Integrating Environmental Management, Regional Planning, TDR and LEED-ND through Impervious Surface Cap and Trade: A Conceptual Framework

John Hasse and Michael Ontko, Rowan University

Abstract – This paper proposes a conceptual framework for an innovative approach to Transferable Development Rights (TDR) that utilizes an impervious surface cap and trade system to better integrate environmental management with smart growth and sustainability land planning objectives. It utilizes the State of New Jersey as the testing ground for developing the concept since the state has excessive growth pressures as well as a long record of experimenting with land management initiatives, some more successful than others. The paper puts the proposed system in the context of New Jersey's existing land management toolbox. The concept is designed not to replace existing land management programs, but to instead provide an overlay mechanism that discourages development in rural and environmentally sensitive areas while fostering smart growth that achieves LEED-ND certification and redevelopment of already urbanized areas. It is envisioned that such an Impervious Cap and Trade (ICT) system would improve the land management process in the following ways: 1) limiting total impervious surface in remaining open lands to justifiable limits, 2) encouraging the redevelopment of urbanized areas by exempting redevelopment of already existing impervious surface from the new restriction, 3) allowing market mechanisms to pay for open space preservation and thus keeping pace with increasing land values, 4) rewarding development and redevelopment proposals that demonstrate substantive smart growth goals of the NJ State Plan and sustainability performance as evaluated by LEED-ND, 5) allowing flexibility and market changes to occur while still maintaining thresholds of environmental standards and objectives, and 6) allowing a substantial amount of local control to remain in the process. In essence, the concept is a unifying overlay that provides a mechanism for the NJ State Plan goals of smart growth, sustainability and environmental management to be actualized through a flexible, market-based impervious surface cap and trade. The paper concludes with an agenda of how impervious cap and trade might be initiated and adopted in New Jersey and in other jurisdictions.

1) Introduction –

Why does New Jersey need yet another land management mechanism? The Garden State has been on the forefront of innovating land management initiatives for decades. It was one of the earliest states to develop a state-wide office of planning and an accompanying state plan. It has a highly effective management plan for the Pinelands region of southern New Jersey encompassing over one million acres of land (20% of the state's territory). It has recently enacted a regional plan for the Highlands region of northern New Jersey. New Jersey has a strong Department of Environmental Protection with some of the most rigorous wetlands and storm water regulatory procedures in the United States. It also has one of the most active and successful farmland & open space preservation programs in the nation. Furthermore, it has set national precedents for affordable housing planning policy. With all these programs in place, why propose an impervious surface transfer of development rights (TDR) system? As the old truism goes, "if you keep doing what you've been doing, you'll keep getting what you've got".

In spite of all the innovative and honorable land management initiatives, the Garden State is still urbanizing in a pattern that is environmentally degrading, socially divisive and fundamentally unsustainable (Figure 1). There are some major gaps in policy that are preventing the state from

reaching its full potential for fostering smart growth and creating a sustainable land management system. Important land resources such as prime farmland, wetlands, and forests continue to be lost at an unsustainable rate. Cities still suffer from disinvestment and neglect, while development of greenfields (undeveloped open land) continues to be more economically attractive to developers than infill and redevelopment. Open space preservation is becoming increasingly expensive, while acquiring public funding to pay for the open space is growing more difficult. Home rule continues to foster development decisions driven by short-term factors such as maintaining high property values and attracting tax ratables rather than regional coordination and long term sustainability objectives. Land development patterns remain scattered, land consumptive, and low-density, causing environmental and social problems while exacerbating the state's prospects for addressing climate change.

Figure 1. *New Jersey is one of the most rapidly urbanizing states in the United States of America, and much of the development is scattered, low density and single use (i.e. sprawl). At current development rates the state will reach buildout by the middle of this century. Photo: J. Hasse.*

The limitations of New Jersey's existing land management system for averting sprawl are made clear by examining recent development patterns. A recent report looking at the detailed land use change patterns in New Jersey (Hasse and Lathrop, 2008) found that the state urbanized 239,960 acres of greenfields during the 16 year period between 1986 and 2002 with an average rate of over 15,000 acres per year. **This rate of urbanization puts the Garden State on track to becoming the first state in the U.S. to reach buildout sometime in the middle of the century** (Hasse and Lathrop, 2001).

The study looked further into detailed characteristics of the greenfields conversion and concluded that urbanization patterns became more sprawling over the study period. Low-density rural residential housing (greater than ½ acre lots) consumed 67% of the open space that was converted to residential land use while providing housing for only 24% of the population entering new housing. Conversely, the

proportion of land that went into higher-density multi-family units decreased during the study period from 9.4% of the pre-1986 residential land acreage to 5.6% of land developed between 1995 and 2002 (Hasse & Lathrop, 2008).

Furthermore, the patterns of new urbanization became more dispersed and fragmented. The average size of development tracts decreased while the annual number of individual developed tracts increased. At the same time, the location of much of the low-density development that consumed greenfield land was in the New Jersey State Plan's environmentally sensitive and rural planning areas. Meanwhile, many of New Jersey's inner cities such as Camden and Newark continued to experience extreme social stress related to disinvestment, concentrated poverty and flight of the middle class population to the sprawling outer-ring suburb (Evans, 2004). During the 1990 – 2000 census the statewide population increased by 8.9% to 8.4 million, but at the same time 145 municipalities, generally in the older inner-ring core areas, actually lost population to the rapidly growing suburban municipalities.

The geographic, economic, historical and political circumstances of the state make it very difficult for New Jersey to achieve the goals of smart growth and sustainability under the state's current set of land regulatory mechanisms. Barring complete economic collapse, New Jersey will reach buildout within the next several decades. The socioeconomic and ecological implications of that buildout landscape are far-reaching. A big game-changing idea is needed if the Garden State hopes to change its land development trajectory.

2) Need for a Big New Idea in New Jersey

We proposed that the pending buildout of the state warrants a buildout approach to planning and land management. In this light we suggest that there are two possible future land use scenarios for New Jersey. The first scenario continues recent trends of growth over the past several decades. Development patterns will continue to be driven by the prevalent economic and political forces and guided by the current mosaic of land management policies. Under this first scenario the remaining available lands will be developed in a manner consistent with current zoning ordinances, but poorly coordinated across municipalities. Much of the future development that will occur under scenario one will fail to achieve the smart growth goals of the New Jersey State Plan and measures of sustainability since there are few mechanisms under the current system for the actualization of these goals in the development process. Additional open space preservation will become increasingly difficult to acquire as land becomes scarcer and property values rise accordingly. Significant amounts of remaining prime farmland, wildlife habitat, aquifer recharge areas, forests and important land resources will be lost. New Jersey's older towns and urbanized areas will continue to struggle for revitalization and to retain a middle class tax base, while suburbanizing rural municipalities will continue to grow at rapid rates, stressing school, infrastructure and road network capacities and consuming large amounts of land. Under scenario one, the state develops in a manner similar to what it has experienced over past several decades until land runs out. The final landscape of New Jersey under scenario one will be substantially diminished in its ecological and socioeconomic function compared to its current state.

The second scenario envisions a future New Jersey landscape in which development growth occurs in a manner that accomplishes the smart growth goals of the State Plan and that achieves meaningful measures of sustainability. Scenario two significantly slows development of remaining greenfields and encourages reinvestment and redevelopment of New Jersey's already urbanized areas. It encourages the development of high quality neighborhoods that foster community. In this scenario the development industry thrives economically on building and redeveloping sustainable development in

collaboration with environmental stakeholders. Scenario two provides for the preservation of the most vital open spaces and natural resources so that the integrity of wildlife habitat, water quality, ground water recharge, forest and agricultural lands can be maintained. Under scenario two, New Jersey will accomplish its maximum potential for designing and achieving the highest level of integrity for the ecological and socioeconomic function of its land systems, while maintaining and even enhancing them from their current state.

Scenarios one and two respectively represent worst case and best case outcomes for New Jersey's future development. In order to shift development patterns from scenario one (trend) to scenario two (smart growth and sustainability), there needs to be a game-changing shift in policy. We argue that such a new land management initiative is called for to specifically address a number of unmet needs.

First, there is a vital need for additional open space preservation that fills in many significant gaps and vulnerabilities in open space protection goals. For example, the Garden State Greenways project (GSG, 2009) identified over one million acres of lands that needed to be protected in order to create a system of open space hubs and corridor networks that maintain ecosystem and recreational functional integrity. Reports such as the State Comprehensive Outdoor Recreation Plan (SCORP) identify a need to preserve 700,000 additional acres of high value natural resource lands statewide to protect ground water resources, flood prone areas and other habitats and environmentally sensitive areas (NJDEP SCORP, 2007). The State Agriculture Development Committee (SADC) estimates that in order to ensure a viable long-term agricultural industry, an additional 450,000 acres of land should be put into preservation (SADC 2009). New Jersey's climate change mitigation efforts will require the increase of forest lands and wetlands for carbon sequestration in order to meet its carbon reduction goals (State of NJ Global Warming, 2008). The value of New Jersey's remaining open lands for the ecosystem services they provide are estimated to be worth, at a minimum, $11.6-19.4 billion/year (Costanza et al., 2007). These services will be diminished at significant cost to the state if development patterns continue to consume open space and follow the sprawling trends of the past several decades.

As these reports document, there is yet still a huge need for additional open space preservation to achieve the sustainability goals of the state. However, the prospects of acquiring the needed open space with the old models of public funding will continually diminish. As more and more land in New Jersey becomes developed or preserved, the remaining available land becomes increasingly expensive as dictated by basic supply and demand economics. Currently 81% of requests for NJ DEP Green Acres funding grants remain unfunded (Ruga 2009). Future requests for open space preservation will grow increasingly more difficult to fund especially during a period of economic uncertainty. A new means of accomplishing open space preservation is needed that can keep up with the rising costs of land while at the same time lessening the tax burden on the public to purchase the open space.

In addition to a different approach to open space preservation, the second need is to develop a better mechanism for guiding future development so that it demonstrably achieves the smart growth goals of the State Plan and meaningful measures of sustainability. Such a mechanism should result in development patterns that: 1) provide high-quality of life communities; 2)provide a unique identity and sense of place; 3)are safe and healthy; 4) are fiscally sound; 5)accomplish the goal of the NJ State Plan; and 6)conserve energy and resources.

The third need is for a better mechanism of protecting natural lands and restoring ecosystem functional vitality across scales. This includes the ecological function of land for the following purposes: 1) water quality, including surface quality, ground water quality and flood control; 2) wildlife habitat & wildlife

movement corridors; 3) agricultural land protection, including prime agricultural soils; and 5) addressing climate change through the carbon sequestration function of forests, wetlands preservation, local food/fiber production, and compact settlement patterns that reduce VMT.

The fourth need for New Jersey to realize scenario two for smart growth and sustainability is for a mechanism that makes redevelopment of existing developed lands more fiscally attractive than development of greenfields. Redevelopment is only likely to occur if it can be made as profitable as or more profitable than greenfield development.

