Alternative Futures Analysis Case Studies
&
Tools for Visualizing Quality Urban Growth

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Introduction

This paper provides a set of case studies on Alternative Futures Analysis for community growth. We were asked to develop this report and a recommended course of action for Alternative Futures Analysis of the Etowah Watershed by the Etowah Habitat Conservation Plan Steering & Technical Committees.

The Etowah Watershed Habitat Conservation Plan (HCP) endeavors to protect the aquatic species of the Etowah, while at the same time accommodating population growth and associated services in the region. Alternative Futures Analysis plays a logical role in this process as a means of evaluating urban growth patterns.

Located in Northwest Georgia, the Etowah River Watershed is an area of tremendous aquatic diversity and declining water quality. Currently, the Watershed is approximately 45% urban (US EPA, 2003). Sedimentation in the river, high levels of phosphorous, and high levels of fecal coliform particularly following storm events have, in recent decades, become pressing threats to the water quality of the river and its tributaries.

Conceptual Framework for Alternative Futures Analysis in the Etowah Watershed

The Alternative Futures Analysis concepts discussed in this paper are best visualized as one large umbrella resting above a smaller one. Case studies one through four, as well as the studies located in Appendix A represent the large over-arching umbrella version of Alternative Futures Analysis. These studies project consequences based on one of a few predetermined scenarios. Demographic, economic and environmental data are plugged in to the scenarios and the resulting consequences serve as bench marks for communities to choose the way in which they want to grow.

The small umbrella in this analogy is represented in the Tools for Visualizing Growth section of the paper. Community Viz softwear and *What if?* softwear together are the small umbrella. While still data intensive, these softwear packages operate as a modified form of Alternative Futures Analysis, working on sets of general assumptions about growth to create visual images. The main advantage of Community Viz and *What if?* is that the softwear generates visual images of how development will appear in a community. The main disadvantage is that they are not tools that can answer more refined scientific questions such as: "what effect will a growth pattern have on peak water flow of streams in the watershed?"

Overview of Alternative Futures Analysis

Carl Steinitz, along with colleagues Theobald and Hobbs are recognized authorities on the theoretical framework of Alternative Futures Analysis. Their work explains that there are two main ways of embarking on the Alternative Futures Analysis process (Steinitz 2003 and Theobald & Hobbs 2002). The first method is to design a small number of alternative plans for land use followed by comparing them to assess the consequences. This method is based on geometrically defined development patterns and priorities of political interest groups or on single dominant policies. The advantage to using this approach is its simplicity. However, this can also be a drawback due to the potential for misleading simplification, as it is often impossible to identify the full set of policies needed to achieve the future scenarios that are created (Steinitz 2003).

The second method to be used when conducting and alternative futures analysis is to identify several of the most important issues responsive to policy and planning decisions (Steinitz 2003). A flexible scenario is created to reflect the choices among the possible options.

The difference between the two methods is that the first method is based on a small number of alternative plans for land use and the second method is more fluid. A more thorough description of the theoretical framework of Alternative Futures Analysis is located in Appendix C.

Case Studies of Alternative Futures Analysis

<u>Case Study 1:</u>

Growth Management for Watershed Protection in Maryland:

Chesapeake Bay Program

The State of Maryland, in cooperation with the Chesapeake Bay Program, undertook an alternative futures analysis in the Patuxent River Watershed. The initiative aims to aid in meeting the Chesapeake Bay nutrient loading limit goals. The Patuxent River watershed, located in central Maryland, is approximately 930 square miles. It includes parts of seven counties: Howard, Montgomery, Anne Arundel, Prince George's, Calvert, Charles, and St. Mary's, with no county located entirely within the watershed. The watershed is large and heterogeneous in terms of the amount and type of land cover (24% developed, 45% forest, and 27% agriculture). The Alternative Futures analysis process in the watershed was based on the following three scenarios:

Alternative Development Scenarios:

1. **2010 Base Zoning.** Base Zoning scenarios portray new development according to current zoning, but without the influence of other existing county subdivision and environmental ordinances, and without BMPs for nutrient pollution control. Base Zoning provides a 2010 "worst case" scenario, against which the performance of growth management and pollution control measures in the other scenarios can be evaluated.

2. **2010 Current Programs.** This scenario estimates the effects of existing programs for growth management and pollution control. New development occurs according to current zoning, subdivision, and associated environmental regulations and requirements. Implementation of agricultural nonpoint source pollution control measures is projected to occur at approximately current rates to the year 2010. Implementation of Stormwater Management practices represents counties' current stormwater management program, according to the guidelines provided by each county. The effects of wetlands and riparian areas on pollution loads are estimated for those that remain in 2010 under current protection programs and growth management options.

3. **2010 Directed Growth.** Directed Growth scenarios include enhanced levels of growth management, land conservation, and pollution control practices. Stormwater management program requirements were essentially the same as those in the Current Programs scenario. The effect of wetlands and riparian areas on pollution loads is estimated for those areas predicted to remain in existence in 2010.

