides residents with easy access to stores, restaurants, offices, the homes of friends and extended family through pedestrian walkways and bicycle paths. As a result, human networks more easily form in real time and place, creating the fiber of a community that sustains individual health, a sense of belonging,



*Weeden Park, located in Lawrenceville, provides passive open space and a community gathering area*

and continuity of the community.

These possibilities are enhanced by a pedestrian friendly design that attracts people to the pathways so they want to walk along them toward the coffee shops, stores and other destinations. Strategically placed benches and trees, attractive paving stones, and safe intersection crossings help to generate pedestrian activity.



*Mixed use core in Lawrenceville*

Providing community facilities within or proximate to neighborhoods is another important component of sustainable communities. Community facilities, such as parks with passive and active recreation, community centers and municipal facilities are best located in or proximate to neighborhoods to ensure that the maximum number of residents have convenient access to them. They also provide a place for social interaction – for neighbors



*Mixed use core in Lawrenceville*

to get to know each other – and thus contribute toward a sense of community. Additionally, and critical to sustainability, locating these facilities in or near concentrations of users will reduce vehicle miles traveled as visitors will have less distance to travel to reach the facilities and may not need to rely upon a car to do so. Safe, convenient and pleasant pedestrian, bicycle and mass transit access should be provided to these facilities.

As stated, reducing vehicle miles traveled is one of the most fundamental objectives of sustainability. This not only refers to passenger vehicles moving residents, commuters, etc., but it also refers to the movement of goods. By supporting compact development patterns and providing safe, convenient and pleasant alternative forms of transportation, the Township can support the local economy. Today many find it just as convenient to get in the car and drive miles outside of their community for shopping; however, this occurrence would be reduced if it were more convenient to shop locally. This convenience is largely dependent on access to the site, as well as the availability of goods. Goods and services, which may be in the form of a neighborhood center, should be located in or proximate to neighborhoods, depending on the neighborhood size. Lawrence Township has a history of success with this and can look to multiple examples to guide future development and redevelopment. These examples include but are not limited to Lawrenceville, the Slackwood neighborhood and the Edridge Park neighborhood. It is important that the Township support the commercial component of its neighborhoods. They contribute positively to the sense of community and quality of life and serve to cut down on the Township's vehicle miles traveled. Additionally, supporting the small businesses which are located in these neighborhood centers support goals for economic development and a diverse tax base. The Township can further support these goals by evaluating the Land Use Ordinance to determine if an expansion of home occupations is appropriate and by supporting a buy local, or similarly styled, campaign.

Important to sustainability, local food shrinks a municipality's environmental footprint by reducing the travel required to bring food to a community. Food systems account for 17% of national energy usage<sup>2</sup>. Local food production can reduce this figure with its lower vehicle miles required for carrying food.

Food systems that rely on fresh locally grown food can offer benefits including increased access to nutrition and farmland preservation. However, coupling this concept with economic development and planning goals will bring far more benefits to the community. Through land use policies, economic development activities and farmland preservation efforts the Township can have a positive impact on retaining and enhancing local food systems. In the northern, rural part of the Township, large expanses of agricultural lands are common, the Township should focus its efforts on supporting farmers by ensuring that agriculture can be practiced undisturbed and while minimizing impacts on residential neighbors. This can be done through supporting the right-to-farm ordinance

and requiring buffers to agricultural lands that reduce the impacts of farming, such as smell or noise, on neighboring lands. Supporting existing farmers is the first step toward supporting local food production.

The Township should amend the Land Use Ordinance to expand its support for local small agriculture as a means of reducing vehicle miles travelled, as well as increasing access to fresh and healthy foods. While it may not be appropriate for large farm animals, such as cows and pigs, to be kept on a modest sized neighborhood lot, fruit and vegetable gardens can easily be accommodated. Additionally, small farm animals, such as chickens, should be permitted on residential lots where reasonable conditions can be met. There are numerous community benefits to local food production and supporting the growing movement of “urban homesteading”, or victory gardens, where people take food production into their own hands and, for example, convert their rear, side or front lawns to fruit and vegetable gardens and/or raise chickens. The Township’s expanded support should include not only allowing agriculture by right (with reasonable conditions) but also specifically allowing gardens in front and side yards and permitting small farm animals on residential lots based on a sliding scale of lot size and reasonable conditions. The potential benefits of this movement may include, aside from increased

food production, reduced stormwater runoff, a more interesting landscape and fewer chemical inputs if people choose organic agriculture. This includes not only gardens at the ground level, but roof-top gardens too.

It is important to note that the Township has a history of supporting local agriculture. The Township partnered with the Lawrenceville School to provide an approximate 140 plot community garden on school lands along Route 206. Each garden plot is 20’ x 20’ and the gardeners are responsible for their plot but the Township provides some support services on site, such as water, and administers the program. This program has been so successful that in the 2010 season, the approximate 140 plots sold out in just one day.

The Township can couple economic development strategies with those of local agriculture by permitting farmer’s markets on Township owned parks and permitting them as conditional uses in nonresidential districts. Additionally, farm stands for products grown on-site should be encouraged on agricultural lands, and if modestly sized, on residential properties. These revisions to Township policies will not only support local agriculture but will increase access to fresh and healthy fruits and vegetables.



*Agriculture in Lawrence Township  
Photo courtesy of Chris Altomari*



*Community Garden  
Photo Courtesy of <http://paxarcana.files.wordpress.com/2009/04/community-garden-intro1.jpg>*

## Goals, Objectives & Strategies : Sustainable Land Use Patterns

Implementing sustainable land use practices will reduce energy consumption from vehicle miles traveled by providing a mix of uses in proximity to each other and by ensuring that residents and visitors may rely upon not just vehicular transportation, but also pedestrianism, bicycling and mass transportation. Sustainable land use practices promote alternative modes of transportation, increased reliance on local goods and services and improved public health. Additionally, sustainable land use practices which encourage neighborhood-scale building patterns will promote stronger community ties and lower infrastructure costs from reduced street miles and more efficient building patterns.

### GOAL A : Promote compact development in areas well served by transportation infrastructure.

Objectives	Strategies
<p>#1. Encourage density around existing and potential transit infrastructure. Such infrastructure includes, but is not limited to, items such as existing bus stops throughout the Township and potential bus and bus rapid transit (BRT) stops along State Highway Route 1.</p>	<p>(a) Evaluate the Land Use Ordinance for opportunities to increase permitted residential density or introduce residential land uses around existing and potential transit infrastructure, such as bus stops.</p>
	<p>(b) Evaluate the Land Use Ordinance for opportunities to increase permitted non-residential floor area ratios for non-residential projects or introduce nonresidential uses around existing and potential transit infrastructure, such as bus stops.</p>
	<p>(c) Evaluate the Land Use Ordinance for opportunities to permit mixed use development around existing and potential transit infrastructure, such as bus stops.</p>
<p>#2. Encourage residential density in proximity to mixed-use neighborhood centers.</p>	<p>(a) Evaluate the Land Use Ordinance for opportunities to increase permitted residential density in areas that are within ¼ mile of a diverse number of uses, such as a mixed-use neighborhood center.</p>
<p>#3. Promote the development of mixed-use neighborhood centers in order to encourage residents to shop locally and reduce vehicle miles travelled.</p>	<p>(a) Strengthen the viability of existing mixed-use neighborhood centers by removing regulatory barriers to success, provided there is no negative impact to health and welfare. Examples include, but are not limited to, permitting a variety of complementary and supporting uses and encouraging shared parking.</p>
	<p>(b) Identify opportunities for new mixed use neighborhood centers within walking and biking distance of existing or planned residential neighborhoods. The Township should consider revising the Land Use Ordinance to permit a mixed-use neighborhood center as a conditional use in residential zones that have adequate residential density within walking distance to support the development.</p>

**Goal B : Promote a diverse housing stock in order to accommodate a mix of incomes and household sizes and to allow for a modest increase in density in areas well served by transportation, services and employment.**

Objectives	Strategies
#1. Provide opportunities for affordable housing near transit, service centers and employment centers.	(a) Include affordable housing in the development and redevelopment of mixed use neighborhood centers.
	(b) Provide inclusionary housing within walking and biking distance of transit, service centers and employment centers.

**Goal C : Locate community amenities in areas in or near existing and planned neighborhoods.**

Objectives
#1. Concentrate community facilities, such as schools and community centers, within a five- minute walk (1/4 mile) of residential neighborhoods.
#2. Locate parks and recreational amenities within a five- minute walk (1/4 mile) of all residential neighborhoods.

**Goal D : Reduce vehicle miles traveled by employees of and visitors to new and existing non-residential developments.**

Objectives	Strategies
#1. Encourage a mix of uses in typically single- use employment centers, such as office parks. Additional uses that should be considered include, but are not limited to restaurants, banks, drycleaners and childcare centers. Such a mix will provide convenient services in proximity to employment centers and eliminate the need for separate trips.	(a) Revise the Land Use Ordinance as necessary to permit a wider range of complementary uses in employment centers.
	(b) Revise the Land Use Ordinance to encourage property owners to provide a civic or passive use space, such as a square, park or plaza near non-residential building entrances.