The fifth need is for any new land management mechanism is to realistically Integrate with New Jersey's existing land management system including: 1) the New Jersey Municipal Land Use Law; 2) home rule zoning control of the municipality; 3) the regulatory authority of the NJ DEP; 4) smart growth goals proscribed in the State Plan; and 5) regional planning authorities such as the Pinelands, Meadowlands and Highlands management plans. A new planning initiative that appears to usurp regulatory stakeholder interests simply won't pass politically, no matter how visionary it may be.

The sixth need for developing a land management mechanism that guides the Garden State to the smart growth and sustainable vision of scenario two is that it must be acceptable to a multitude of New Jersey stakeholders. These include prospective homebuyers, home builders and the real estate industry, environmental watch groups, housing and social justice advocates, farmers and rural land holders and many others. If any stakeholder feels that a new land management mechanism is unfair to their interests, then the prospects of success will be diminished. In order for a new land use management mechanism to be successful, each of these six needs outlined above must be adequately addressed.

3) Of What Cloth do we make this Big New Idea?

Creating a new land use mechanism that fulfills the needs outlined above is no small task. Rather than reinvent New Jersey's land management system from scratch, we pull together a number of already existing ideas of land use management and combine them to create an overlay system for sustainable land management. We draw on *Transfer of Development Rights* (TDR), *impervious surface regulations*, *smart growth principles of the New Jersey State Plan* and the *LEED-ND sustainable building evaluation systems* developed by the US Green Building Council. We integrate all these components through an **Impervious Cap and Trade** (ICT) program that would regulate and limit the creation of new impervious surfaces, allowing purchase and selling of impervious credits. The program is arranged into a regulatory framework that overlays New Jersey's existing land regulation system. Each of these elements is outlined below.

Transfer of Development Rights

Transfer of Development Rights is a land use mechanism that aims to cluster development in certain areas at increased density, while leaving other areas undeveloped yet able to receive an economic share of the compensation for the development. In essence, the right to development is severed from the property parcel and allowed to be moved to another parcel. The parcel that sells its development rights is then deed-restricted from future development. The concept has its roots in the 1916 New York City zoning ordinance (the nation's first zoning code), which allowed owners to sell unused air rights on one parcel to an adjacent parcel that could then exceed the zoning height limitations. During the 1970s, TDR developed into an approach for growth control and open space preservation. The constitutionality of TDR was first tested and upheld in the US Supreme Court in 1978 in *Penn Central Transportation Co. v.*

New York City and revisited in 1997 in *Suitum v. Tahoe Regional Planning Agency.* The New Jersey supreme court upheld TDR within the state in 1991 in *Gardner v. New Jersey Pinelands Commission* (Beetle, 2002).

Conceptually, TDR is a land management mechanism with many advantages including the following: 1) the creation of open space without spending public funds; 2) the price demanded to create open space keeps pace with the value of land for development; 3) open space is created without unfairly "taking" value away from properties through regulation (Danner, 1997); 4) the preservation of open space is permanent as the sale of the development rights retires the parcel from potential development in perpetuity; 5) land planning can occur in a more efficient manner than generally occurs with Euclidian zoning; and 6) TDRs have been shown to be more effective at preserving substantial amounts of land and to be less fragmentary of land than other land preservation strategies such as *purchase of development rights* (PDR) and zoning-based clustering (Brabec, 2002).

Since the 1970's more than 190 different TDR programs have been implemented across the U.S. (Pruetz and Standridge, 2009). While each program is unique in its design, there are three components to TDR that are generally necessary but which can vary. A TDR can be: 1) either voluntary or mandatory; 2) single zone or dual zone; and 3) permit-based or zoning based (Johnston and Madison, 1997). Voluntary programs allow property owners to realize a degree of development on-site, but offer incentives or bonuses for land owners to voluntarily sell their development rights to build units elsewhere at a higher density than would otherwise be allowed (Pruetz, 1997). Mandatory programs designate a sending and receiving zone where the sending area is rezoned to substantially lowered density and the receiving area is at a low base density that encourages developers to purchase the development rights from the sending areas in order to realize higher densities (Johnston and Madison, 1997). Single zone programs treat all properties in the planning region with the same base density and incentives for development transfer and are generally associated with voluntary programs. Dual zone programs have a pre-delineated zone for sending development rights and a pre-delineated zone for receiving the extra development (Johnston and Madison, 1997).

TDR has been a promising concept but it has proven difficult to successfully implement. When TDR works well it can result in significant tracts of preserved open space as well as denser development patterns more consistent with the principles of smart growth. Since TDR first came on the scene in the 1970s, the top twenty most successful programs have preserved over 350,000 acres throughout the United States (Pruetz and Standridge, 2009). Unfortunately, while the top twenty have demonstrated that TDR can be quite successful, there are many dozens of less successful TDR programs that have preserved little or no open space at all since their inception due to inherent difficulties with TDR (Pruetz and Standridge, 2009; Levinson, 1997; Danner, 1997).

Designing a successful TDR requires careful crafting, long time horizons and political skill. Table 1 lists the ten most critical factors of success for TDR according to Pruetz and Standridge (2009). Factors 1 and 2 are considered "essential" because they are included in all of the top twenty most successful TDR programs in the US. The top 5 factors are considered "important" because three quarters of the successful programs employ them. The remaining factors (6 through 10) are considered "helpful," but not critical.

Table 1. Success factors of the top 20 most successful TDR's in the US based on the amount of land preserved (from Pruetz and Standridge 2009)

	Factor Description	Level of importance
Factor 1	Demand for bonus development allowed by the TDR	Essential
Factor 2	Receiving areas customized for the community	Essential
Factor 3	Strict sending-area development regulations	Important
Factor 4	Few or no alternatives to TDR for achieving additional development	Important
Factor 5	Market incentives: Transfer ratios and conversion factors	Important
Factor 6	Ensuring that developers will be able to use TDR	Helpful
Factor 7	Strong public support for preservation	Helpful
Factor 8	Simplicity	Helpful
Factor 9	TDR promotion and facilitation	Helpful
Factor 10	A TDR bank	Helpful

New Jersey has played an important role in developing TDR. The Pinelands Development Credit program created in 1981 has been credited with preserving 55,905 acres as of 2008, the second most successful program in the nation in terms of acres preserved (Pruetz & Standrige, 2009). Burlington County, New Jersey has had a TDR program on the books since the 1989 Burlington County Demonstration Act. In 1998 Chesterfield Township became one of the first municipalities to implement a TDR in the county (Gottsegen & Gallagher, 1992) preserving 2,272 acres within ten years. The 2004 State Transfer of Development Rights (TDR) Act made New Jersey the first state in the nation to adopt statewide enabling legislation for TDR. Furthermore, the 2004 New Jersey Highlands Water Protection and Planning Act has also developed a TDR system that encompasses 88 municipalities within seven counties (New Jersey Highlands Council, 2007). Nevertheless, the 2004 state-wide legislation legalizing TDR for any NJ municipality has not been as enthusiastically embraced as some had hoped and TDR at the municipal scale has proven complicated and difficult to orchestrate. Regional level TDR programs tend to have a more successful track-record than municipal level programs (Pruetz and Standridge, 2009).

New Jersey recently convened a task force of nearly four dozen land management professionals from various governmental, non-governmental and academic organizations to evaluate the difficulties of TDR in order to gain insight into why the 2004 NJ State TDR act has not been more successful. The preliminary list of obstacles in TDR Implementation defined by the task force organizers (Sturm and Caton, 2009) includes:

- Expensive, lengthy process
- Community concerns with higher density
- Cost and complexity of preparing for rapid growth
- The need for state agency support and coordination
- Potential COAH problems
- Difficulty getting state approvals for infrastructure
- Potentially high costs for developers
- Fiscal disincentive for regional transfers

The Lake Tahoe Impervious TDR

One of the more successful TDR systems outside of New Jersey that we turn to as an interesting model is administered by the Tahoe Regional Planning Agency (TRPA). The TRPA is a bi-state agency with representatives from both Nevada and California which share the lake. The TRPA mission is the management of activities within the 506 square mile Lake Tahoe basin in order to protect the lake's pristine water quality. Land use is one of the agency's jurisdictions and in an effort to minimize the environmental impacts to the basin and, in particular, the water quality impacts to the lake of uncontrolled development, they have designed a TDR based on *impervious coverage*. Each parcel in the basin is assigned a base allowable coverage of the lot and a maximum allowable coverage determined by a point system that considers the site conditions and geographic location of the lot. Base levels of impervious cover can range from 1% to 30% of the given lot depending on the environmental sensitivity of the parcel (TRPA, 2009).

A parcel is allowed by right a development footprint that can cover up to the base-level of allowable impervious surface for the lot. If the parcel owner desires development with an impervious footprint greater than the base amount, it can purchase impervious surface allocations from another lot up to the maximum allowable coverage for the lot. The selling lot is then deed-restricted from development for the impervious coverage sold to the receiving lot. Although the TRPA program has its critics, the degradation of the lake water quality has been improved since the implementation of impervious surface TDR program over twenty years ago (Imperial and Kauneckis, 2003).

TDRs in other states are also beginning to experiment with impervious coverage. For example, Pennsylvania has a number of municipal TDR programs that incorporate impervious surface in some dimension including: Honey Brook Twp., Chester Co., Manheim Twp., Lancaster Co., Warrington Twp., Bucks Co., Warwick Twp., Lancaster Co., and Limerick Township, Montgomery County (Snook et al., 2009). Other state examples include Queens Anne County, Maryland and Austin (Farmland Information Center, 2008).

In conceptualizing an impervious surface-based TDR, we draw heavily on New Jersey's experience with TDR over the past three decades as well as from the successes and weaknesses of the mosaic of TDRs described in the literature. And finally, we take inspiration from the Lake Tahoe impervious surface TDR program and other municipalities that are experimenting with impervious surface as it holds promise to be the most rational and scientifically justified means of allocating development rights.

Impervious Surface Management as a Comprehensive Planning Tool

The value of capping and utilizing impervious surface credits for a statewide TDR program in New Jersey becomes explicit when exploring the impervious surface condition of the state. Impervious surfaces are any man-made materials or activities that impede or prevent the natural hydrologic process of infiltration (Figure 2). Impervious surface is one of the consequences of urbanization and can include pavements (roads, parking lots, driveways and sidewalks) that are covered by impenetrable materials such as concrete, asphalt, brick and stone. Impervious surfaces can also include buildings, structures, and even in some cases soils surrounding development that have become compacted by the development process (Booth, et al., 2002).

Figure 2. *Impervious surface has significant implications for water quality and flooding as runoff and non-point source pollution is channeled rapidly into stream systems.*

Studies have demonstrated that accelerated runoff from impervious surfaces directly channeled into water bodies leads to increased frequency and magnitude of flooding and subsequent, potentially disastrous consequences (Carter, 1961; Wilson, 1967; Seaburn, 1969; Hammer, 1972). Impervious surface also impacts water quality by concentrating non-point source pollutants such as road salts, sediments, hydrocarbons and refuse, channeling them directly into waterways (Klein, 1979; Booth, 1991). Other research has indicated that the overall environmental quality of water within a watershed is directly related to the amount of impervious surface within that basin. For instance, important impacts such as changes in alkalinity, nutrient loading and chemical contamination have been associated with impervious surface coverage (Alley and Veenhuis, 1983; Horner, et al., 1996; Booth, 1991). Impervious surface reduces or eliminates the capacity of the underlying soil to percolate water and thus increases the direct discharge of storm-water into water bodies, affecting water quality and flood vulnerability (Hurd and Civco, 2004).

