Blackberry Creek Watershed Alternative Futures Analysis

REPORT SUMMARY

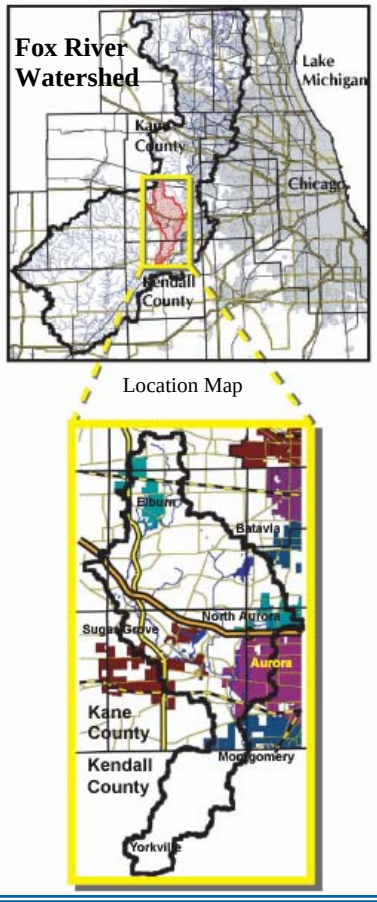
Introduction and Purpose

In July 1996 a major rainfall struck northeastern Illinois. One of the most heavily impacted areas was the Blackberry Creek Watershed, a major tributary to the Fox River. The flooding and associated damage prompted formation of the Blackberry Creek Watershed Resource Planning Committee. This committee, with the assistance of municipal, county, regional, state, and federal agencies, as well as private consultants and residents, developed the Blackberry Creek Watershed Management Plan. This plan was completed in 1999 and adopted by all of the municipalities and Kane and Kendall Counties. The Plan's recommendations focus on preventing problems as the watershed develops. In addition to increased flooding, stakeholders were concerned about degradation of the water quality, biological integrity, and streambank erosion .

Due to the existence of an Implementation Council for the Watershed Management Plan as well as the growth in central Kane County, USEPA and IDNR funded an alternative futures analysis for the Blackberry Creek Watershed. This project was to identify alternative build-out options for the watershed and to evaluate their implications. Armed with this information, the municipalities and counties will be able to make informed decisions about site design practices and future land uses. Kane County will be using this information in its 2030 Land Resource Management Plan and as it coordinates with municipalities on the development of stormwater management strategies.

A Watershed Project Sponsored by:

Flooding in Blackberry Creek Watershed, July 1996



Location Map

Project Components

Protection of the watershed's aquatic resources from both direct and indirect impacts will be essential during its transition from a largely rural watershed to a mixed rural and urban watershed. To that end, both a land use focus to protect the streams and wetlands from direct modifications, and a site design focus to prevent degradation of watershed hydrology. The components of the project were:

1. Develop model site design templates on a 40 acre hypothetical parcel for a range of land uses (commercial, three densities of residential, agriculture, as well as streams and wetlands) that illustrate conservation based stormwater and site design principles, preserving natural hydrologic mechanisms, and minimizing changes in water quality. Along with the conservation version of each template, a "conventional" version was developed. The conventional version was based on current practice for site design and stormwater management that collects, conveys, and detains stormwater rather than distributes, infiltrates and retains stormwater. The stream and wetland templates illustrate ways to protect and improve the natural capacity of these systems to mitigate the effects of intensive land use change.