**Goal E. Reduce vehicle miles traveled by reducing the need for transported goods and travel for services.**

Objectives	Strategies
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<p>#1. Encourage local food production through community gardens and permitting urban agriculture on residential and commercial lots.</p>	(a) Provide assistance to the Township's farmers by supporting right-to-farm policies.
	(b) Evaluate the Land Use Ordinance for opportunities where it is appropriate to permit community gardens to qualify as open space in planned unit developments.
	(c) Evaluate the Land Use Ordinance for opportunities where it is appropriate to permit food gardens in front and side yards.
	(d) Evaluate the Land Use Ordinance for opportunities where it is appropriate to permit small farm animals in back yards; however the permitted number and type of small farm animals should utilize a sliding scale based on lot size.
	(e) Evaluate the Land Use Ordinance for opportunities where it is appropriate to permit farmers' markets on Township owned parks and as a conditional use in the Township's nonresidential districts.
	(f) Incorporate fruit trees into neighborhood landscapes.
	(g) Encourage the establishment of farm stands on residential and agricultural properties. Farm stands on residential properties should be of modest size.
<p>#2. Provide support for and encourage the establishment of local owned and operated businesses</p>	(a) The Township should support locally owned and operated businesses through promotion of new and existing businesses via a buy local campaign, or similarly styled campaign.
	(b) The Township should consider expanding the standard for home occupations to permit more than one nonresident employee. The maximum permitted size of a home occupation should utilize a sliding scaled based on the lot size and parking area.

**Goal F : Focus the Township's remaining development potential on lands that can support compact development, are well served by transportation infrastructure, and are in proximity to employment and service centers. Direct the Township's remaining development potential away from productive agricultural lands, environmentally sensitive lands, stream corridors, and wildlife corridors.**

**Objectives**

#1. Adopt the Environmental Resource Inventory as part of the Master Plan.

#2. Encourage infill development throughout the Township's previously developed areas.

#3. Actively pursue the preservation of productive agricultural lands and environmentally sensitive lands via fee simple acquisition, land trust dedication, conservation easement or other means during the development review process.

#4. Actively pursue the preservation of wildlife corridors via fee simple acquisition, land trust dedication, conservation easement or other means during the development review process.

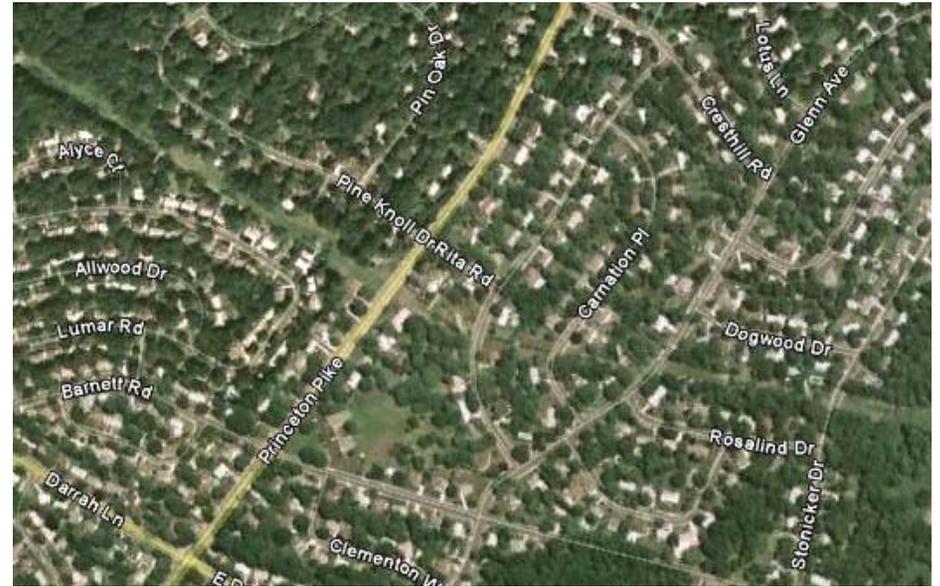
## Sustainable Circulation Systems

This section is related to and should be read in conjunction with the Land Use Element and the Circulation Element of the Master Plan.

The circulation policies of a municipality have a significant impact on its environmental footprint. As discussed in the Sustainable Land Use Patterns section of this Element, vehicle miles traveled is an important component to this. While the Land Use section focuses on compact development and mixed use as a way to reduce vehicle miles traveled, as well as having positive health, social and economic impacts, this section will focus generally on interconnectivity and the principle of complete streets to achieve these goals.

Street connectivity is defined as a system of streets with multiple routes and connections serving the same origins and destinations. A connected street system supports a vibrant economy, reduces traffic congestion and provides safe and convenient access to people, recreation, good and services. It is important to note that connectivity applies at all levels – connections between local streets, connections between neighborhoods and connections between regions. There are many advantages to a connected street system:

- Decreased vehicle miles traveled. A lack of local street connections forces travelers to take longer routes, often using the regional transportation systems, for local trips. Furthermore, a lack of local street connections causes inefficient delivery of goods and services and inefficient school bus routes. The decreased vehicle miles traveled will have a corresponding improvement in air quality as there will be fewer vehicles to release pollutants.
- Enhanced safety. Emergency vehicles will have multiple and potentially more direct routes to their destinations, therefore shortening emergency vehicle response time.
- Decreased traffic congestion. Traffic will not be concentrated on only a few streets or intersections; instead, travelers will have multiple routes to and from their destination and will rely less on the regional transportation system for local trips.
- Inefficient utilities. Local street connections supports more efficient utility distribution networks since utilities are typically laid within the street right-of-way.



*A residential neighborhood in Lawrence Township with generally good connectivity.  
Photo courtesy of GoogleEarth; accessed March 29, 2009*



*A residential neighborhood outside of Lawrence Township with poor connectivity.  
Photo courtesy of GoogleEarth; accessed March 29, 2009*



A residential neighborhood in Lawrence Township with generally good connectivity.  
 Photo courtesy of GoogleEarth; accessed March 29, 2009



A residential neighborhood outside of Lawrence Township with poor connectivity.  
 Photo courtesy of GoogleEarth; accessed March 29, 2009

Complete streets, another critical component to a sustainable circulation system, are defined as streets that are designed and operated to enable safe access for all users, including children, seniors and those with physical disabilities. This means that pedestrians, bicyclists, motorists and transit riders of all ages and abilities must be able to safely use and cross the street.<sup>3</sup> There are many advantages to complete streets:

- Decreased vehicle miles traveled. Complete streets promote safe and convenient alternative forms of transportation – walking, biking and mass transit – and therefore encourage less reliance on the single occupancy vehicle. The decreased vehicle miles traveled will have a corresponding increase in air quality as there will be fewer vehicles to release pollutants.
- Improved Public Health. Providing safe and pleasant alternative forms of transportation encourage residents and visitors to walk and bike to their destinations or for recreation. In fact, it has been reported that 43% of people with safe places to walk within 10 minutes of home met recommended activity levels while only 27% of those without safe places to walk met the recommendation. Another study found that residents are 65% more likely to walk in a neighborhood with sidewalks.<sup>4,5</sup>
- Improved safety. Complete streets reduce crashes by providing safe and dedicated areas for pedestrians, bicyclists and mass transit facilities, therefore reducing conflicts with vehicles. This is particularly important for those with limited mobility options, such as children and seniors.
- Decreased traffic congestion. Complete streets reduce reliance on single occupancy vehicles by encouraging people to reach their destination using an alternative form of transportation.



A bike lane in Carrboro, NC  
 Photo courtesy of [www.pedbikeimages.org](http://www.pedbikeimages.org) | Austin Brown



Sidewalk facilities and pedestrian friendly building design in the village of Lawrenceville



*Corner of Route 206 and Marlboro Road, before improvements*



*Corner of Route 206 and Marlboro Road, after improvements*



*Corner of Route 206 and Marlboro Road, after improvements*

To reach its full potential, a complete streets policy must be coupled with land use requirements that make walking, biking and mass transit use a pleasant experience. The streetscape should be interesting and should provide direct access to destinations. This requires that buildings be oriented toward the street with interesting architecture, as opposed to blank walls, and that a functional entrance be accessible from the street. As such, parking should be located along the side and rear of buildings. Streetscapes which are inviting for pedestrians and bicyclists include, not only dedicated areas for each as required by complete streets policies, but also street furniture, such as benches for rest, trash receptacles, street trees and street lights. Furthermore, public art can be incorporated into the streetscape to further enhance the experience and the appearance of the area. This was recently accomplished in the Eldridge Park area at the corner of Route 206 and Marlboro Road, adjacent to the Lawrence Road Fire House. The streetscape at this corner was recently improved to include a bench, an improved sidewalk, plantings and a wall to screen the view of the Fire House Parking lot. The result is a more interesting and inviting streetscape in one of the Township's mixed use cores.