Indicators of stream quality impact are generally broken down into biotic and abiotic factors with the biotic more conducive for assessing the long-term health of the water body (Karr, 1987). Abiotic factors can include variables such as pH, specific conductance, calcium, magnesium, chloride, sulfate, nitrogen, and phosphorus. Biotic factors of water quality can include stream vegetation and stream-fish, impoundment-fish, anuran assemblages and macro invertebrates. For example, research in the New Jersey Pinelands has suggested that impacts on abiotic and biotic indicators of stream health begin to be measurable at proportions as low as 10% altered land cover (urban and agriculture) within a watershed (Zampella et al., 2007).

As the proportion of impervious surfaces within a watershed increases, the physical changes to the stream change in a corresponding manner (May et al., 1997). Although the relationship is continuous, there are thresholds that have been identified at which the water quality condition makes a demonstrable transition. Schueler's (1994) review of eleven previous studies documented thresholds of water impact beginning when a watershed became covered with 10-15% impervious surface. Arnold and Gibbons (1996) further refined the threshold discourse by demonstrating a fairly consistent relationship of 10% impervious cover resulting in water quality "impact" and 25-30 % impervious coverage resulting in water quality "degradation," as stream ecology can no longer adequately function in its original capacity (figure 3).

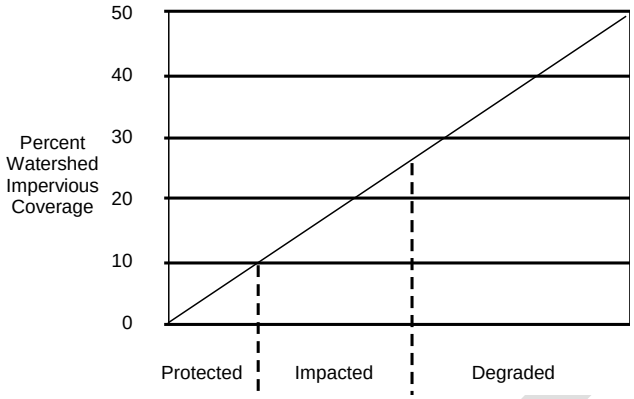

Figure 3. *As the area of imperviousness in a watershed increases, water quality decreases. Research has indicated that thresholds where changes occur are around 10% and 25% impervious (adapted from Arnold and Gibbons, 1996*).

The vital associations to water quality demonstrated in the literature are leading impervious surface coverage to become increasingly relied upon as a defensible environmental indicator for basing land planning decisions (Arnold and Gibbons, 1996, Brabec et al., 2002). Furthermore, looking beyond water quality, the increase in impervious surface associated with development can also be linked to other environmental impacts including the loss and fragmentation of important land resources such as farmlands, forests, wetlands, and wildlife habitats. Many New Jersey municipalities that experienced the greatest increase in impervious surface in recent decades were the same municipalities that lost the greatest amounts of important land resources (Hasse and Lathrop, 2008). These losses occur because the urbanization process entails a transformation of land from a natural or rural state into a built environment.

In a rapidly urbanizing region such as the state of New Jersey, the combined impact of hundreds of independent development projects occurring over the course of a year can have ecosystem-wide implications greater than the site-level water quality impacts that are generally reasonably managed using best management practices (BMPs) under current local land use regulation. Incorporating every ecosystem-wide impact of urbanization into land management policy is impractical. However, more effectively incorporating impervious surface into land management policy has the potential to benefit many environmental issues in addition to protecting water quality. For this reason we consider impervious surface a hinge pin indicator for basing environmental land management.

New Jersey's Impervious Footprint - In order to get a handle on the geographic distribution and temporal change of impervious surface, Hasse and Lathrop (2008) evaluated the New Jersey 2002 digital land use database (NJDEP, 2007). The findings indicate that as of 2002, New Jersey's landscape was covered with nearly 490,000 acres of impervious surface or about 10% of the state's total land area (Figure 4). To put this vast amount of impervious surface into perspective, it is the equivalent of a wall to wall slab of concrete the size of the state's Ocean County. During the study period of 1995 to 2002, 35,809 acres of impervious surface were added to New Jersey's landscape, representing an annualized rate of 5,116 acres of impervious surface increase per year. This rate of impervious surface formation is roughly equivalent to paving 1,742 new parking spaces every day. The data revealed that growth trends of the 1980s and 90s added one acre of impervious surface for every 4.2 acres of development. In other words, land developed between 1995 and 2002 is, on average, 24.8% impervious surface.

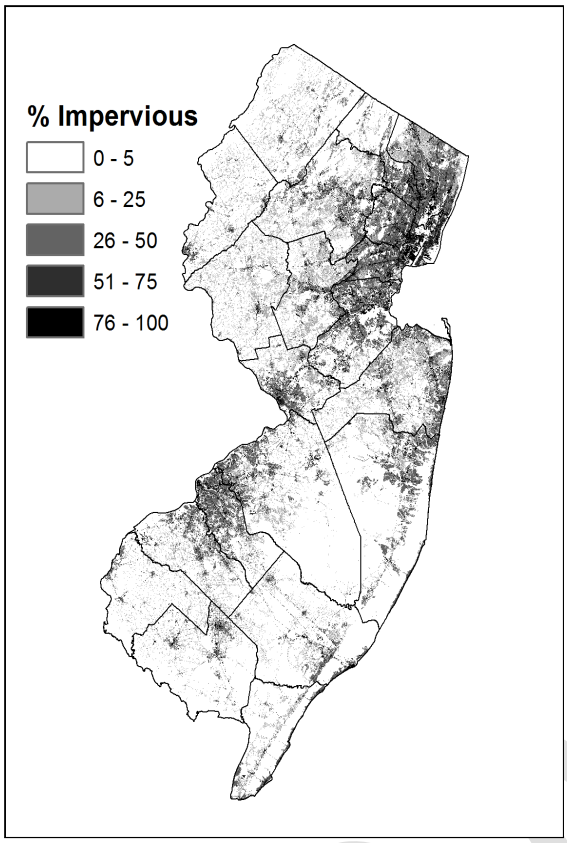

Figure 4. *Impervious surface. This map depicts the pattern of impervious surface in NJ. Darker shades of gray represent higher percentage of impervious cover.*

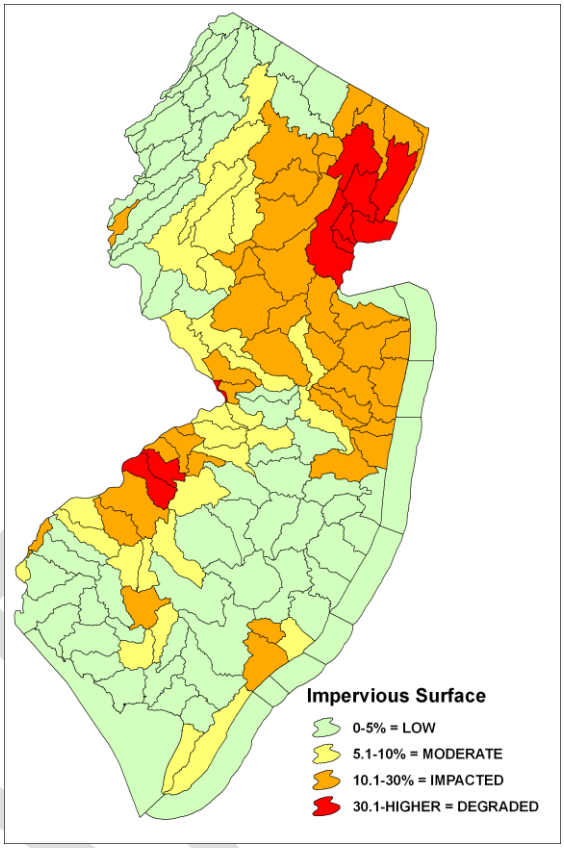

Figure 5. *Impacted and degraded watersheds as indicated by percent impervious surface cover.*

Figure 5 illustrates the impervious surface conditions for New Jersey's watersheds. Ten watersheds, representing 315,351 acres or 6.4% of watershed lands in New Jersey were 30% or greater impervious surface as of 2002. This indicates that stream water quality in these basins has a high likelihood of being in a degraded condition. These watersheds are located in the highly urban areas of the state adjacent to the cities of New York and Philadelphia. Forty watersheds representing 1,372,189 acres of New Jersey's watershed lands are between 10% and 29.9% impervious surface, indicating a high likelihood of impacted water quality. Twenty-nine watersheds representing 1,006,060 acres of New Jersey's watershed lands are between 5% and 9.9% impervious suggesting impending water quality impacts. The remaining seventy-three watersheds representing 3,015,159 acres of New Jersey's watershed lands are less than 5% impervious surface, indicating relatively non-impacted water quality (though this does not include possible agricultural impacts).

The amount of impervious surface associated with developed land is directly related to land use category. Some land use categories have a significantly higher intensity on average than others. For example, Table 2 provides an analysis of the average of impervious footprint of various land use categories for land developed in New Jersey between 1995 and 2002. Commercial, Industrial and Highway land use categories have a significantly higher average of impervious cover but add up to significantly fewer total acres of impervious surface compared to various residential categories.