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Project Components (Continued from Page 1)

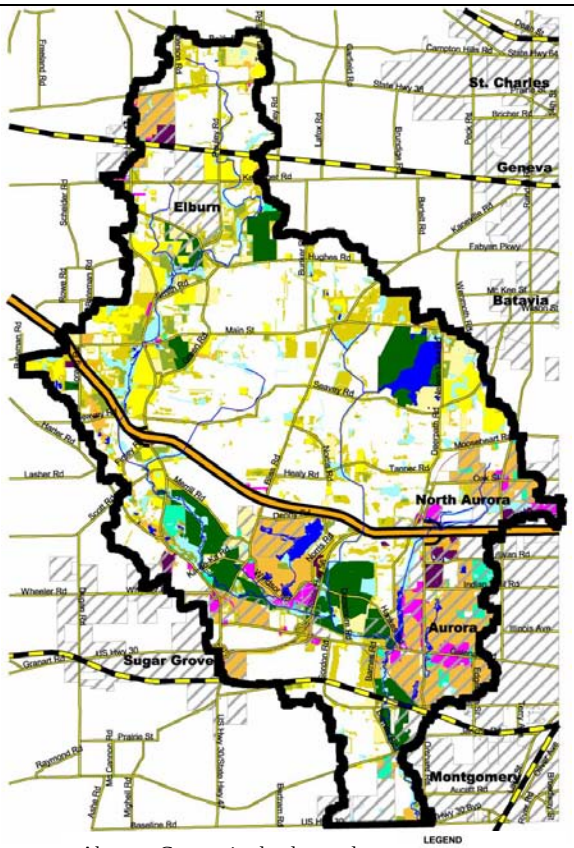
2. Assemble a conservation based watershed land use scenario that provides protection of stream and wetland resources. The conservation land use scenario is then contrasted with existing land uses and future land uses based on current proposed land use plans. The conservation scenario does not change the overall character of current land use plans, but demonstrates how the streams, wetlands, floodplains, and natural drainage of the watershed can be integrated into those plans.
3. Evaluate the consequences to water quality and flooding on the parcel-sized land use templates and watershed scenarios. The hydrologic response was characterized to assess the implications on biological health, protection of aquatic habitat, and impacts on flooding and streambank erosion.

Alternative Futures Evaluation

As a watershed urbanizes there is an increase in the magnitude and frequency of flooding, and a reduction in base flow between storm events. The reduced stability of hydrology associated with more frequent flood events can destroy streams and habitats through streambank erosion and deposition, and through shifts in vegetation resulting from greater water level fluctuation. The lower low flows stress aquatic insects and other organisms that live in the bottom of streams and serve as food for fish and other life on the food chain.

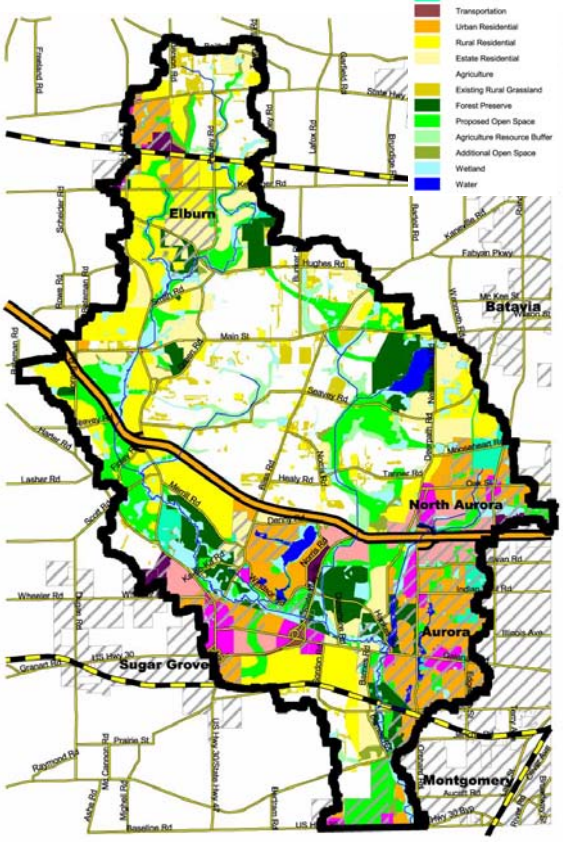
Site Scale Modeling Results

The analysis performed for this project indicates that all hydrologic measures are improved under the conservation templates relative to the conventional templates of the same land use. The flashiness of the stream is decreased, low flows are maintained, and the magnitude of floods is decreased. As expected, the modeling also indicates that the conventional versions of the urban templates generally have less stable hydrology than an assumed existing condition of cropland. However, the conservation version of all the templates, including commercial, should be able to improve many measures of hydrologic conditions relative to conventional agriculture.



