Conservation Design – Analysis and Modeling Assumptions

Introduction and Purpose

The *GO TO 2040* plan, due to be complete in 2010, will make recommendations for policies, strategies, and investments needed for northeastern Illinois to reach its potential. For the plan to be viable, it is critical that the *benefits* and *costs* of these recommendations be understood. This document is part of a series that begins to analyze potential plan recommendations in this context by developing "sample programs" for the implementation of potential plan recommendations.

In this case, a "sample program" for conservation design was developed involving regional forecasts about population growth and land use for 2040. An assumption is that greenfield residential development will be continued and conservation design may be used a strategy to address environmental concerns associated with that development. The primary locations of conservation design were then selected based on the Chicago Wilderness Green Infrastructure Vision, which identifies ecologically sensitive areas in the region. The remainder of this document, and the accompanying presentation, describe how this "program" was developed.

Before reviewing the remainder of this document, please read the following notes, which explain its purpose and limitations.

- **Implementation:** This document does not address the responsibility for implementing the "sample program" described here. This is a very important consideration and will be addressed as a next step.
- **Scenario context:** Conservation Design will not be pursued in the absence of other strategies. CMAP recognizes that the benefits of the strategy are magnified when linked with investment in green building design, for example. As a later step, conservation design will be analyzed along with these other strategies; but for this series of documents, CMAP is attempting to isolate and examine the benefits of individual strategies.
- **Site specificity:** The results of this analysis are not accurate at the parcel level, and further geographic detail beyond what is shown in this document cannot be given.
- **Assumptions:** To perform the analysis of the "sample program" described here, assumptions were made for appropriate locations, unit costs, and others. The purpose of this document is to allow these assumptions to be discussed and questioned, but please note that *some* assumptions must be made for any analysis to be possible.

The purpose of the analysis and modeling exercise is to determine, on a regional scale, where and how much conservation design would occur under the "sample program," how much such a program would cost, and how it would impact key indicators.

Key Assumptions

Any regional analysis and modeling process involves making assumptions. The fundamental assumptions for the conservation design strategy involve the following:

- The definition and benefits of conservation design and "green" stormwater management practices;
- The preferred locations for conservation design subdivisions;
- The fiscal impact of this development type; and
- Land use and environmental impacts.

The assumptions within each of these stages of analysis will be fleshed out in greater detail below.

1. **The definition and benefits of conservation design.**

   Conservation design can be implemented as if selecting from a "menu:" one development could utilize permeable pavement while another could install rain gardens and swales. For the purpose of this analysis, we consider two types of conservation development, premium and midgrade. These categories represent developments implementing many green practices or a smaller number of them, respectively. The two categories are defined by their expected benefits, as given in Tables 1 and 2.

   Table 1. Residential conservation design

Type	% Impervious Surface	Runoff Volume	Open Space
Midgrade	–15% relative to reference	1.25× pre-development	40%
Premium	–25% relative to reference	1.1× pre-development	50%

   Source: Based initially on Conservation Design Evaluation System (CeDES), reproduced in *Conservation Design Resource Manual*, 2003, NIPC and Chicago Wilderness; revised with additional Chicago Wilderness input. Runoff volume based on Wisconsin Department of Natural Resources.

   For residential conservation design, it is estimated that total impervious surface could be reduced by 15% and 25% for premium and midgrade conservation design. Decreased runoff volumes are based on maintaining a certain pre-development infiltration volume, an approach pioneered in the Midwest by the Wisconsin Department of Natural Resources. Based on expert input, it was estimated that a midgrade subdivision could hold runoff volume to 125% of predevelopment volume while the premium type could achieve 110%. The amount of open space preserved as part of a development also increases with conservation design, which for modeling purposes is assumed to be 40 and 50 percent for midgrade and premium (a conventional subdivision will have a small amount of open space, generally used for stormwater management and held in common). The open space in a conservation design subdivision is placed under a conservation easement and a special assessment, generally speaking, is used to maintain it.