Table 2. Impervious Surface Analysis of Various Land Use Types Urbanized in New Jersey from 1995 to 2002

LAND USE	Acres Urbanized 1995-2002	Average Percent Impervious	Percent of Total Land Urbanized	Percent of Total Impervious Created '95-'02
COMMERCIAL/SERVICES	7,234	69.0	5.9	18.1
INDUSTRIAL	4,972	57.4	4.0	10.4
MAJOR ROADWAY	476	88.5	0.4	1.3
OTHER URBAN OR BUILTUP LAND	14,494	5.7	11.8	2.2
RECREATIONAL LAND	10,149	15.7	8.2	2.4
RESIDENTIAL, HIGH DENSITY MULTIPLE DWELLING	7,044	59.9	5.7	14.0
RESIDENTIAL, RURAL, SINGLE UNIT	35,753	13.5	29.0	15.4
RESIDENTIAL, SINGLE UNIT, LOW DENSITY	16,590	21.5	13.5	11.8
RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	18,595	32.4	15.1	20.3
STORMWATER BASIN	4,174	2.5	3.4	0.3
TRANSPORTATION/COMMUNICATION/UTILITIES	1,563	51.8	1.3	2.4
ALL OTHERS	2,147	18.4	1.7	1.3
Total Urbanized Land 1995-2002	**123,191**			
Total Impervious Increase 1995-2002	30,562			
Average Acres Impervious per Acre Development	0.248			

The creation of impervious surface comes at a cost. For every one acre of impervious surface that is created in New Jersey by urbanization, 1 acre of farmland is lost including 0.78 acres of prime farmland, 1.28 acres of forest land is lost including 0.89 acres of core forest, and 0.55 acres of wetlands is lost including 0.41 acres of natural wetlands (Figure 6). Forest core is the central area of the forested land located 100 meters from the forest edge. Natural wetlands exclude altered wetlands such as

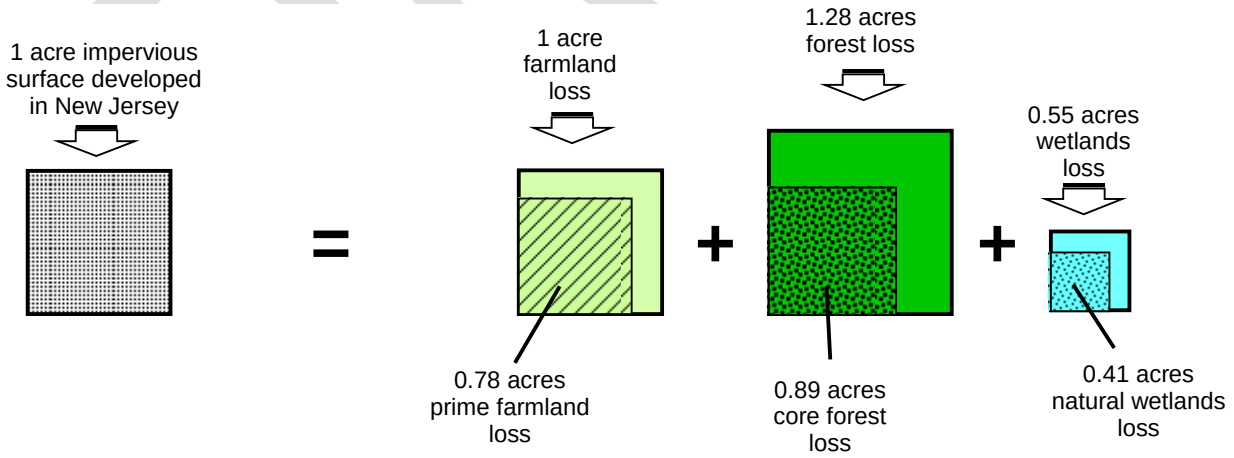

Figure 6. *Impervious surface is not only an indicator of water quality impairment but also directly linked to land resource depletion. In New Jersey for every acre of impervious surface created by urbanization, 1.0 acres of farmland is lost including 0.78 acres of prime farmland, 1.28 acres of forest land is lost including 0.89 acres of core forest, and 0.55 acres of wetlands is lost including 0.41 acres of natural wetlands. Regulation of impervious surface will help to protect these vital resources.*

agricultural and urban wetlands. These forest core and natural wetlands along with prime farmland represent the most critical land resources of the state.

The creation of 5,116 acres of impervious surface per year is simply not sustainable and regulation of impervious surface has a clear and direct relationship to the public interest of environmental integrity for water quality and land resource management. Impervious surface management has the potential to play an important role in sound land management practice. The 10% and 30% thresholds have become widely accepted rules of thumb for correlating water quality with impervious surface, although in some studies even lower thresholds have be revealed. For example, recent research in the New Jersey Pinelands confirms the extreme vulnerability of stream water quality in this region to human altered land use (Zampella et al., 2007). In the Pinelands, even at impervious surface covers of below 5%, significant water quality impacts have been observed (Conway, 2007). We believe that the 10% threshold is a defendable and prudent cap for New Jersey's remaining undeveloped lands.

Impervious Surface Management As A Comprehensive Planning Tool - In a rapidly urbanizing region such as the state of New Jersey, the combined impact of hundreds of independent development projects occurring over the course of a year can have ecosystem-wide implications. We argue that intelligent regulation of impervious surface can become the hinge pin element uniting environmental protection and management with smart growth development. Impervious surface is relatively easy to measure and is highly correlated with the magnitude of multiple environmental impacts imposed by urbanization.

While other factors such as the amount of forested land and the location of the impervious surface within a watershed can also have an independent relationship to water quality (Brabec et al., 2002; Booth et al., 2002), the percentage of total impervious surface within a watershed and the corresponding water quality is remarkably consistent across many studies. Best management practices in storm water management can help to reduce water quality impacts, but do not offer a universal solution and should be considered only as one part of a water treatment train (Schuster et al., 2005). BMPs have been shown to be most effective at low percentages of impervious surface, yet limited at levels higher than 20% (Maxted and Shaver, 1999). Ultimately, BMPs in and of themselves are not a comprehensive solution and can carry their own disadvantages such as often-unsightly retention basins.

We propose that the comprehensive solution lies in expanding impervious surface regulation under New Jersey's land use regulatory system. Since ecosystem impacts span municipal boundaries, impervious surface regulation should be handled at a regional level. The New Jersey DEP has already developed a system for regionally organizing environmental management activities that delineates twenty Watershed Management Areas (WMA's) (Figure 4). The WMA's better match the natural functioning of the ecosystems than the haphazard municipal and county political boundaries. The NJDEP already organizes some water quality and resource protection and restoration efforts on the WMA basis.

However, inserting impervious surface regulation into the existing land management system will not be an easy task. Rather than dismantling New Jersey's home rule system, we support an overlay approach where local zoning and planning decisions are still handled by the municipality, but regulation of the creation of impervious surface is handled by state agencies administered at the watershed management area level. Underlying zoning ordinances remain in effect, but the impervious surface credits would be bought and sold throughout the WMA to maintain a total impervious cap.

The literature has clearly documented the correlation of impervious surface to water quality. Furthermore, since land is a limited resource or in Will Rodgers words "they ain't making any more,"

with each acre of land that becomes covered with impervious surface through urbanization, a corresponding acre of prime farmland, wildlife habitat, forest, ground water recharge area or other important environmental resource are usually lost (Figure 5). For a state such as New Jersey that is perhaps only decades away from buildout (Hasse and Lathrop 2001), the degree to which farming becomes unviable, habitat becomes overly fragmented, or carbon sequestration becomes more difficult to achieve due to forest loss will also have a relationship to the amount of impervious surface created by urbanization.

There is a scientifically and politically defendable rationale for capping the total amount of impervious surface allowed to be created in New Jersey at buildout. Precedent has already been set for impervious surface regulation in the state under the Coastal Area Facilities Review Act (CAFRA) which caps impervious surface at levels as high as 90% in urban areas to as low as 3% in environmentally sensitive areas (NJ APA, 2004). Utilizing a *cap and trade* approach, we propose that impervious surface management has the potential to become an umbrella regulation that allows development to occur up to a limited threshold of New Jersey's remaining available lands. By limiting the amount of future impervious surface that can be created, the magnitude of urbanization can be justifiably managed. But while simply capping impervious surface and allowing a tradable market may save open space, it won't necessarily result in development that achieves smart growth and sustainability. Another lever is needed to guide future urbanization to exemplify sustainability and the principles of smart growth.

Smart Growth Planning Via the State Plan and Sustainability Rating Systems

New Jersey has been an early champion of the principles of smart growth long before the term became popularized. The New Jersey State Development and Redevelopment Plan (SDRP or the "State Plan") has been a vision and master plan for smart growth for nearly three decades. The SDRP articulates nine goals of the plan to benefit the quality of life in New Jersey by following ten principles of smart growth, including mixed use, compact development, walkable neighborhoods, and open space preservation, among others. The State Plan includes a planning map with five distinct Planning Areas spanning a transect from urban to rural environmentally sensitive areas. It contains a vision for settlements to be organized in and around "centers" running from small hamlets to large metro areas (NJ Office of Smart Growth, 2009).

Many stakeholders agree that the NJ State Plan has been a visionary prescription for smart growth in the state. However, most will also agree that it has not lived up to its promise in actually achieving smart growth because it its provisions have not been meaningfully integrated into the regulatory framework of New Jersey's land management system. Much of the land regulatory control in New Jersey rests with the municipality which has no legislated requirement to follow the State Plan and little perceived benefit from following it voluntarily. Home rule still rules in the Garden State and thus land use decisions are many times driven by what is expedient for the short time spans of local politics. The New Jersey State Plan is nonetheless an established and achievable vision for smart growth if it can only have a more meaningful integration into layers of land use management within the state. Furthermore, there needs to be a mechanism for evaluating whether or not any new development is actually achieving the smart growth goals and objectives spelled out in the State Plan. The emergence of green building sustainability rating systems is beginning to play that role (Retzlaff, 2008).

LEED for Neighborhood Development

In the past few years a number of green building and smart growth assessment systems have been developed in North America. While several have gained popularity in certain regions of the US, the most widely recognized national standard is Leadership in Energy and Design for Neighborhood Development (LEED-ND) (Garde, 2009; Retzlaff, 2008). LEED-ND is a smart growth, green building and sustainability rating system developed as a collaboration of the US Green Building Council (USGBC), the Congress for New Urbanism and the Natural Resources Defense Council. Whereas other LEED products such as LEED for New Construction (LEED-NC) focus primarily on green building practices, with only a few credits regarding site selection, LEED-ND emphasizes smart growth aspects of development while still incorporating a selection of the most important green building practices. The variables evaluated for smart growth design were guided by the Smart Growth Network's ten principles of smart growth, which include density, proximity to transit, mixed use, mixed housing type, and pedestrian- and bicycle-friendly design. The criteria are organized into five categories (Table 4) which respectively focus on: the *locational aspects* of a proposed project, the *design details* of what's proposed, the *sustainable building practices* employed in the project, *innovative design* ideas and *regionally specific goals*.

The LEED-ND system provides an objective basis on which to certify developments as achieving a measurable degree of smart growth performance and exemplifying sustainable building practices. Different levels of LEED-ND certification are awarded on the basis of points earned in each category of smart growth development (Table 3). At this early stage, the rating system is voluntary and requires considerable costs for application and consulting time for evaluation. The benefit for achieving any of the certifications at this stage is only in public relations value for the project achieving sustainable sanction by the USGBC. However, green building evaluation systems are beginning to be incorporated into public policy in factors such as expedited permit processing, density bonuses, permit fee waivers, subsidizing of fees related to green building certification, and other federal and state incentives for green building assessment (Rainwater, 2007). A study of the LEED-ND pilot program demonstrates the strengths of the initiative in encouraging sustainable building practices at the neighborhood scale as well as the limitations to any program having a one-size fits all approach (Garde, 2009). As LEED-ND moves from the pilot phase to the official release in the coming year, it is likely to become more officially integrated into land management and planning policy systems.

The LEED-ND rating system brings an objective and standardized measure for evaluating the effectiveness of a given plan for accomplishing the goals and objectives of smart growth and sustainability. We believe that the LEED-ND program has the potential to be paradigm-changing planning tool. Integrating the NJ State Plan and LEED-ND into a new planning framework can be an effective mechanism for achieving the state's smart growth and sustainability goals.