Above: Composite land use plan for watershed using current County (2020) and municipal comprehensive plans.

Below: Proposed Conservation-based land use plan using strategies defined as part of the project.



Recommended Best Management Practices for Development Planning and Stormwater Management

The following Best Management Practices were incorporated into the Blackberry Creek Alternative Futures Project as essential components for each Conservation Template and the watershed analysis for the Conservation Scenario.

Planning/Zoning BMPs

Conservation Development

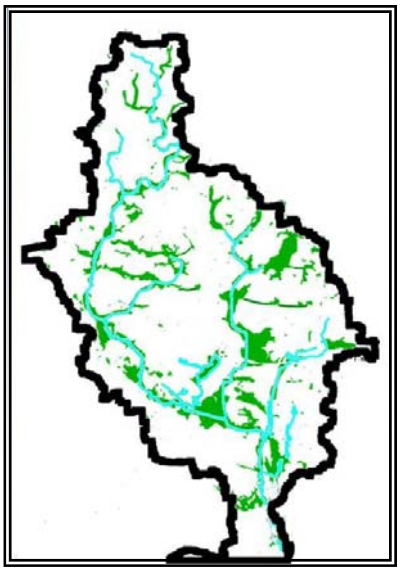
Site planning and design approaches that preserve existing natural areas, enhance habitat, utilize naturalized drainage and detention measures for stormwater management, conserve energy, and improve transportation efficiency.

Impervious Area Reduction

Impervious area reduction can be achieved in a number of ways, including use of narrower streets, shorter streets in lower density residential neighborhoods, creative driveway design, shared parking facilities, and designing roads, walkways, and trails for multiple uses as an integrated system.

Open Space/Natural Greenway

Designation of linear open spaces and/or natural areas as greenways, in order to preserve and connect significant natural features and accommodate aesthetic, recreational and/or alternative transportation uses. Floodplains, wetlands, and woodlands protected from encroachment by new development.



Conceptual Greenway Plan for the watershed to preserve floodplains, isolated wetlands, etc.

Stormwater BMPs

Bioswales

Filtration and infiltration systems planted with grasses, and designed to filter, retain and evaporate stormwater. Vegetation enhances filtration, cooling and cleansing of water to improve water quality and prevent sealing of subsoils. Bioswales typically include an infiltration trench below the vegetated swale to provide temporary storage to increase the volume of runoff water infiltrated.

Filter Strips/Level Spreaders

Filter strips are an area of dense, preferably native, vegetative cover used to filter and absorb runoff. Level spreaders are often used in conjunction with filter strips to distribute runoff over filter strip areas. Filter strips/level spreaders can be used within stream and wetland buffers to de-concentrate stormwater before discharging to streams and wetlands.

Green Roofs

Vegetated roof system designed to capture, temporarily store, and evaporate rainwater on the top of roofs. Green roofs are generally planted with drought and wind tolerant native vegetation. Green roofs can be designed as simple, lightweight systems primarily providing stormwater benefits or as more elaborate rooftop gardens that provide an attractive outdoor space.

Naturalized Detention

Naturalized detention basins are used to temporarily store runoff and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improves water quality and habitat benefits. Naturalized detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

Porous Pavement

Permeable or perforated paving materials with spaces that allow for the infiltration of rainwater and the movement of water through an aggregate base to the subsoils. Runoff is temporarily stored in the base for infiltration into the subsoils and/or slow release to a bioswale or stormwater system.

Rain Barrels/Cisterns

A vessel that captures and temporarily stores rainwater for various uses, including landscape irrigation, reuse for graywater purposes, etc..