   Table 2. Commercial conservation design

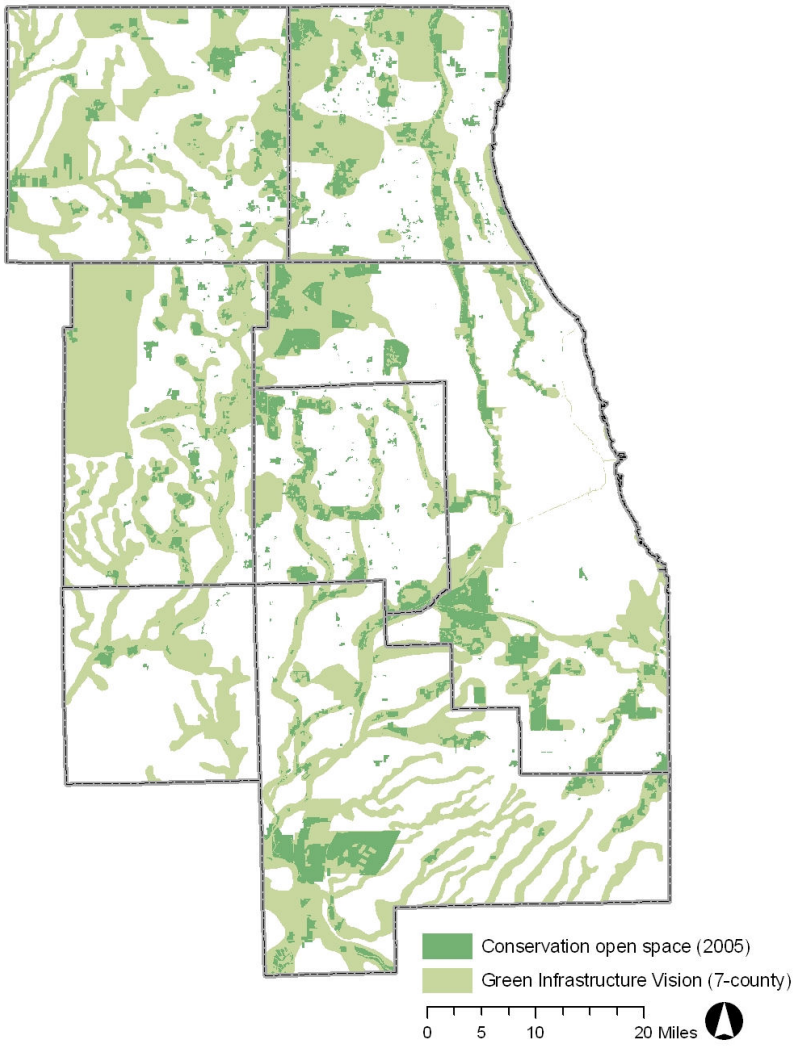
Type	% Impervious Surface	Runoff Volume	Open Space
Midgrade	No change from reference	1.25× pre-development	0%
Premium	No change from reference	1.1× pre-development	0%

   Source: Recommendations from Chicago Wilderness members

   For conservation design in commercial uses, the situation is somewhat different since development requirements are generally regarded as less flexible. The main way to affect total imperviousness is through reduced parking dimensions or parking ratios, but this has a minor effect and may not be acceptable to a commercial tenant. We therefore assume that conservation design on commercial sites will not measurably decrease total imperviousness. More important in a commercial development is the use of stormwater management techniques that promote infiltration. It is assumed that parking island bioretention, directing roof leaders to pervious areas, and so forth can hold post-development runoff volume to 110% and 125% of pre-development volume for premium

and midgrade types, respectively. Finally, additional open space may be provided onsite in the form of additional landscape islands and stormwater retention areas, but not as an area set aside under an easement. We therefore consider commercial conservation design not to protect open space/natural areas in a significant sense.