Table 3. LEED-ND Certification Thresholds

0 to 39 points	NOT CERTIFIED
40 – 49 points	Certified
50 – 59 points	Silver
60 – 79 points	Gold
80+ points	Platinum

Table 4. LEED-ND Criteria for earning points

Evaluation Category	Intent	Prerequisite for earning points	Possible points
Smart Location & Linkage	Build development in locations that: utilize existing infrastructure, avoid sensitive lands, redevelop or infill, lessen demand for automobile travel, encourage bicycling, revitalize distressed communities, encourage brownfield redevelopment and create a balance of housing to jobs within a walkable distance	• smart location • sewer & water • habitat • wetlands & water bodies • farmland conservation • floodplain avoidance	27
Neighborhood Pattern & Design	Design development to achieve the following: attractive and safe pedestrian streetscapes where buildings front onto sidewalks, on-street parking, streets widths are balanced with building heights and traffic is calmed, compact development, mixed use, mixed income, reduced parking footprint, connected street network, transit is encouraged, easy access to civic & public spaces, recreation facilities, universal design, community outreach, local food production, street trees and schools integrated into the plan	• walkable streets • compact development • connected and open community	44
Green Infrastructure & Buildings	Create developments that exemplify sustainable practices by: encouraging green certified buildings, high energy efficiency, low water usage, reuse of existing buildings, historic building preservation, minimize site disturbance, manage storm water runoff, incorporate solar orientation, reduce heat island effects, promote on-site renewable energy, manage wastewater, use recycled materials, reduce solid waste generation and minimize light pollution	Must meet the following • at least 1 Certified green building • minimum energy efficiency • minimum water efficiency • construction pollution prevention	29
Innovation & Design Process	Encourage creativity and innovation regarding sustainability beyond the scope of the above criteria.	None	6
Regional Priority Credit	Allow points for regional differences and needs regarding sustainability	None	4

4) Impervious Cap and Trade (ICT) to Accomplish Smart Growth and Sustainability: How It Might Work - A Conceptual Framework

We weave together the ideas of Transfer of Development Rights (TDR), impervious surface regulation for environmental protection, the New Jersey State Plan, and the LEED-ND smart growth and sustainability rating systems into a conceptual framework for an overarching new state-wide overlay land management regulation initiative. The concept begins by capping impervious surface for all property parcels and then allowing free-market trade of that impervious surface to areas where it is most demanded for development. Such an impervious cap and trade (ICT) system would ensure the protection of significant amounts of New Jersey's remaining open space while promoting more compact development. In addition to the base impervious cap and trade function, we add substantial bonus provisions for: 1) urban redevelopment, 2) following the NJ State Plan, and 3) achieving smart growth and sustainability standards as recognized by the LEED-ND rating system.

We introduce the ICT conceptual framework by beginning with a fictitious rural area (Figure 7) that is experiencing mounting development pressures. There is an older town in the northwestern quadrant that is bisected by a highway with some strip shopping centers south of the town center. The zoning in place is typical single use Euclidian zones found in many NJ municipalities. This demonstration area represents the circumstances of most remaining rural areas in the State.

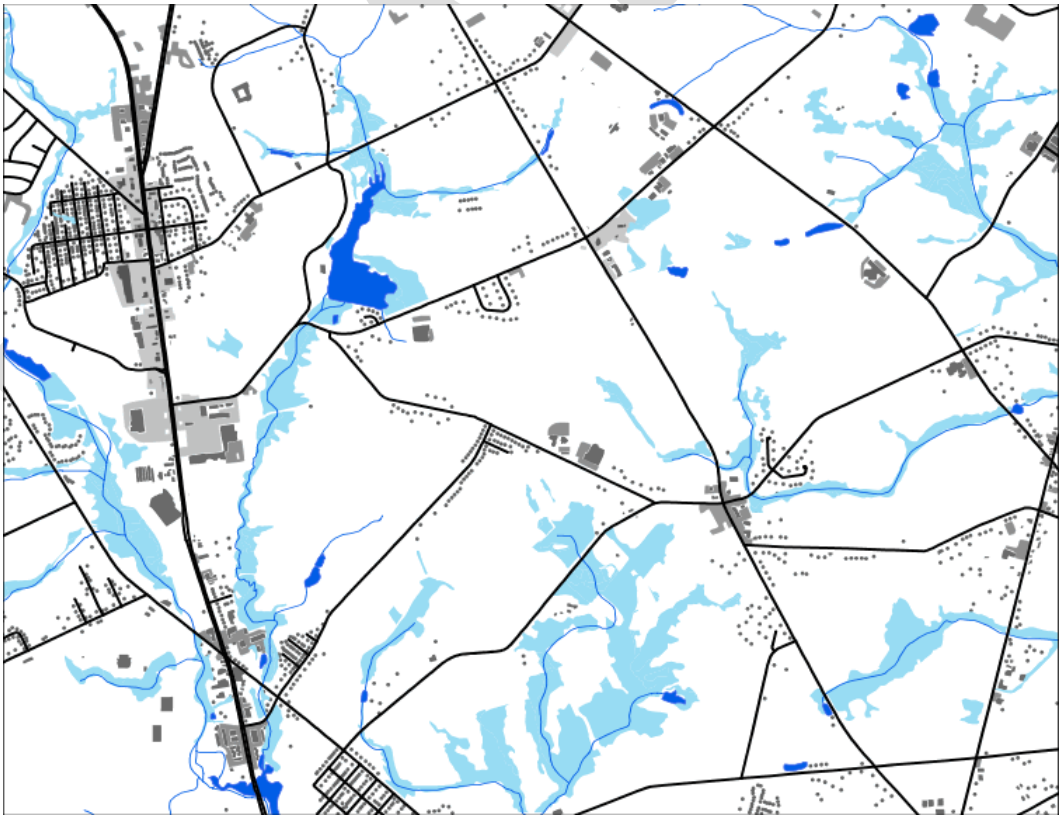

Figure 7. This map depicts a rural area that is beginning to experience increasing development pressure. An older town is located in the northwestern quadrant bisected by a highway with some commercial strip shopping centers. The area is typical of many rural areas remaining in NJ.

If development were to follow the underlying zoning, the demonstration area will buildout in the typical low-density, scattered pattern that consumes large tracts of open space, it will be single use and automobile dependent (Figure 8). The spread of suburban track development into the former rural lands leaves the older town to experience economic decay and disinvestment.

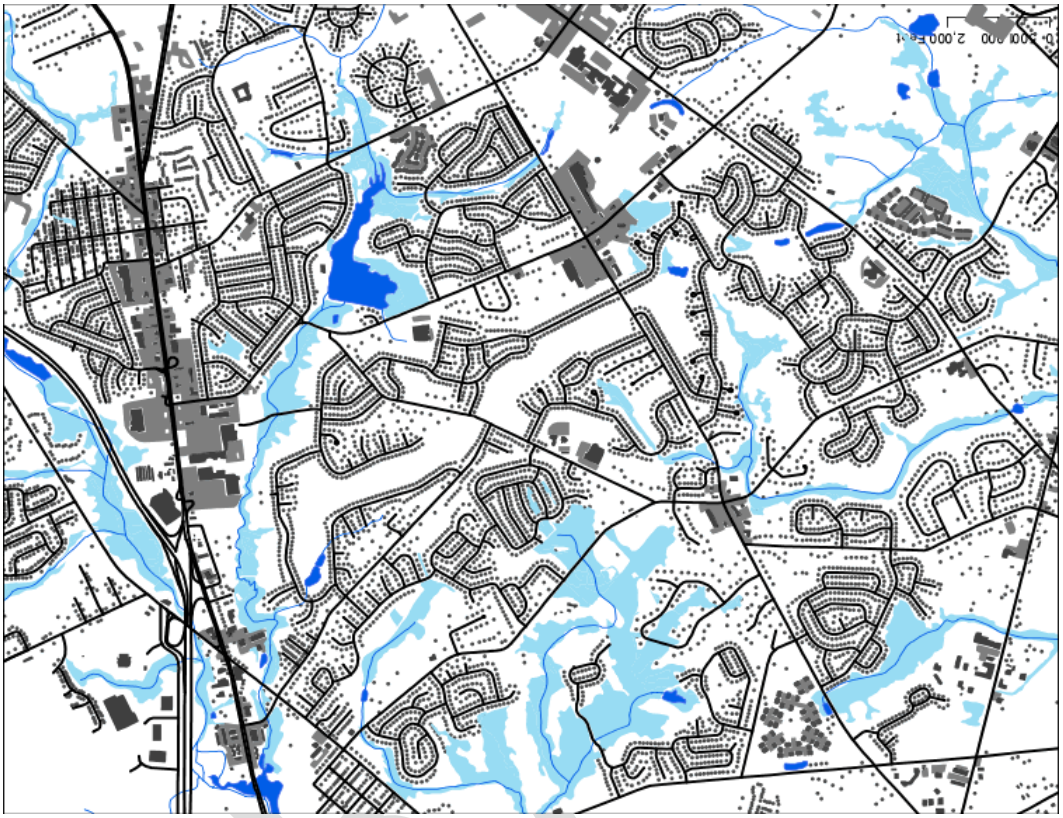

Figure 8. The demonstration area at buildout under the current zoning. Residential development tracks are scattered, low density and land consumptive. Highway strip commercial is spread throughout the area and only accessible via automobile.

The Impervious Cap and Trade (ICT) concept begins by the creation of a state-wide regulation on amount of impervious surface that any property parcel can create by right. We turn to the literature for our suggested threshold of 10% of buildable land since this value has emerged as a rule of thumb for demonstrable water quality impact at the watershed level (Arnold and Gibbons, 1996; Brabec et al., 2002). This 10% coverage of buildable land limitation is shared equally by all parcels since if all parcels exceeded this amount, water quality in the entire watershed would pass the impacted threshold.

Under the ICT system, all properties would carry the right to create up to the capped amount of impervious surface (Figure 9(a)). If a property owner proposed a project that would create more impervious surface than their 10% limit, they would have to acquire additional impervious surface "credits" either through purchases and/or through bonuses (described in detail below). Such impervious credit purchases would be negotiated through private market transactions facilitated and augmented by an impervious credit bank. The initial goal of ICT is to limit the total amount of impervious surface within watershed management areas at buildout to levels that maintain

environmental integrity and open space goals while allowing the market place to determine where that impervious surface is most valuable for development.

As an example, a ten acre parcel (Figure 9(b) parcel A) with a threshold limit of 10% impervious cover could create no more impervious surface "by right" than one acre. If the parcel was to be developed into a shopping center that required eight acres of impervious coverage, the developer would have to purchase seven additional acres of impervious surface *credits* from a willing seller (Figure 9(b) parcel B) to add to the one acre he is allowed to create by right. A 70 acre land owner wishing to preserve his land can realize the equity in his property by selling 10% of his buildable lot (seven acres) as impervious surface credits to the developer and in doing so his land would be preserved. The farm parcel would be deed restricted from further development and the developer would be permitted to build his shopping center.