Rainwater Gardens

A landscaped garden designed to retain, detain, infiltrate, and evaporate stormwater runoff from individual lots and roofs.

Vegetated Swales

Vegetated stormwater features that convey, retain, infiltrate and cleanse stormwater. Native vegetation enhances filtration and retention of stormwater.

Native Landscaping

Native vegetation used in either large restoration or smaller gardening projects. Native vegetation refers to plants that existed in a location before European settlement. Native landscaping can serve a variety of purposes including wildlife habitat and stormwater infiltration, filtering, and evapotranspiration.

Rain Barrel installed on the side of a residence

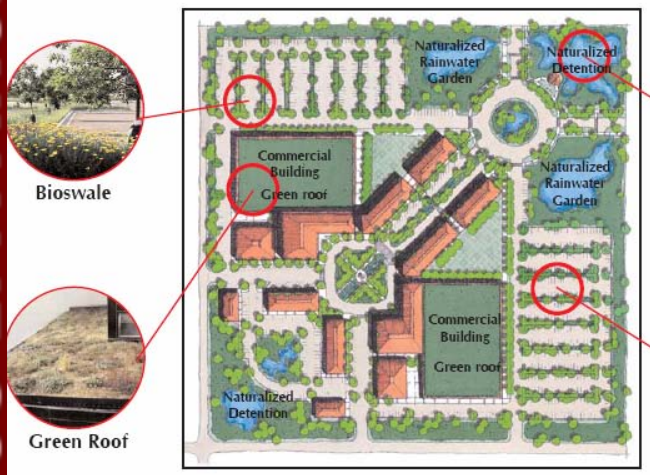
Porous Pavement adjacent to a government building

Rain Garden in front of a residence

Vegetated Swale along roadside

Native Landscaping around a single family home

TEMPLATES USED IN WATERSHED AND PARCEL SCALE EVALUA-



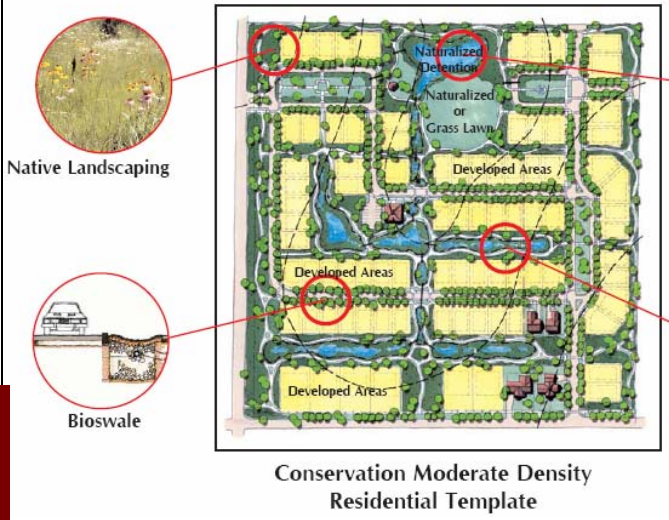
Conservation Commercial/ Industrial Template

Conventional Commercial / Industrial Template

Conventional Design Features:

- Centralized detention
- Curb & gutter
- Large asphalt parking lot
- Extensive storm sewer network