Figure 1. Green Infrastructure Vision Resource Protection Area boundaries

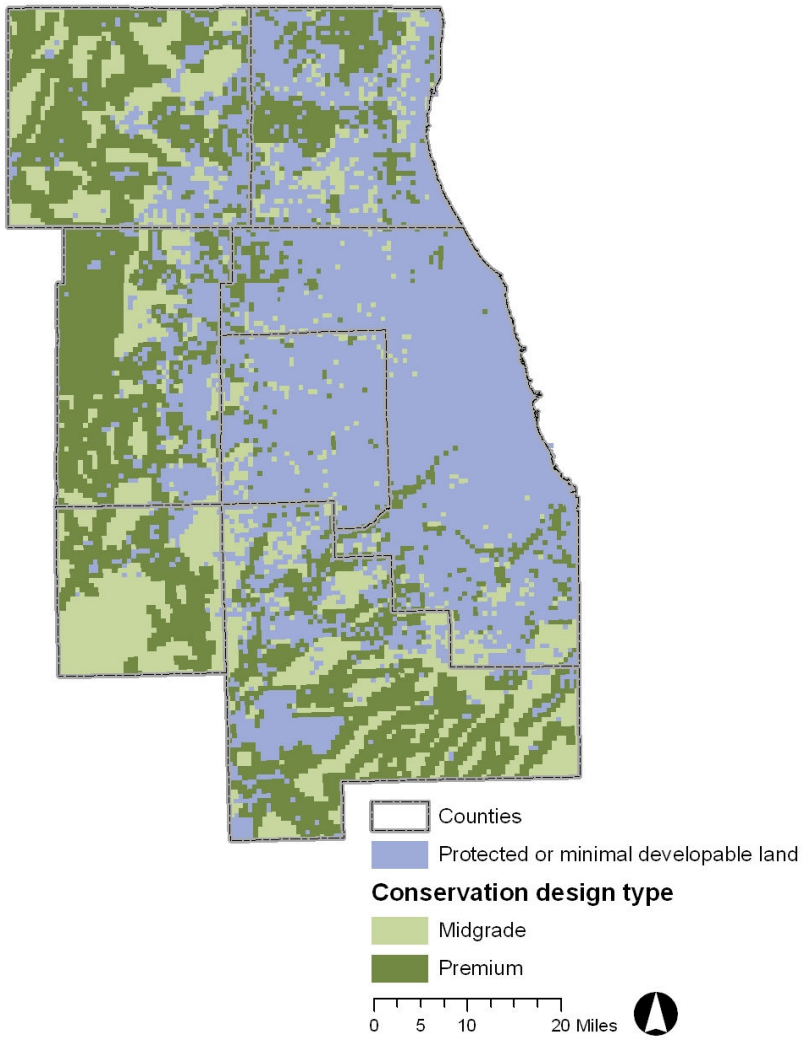


2. Preferred location of conservation design subdivisions.

Conservation design is most important on tracts that include environmentally sensitive features such as floodplains, significant stands of trees, highly permeable soils, and so forth. The Chicago Wilderness Green Infrastructure Vision is being used to define these sensitive lands, called “Resource Protection Areas” (Figure 1). For the conservation design sample program, we stipulate that all residential and commercial development within the GIV Resource Protection Areas be carried out at the “premium” level of conservation design and that development outside the Resource Protection Areas be carried out at the “midgrade” level.

We conceive of conservation design as a strategy that applies to greenfield development. Figure 2 shows where the premium and midgrade conservation design types would be applied by subzone, a geography used in CMAP forecasting which is essentially a quarter-section (160 acres). The dark blue indicates areas that are already protected open space or that have minimal undeveloped land, based on the 2005 CMAP land use inventory, and thus are not available for greenfield development. None of this is to say that green stormwater practices cannot be employed during redevelopment; indeed, redevelopment may be an excellent chance to improve stormwater management and aquatic and terrestrial habitat. This will be dealt with as a next step.

Figure 2. Developable subzones and conservation design type assumed in sample program



3. Fiscal impact of conservation design.

It is anticipated that conservation design will reduce the cost of infrastructure maintenance born by local governments. It will also reduce the capital cost of site improvements, but while this is a selling point from the developer's perspective, it does not relate to CMAP's

primary concern with impacts to local government budgets. CMAP used the Center for Neighborhood Technology's Green Values Calculator[1] to estimate the annual savings to local government, which calculates savings on infrastructure maintenance for four cost items: curbs and gutters, detention basins, storm sewers, and streets.