To further reduce vehicle miles traveled, the Township should continue its policy of requiring interconnectivity and shared parking between nonresidential uses. This policy has been particularly successful in the village of Lawrenceville where parking lots to the rear of the buildings along Route 206 are connected even though the parking lots run across different property lot lines. This not only increases the total available parking and makes visiting the area more convenient but nearly eliminates the need for motorists to drive around the block in search of parking.



*Interconnected and shared parking at the rear of buildings along Route 206 in the village of Lawrenceville*

Another important component of sustainable circulation systems is multi-use paths, paths which provide shared space for pedestrians and bicyclists. While these paths are often referred to in the context of recreation, they are also a valuable way to reduce dependence on the single occupancy vehicle. In high speed, high vehicle traffic areas, they can provide pedestrian and bicycle facilities which are a safely separated from the vehicle cartway. They can also provide shortcuts between streets and neighborhoods that will potentially make for a more pleasant experience and a more convenient route. Successful examples of this include the Lawrence Hopewell Trail and the Lawrence Greenway. The Lawrence Hopewell Trail is unique in that the 20 mile pedestrian and bicycle trail through Lawrence Township and Hopewell Township was conceived by Bristol Myers Squibb and Educational Testing Services, two large land owners in the Township that now currently host part of the trail.

Lastly, but certainly not least, sustainable circulation systems must incorporate mass transit. The Township is fortunate to have existing mass transit facilities; there are a number of New Jersey Transit bus lines that stop in the Township's neighborhoods and in commercial centers. The Township should work with New Jersey Transit to determine if there are opportunities to increase the efficiency of these lines and/or to expand the lines to include additional stops and destinations. To encourage bus ridership, which is heavily dependent on safety and convenience, there should be conveniently located bus stops that include comfortable waiting areas, lighting and bicycle facilities.

To further enhance mass transit opportunities, the Township should continue working with area municipalities and the New Jersey Department of Transportation on obtaining bus rapid transit (BRT) along the Route 1 corridor as well as other mass transit opportunities which may present themselves. The Federal Transit Administration describes bus rapid transit as the following:

*“An enhanced bus system that operates on bus lanes or other transit ways in order to combine the flexibility of buses with the efficiency of rail. By doing so, BRT operates at faster speeds, provides greater service reliability and increased customer convenience. It also utilizes a combination of advanced technologies, infrastructure and operational investments that provide significantly better service than traditional bus service.”*

Bus rapid transit along the Route 1 corridor between the City of Trenton and South Brunswick Township, as currently proposed, would provide mass transit access to one of the most significant shopping and employment centers in the region and would reduce trips on Route 1 and surrounding streets and therefore vehicle miles travelled in the Township.



Walkers using the Lawrence Hopewell Trail, Photo courtesy of <http://htrail.org/gallery/>



Above Left: Multi use path  
Photo courtesy of <http://trailcycle.net/Page%20images/>

Above Right: New Jersey Transit bus stop at Quakerbridge Mall in Lawrence Township  
Photo courtesy of <http://www.philadelphiatransitvehicles.info/trentonconnections.php>



Bus rapid transit stop  
Photo courtesy of <http://www.green-wheels.org/brt>

## Goals, Objectives & Strategies: Sustainable Circulation Systems

Implementing sustainable circulation systems are necessary to support the Township’s sustainable land use goals, objectives and strategies. The benefits from increased development intensity cannot be realized if it cannot be supported by the transportation system. Specifically, the benefits of residential density and proximity to neighborhood centers cannot be fully realized if people feel compelled to drive to nearby destinations rather than walking or biking. The Township supports the New Jersey Department of Transportation’s Complete Streets Policy.

### Goal A : Promote connectivity through an integrated circulation plan that addresses the needs of pedestrians, bicyclists, and drivers

Objectives	Strategies
#1. Adopt the Lawrence Township Bicycle and Pedestrian Planning Assistance Study as a technical appendix to the Master Plan.	
#2. Ensure new streets are interconnected with the existing circulation system, and retrofit the Township, as needed, to provide additional connections throughout the circulation system.	<ul style="list-style-type: none"> <li>(a) Prohibit the creation of cul-de-sacs.</li> <li>(b) Retro-fit existing cul-de-sacs to provide vehicular, pedestrian and/or bicycle access to nearby streets and pedestrian/bicycle facilities where the connection will reduce vehicle miles traveled and/or enhance pedestrian/bicycle access.</li> </ul>
#3. Retrofit the Township, as needed, and require new development to ensure safe and convenient pedestrian and bicycle travel throughout the Township. This requires revisions to the Land Use Ordinance to further promote connectivity within new developments and redevelopment projects, as permitted by the Residential Site Improvement Standards.	<ul style="list-style-type: none"> <li>(a) Proceed with implementation of the Lawrence Township Bicycle and Pedestrian Planning Assistance Study.</li> <li>(b) Explore opportunities to connect existing and planned residential neighborhoods with commercial areas via pedestrian and bicycle infrastructure.</li> <li>(c) Provide bicycle lanes and continuous sidewalks on both sides of streets and internal drives of new developments and redeveloped projects.</li> <li>(d) Retrofit existing streets to provide bicycle lanes and continuous sidewalks on both sides of the street. <i>(Retrofitting streets to accommodate pedestrians and bicycles should consider right-of-way width, cartway width, street character, interconnection to other pedestrian and bicycle facilities and traffic intensity to determine what type of bicycle facility, bike lanes, bike path (multi- or single use) or street sharing, is appropriate.)</i></li> <li>(e) Seek retrofits of existing developments and require new developments to provide cross access to adjacent properties. Cross access between properties should be provided for pedestrians, bicycles and vehicles.</li> <li>(e) Require new developments and redevelopment projects to utilize a gridded street system or a street system that requires multiple intersections.</li> <li>(f) Invest in bicycle infrastructure, such as bicycle storage systems on public right of ways and on Township owned amenities.</li> </ul>

## Goal A : (Continued)

Objectives	Strategies
#3. (Continued)	(g) Work with Mercer County, New Jersey Department of Transportation and local advocacy groups to install appropriate pedestrian and bicycle facilities along County and State Streets.
	(h) Evaluate the Land Use Ordinance to determine if it is appropriate to prohibit the introduction of gated communities.
	(i) Utilize traffic calming measures to slow the speed of vehicles in order to increase pedestrian safety and comfort.
	(j) Provide pedestrian crosswalks and crossing signals at busy intersections.
	(k) Limit the number of curb-cuts permitted in new developments in order to increase pedestrian safety and comfort.
#4. Require pedestrian- friendly street design.	(a) Require functional street entries of commercial buildings to be primarily accessed directly from a public street with secondary access oriented towards parking lots.
	(b) Require parking to be located to the rear or side of buildings. Buildings should not be separated from the street by parking areas.
	(c) Ensure that appropriate street furniture is provided, such as but not limited to, benches, bicycle parking and trash receptacles.
	(d) Provide barriers between pedestrians and moving vehicles, such as through the placement of street trees between sidewalks and curbs, to enhance pedestrian safety and comfort.
	(e) Incorporate public art into streetscape design as another means to enriching the pedestrian experience of streets and other public places
	(f) Township parking requirements should be reviewed for opportunities to reduce minimum required parking standards for nonresidential uses in order to reduce impervious cover, improve the appearance of nonresidential sites and encourage walking and bicycling.

## Goal B : Reduce vehicle miles traveled and enhance recreation opportunities with the use of multi-use paths along and between greenways.

### Objectives

#1. Encourage the installation of multi-use paths along public and private greenways

#2. Encourage private property owners to provide a public easement that would allow for public travel along a multi-use path. Such paths are best located, but should not only be located, along scenic features, areas that can connect to other pedestrian and/or bicycle facilities, areas lacking in recreation amenities, and land uses with significant traffic demand.

## Goal C : Reduce vehicle miles traveled by employees of and visitors to new and existing non-residential developments

Objectives	Strategies
#1. Encourage inter-connectivity between nonresidential developments.	(a) Provide for sidewalks along commercial establishments, such as retail and office uses.
	(b) Provide street furniture and shade trees along sidewalks in front of commercial establishments.
	(c) Utilize traffic calming measures to slow the speed of vehicles in order to increase pedestrian safety and comfort.

## Goal D : Provide mass transit access to all employment and service centers and other areas that can demonstrate need or desire for mass transit.

Objectives	Strategies
#1. Encourage increased use of regional bus lines.	(a) Work with New Jersey Transit to determine if there are opportunities for additional bus lines and stops as well as opportunities for additional connections between neighborhoods and employment and service centers.
	(b) Work with New Jersey Transit to provide conveniently located bus stops which are safe and comfortable. Concerns include, but are not limited to lighting, comfortable waiting areas and location in proximity to goods, services, parks and institutions.
	(c) Provide convenient and safe waiting areas and bike storage areas at mass transit stops.
#2. Encourage the development of bus rapid transit (BRT)	(a) Continue working with area municipalities and New Jersey Department of Transportation on developing BRT service along State Highway Route 1 corridor. .
	(b) Discuss with New Jersey Transit replacing the highest ridership bus routes with BRT.
#3. Consider opportunities for Township- sponsored mass transit opportunities, such as but not limited to mass transit for seniors and to/from large employment centers.	