TEMPLATES USED IN WATERSHED AND PARCEL SCALE EVALUATIONS

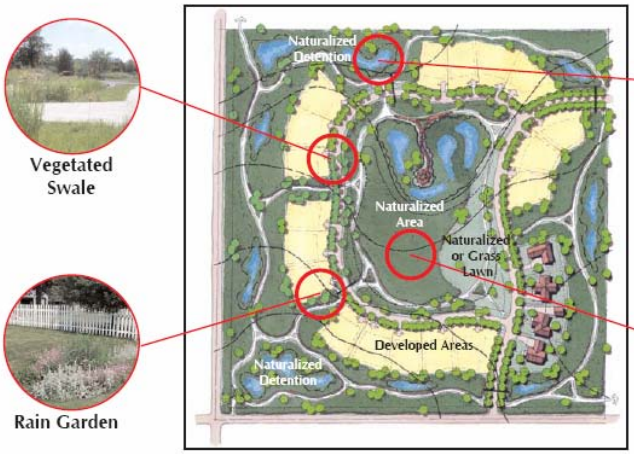


Conservation Moderate Density Residential Template

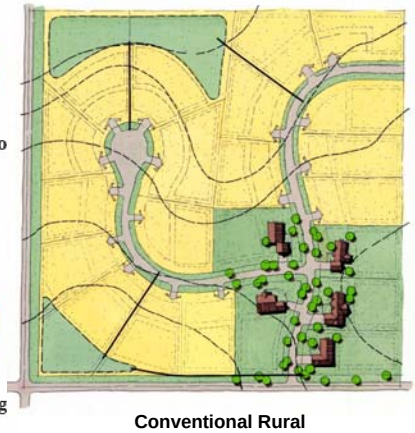
Conventional Moderate Density Residential Template

Conventional Design Features:

- Centralized detention (turf or rip rap shoreline)
- Curb & gutter on all streets
- Extensive storm sewer system
- No provisions for infiltration of runoff
- Little, if any preserved natural areas (floodplain, wetlands, woodlands, or prairie)



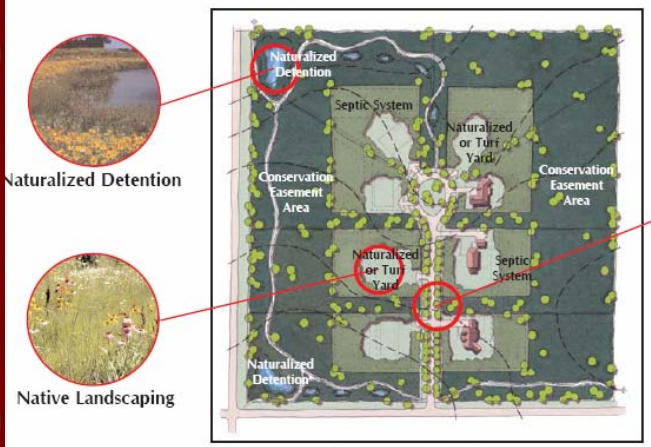
Conservation Rural Residential Template



Conventional Rural Residential Template

Conventional Design Features:

- Centralized detention (turf or rip rap shoreline)
- Large turf lawns
- Mowed roadside swales
- Storm sewers from road to detention basin
- No provisions for infiltration of runoff
- Little, if any preserved natural areas (floodplain, wetlands, woodlands, or prairie)



Conservation Estate Residential Template

Conventional Estate Residential Template

Conventional Design Features:

- Centralized detention (turf or rip rap shoreline)
- Large turf lawns
- Mowed roadside swales
- Storm sewer from road to detention basin
- No provisions for infiltration of runoff
- Little, if any preserved natural areas (floodplain, wetlands, woodlands, or prairie)