The different conservation design types described above were represented in the Green Values calculator as:

- **Midgrade:** native landscaping on half of lot, additional tree cover, swales, ~15% impervious reduction
- **Premium:** midgrade plus rain gardens, porous pavement, and ~25% impervious reduction

The savings to local government on curb and gutter and storm sewer maintenance is due to their replacement by an open drainage system with vegetated swales; swales are assumed to be maintained by the homeowners association rather than local government. Reductions in street maintenance costs result from decreasing paved areas to reduce impervious coverage. Finally, a small part of the savings comes from the decreased detention basin maintenance associated with reducing the volume requiring detention through the use of green stormwater practices.

This results in the average per-lot cost savings shown in Table 3, which vary by underlying density. Although conservation design is flexible with regard to lot sizes, the total number of units on a site is still controlled by the allowable density in the jurisdiction's zoning code. Savings are then computed on the basis of what the equivalent density would be for a conventional subdivision.

Table 3. Estimated annual per-lot cost savings by lot size (2005$).

	Lot size (ac)			
Type	**0.3**	**0.5**	**1.0**	**2.0**
Midgrade	$30	$38	$61	$100
Premium	$42	$54	$81	$128

Note: The Green Values Calculator adjusts costs to 2005 based on the Engineering News-Record's Construction Cost Index.

To estimate total savings, we utilized the 2040 "reference" forecast for the region, which indicates population and employment levels by subzone if current trends continue as they have. With the assumption that prevailing densities across the region in 2040 will follow the same patterns as they do now, the sample program of premium conservation design in the GIV and midgrade everywhere else works out to an annual savings to local governments across the region of $19,200,000 in 2040 relative to conventional development patterns (2005$). Cumulative savings over 30 years would be much higher, probably on the order of $300 million in 2005$, but this is a simple estimate based on a constant number of units built per year. Cost savings were not estimated for commercial development because the Green Values calculator does not address commercial development.

[1] http://greenvalues.cnt.org/calculator

4. Land value impact of conservation design.

Research shows that buyers pay a price premium for conservation design subdivisions vs. conventional subdivisions. Based on an analysis of data from Rhode Island, the premium was between 12% and 16% per acre, although premiums vary greatly between regions and neighborhoods.[2] From the perspective of developers, buyers are willing to pay a higher price for scenic areas and more exclusive neighborhoods, and they will trade off larger lot sizes and private open space for smaller lots and common open space. On the positive side, this may translate into higher assessed values and therefore larger tax bases for local government. Unfortunately, price premiums also make units less affordable for many buyers in the market. It is possible that these price premiums will be reduced if conservation design is made widely available across the region, as this strategy proposes. On the other hand, it is also possible that the region as a whole will simply have higher land values and more expensive residences because of the use of conservation design. If the latter is the case, additional strategies to ensure affordable housing will be necessary within this scenario.

5. Land use and environmental impacts.

We assume that conservation design will not cause any regional shifts in population and employment location – that is, growth will occur as it does in the reference scenario – but decreases the environmental impact of such growth. The following are the main benefits:

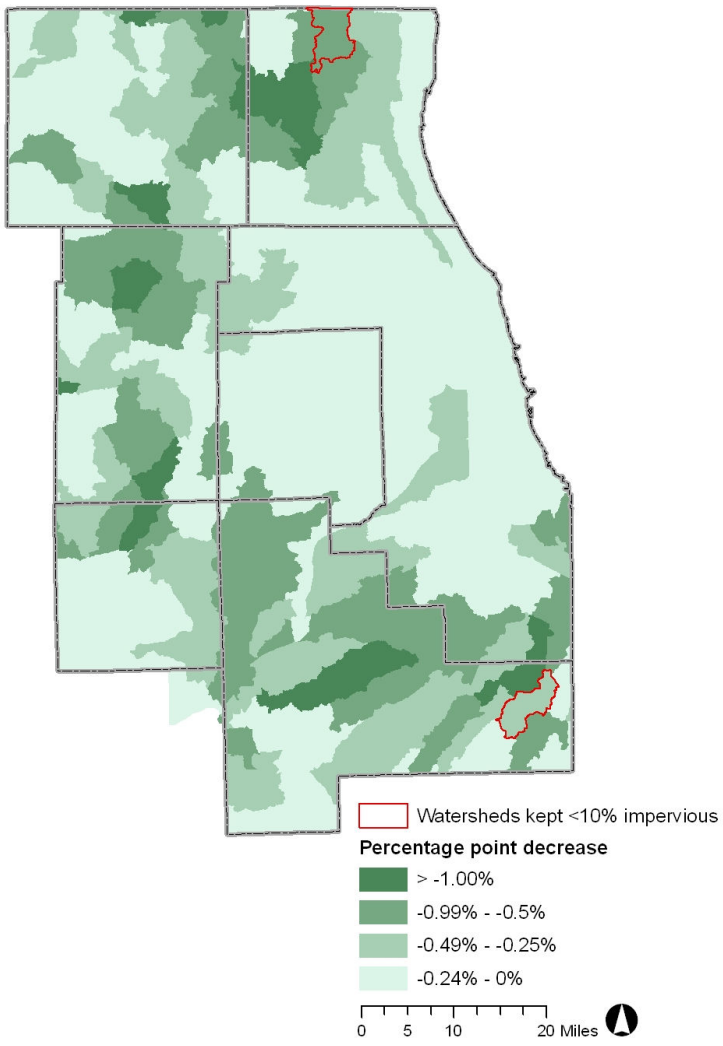
- Conservation design will decrease imperviousness from the reference scenario.
- Conservation design will decrease annual runoff from the reference scenario.
- Conservation design will decrease land consumption from the reference scenario, although the preserved open space will be part of a private development and may not be as accessible to persons who do not live in the development.

One key benefit of conservation design is its reduction of imperviousness compared to conventional subdivisions, which is due to reductions in street and sidewalk widths, driveway lengths, etc. Decreasing imperviousness reduces runoff and improves water quality. There would be a small but noticeable effect on region-wide imperviousness by adopting conservation design practices on the scale imagined in the sample program. The map in Figure 3 shows that effect reported by HUC 12 watershed.

Compared to the reference case, the conservation design sample program reduces imperviousness across all watersheds by 0.3 percentage points. Region-wide imperviousness in 2001 was 18.9%,[3] while in the 2040 reference forecast it would be 24.9% and with the conservation design sample program it would be 24.6%. Two watersheds that in the reference case would have exceeded 10 percent imperviousness – a rule-of-thumb cutoff for declines in aquatic community health – would be prevented from doing so by adopting the sample program.