## Energy Conservation and Renewable Energy Production

This section is related to and should be read in conjunction with the Land Use Element, Community Facilities and Recreation Element, Utility Element and the Historic Preservation Element of the Master Plan.

Energy usage is central to any discussion of sustainability. The way we use and produce energy for buildings and facilities is arguably the number one environmental issue today due to its global impact on ecosystems, climate change and international relations. In the United States, buildings alone account for 72% of electricity usage, 39% of total energy use and 38% of all carbon dioxide emissions.<sup>6</sup>

The Municipal Land Use Law was recently amended to encourage the installation of renewable energy facilities. One of the amendments granted renewable energy facilities status as an inherently beneficial use – defined as a use which promotes the health and welfare of a community. Additionally, the Law was amended to make renewable energy facilities a permitted uses in industrial zones on lots of 20 acres or greater in size. The State Legislature is continuing to tackle regulation of renewable energy facilities and it is expected that additional bills regarding this topic will be passed.

Aside from a minimal market power from its buying practices, Lawrence Township has little direct influence over the production and transportation of conventional energy sources, such as oil, coal and natural gas. However, the rise of available renewable energy sources has made it easier for households, businesses and communities as a whole to participate in energy policy decisions by choosing to conserve energy and choosing what type of energy powers their home, business, etc. Of course, the other reason many are choosing to conserve energy is cost, particularly in light of recent energy cost increases. The immediate cost savings that can be realized from energy conservation measures is often the primary reason building occupants choose to enact energy conservation measures.

Lawrence Township has been a leader in the production of renewable energy. In 2009, the Lawrence Township school system completed a solar initiative which installed solar panels on the roofs of seven schools. With the help of outside funding sources, this is a cash positive project, meaning that the project will pay for itself over time. These solar panels are projected to produce approximately 1.2 megawatts per year and are projected to reduce the school system's demand on the electrical grid by 23%. The Township should also consider renewable energy and energy conservation infrastructure and

building renovations. Infrastructure which should be considered includes, but is not limited to, the following:

- solar powered street lights;
- LED (light emitting diode) street lights, traffic lights and exterior safety lighting;
- High efficiency pumps for water and wastewater supply, storage and distribution (note that this must be coordinated with regional water and wastewater authorities);

The Township should also conduct energy audits of municipal facilities as needed. These energy audits will not only lead to energy conservation but will also reduce operating costs. Furthermore, this offers another opportunity for the Township to lead by example. To date, the Township has begun audits on the municipal buildings. These audits should be used as a roadmap to increase the energy efficiency of municipal buildings.

The primary avenue for utilizing renewable energy in this region and the Township has been through harnessing the sun's energy. Cost efficient wind energy is largely not feasible in the Township due to low wind speeds and geothermal heating and cooling has longer payback horizons and has received less publicity than solar. This Master Plan Element supports solar and wind energy consistent with the below Goals and Objectives set forth below. It also supports geothermal energy; however, the regulation of such facilities is more appropriate for the construction code than the Land Use Ordinance.

Due to the Township's physical characteristics, solar energy is likely to be the most widely used form of renewable energy for the foreseeable future. This is consistent with trends reported by the Township office of Construction Code Enforcement. Since 2001, each year the number of solar energy systems has been steady or increased – consider that in 2001 there was one permit and in 2009 there were 13.

Roof mounted solar panels, when mounted parallel to the roof, are the most desirable type of alternative energy. With the exception of within historic districts, they provide the most unobtrusive form of renewable energy since they do not disturb the ground and are able to visually blend into the built environment. Where proposed in historic

districts or on a historic building, solar panels should not be visible from the front of the building.

Where roof mounted panels are not possible, ground arrays can be considered in appropriate areas of the Township. While they provide the same benefit of renewable energy, they do present potential drawbacks of being visually obtrusive and being located on land which could otherwise serve as productive farmland and/or wildlife habitat. Ground arrays are best located on lands that are not prime farmland and those that do not serve as important wildlife habitat. To further mitigate this circumstance, ground arrays should be installed such that some agriculture can continue beneath them, such as, but not limited to, grazing land for sheep, and/or the land can function as a natural meadow that can serve as wildlife habitat. This will require that the panels be installed at a height sufficient to allow vegetation to grow beneath.



Above : An example of integrating a ground solar array with agriculture. Photo courtesy of [http://hathorenergy.com/Home\\_Page.html](http://hathorenergy.com/Home_Page.html)

Right: Roof mounted solar panels in Lawrence Township. Photo courtesy of Chris Altomari



Skating rink in Randolph, NJ. This facility demonstrates how solar panels can be well-integrated into even large commercial buildings. By designing with this in mind, roof penetrations for vents and other rooftop equipment can be concentrated in one area to allow for full coverage of the remaining roof. Photo courtesy of Phil Duran



5Kw wind turbine  
Photo courtesy of Phil Duran

For some residential and many commercial sites, wind power may be an option to consider. Given the mapped wind speeds for our area, a wind turbine similar to the one shown here (5Kw) set up at least 100 feet from the ground would be needed to supply most of the needed electricity for a typical home. Businesses, large homes and farms would need a larger version or multiple turbines. Issues of location for the turbines and type of tower needed must be carefully considered due to their visual and environmental impacts.

Wind farms designed with clustered towers may have a negative impact on bird and bat flyways; they also have an industrial appearance and may not be a compatible adjacent land use to residential neighborhoods. This type of approach probably won't be used in Lawrence due to limited wind resources, but small-scale versions may be considered. If smaller scale wind farms are to be used, a linear approach is recommended. This reduces the industrial character and makes it easier for the birds and bats to fly through.



Wind farm that has a linear tower pattern. Photo courtesy of <http://my.opera.com/Wulpen/albums/showpic.dml?album=379570&picture=8602865>



Wind farm that has a clustered tower pattern. Photo courtesy of <http://www.sxc.hu/photo/495326>

Energy conservation is critical in the discussion of reducing dependence on fossil fuels as well as reducing building operating costs and supporting sustainability principles. It is recognized that the Township is constrained in its ability to rely upon passive solar strategies due to its developed character. However, new construction and redevelopment should utilize passive solar strategies to the extent possible. Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces; it does not involve mechanical or electrical equipment. Building design examples of this include roof overhangs to provide shade in the summer and window glazings to maximize solar heat gain in winter and minimize it in summer. Another aspect of passive solar design, and one which is ripe for land use ordinance regulation, is building orientation to maximize solar heat gain in winter and minimize it in the summer. For a development to make best use of its solar resources, the homes must all be aligned with their long axis facing south and with no obstructions for their solar collectors. It may also require creative placement of roadways. To maximize this principle, blocks should be oriented within plus or minus 15 degrees of geographical east/west, and the east/west lengths of those blocks are at least as long, or longer, as the north/south lengths of the block. Additionally, buildings should be designed and oriented such that the longer axis is within 15 degrees of geographical east/west axis.

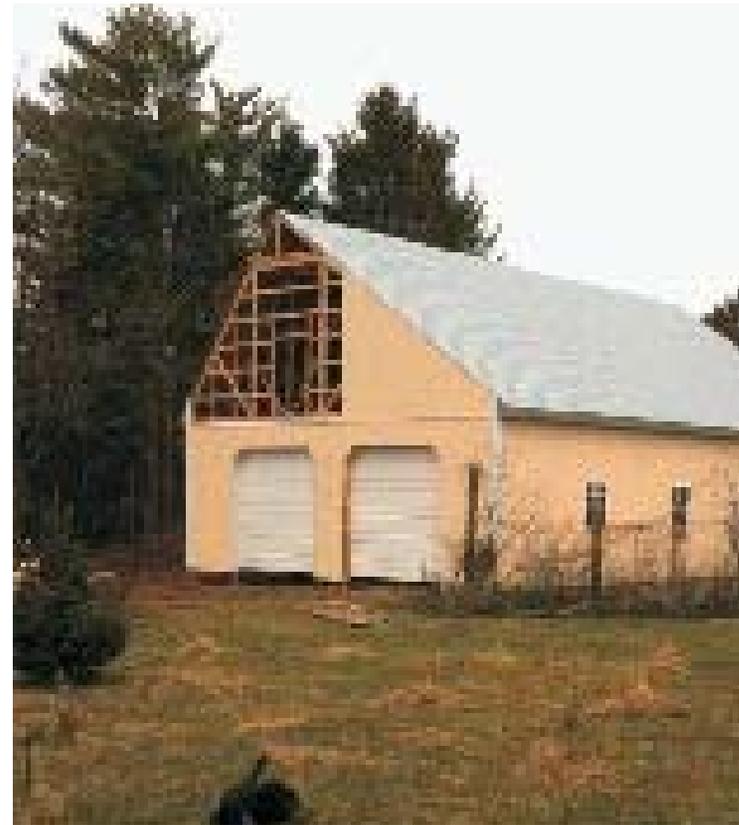
If designed from the start to be energy efficient, the structure should be oriented with the long axis to the south and with most of the windows on that side. Thick, fully insulated walls and roofs (allowing for solar panel installation) along with efficient heating and cooling systems (such as geothermal) and energy smart appliances and lighting complete the picture. The source and nature of building materials and the waste stream from construction must also be factored into the building's lifetime energy demand.