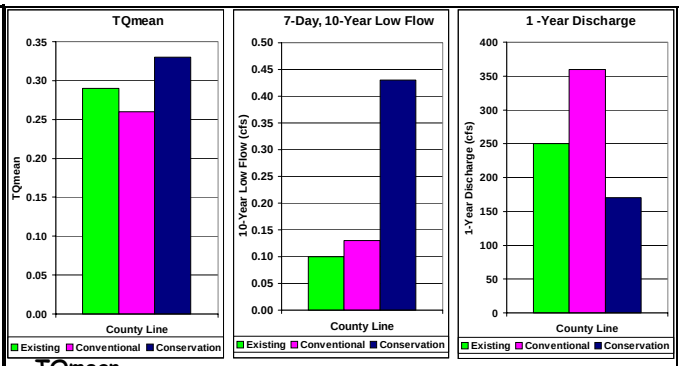
Watershed Scale Modeling Results

The watershed-scale scenario results are similar to the parcel-scale template results. The results show that hydrologic, physical, and biological conditions in the streams and wetlands of Blackberry Creek are likely to degrade as the watershed urbanizes based on current plans and conventional templates. Conversely, under the conservation scenario with conservation templates, hydrologic, physical, and biologic conditions have the potential to improve as conservation plans and developments are implemented. However, the results indicate that the negative impacts of conventional development and the positive impacts of conservation development are less pronounced than at the site (template) scale. This appears to be due to the mix of existing conventional and proposed conservation land uses in the conservation scenario as well as due to the moderating influence of floodplains and protected natural areas that occur in both conventional and conservation scenarios. Flooding, as measured by the 100-year flood flow, is expected to remain the same or even decrease even under the current proposed land use scenario with conventional templates due to Kane County's detention release rate standards. Under the conservation scenario with conservation templates, flooding could be expected to actually decrease. Although not a direct focus of this study, the results suggest that implementation of the conservation templates may also improve deep groundwater recharge, potentially improving the water supply for a growing population.

Conclusions

The report indicates that with proper planning and site design, Blackberry Creek and its wetlands can be protected from many of the negative impacts often associated with urbanization. These results reflect full implementation of the stormwater management practices outlined in the conservation templates and not just the general land use plan. Although substitution of native prairie and wetland landscaping for turf will improve hydrology, that design modification alone will not achieve the benefits identified here. It is essential that a distributed stormwater management approach that utilizes created prairie and wetland systems to filter and retain stormwater runoff be implemented if the benefits outlined here are to be achieved. Two future landuse scenarios were evaluated as part of this project. There are many other possible scenarios that could be conceived for this watershed as the County and municipalities proceed with development of 2030 land use plans. The scenario models could readily be adapted to evaluate other potential scenarios and factor water resource implications into the land use decision-making process.

For more information on how to incorporate these essential conservation techniques into local ordinances and development codes, the Northeastern Illinois Planning Commission has developed a Conservation Design Resource Manual to aid local governments.



TQmean

TQmean is defined as the proportion of time that the flow rate is above the mean annual flow rate of the stream. This is a measure of the variation in streamflow and provides indications as to the stability of the stream. A high TQmean value (0.4-0.5) indicates that the high volume flood flows occur over a period of 40 to 50% of the total time in a given year, which is typical for a stream in a rural, natural watershed. However, the study indicates that TQmean values under conventional development scenarios will be reduced, suggesting that Blackberry Creek will be subjected to very short, intense flood flows, which are more detrimental to the stream's habitat and ultimately it's ecosystem. Modeling of the parcel-scale templates indicate that this impact will be even more severe on all the minor tributaries which drain into Blackberry Creek.

1-2 Year Discharges

These are the minor floods which have between a 50% and 100% chance of occurring in any given year. Floods in this range (1.5 year, for example) have been shown to be the most significant factor in maintaining a natural and stable stream system. The study indicates that although the Kane County Stormwater Ordinance provides effective control for eliminating increases in the peak 100 year discharge after development, it does little to control the smaller, more frequent flood flows which dominate channel stability and stream habitat characteristics. Increases in the 1-2 year flood event were predicted to be more than 60% if conventional development practices are followed. Conversely, employing conservation development practices REDUCED 1-2 year flood discharges from existing conditions by about 30%.

7-Day, 10 Year Low Flow

This is the low flow rate over a 7 day period that has a 10% chance of occurring in any given year. It is a good estimate for stream base flow, which is vital to aquatic species. The study indicates that the creek's base flow is already heavily impacted by the changes to the landscape drainage due to agriculture. As expected, the study also indicates further reduction in this flow under build-out by conventional development methods. This would have disastrous consequences to the aquatic species which depend on a stabile base flow for survival. In contrast, using conservation development techniques, the base flow could be expected to increase dramatically, 100%-400% in most reaches. This is a direct result of the distributed stormwater management system used in conservation development to maximize stormwater retention and infiltration.