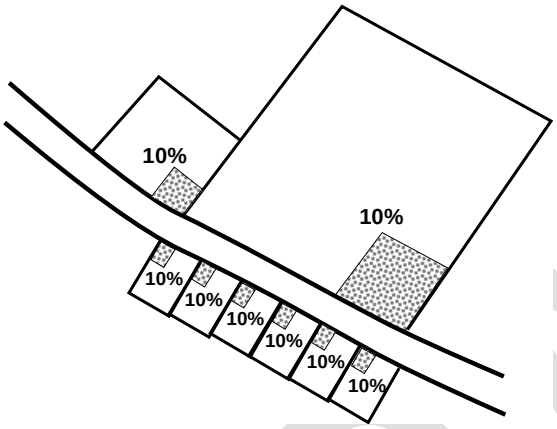

Figure 9 (a) - *Under impervious surface trading each parcel is allowed to create their "fair share" of impervious surface by right, 10% of their buildable lot.*

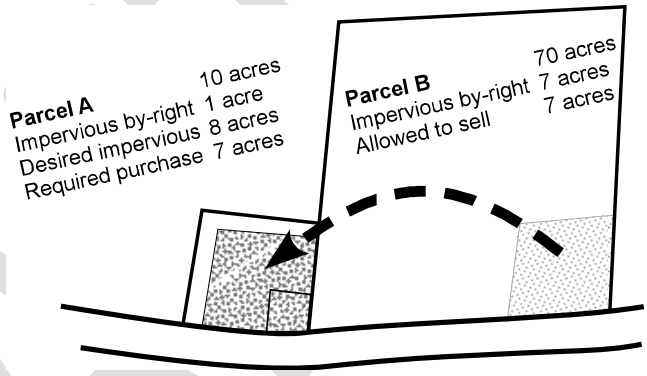

Figure 9 (b)- *If a parcel wishes to create more impervious surface than their capped amount, they are permitted to purchase the impervious surface from a willing seller on the open market.*

Development still occurs, but significant tracks of open space are preserved thus keeping the total impervious footprint for the whole region below the 10% cap at future buildout (Figure 10). Under ICT significant tracts of open space would be preserved automatically by the drive for new development without expending any public funds. Since development in New Jersey is on average 25% imperious, with a 10% threshold, every acre of new development will require the preservation of 1 ½ acres of open space since 15% more impervious surface would be required to build the development. The impervious surface can be bought and sold from parcel to parcel throughout the entire area but the cap of 10% total impervious surface is never exceeded for the whole region.

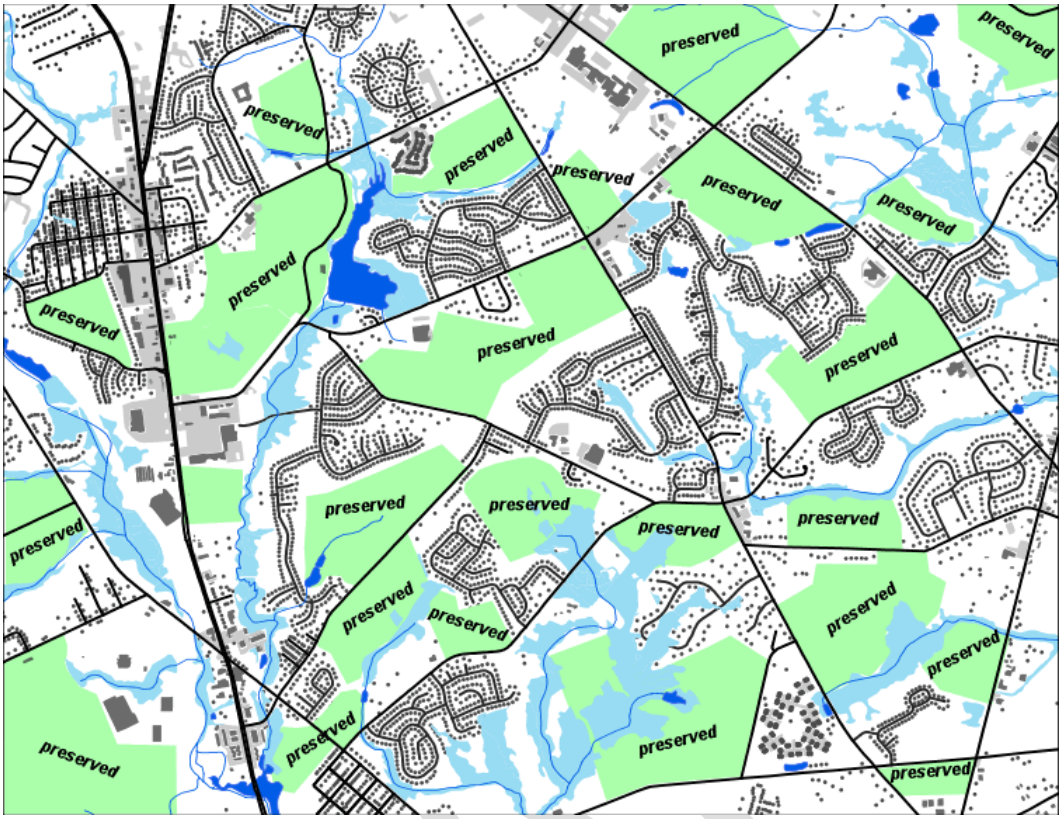

Figure 10. *With impervious cap and trade (ICT) in place, development occurs guided by existing zoning but for every development created, preserved open space is automatically created keeping the total impervious surface for the whole region below threshold at buildout. With a 10% impervious cap, each acre of development will result in 1.5 acres of preserved open space.*

Additional Bonus Incentives for Smart Growth and Sustainability

Impervious cap and trade as described above would accomplish the goals of protecting water quality, preserving substantial tracts of open space. However, the growth that would occur may not necessarily be an example of smart growth and sustainability. Development can still occur in whatever pattern is dictated by the underlying zoning. Most of the zoning in New Jersey proscribes sprawl so although ICT would require the preservation of 1 ½ acres of open space for every acre of development, the development that results could still occur in an undesirable pattern. In order to create incentives for urban revitalization, smart growth and sustainability, ICT would include three additional key policy bonuses for: 1) *urban exemption*, 2) State Plan compliance and 3) achievement of LEED-ND sustainability certification.

Urban Exemptions- First, all previously existing developed areas would need to be grandfathered for their impervious footprint. Whatever impervious surface a parcel already has would be locked in at the date of vestment. This then creates an incentive for redevelopment since a property with impervious surface could redevelop up to the existing impervious footprint avoiding the ICT requirements. Furthermore, land within designated "urban cores" or redevelopment zones, including vacant infill lots, would also be exempted from impervious surface restrictions (Figure 11). Grandfathering existing impervious surface and exempting urban cores provides a considerable incentive for redevelopment of

previously developed lands over greenfields development because there would be no impervious surface trading regulation required in these areas (all pertinent zoning and other state regulations such as storm water rules would remain in place). Developers would be more inclined to consider urban redevelopment because it would be less costly than greenfield development which would have the ICT requirement. Urban cores could be defined as distressed urban areas, redevelopment zones or other similar designated criteria.

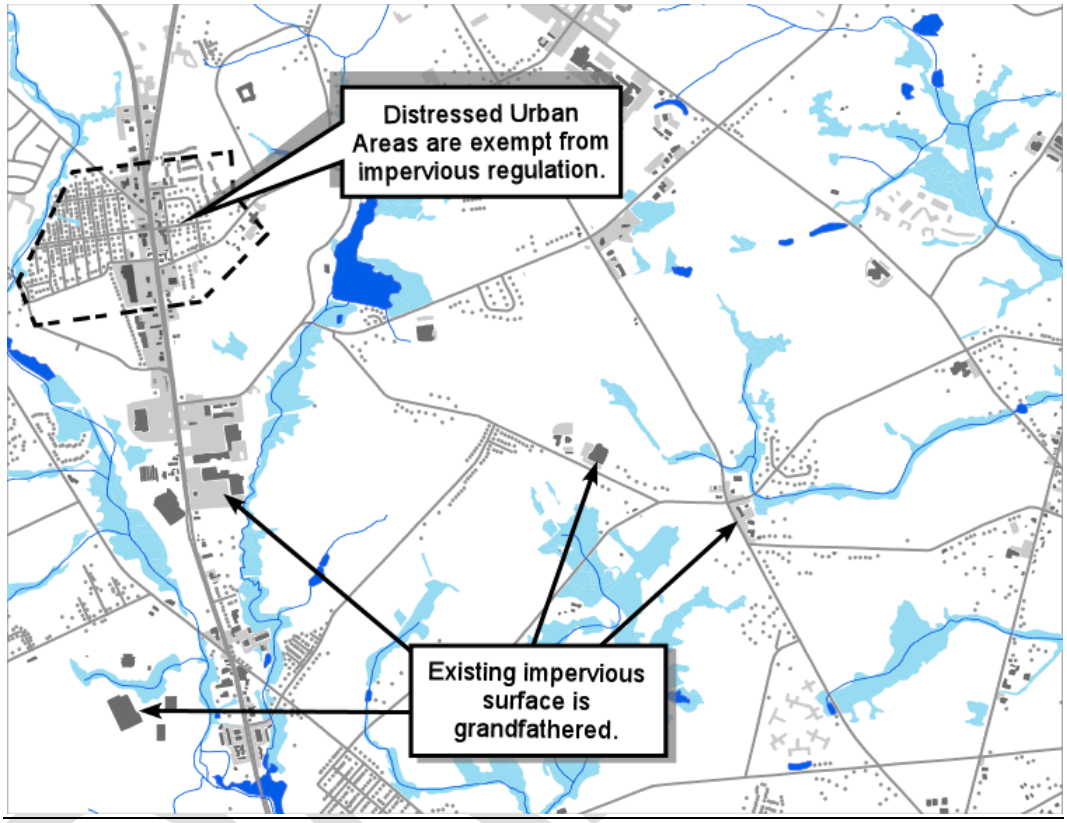

Figure 11. *In order to encourage redevelopment over Greenfield development, existing impervious surface would be grandfathered and special urban core areas would be exempt from the ICT regulation.*

State Plan Compliance - The second bonus provision would grant incentives for demonstrating compliance with the State Plan (Figure 12). The State Plan divides New Jersey into five State Planning Areas (PAs), with PAs 1 and 2 designated for growth and PAs 3, 4, and 5 designated for limited growth or conservation (NJ Office of Smart Growth, 2009). The impervious threshold in the rural and environmentally sensitive planning areas (PA's 3, 4 & 5) would be reduced for on-site development to ½ the overall threshold (or 5%). However, a parcel could realize their full 10% impervious right if they sell their impervious surface credits to a parcel in the smart growth zones (Planning Areas 1, 2, or within a *designated center* of the state plan) or if the parcel builds or sells to a LEED-ND certified development (see below). Development can still occur in the rural zones but there is a substantial incentive to transfer the impervious surface credits from the rural planning areas to the smart growth planning areas.