Older homes may not be aligned to take advantage of the sunlight, or may not have rooflines with the long axis facing south. In addition, the windows tend to be equally distributed on all four sides. To help address these issues, this homeowner in Lawrence put solar panels on an outbuilding that had the right solar orientation and replaced the oil-fired boiler with an open loop geothermal system. Rainwater collection, blown-in insulation, new energy efficient windows and high-efficiency appliances also helped to green this home.



*A “green” home in Lawrence Township, Photo courtesy of Phil Duran*

When preparing planting and site plans, designers should be cognizant of the need for solar access for existing or future nearby solar arrays. Solar access is defined as availability of (or access to) unobstructed, direct sunlight. The placement of new trees and buildings should be sensitive to the solar access needs of an existing array and should consider the solar access needs of any likely locations for future arrays.



*This pole barn in Lawrence Township is being constructed using 95% recycled steel and sustainably grown lumber. The southern roof is larger than the northern one in order to accommodate more solar panels. The roof pitch is set at 8/12 for best solar efficiency. Photo courtesy of Phil Duran*

## Goals, Objectives & Strategies: Energy Conservation and Renewable Energy Production

Energy conservation and renewable energy production will reduce the reliance of Township residents, businesses and institutions on nonrenewable energy sources, support self-reliance and reduce resident and business owner energy consumption and expenses. The overarching goals of this section are to support the New Jersey Energy Master Plan (2008) goal of achieving reductions in energy consumption of homes, buildings and industry of at least 20% by 2020 and 80% by 2050.

### Goal A : Conserve energy through building and site design. New construction and building rehabilitation in Lawrence Township should be designed to conserve energy through passive solar strategies and utilizing renewable energy sources.

Objectives	Strategies
#1. New residential and nonresidential developments should be designed such that buildings are able to utilize passive solar strategies.	(a) It remains important that buildings be oriented toward the street to promote community and create walkable neighborhoods. Notwithstanding, buildings should be elongated on an east/west axis in order to best utilize passive solar strategies.
	(b) To the extent possible, a building's south face should receive sunlight between the hours of 9:00 A.M. and 3:00 P.M. (sun time) during the heating season. To do so, a building should be oriented within 30 degrees of due south.
	(c) To the extent possible, interior spaces requiring the most light and heating and cooling should be along the south face of the building. Less used spaces should be located on the north.
#2. As upgrades and renovations become necessary, municipal facilities and infrastructure should incorporate energy conservation measures.	(a) It remains important that buildings be oriented toward the street to promote community and create walkable neighborhoods. Notwithstanding, buildings should be elongated on an east/west axis in order to best utilize passive solar strategies.
	(b) The Township should consider infrastructure upgrades and changes to facility operations that will conserve energy. Infrastructure upgrade examples include but are not limited to solar-powered streetlights. Changes to facility operations include but are not limited to installation of energy efficient lighting, heating, and cooling systems.
#3. Planting plans should be carefully designed to permit solar access on the subject property and adjacent properties, to the extent feasible.	(a) Trees should not shade areas appropriate for solar power, such as south-facing rooftops appropriate for solar power.
	(b) Planting plans should be designed to support passive solar strategies, such as providing shade during the summer month
	(c) Planting plans should consider how shadows fall not only on the subject property but also how neighboring properties will affect solar access. Solar access is one of the significant determinants of the effectiveness of solar/photovoltaic power.
#4. Review the land use ordinance to ensure that required lighting levels are set at the minimum levels necessary for public safety and convenience in order to reduce energy consumption and light pollution.	(a) Evaluate illumination standards for opportunities to reduce the minimum required lighting levels.
	(b) Establish maximum illumination standards.

**Goal B : Promote local production of renewable energy.**

Objectives	Strategies
<p>#1. Revise the Land Use Ordinance to make it easy for property owners in all zone districts to produce renewable energy on their property as accessory uses.</p>	<p>(a) Accessory solar/photovoltaic shall not be subject to particular design standards intended to screen them from public view.</p>
	<p>(b) Within historic districts, solar/photovoltaic shall be permitted; however, their placement and design should be compatible with the historic character of the building/district or screened to the extent practical. Specifically, renewable energy structures, such as solar panels, should be placed such that they are not visible on the front of an historic building or a building located in a historic district.</p>
	<p>(c) Encourage property owners to cover roof tops and surface parking lots with solar/photovoltaic structures.</p>
	<p>(d) Creation of solar power facilities on undeveloped land is strongly discouraged because of potential loss of carbon sequestration, natural eco-systems and habitats, and potential stormwater impact from ground mounted systems. However, an exception is the installation of renewable energy facilities on agricultural lands and managed open spaces, such as meadows, in such a way that the agriculture or managed open space use may be conducted and is viable under the renewable energy facility.</p>
	<p>(e) The Township should encourage property owners who have existing solar facilities or are proposing to install them to enter into solar easements with neighboring property owners in order to ensure continuing access to sunlight for a solar facility.</p>
	<p>(f) Permit wind energy facilities where appropriate based on neighborhood character and surrounding land uses.</p>
	<p>(f) Encourage the use of other renewable energy technologies such as, but not limited to, geothermal heating.</p>
<p>#2. As upgrades and renovations become necessary, municipal facilities and infrastructure should incorporate renewable energy production.</p>	<p>(a) The Township should consider incorporating new renewable energy production, such as solar power, into existing and any future facilities.</p>
	<p>(b) The Township should consider infrastructure upgrades and changes to facility operations that utilize renewable energy. Infrastructure upgrade examples include but are not limited to solar powered streetlights. Changes to facility operations include but are not limited to installation of energy efficient lighting.</p>

## Goal B : (Continued)

Objectives	Strategies
<p>#3. Revise the Land Use Ordinance to encourage new developments to harness solar/photovoltaic power either at the time of development or in the future.</p>	<p>(a) In new developments with multiple blocks, a minimum percentage of blocks should have one axis within plus or minus 15 degrees of geographical east/west, and the east/west lengths of those blocks are at least as long, or longer, as the north/south lengths of the block, the extent possible.</p>
	<p>(b) In multi-building developments, a minimum percentage of buildings should be designed and oriented such the longer axis is within 15 degrees of geographical east/west axis, to the extent possible.</p>
<p>#4. Promote renewable energy production as principal uses, including both promotion of renewable energy structures but also nonresidential uses which support the renewable energy industry.</p>	<p>(a) Revise the Land Use Ordinance to conform to the 2008 amendment of the Municipal Land Use Law stating the renewable energy production shall be a principal permitted use where the tract is a minimum of 20 acres and it is located in an industrial zone. This change would apply to the Limited Industrial 1 and Limited Industrial 2 districts.</p>
	<p>(b) Revise the Land Use Ordinance to include wind and solar/photovoltaic energy facilities as permitted principal or conditional uses in the Environmental Protection 1 district, Environmental Protection 2 district, Education, Government and Institutions district, Research and Development 1 district and the Research and Development 2 district.</p>
	<p>(c) Revise the Land Use Ordinance to mitigate impacts of renewable energy facilities by requiring that they be screened from public rights-of-way and residential uses.</p>
	<p>(c) The Township should consider a marketing campaign to attract businesses that specialize in renewable energy.</p>

## Green Building Design

This section is related to and should be read in conjunction with the Land Use Element and the Community Facilities Element of the Master Plan.

The United States Green Building Council cites that in the United States, buildings account for the following:

- 72% of electricity consumption,
- 39% of energy use,
- 38% of all carbon dioxide (CO<sub>2</sub>) emissions,
- 40% of raw materials use,
- 30% of waste output (136 million tons annually), and
- 14% of potable water consumption.

The construction methods used in all phases of a development have far reaching impacts on not just the site and the municipality, but also the State's and Nation's global impact. There are green building techniques available which can significantly lessen the impact of development on the environment. To be most effective in not just the short term but the long term as well, green building design should be consistent with the four guiding principles outlined in the introduction of this element – generally to reduce dependence on extracted and manufactured substances which are harmful to the environment, reduce harm to the ecosystem and fairly and efficiently meet all fundamental human needs.

The vast majority of green building techniques are not prohibitively expensive and, in fact, many are responsible for short term economic savings for items such as, but not limited to, a smaller site area of disturbance and reduced tipping fees (fees for disposal of solid waste). Long term economic savings can be realized from reduced life cycle costs in the form of lower water consumption and lower energy consumption. Furthermore, reduced energy consumption can also result in the ability to downsize building operation systems such as the mechanical and or electrical systems. In addition to the benefits to the outdoor environment, green building technologies can also improve indoor air quality and worker productivity.