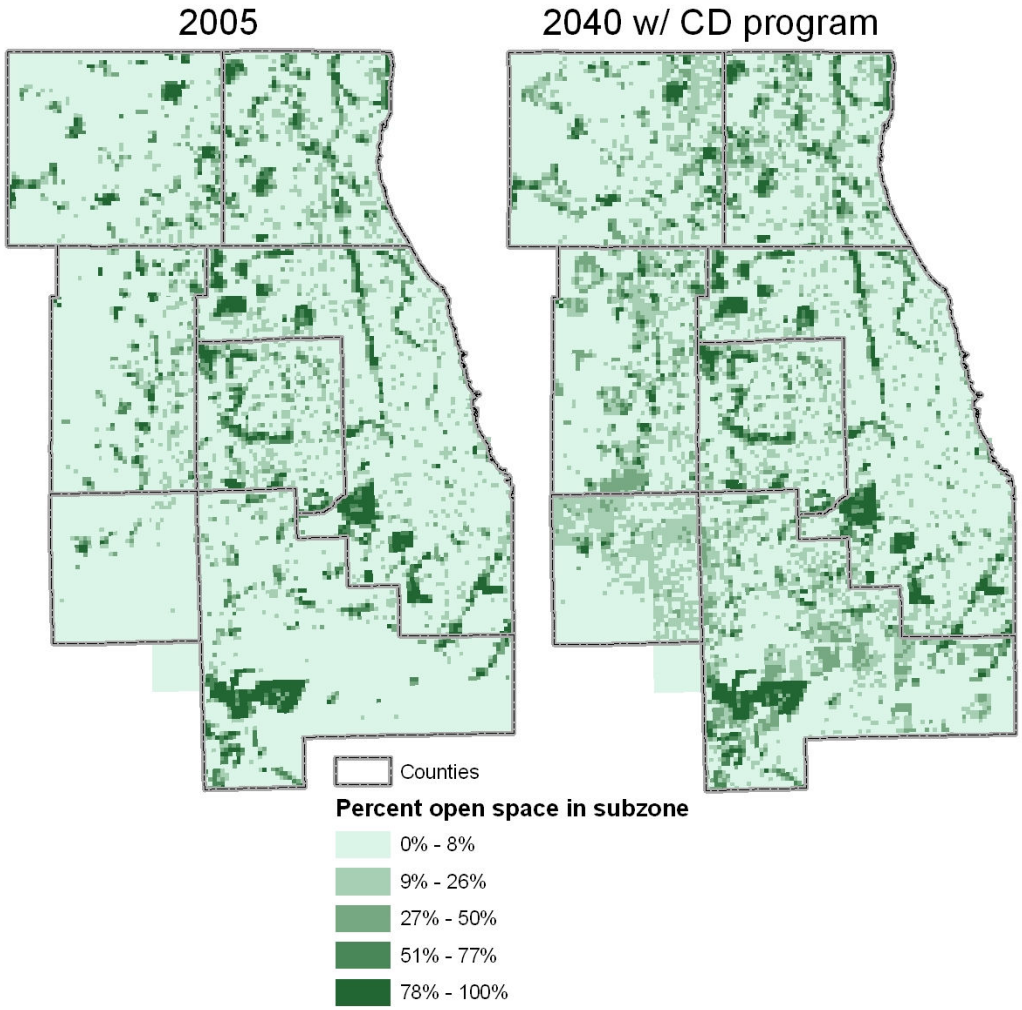
[2] Mohamed, Rayman. 2006. The Economics of Conservation Subdivisions: Price Premiums, Improvement Costs, and Absorption Rates. *Urban Affairs Review* 41(3): 376-399.
[3] Calculated from the 2001 National Land Cover Dataset

Figure 3. Decrease in imperviousness by adopting conservation design program



Another important effect of conservation design is that land consumption is decreased (Figure 4). If premium conservation design and midgrade conservation design result in the protection (by easement) of 50 and 40 percent of the site area, respectively, this would translate into 88,700 acres preserved region-wide by 2040, about 52,400 acres of which would be within the GIV Resource Protection Areas. This compares to about 215,000 acres of protected, conservation-oriented open space as of 2005. However, it should be noted that land preserved through conservation design will generally be on fairly small sites, and may not be fully accessible to the public.

Figure 4. Increase in protected open space with conservation design program



Next Steps

With the stated assumptions, the conservation design program strives to balance development and the preservation of the region's most environmentally sensitive land. Annual cost savings could be $19,200,000 for ongoing operations and maintenance expense line items in public infrastructure budgets. Approximately 88,700 acres of land could be preserved in the course of development, and imperviousness would be decreased on average by 0.3 percentage points across the watersheds in the region.

This analysis is not complete, and there are several additional components which need to be considered:

- In addition to land preservation and reductions in imperviousness, there are other indicators to be modeled and measured, such as the impacts of the strategy on runoff and housing affordability.

- The benefits of green stormwater management practices as used in redevelopment need to be researched and estimated.
- This analysis has not yet considered implementation, including institutional or regulatory changes that might be necessary.

These are important aspects of this strategy which need to be carefully explored and understood in the next steps of analysis.