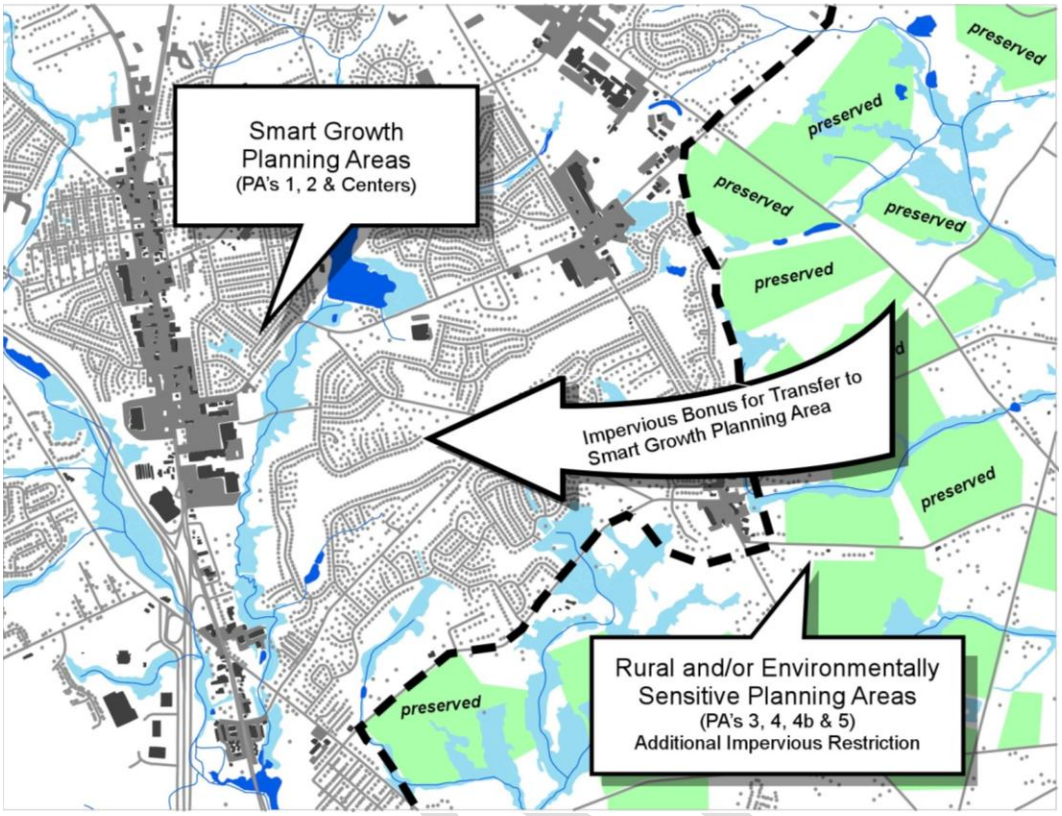

Figure 12. *The impervious cap in the rural planning areas of the state plan will be reduced to 5% for development that occurs on site within those planning areas. However, a parcel can realize their full 10% impervious surface allotment for development by selling their credits to a smart growth planning area or a center in the State Plan or by creating or selling to a LEED-ND certified development (see below).*

LEED-ND Certification – The third incentive provision would provide bonuses to proposed development that achieves US Green Building Council's LEED-ND certification (Figure 13). This provision is desirable since the development that occurs within the smart growth planning areas (as depicted in Figure 12) may still not achieve the design characteristics of smart growth and sustainability. LEED-ND is a tool for fostering such sustainable, walkable community designs. The amount of bonus would be linked to the level of certification. Our suggestion is that the state will cost-share the impervious credit purchase for a project that achieves LEED-ND certification such that a "certified" project would have 20% of the impervious cover purchase costs subsidized by the state; "silver" would have the state pay 30% of the impervious costs, "gold" would have the state pay 40% of the impervious costs and "platinum" would have the state pay 60% of the impervious costs. The state bonuses would come from the impervious surface credit bank, which could purchase impervious surface credits through public open space funds.

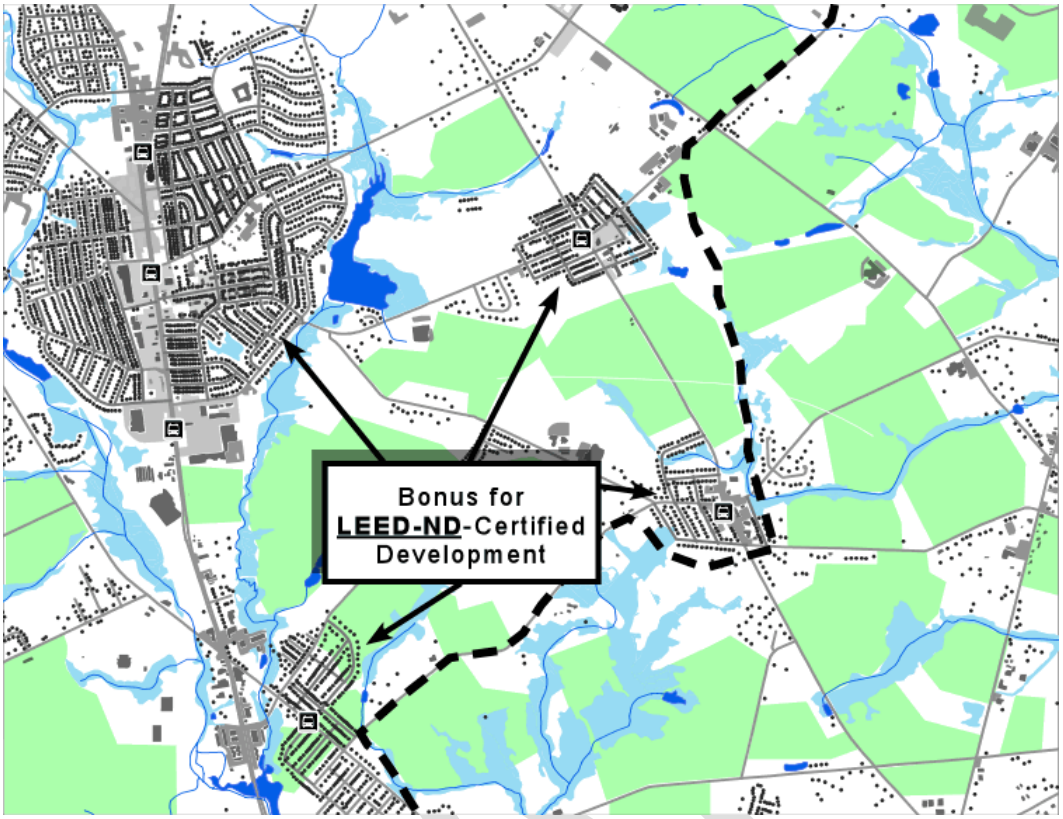

Figure 13. *Impervious Cap and Trade with bonus for LEED-ND certified development. Sustainable development patterns would be highly encourage through substantial bonuses such as ICT credit cost sharing and perhaps expedited permit processing.*

The impervious cost sharing approach to rewarding LEED-ND development rather than the state simply giving impervious bonuses would ensure that the developer lined up impervious purchases necessary for the development and still had a financial interest in acquiring the open space at the best market rates. The public cost of sharing impervious surface purchase could be funded through New Jersey's Garden State Preservation Trust. The costs of impervious subsidies for LEED-ND certification would be offset by the substantial environmental benefits gained through urban revitalization, compliance with the State Plan, and achievement of smart growth and sustainability, such as reduction in vehicle miles traveled (and water and air quality improvements, among other documented smart growth benefits (McCann and Ewing, 2003; Ewing, et al., 2002). Other incentives to encourage LEED-ND development could include expedited permit processing.

The state could also bank impervious surface credits by purchasing them from critical parcels that needed to be preserved but for which there was not a willing buyer at the time of sale. Protecting open space by the purchase of impervious surface credits would be substantially less expensive to tax payers than outright fee simple purchase since the selling parcel remains in private property but has had only the impervious surface rights retired.

5) How ICT Might be Implemented in New Jersey

Impervious surface trading would not need to replace existing state, county or local land management laws and programs but would instead be an overlay regulation. The rule would be imposed at the state level in a fashion similar to the way that statewide wetlands regulation is overlaid on top of local zoning control. When a project is proposed for development an *impervious surface plan* would be required as part of the preliminary site plan application. If the total proposed impervious surface to be created by the project was less than 10% of the buildable area of the lot, the building permits would proceed as normal through the locality.

If the total proposed impervious surface of a project exceeded the 10% "by-right" amount, then the developer would have to document that the additional impervious surface credits were acquired through purchase as sanctioned by the ICT bank or that bonus ICT credits were officially granted from the Office of Smart Growth for compliance with the NJ State Plan and/or for LEED-ND certification.

Private purchase of impervious surface credits would be officially monitored and sanctioned by the ICT bank, ensuring that the proper deed restriction was imposed. The state of NJ is nearing a completed statewide GIS database of property parcels which will facilitate the ICT bank in managing the impervious record keeping. For the LEED-ND bonus, a developer would have a private consultant calculate the LEED-ND performance as per the USGBC protocol and the findings would be verified and certified. Bonuses ICT credits would then be granted to the developer by the NJ Office of Smart Growth through the ICT bank.

The developer then takes the LEED-ND certification and bonus ICT credits back to the municipality for final plan approval. Additional incentives for LEED-ND certification could include expedited development review, planning assistance, assistance for public outreach, etc. Developers should be substantially rewarded for creating LEED-ND certified smart growth.

In order to maintain economic balance, the ICT bank would operate on a Watershed Management Area basis (Figure 14). Trades would be freely sanctioned within a WMA unit in order to maintain the impervious threshold within a given WMA. This would be important since the value of an impervious surface credit could vary dramatically throughout the state and the intent of the program is for preserving the environmental quality within each region. That being said, the ability to allow some transfer between WMA's is probably warranted since different WMA's are at different stages of buildout and there may need to be some market flexibility. A distance decay model could be used such that ICT credits could be purchased at a rate increased by a multiplier based on the number of WMA's distance from the receiving WMA. For example ICT credits from an adjacent WMA would require 1.5 times the amount of

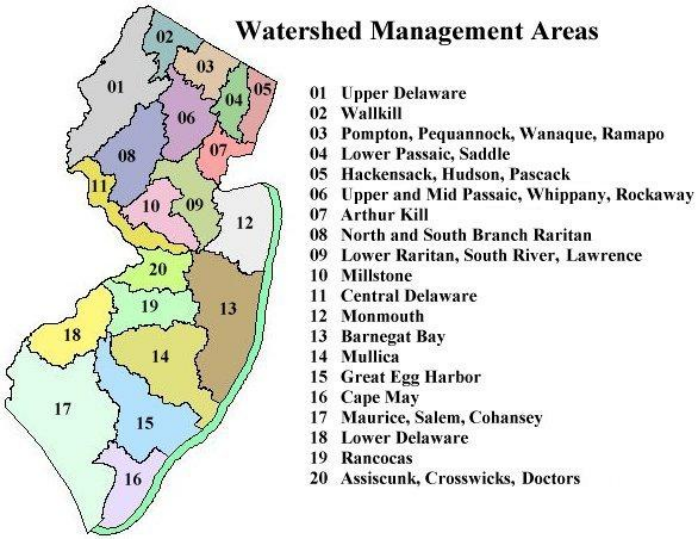

Figure 14. *New Jersey watershed management areas. (source: NJ DEP)*

impervious surface to be purchase as the base requirement within the WMA. Purchase for a WMA that is one away from adjacency would require two times the amount of impervious surface to be purchased. And so on, so that areas with high development demand could purchase ICT credits from distant WMA's but at a substantially increased cost in order to encourage local purchase within the region.