In order to realize many of these benefits, a “green building” should be designed using a multi-disciplinary and integrated design process – one which relies upon collaboration

and synergies between the design disciplines and building systems. This process is key to realizing the cost savings green building design can offer. The consideration of additional costs for green construction, compared to savings over the life of the building, is critical for those that own and operate buildings – including municipalities. Increases in cost may occur due to the following:

- The extent of green construction techniques employed;
- The stage at which green construction goals and techniques are integrated in the building design; and
- The construction team's experience with green construction.

Despite initial costs, buildings that integrate sustainable practices will result in long-term cost savings derived from reductions in energy and water consumption, as well as, waste generation. While the actual additional cost of green building construction is variable, indications are that savings in electricity consumption, waste output and potable water use from green construction results in financial savings in the form of reduced electricity bills, waste collection bills and water / sewer bills.

While New Jersey municipalities do not have authority to alter building codes to prescribe such standards as energy and water efficiency, the Township should consider incentives in the Land Use Ordinances to encourage property owners to utilize green building design techniques. The Township can also provide leadership in this arena by including green building design techniques in its own buildings as upgrades become necessary.

The Township requires that a sustainable design assessment be completed for larger projects. This assessment provides information on what green building techniques have been used in the development and it lays the foundation for a dialogue with developers about what green building techniques are included and excluded from a project and why. Over time, the assessments will provide information on what green building techniques are the most cost efficient and effective in Lawrence. The Township may want to evaluate this section of the Land Use Ordinance to determine if the sustainable design assessment should be applied to a larger range of projects to ensure that developers of small and/or modest sized projects consider green building techniques. Particularly for small and modest sized projects, the Township should consider providing additional guidance on the information required to reduce the burden on the developer of completing an assessment with sufficient detail. The Township should also consider requiring

that the assessment be a required component of a development application completeness determination.

A sample of green building techniques is listed below. Please note that additional green building design techniques are addressed in this Element's other sections:

- Vent all combustion-based equipment
- Install energy-efficient lighting
- Choose eco-friendly paints, sheens, and finishes
- Use low-VOC construction products
- Choose hard, low-formaldehyde floors
- Use reclaimed or renewable materials
- Install a green roof
- Install water-saving fixtures
- Choose a high-efficiency water heater
- Select energy-efficient equipment
- Minimize site disturbance
- Install or upgrade insulation
- Provide controls and zoning for HVAC
- Use ceiling fans for natural ventilation
- Install energy-efficient lighting
- Provide rainwater collection system

The Township has already shown leadership in green building with the Lawrenceville Public Schools solar initiative which installed solar panels on the roofs of seven schools. This initiative has allowed the Township to lead by example and continues to be a source of pride in the community.



*Green roof at the Essex County Environmental Center  
Photo courtesy of <http://www.mgessex.org/cms/index.php?page=green-roof>*



*The Willow School in Gladstone New Jersey which earned LEED Gold certification from the United States Green Building Council, <http://www.willowschool.org/campus/viewer/index.htm>*

## Goals, Objectives & Strategies: Green Building Design

Buildings are responsible for a tremendous amount of water and energy usage as well as raw materials and solid waste. Indoor air quality, a byproduct of a building's design and materials, affects occupants' health. Note that many components of green design, such as water conservation and renewable energy production, are specifically addressed in other sections of this Element.

### Goal A : Encourage new and rehabilitated buildings to employ green building design techniques.

Objectives	Strategies
#1. Evaluate the land use ordinance for opportunities to allow for increased development intensity or other compensatory zoning measures where green building design techniques are utilized.	(a) Target development and/or redevelopment areas where green building techniques will be visible to the community and where land can support increased building intensity.
#2. As upgrades and renovations become necessary, municipal facilities and infrastructure should utilize green building design techniques.	(a) New buildings and building renovations should be completed using green building technologies. The Township should consider requiring new buildings and building renovations to achieve green building certification, such as, but not limited to, Leadership in Energy and Environmental Design.
#3. Consider applying the sustainable design assessment in the Land Use Ordinance to a larger range of projects and providing additional guidance to developers on information to be included.	

## Sustainable Water Resource Practices

This section is related to and should be read in conjunction with the Land Use Element, and Conservation Element.

Implementing sustainable water resource practices will provide reliably clean water to serve the needs of the current residents of Lawrence Township without compromising the ability of future generations to meet their own needs. The conservation of water quantity and the preservation and enhancement of water quality should be a priority, as related to the water supply and all the beneficial uses of water resources within the community.

Nationally, the average amount of water used by each person is 100 gallons per day.<sup>7</sup> In New Jersey, lawn irrigation consumes nearly half of homeowner water usage.<sup>8</sup> The goals for sustainable water resources practices must accommodate growth and redevelopment within the community and be integrated with land use and community planning. Drinking water in the Township, depending on location, is provided by either a public authority, Trenton Water Works, or by individual private wells.

The Lawrence Township Environmental Resource Inventory (ERI) was developed in March 2008 to document the natural and biological resources within the Township. The ERI states that *“Lawrence’s surface waters and groundwater resources, and the terrestrial resources that sustain the area’s hydrology, will become increasingly important to its population and that of neighboring communities as continuing development places increasing pressure on diminishing natural resources”*. There are areas of the State where the availability of water is limiting the scale and timing of development. In the northern part of the State known as the Highlands region, for example, the Highland Council was created and is now implementing development standards, most importantly intensity limits, aimed at maintaining water quantity and quality for this area which provides drinking water to approximately half of the State. It is therefore critical for us to understand how our actions impact the water resources in the community and what goals, objectives, and strategies are necessary to sustain both the availability and quality of water. Knowledge and understanding of the Township’s water resources should be promoted. Education is a critical component to encouraging property owners to use innovative stormwater management techniques and to reduce nonpoint source pollution.

The streams located in the central and southern portions of Lawrence Township drain to the Delaware River through the Assunpink Creek Watershed. The northern part of the Township drains to the Raritan River through the Stony Brook Watershed. A watershed is defined as the land area and surface water bodies, such as streams and lakes, which drain to these water bodies. Many factors, including land use, soils, vegetation, and hu-

man activity impact the water quality and ecological value of a watershed. According to the 2008 Integrated Water Quality Monitoring and Assessment Report, published by the New Jersey Department of Environmental Protection (NJDEP), impairments of the Township’s waterways include aquatic life, dissolved oxygen, total phosphorus, e. coli, arsenic, lead, and mercury.

Wetlands and riparian areas are of particular importance to water quality. Wetlands are areas where water occurs at the soil surface for long enough periods to establish a certain biological and ecological community. These areas are known for their ability to filter pollutants and thereby improve water quality. Riparian areas are the land adjacent to surface waters that act as a buffer. When these areas contain vegetation, especially native and adaptive tall grasses, shrubs, and woods, this buffer acts to protect the surface waters from nonpoint source pollution (contaminants carried via stormwater runoff). Both wetlands and riparian areas are regulated by the NJDEP. In order to develop a sustainable plan for water resources, the Township must understand the importance of these areas and the impacts from their development.



*Shabakunk Creek at Drexel Woods in Lawrence Township*  
Photo courtesy of <http://www.lawrencetwp.com/gallery-5.html>

While groundwater is not nearly as visible as streams and lakes, it is still heavily impacted by the land use and development at the earth’s surface. Interestingly, groundwater makes up approximately 30.1% of the earth’s total freshwater, while surface waters,

including streams and lakes, make up only 0.3% (the remaining is held in icecaps and glaciers).<sup>9</sup>

The water cycle demonstrates how atmospheric moisture, surface waters, and groundwater are all interconnected. The figure below of the water cycle in an urban setting portrays the negative hydrologic impacts of urbanized development to both surface waters and groundwater. The impervious coverage caused by land development blocks water from infiltrating into the soil and recharging groundwater. As a result, when storms occur, more runoff enters the streams, causing increased flooding, and less water goes into the soil to recharge groundwater. In addition, during drought conditions, there is less groundwater (because of decreased recharge), causing a shortage in the availability of drinking water from wells and a shortage of groundwater flow into streams and lakes. The shortage of groundwater flow into surface waters (base flow) during low-flow conditions causes water quality to degrade, as a larger and larger percentage of the surface water is polluted water from point and nonpoint sources.

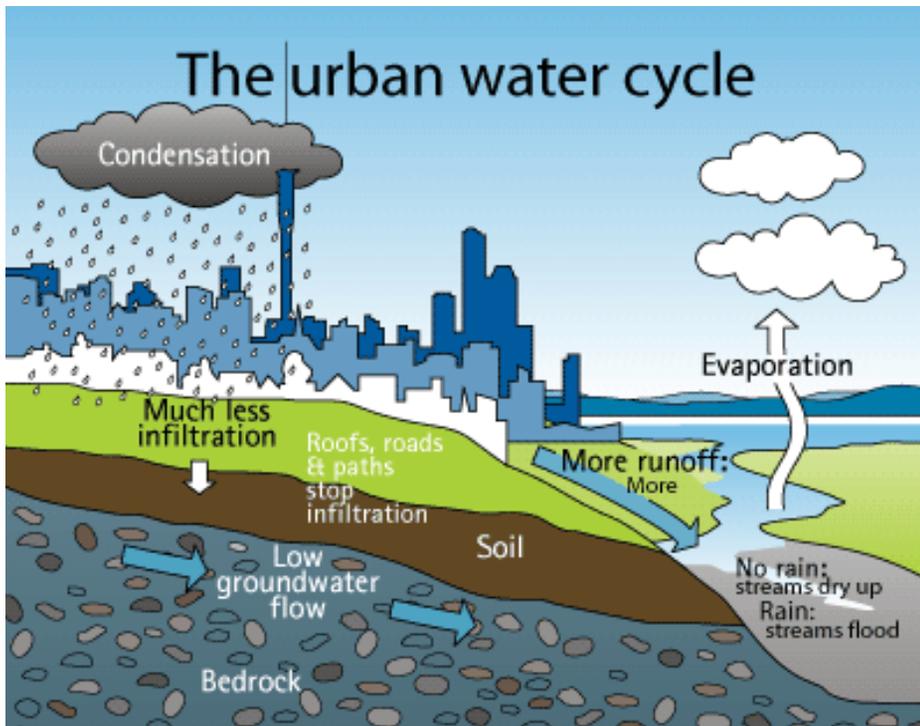


Image courtesy of <http://www.aucklandcity.govt.nz/council/services/stormwater/about.asp>

For these reasons, the Township should seek to reduce impervious cover. One of the largest sources of impervious cover in the Township is parking areas. The Land Use Or-

dinance should be evaluated for opportunities to reduce the required parking standards, as well as to create incentives to reduce impervious cover in existing and proposed developments. Additionally, porous pavement should be used when appropriate to increase water infiltration.

In order to mitigate the impacts of development and impervious cover, innovative stormwater management techniques can be used to treat and infiltrate runoff and mimic the natural hydrology. Some examples of these types of best management practices (“BMPs”) include bioretention basins, porous pavement, infiltration trenches, and vegetated swales. The Township should encourage the use of these types of facilities that treat runoff, reduce runoff volume, and recharge groundwater. Unfortunately, the majority of the Township has been developed without the benefit of these types of BMPs. Many of the developments in the Township use traditional detention basins, which don’t allow for any infiltration during most storm events. Other developments do not have any stormwater management BMPs. In order to improve stormwater management and reduce non-point source pollution in these areas, residents and business owners should be encouraged to use smaller on-site BMPs, such as rain gardens (small bioretention basins), dry wells, porous pavers, rain barrels, and disconnecting downspouts that are tied in directly to the storm sewers. If these types of on-site BMPs are used by many people in the community, they can become an effective tool to improving the water quality in the Township’s watersheds.



Rain garden on a residential property in Lawrence Township  
Photo courtesy of Chris Altomari

When humans consume water, the source may be many miles away and the energy required to treat and convey the water can be significant. In addition, the withdrawals from the surface waters and groundwater bypass the natural hydrology through hard piping. The water that is consumed then becomes wastewater which is then treated and later discharged further downstream. This bypass of the natural hydrology is, in part, a cause for the impairment of the local watersheds. In order to provide a sustainable water supply and healthier watersheds, it is important to incorporate water conservation strategies that will reduce consumption and keep water local to the community. Some examples of these types of strategies are infrastructure improvements, leak detection surveys, high-efficiency appliances, rain barrels, cisterns and low-maintenance native and adaptive landscaping that requires less irrigation.

Sustainable landscaping practices provide a number of benefits. Plants which are native or adapted to this region are geared toward the local climate and soil conditions. As such, they typically require fewer or no pesticides and fertilizers, which have a positive impact on water quality since the runoff will contain less or none of these inputs, and they are typically compatible with area precipitation rates and therefore require less irrigation, which has a positive impact on water quantity. While they may be well adapted to the region, invasive plant species should be avoided. Invasive plant species are defined as introduced species that can thrive in areas outside of their range of natural dispersal and are commonly adaptable, aggressive and have a high reproductive capacity. Invasive plant species can cause a loss of habitat as they replace native plants and landscapes which are relied upon by wildlife. They can also cause significant maintenance problems when they spread to unintended areas.

Sustainable landscaping practices also address watering methods. Property owners can reduce water use by installing drip irrigation rather than sprinklers and installing rain sensors to ensure that plants and lawn areas are not watered when it is unnecessary.

An additional consideration of sustainable landscaping is the reduction of lawn areas. Lawn areas do not provide good water infiltration and in fact, they can only absorb about a tenth the rainfall as a forested area.<sup>10</sup> Replacement of lawn areas with forest, meadow or naturalistic plantings can also lead to fewer fertilizer and pesticide inputs, therefore positively impacting water quality.



Rain barrel, Photo courtesy of <http://www.backyardcomposters.com/store/1816388/product/Rain%20Barrel%201>

## Goals, Objectives & Strategies: Sustainable Water Resource Practices

Implementing sustainable water resource practices will provide reliably clean water to the current residents of Lawrence Township without compromising the ability of future generations to meet their own needs. The conservation of water quantity and the preservation and enhancement of water quality should be a priority, as related to our water supply and all the beneficial uses of water resources within the community. The goals for sustainable water resource practices must accommodate growth and redevelopment within the community and be integrated with land use and community planning.

### **Goal A : Encourage residents and business owners, through educational programs and incentives, to utilize water conservation practices.**

#### **Objectives**

- #1. Promote the use of high-efficiency appliances, such as water heaters, toilets, dishwashers, low-flow shower heads, and washing machines in the Township.
- #2. Encourage recycling of rainwater and reuse of “grey” water for landscape watering and irrigation.
- #3. Evaluate the Land Use Ordinance for opportunities to require landscaping vegetation that requires little to no irrigation, such as native plants and xeriscaping (landscaping or gardening that reduces or eliminate the need for supplemental watering or irrigation).

### **Goal B : Improve how runoff is managed and treated throughout the Township in order to improve water quality, increase groundwater recharge, and improve runoff management and treatment throughout the Township.**

#### **Objectives**

- #1. Encourage use of innovative stormwater management technologies that not only protect against flooding, but also address nonpoint source pollution, recharge groundwater, and mimic natural hydrology.
- #2. Retrofit existing stormwater management infrastructure that is failing or not providing groundwater recharge and/or water quality treatment.
- #3. Modify land use ordinances as necessary to encourage vegetated conveyance, rain gardens, bioretention islands, and other low-impact development strategies. (i.e. allow for depressed/slotted curbs along roadways, vegetated islands in cul-de-sacs, etc.).
- #4. Encourage homeowners and business owners to use rain barrels, rain gardens, and porous pavement on their property.
- #5. Promote the disconnection of impervious surfaces throughout the Township.

**Goal C : Increase vegetated riparian buffers around surface waters in the Township to reduce nonpoint source pollution.**

**Objectives**

- #1. Direct the Township's remaining development potential away from riparian buffers, flood hazard areas, wetlands, and wetland buffers.
- #2. Encourage compact development that preserves riparian buffers, wetlands, steep slopes, wooded areas and other environmentally sensitive areas.

**Goal D : Encourage the use of sustainable landscaping in the Township.**

**Objectives**

- #1. Promote native plant and native ecosystem landscaping in development applications.
- #2. Revise the Land Use Ordinance to prohibit the use of invasive plant species.
- #3. Promote functional landscaping that provides runoff treatment, such as vegetated islands, rain gardens, bioretention areas, vegetative filters, constructed wetlands, etc.

**Goal E : Reduce impervious coverage surfaces in the Township.**

**Objectives**

- #1. Evaluate the Land Use Ordinance for opportunities to reduce required impervious cover. Areas for consideration should include parking ratios, shared parking and/or pervious pavement.
- #2. Promote use of porous pavement as an alternative to impervious surfaces where appropriate. Areas for consideration should include, but not be limited to, parking areas, pedestrian and bicycle facilities, and/ or emergency access areas.
- #3. Provide incentives to reduce unnecessary impervious coverage on existing sites and development projects.

**Goal F : Develop and implement an education and outreach program for the reduction of nonpoint source pollution in the Township's watersheds.**

## Waste Reduction and Recycling

This section is related to and should be read in conjunction with the Land Use Element and the Utility Element of the Master Plan.

Through waste diversion practices, the Township can decrease its budget expenditures on waste hauling, reduce its environmental impact, and to serve as a role model to residents and businesses. Lawrence's recycling program has been successful. In fact, Township recycling rates increased from 2006 through 2008; in 2006 a total of 36,730 tons of material was recycled and in 2008 37,209 tons of material was recycled – an increase of 479 tons.