6) Expected Results

We believe that the creation of an impervious cap and trade system as described can rapidly and dramatically shift development patterns in New Jersey toward a significantly more sustainable outcome than current trend development. A multitude of goals can be realized through this proposed program including:

a) Preservation of the needed remaining open space made much more achievable.
b) Limit the total impervious surface in remaining open lands to a scientifically justifiable limit for many environmental goals, including water quality, farming viability and habitat preservation.
c) Encourage the redevelopment of urbanized areas by exempting redevelopment of already existing impervious surface from the new restriction.
d) Empower the New Jersey State Development and Redevelopment Plan through valuable bonuses.
e) Allow market mechanisms to pay for open space preservation and thus keep pace with increasing land values.
f) Reward development and redevelopment proposals that demonstrate substantive smart growth goal performance as indicated by LEED-ND certification.
g) Allow flexibility and market changes to occur while still maintaining thresholds of environmental standards and objectives.
h) Maintain a substantial amount of local control in the process.
i) Slow down new rural sprawl, while increasing the redevelopment of older areas.
j) Accomplish better watershed-level water quality protection.
k) Accomplish open space goals of the Garden State Preservation Trust.

In essence, the ICT concept is a unifying overlay that provides a mechanism for the goals of the NJ State Plan and sustainability to be actualized through flexible, market-based means.

7) Discussion

As outlined above, we believe that there is great potential for impervious cap and trade to dramatically and substantially benefit New Jersey's future development pattern. It is a form of Transfer of Development Rights (TDR) that sidesteps many of the difficult challenges of creating a successful TDR.

How ICT Improves on Traditional TDR - In spite of a few successful programs over the decades since its inception, TDR has not been widely embraced (Machemer, 2006). Some of the major problems that have beset successful adoption of TDR's are their complex nature, the perceived loss of equity, a cloudy justification for a public benefit and the trends of the housing market toward large lot and against cluster development. Setting up a traditional TDR requires expertise generally not found in many localities. Furthermore, the few successful programs that do exist, such as that within the NJ Pinelands, commonly are at a regional scale, whereas some of the poorly performing TDRs are at the municipal scale (Pruetz and Standridge, 2009).

We believe that an impervious cap and trade variation of TDR would be more successful. ICT would be implemented uniformly throughout the state taking advantage of the state-wide expertise for design of the program but with trading managed regionally within watershed management areas. ICT would accomplish the open space preservation and clustering benefits of traditional TDR while more effectively addressing a number of its inherent problems and weaknesses. ICT will be less complex. Rather than the trade of development rights (the right to create building units based on zoning) ICT is based on the obligation not to create more than your fair share of environmental impact, a far less arbitrary objective than the right to build a housing unit. The goals of ICT are easier for the general public to embrace than traditional TDR. ICT also, more fairly maintains property equity and treats all property owners the same, another factor adding to public acceptability.

In addition, ICT with the bonus provisions will better integrate environmental and sustainability goals and be more comprehensive and flexible than traditional TDR. A parcel owner could choose to sell its impervious surface credits but if later that parcel had the need to develop, it could purchase back the necessary impervious surface credits. This might be attractive to the farming community who would like to preserve farmland but may later find the need to create a lot for a child to build a house. While all properties would have the 10% development right, the state plan would become the default sending and receiving zones. Furthermore any LEED-ND certified development could also become a receiving zone giving the building community and municipal government considerable flexibility. Municipal government would still have say over zoning decisions but the distribution of development intensity would be managed on a regional and state level.

The Challenges of Creating an ICT System - There are many details that will need to be worked out if there is to be a chance of success. The envisioned benefits must be put in the context of New Jersey's complex and dynamic land management collage. Any effort to implement the proposal would first require that the Impervious Cap and Trade program be authorized as a method for development control consideration. This step was likewise necessary to enable municipalities to implement Transfer of Development Rights (TDR) programs. For state agencies to have a regulatory role in the process would require the inclusion of provisions under the rulemaking procedures for the appropriate sections of the New Jersey Administrative Code (NJAC).

Impervious Cap and Trade would work like TDR except that the action to be transferred is the right to create impervious surfaces rather than the full development right itself. It involves a sending area comprised of undeveloped land where impervious surface credits reside and a receiving area where they would be utilized. The process can be owner to owner, but credits would more effectively be transferred through a credit bank which establishes a credit value, facilitates the credit transfer, and does not require the receiver to find a specific sender. Careful establishment of an ICT credit bank would be a key challenge in designing a successful ICT program.

Legislation to allow ICT will require considerable effort, especially since the concept is new and most likely unfamiliar to those who must approve it. The present enabling legislation for TDR will help in this regard since that concept has current standing. However, incorporating rules and regulations in the NJAC is much more problematic.

Perhaps the greatest challenge rests with the ability to convince stakeholders that this concept is beneficial to a variety of interests, financially feasible for the participants, a path to developments that are affordable as well as attractive to the market and is administratively efficient. The stakeholders are the many groups and organizations who have an interest in the idea, are impacted by the application of

the concept and who must feel confident that the concept will have positive benefits to their circumstance. Therefore, a variety of stakeholders must be brought into the process. These include real estate agencies, developers, landowners, agricultural interest groups, farmers, environmental organizations, municipal officials, planners, regulators and others who wish to comment. Rule-making is arduous since participants challenge every phrase and sometimes each word which may affect their interests or operations.

Overall, to be accepted, the concept must have environmental and social benefit, protect property rights, enhance property values, be attractive to the development market, have positive financial benefits, and be administratively manageable. Changing the way in which development is managed is always a difficult process. Yet, it is necessary to explore new techniques if there is hope to improve on past performance with the limited amount of time and limited amount of land that is still undeveloped in New Jersey.

The Right Impervious Threshold- We realize that the specific threshold of impervious surface coverage for water quality impact may vary somewhat from watershed to watershed in New Jersey, but we believe that the advantages and simplicity of having a single threshold shared among all property parcels is politically most acceptable. Furthermore, the fact that the impervious regulation has multiple ecosystem goals beyond the protection of water quality also warrants a single shared threshold. While protecting water quality is one of the major goals of impervious surface restriction, this regulation is also a planning tool for preserving important agricultural, forest and wetlands resources as well as for fostering sustainable smart growth patterns of development, which are also in the public interest. To be an effective planning tool, the impervious surface cap must be set high enough so that it is not vulnerable to a constitutional takings, yet low enough that it creates an incentive to make adequate transfer of credits happen. If the impervious cap was, for example 20%, many subdivisions could be built to this limit without requiring the purchase of ICT credits.

Thus the 10% threshold is not only defendable for environmental purposes, but also a reasonable planning upper limit allowing some development by right but creating sufficient restriction in development so that a credible market can develop for trading the impervious allocation. This aspect is a vital ingredient in successful TDR programs (Pruetz and Standridge, 2009). The 10% cap effectively incentivizes all remaining undeveloped land to participate in the ICT program. Another way at viewing the 10% cap is that it will result in 1 ½ acres of open space preservation for every 1 acre of future development. To illustrate this point, on average, New Jersey development is 25% impervious. A parcel wishing to develop will have its 10% by right and thus have to purchase an additional 15%. The 15% purchase will come from a parcel that is 1 ½ times the size of the developers parcel, thus the 1 ½ acres of preservation for every acre of development. This should be a reasonably acceptable balance for the building and real estate industry as well as the environmental stakeholders.

Potential Problems of Impervious Surface Trading - As the concept of Impervious Cap and Trade is developed, a number of important potential problems need to be addressed. One potential quagmire is that the low 10% impervious surface threshold may result in the promotion of very low density development which would be allowed “by right.” Rural, single unit large lot sprawl is highly impacting to the landscape and on average only 12% impervious. An effective means of discouraging low density rural sprawl must be coordinated with ICT to prevent the program from encouraging more large lot development. This is one of the rationales for having a 5% threshold in the sensitive planning areas of the State Plan with option for realizing the full 10% right of ICT credit for transferring it to a smart

growth planning area or LEED-ND development. Other means of discouraging rural sprawl may also need to be designed into the program.

A second important issue with ICT is that while the exemption of impervious surface regulation in the already urban areas will promote urban renewal, it may also result in the continued degradation of water quality in urban watersheds. It needs to be made clear that all current storm water policy remains in place in urban areas. Only the impervious cap and trade is exempted in the urban core areas.

Bonuses for compliance with the State Plan and/or principles of Smart Growth and sustainability would have to be administered by such an agency that reviews the LEED-ND certification and sanctions the proposed development. This may require a substantial organizational effort under appropriate state offices perhaps with a new agency that is a collaboration between the Office of Smart Growth and the NJ DEP.

Agenda for Implementing ICT – The development of an impervious cap and trade TDR will require the collaboration of many stakeholders. We envision a multi-step process:

1. Conceptualization Stage
    a. Collaboration of technical advisory committee consisting of statewide experts in TDR, smart growth, impervious surface and LEED-ND to flesh out technical details
2. GIS Analysis
    a. Buildout modeling analysis of land use under trend development and ICT scenarios.
3. Refinement and adjustment
    a. TAC refines program design based on results of GIS analysis
4. Public Feedback
    a. Draft ICT program is released for public comment and input
5. Refinement and adjustment
    a. TAC refines program design based on results of public comment
6. Drafting of legislative implementation
7. Development of agency to oversee ICT
8. Development of ICT Bank
9. Program initiation

8) Conclusion

Land management is at a critical juncture in New Jersey. As it becomes clear that the Garden State will reach a buildout within the next several decades, it becomes increasingly important to plan with the overarching goals of shaping that final landscape are needed. New tools that more effectively channel development into patterns of smart growth and sustainability while protecting significant tracts of open space. To date, smart growth measures have been only marginally successful. It is still simply too challenging to create smart growth and too difficult to reign in sprawl with the current land management framework.

TDR in its traditional form has been only marginally successful and the few programs that are successful have taken decades to get off the ground. For New Jersey, it is simply unrealistic to expect traditional models of TDR and existing land management tools to accomplish the task at hand. New Jersey's time horizon for creating meaningful policy simply does not have decades to spare to solve this challenge.

We believe that the impervious cap and trade conceptual framework outlined above holds promise to more effectively address a number of land management quagmires facing the state. In this paper we have sketched out the concept but there are many details yet to work out. This is the first lump of clay thrown on the pottery wheel. If this idea has potential it will no doubt evolve with the input of multiple land management stakeholders. We can only hope that the concept will at a minimum stimulate discussion for other approaches for better managing land.

Notwithstanding, by designing a system that leverages market forces to accomplish the goals of smart growth, sustainability and open space preservation while protecting watersheds, ICT may be an idea whose time is ripe. New Jersey with its long history of experimenting with land use initiatives, its small size and its intense development pressure makes it an ideal state for exploring the potential of impervious cap and trade for integrating environmental management, regional planning, TDR and LEED-ND.

NOTE: As this paper is a development in progress and in preparation for publication, the authors would appreciate any comments, thoughts, critiques or feedback.

E-mail Dr. Hasse at hasse@rowan.edu or Mike Ontko at ontko@rowan.edu

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