The Township's recycling program is handled by the County; the Mercer County Improvement Authority (MCIA) provides bimonthly recycling services to all of its municipalities. The MCIA provides single stream recycling for glass, aluminum, some plastics, paper and cardboard. The MCIA also collects additional items, such as electronics and chemicals, a few times a year. The Township's garbage collection is handled by a company which the Township contracts with. Successful waste reduction in Lawrence Township can lead to cost savings since solid waste is billed by weight and the recycling program is billed as a flat rate; as such, if recycling rates increase, the Township will reduce its garbage collection costs while keeping recycling rates flat.

Unfortunately, there are many recyclable materials, such as additional plastics, which the County does not accept. Since public education is key to increasing recycling rates, the Township should provide a public education campaign informing the residents and business owners of the MCIA program as well as available recycling programs throughout the region in order to increase recycling rates and decrease garbage collection costs. The public education campaign can involve newspaper articles, the Township website, the schools and working with community groups. The Township may also wish to partner with nearby municipalities on recycling programs in order to save on administrative costs and to expand the reach of the program.

To further reduce solid waste, the Township should consider how sale and exchange of used goods can be accommodated while maintaining character of an area. These sales or exchanges, such as yard sales, flea markets and organized salvages, are a valuable way to reduce solid waste and provide an outlet for local recycling and reuse efforts.

Additionally, the Township should review the Land Use Ordinance to ensure that all commercial and multi-family developments provide adequate recycling space. Recycling should be as simple as possible. The Township may also wish to consider ways to reduce construction and demolition waste. Construction and demolition waste, is a particularly high contributor, in a municipality such as Lawrence where much of new development will be in the form of redevelopment. This could be done through an incentive program and/or mandatory requirements.

Additionally, the Township should consider best practices in waste reduction. The following practices provide a few of the strategies that are being employed by municipal operations throughout the United States:

- Placing recycling containers conveniently next to every garbage;
- Clearly labeling what materials may be recycled so that all possible materials are diverted;
- Set double-sided as the default preference for all printers and copiers within the municipal building and other municipal agencies;
- Refurbish printer toner cartridges rather than purchasing new cartridges;
- Promote the use of electronic documents rather than paper documents;
- Remove the municipality and municipal employees from junk-mail lists;
- Select products from suppliers and manufacturers that use minimal packaging;
- Purchase products made of post-consumer recycled paper;
- Re-use packing material whenever possible; and,
- Create boxes for single sided prints. When enough single sided prints are compiled, create notepads.

### Total MSW Generation (by Material), 2008 250 Million Tons (Before Recycling)

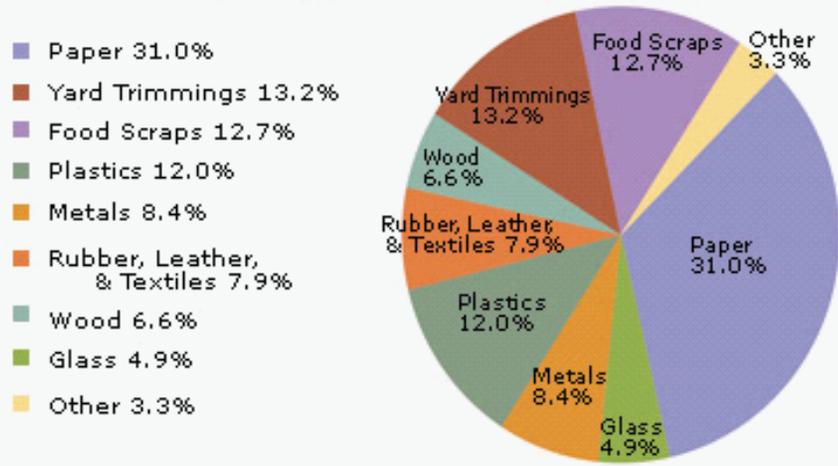


Image courtesy of the US Environmental Protection Agency. <http://www.epa.gov/osw/conservation/materials/organics/food/food-basic.htm>

In the United States, 12.7% of the total municipal solid waste is derived from food scraps.<sup>11</sup> Nearly two thirds of the solid waste stream is comprised of organic materials such as yard trimmings, food scraps, wood waste and paper/paperboard products.<sup>12</sup> A municipality can limit the amount of organic generated by implementing a multi-faceted composting policy. For years now the Township has operated a compost facility that composts yard waste and is available to Township residents. The Township can increase its composting rates through a public education campaign to educate residents and business owners about the benefits of composting, how composting works, and best practices on integrating composting into the home or business. Township residents and business owners should be encouraged to compost their own yard waste and food scraps to reduce their own waste generation, reduce pressure on the compost facility and increase the sustainability of their home or business. Residents and business should also be encouraged to leave grass clippings on the lawn when they mow since not only does it cut down on waste (it is to be thrown away) and work (no need to move to the garbage or compose), but they provide a natural fertilizer for the lawn. However, it must be noted that not all organic materials can be composted and composting may not be appropriate on very small lots.



Photo courtesy of <http://www.largo.com/egov/apps/action/center.egov?action=form@item=19>



Photo Courtesy of <http://www.jocorecycles.org/yardwaste.html>



Example backyard compost bin  
Photo courtesy of <http://monsterguide.net/how-to-build-a-compost-bin>

## Goals, Objectives & Strategies: Waste Reduction and Recycling

Reducing waste and increasing recycling, which go hand in hand, are a primary component of sustainability. Recycling limits waste of potentially useful materials, reduces consumption of raw materials, cuts energy use, reduces air pollution (from incineration), reduces water pollution (from landfills) and often lowers greenhouse gas emissions — all as compared to the production of virgin materials. Composting is also an important component of waste reduction strategies but, which is considered distinct from organized recycling programs.

<b>Goal A : Increase recycling rates of Lawrence Township households, businesses and institutions.</b>	
<b>Objectives</b>	<b>Strategies</b>
#1. Raise public awareness of recycling opportunities available to Township residents, businesses, and institutions, including but not limited to, what materials are recyclable and what agencies/organization will accept recyclable materials.	(a) Promote the Township’s current recycling program and other recycling programs available to residents and businesses through a public education campaign that addresses the “what”, “when” and “where” of the programs.
	(b) Ensure that all municipal facilities make full use of the Township’s recycling program so that they model leadership in the community. Provide prominent and convenient recycling facilities at all municipal facilities, such as buildings, playing fields, and parks.
#2. Explore partnerships that can lead to increased Township recycling rates of currently recycled materials and expand the list of recyclable materials.	(a) Explore partnerships with area government and/or nonprofit organizations to create new or expanded recycling programs.
	(b) Explore partnerships with for-profit organizations to create new or expanded recycling programs.
#3. Evaluate the Land Use Ordinance to ensure all new nonresidential and multi-family developments have adequate recycling space in order to facilitate recycling to the fullest extent possible.	
#4. Reduce construction and demolition waste in the Township through education and encouragement and/or requirements in the Land Use Ordinance.	
<b>Goal B : Reduce waste through increased composting throughout the Township.</b>	
<b>Objectives</b>	
#1. Explore partnerships that can lead to increased Township recycling rates of currently recycled materials and expand the list of recyclable materials.	
#2. Encourage composting, wherever appropriate, to reduce waste from households, commercial uses and institutions.	

## Document Footnotes and References

- 1 (Page 4) The listing of redevelopment opportunities does not indicate an ability to meet the redevelopment area criteria pursuant to the Local Redevelopment and Housing Law (N.J.S.A. 40A:12A)
- 2 (Page 5) Pimentel, David and Giampietro, Mario. Food, Land, Population and the U.S. Economy. Accessed April 21, 2009 from <http://dieoff.org/page40.htm>
- 3 (Page 11) National Complete Streets Coalition. <http://www.completestreets.org/complete-streets-fundamentals/complete-streets-faq/>
- 4 (Page 11) Powell, K.E., Martin, L., & Chowdhury, P.P. (2003). Places to walk: convenience and regular physical activity. *American Journal of Public Health*, 93, 1519-1521.
- 5 (Page 11) Giles-Corti, B., & Donovan, R.J. (2002). The relative influence of individual, social, and physical environment determinants of physical activity. *Social Science & Medicine*, 54 1793-1812.
- 6 (Page 17) United States Green Building Council. <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718>
- 7 (Page 27) <http://www.nwf.org/News-and-Magazines/National-Wildlife/News-and-Views/Archives/2004/Water-Pressure.aspx>
- 8 (Page 27) <http://plant-materials.nrcs.usda.gov/pubs/idpmsfs5464.pdf>
- 9 (Page 28) United States Geologic Service. <http://ga.water.usgs.gov/edu/earthwherewater.html>
- 10 (Page 29) US Environmental Protection Agency, Landscaping with Native Plants. <http://www.epa.gov/greenacres/smithsonian.pdf>
- 11 (Page 33) United States Environmental Protection Agency. "Resource Conservation – Common Waste and Materials". <http://www.epa.gov/osw/conserva/materials/organics/food/fd-basic.htm> (Accessed March 26, 2010).
- 12 (Page 33) United States Environmental Protection Agency. "Resource Conservation – Common Waste and Materials". <http://www.epa.gov/osw/conserva/materials/organics/> (Accessed March 26, 2010)