   - Eight specific options for growth management and resource protection were modeled as part of the Directed Growth Scenario.

     1. Forest Conservation
     2. Stream Buffer Protection
     3. Rural Clustering
     4. Increased Development Potential in Growth Areas
     5. Transfer of Development Rights to Growth Areas
     6. Extending Sewer Service to Designated Growth Areas
     7. Protective Agricultural Zoning
     8. Purchase of Development Rights

Questions Addressed by the Study:

- If current growth management and pollution control programs were practiced, and growth occurred as projected to the year 2010, what would be the effects on local streams, land resources, stream buffers, and nutrient loads?
- What effect will growth management have on overall pollution levels, compared to Best Management Practices for pollution control?
- What changes can be expected in each tributary and subwatershed under each of the development scenarios considered, in each of the following issue areas?
    - Loss or gain of forest cover, both riparian and upland
    - Loss of agricultural land
    - Percentage of the watershed covered by impervious surfaces
    - Associated development impacts on local streams
    - Nutrient loads delivered to surface waterways and the estuary

Variables:

- Location and extent of soil types, wetlands, streams, stream buffer zones, and other environmentally sensitive areas.
- Location of zoning, growth and land preservation boundaries, and sewer service boundaries.
- Location of watershed, subwatershed and county boundaries.
- Current and future population, household, and employment statistics
- Number and location of households on sewer and on-site sewage disposal system, by county and subwatershed.

Methods:

The Maryland District Office of Planning collaborated with county and city planning and zoning offices, state and local resource and environmental protection agencies, public works departments, and soil conservation districts to obtain information about existing growth management plans and regulations. Information was also retrieved regarding stormwater and agricultural management programs. GIS mapping data was compiled for the following:

- Land use
- Soil types
- Slope
- Location of streams and wetlands
- Location of septic systems
- Zoning
- Sewer service
- Current and projected population
- Households
- Employment

Three linked computer models used data from GIS and a variety of other sources to model future development and associated impacts on land, resources, environmentally sensitive lands, nutrient pollution loads, and local water resources. The three models were

1) Baseline Inventory Model
2) Growth Management Simulation Model
3) Nonpoint Source Management Scenario Model

The specific steps taken to conduct the build out analysis of the project impacts on land and water resources for the three tributary watersheds are listed below:

1) Create GIS data layers – Layers were organized on land use/land cover, solid, streams, wetlands, stream buffers, zoning, sewer service, population, households, and employment.
2) Develop Baseline Inventory of Land Features – These data were organized by subwatershed within each county.
3) Develop Baseline Inventory of 1990 Pollution Loads – This included nutrient loads from forest, agricultural sources, developed land cover, and septic systems, using the Baseline Inventory model of the Watershed Planning System.
4) Estimate Demand and Capacities for New Development – Exiting Zoning and Comprehensive Plans were used to determine demand.
5) Allocate Demand Under Different Growth Management Scenarios – Each scenario assumed different zoning and regulations, particularly the density and distribution of new subdivisions and requirements/restrictions for site design.
6) Simulate Land Use Change and Project Implementation Levels of BMPs – These were estimated within each subwatershed for each scenario.
7) Inventory Conditions and Estimate Pollution Loads in Each Scenario – Compared existing conditions to 2010 predictions for each scenario.

Study Results:

- In the year 2010, pollution levels will be much lower if growth and new development is directed.

- By the year 2010, stream quality would degrade to nearly half the current quality level under current programs.
- Using the directed growth scenario, water quality degradation would be limited to approximately one quarter of the watershed. This is in contrast to about 62% of one county's streams under current programs. Exact percentages of degradation varied by county, but followed similar patterns.

Case Study 2:

Blackberry Creek Alternative Futures Analysis:

Conservation Design Forum, Elmhurst, Illinois

The Conservation Design Forum, Inc, a landscape architecture and community planning firm based in Elmhurst, Illinois conducted a very progressive alternative futures analysis in the Blackberry Creek Watershed, located in northeastern Illinois. The driving force behind the design of the alternative futures study was a major rainfall event in 1996, after which the community experiences extreme flooding and associated property damage. This study was funded by the U.S. Environmental Protection Agency and the Illinois Department of Natural Resources.

The Blackberry Creek Watershed is approximately 73 square miles in size. However, due to jurisdictional boundaries, the study only included the 58 square miles of the watershed located in Kane County. Land cover for the studied section of the watershed is approximately 66% agricultural, 21% urban/residential, and 13% open space.

The study was performed in the following three steps:

1) Development of land use templates that were not place-specific, and were intended to be representative of urban and agricultural land uses and could be located anywhere within the watershed.

    a. Conservation Templates (these are based on design BMPs for stormwater management)

        - Commercial/Industrial

- ➢ Moderate Density Residential
- ➢ Estate Residential
- ➢ Rural Residential
- ➢ Agricultural
- ➢ Stream Corridors
- ➢ Depressional Wetlands

b. Conventional Templates (these are based on the existing standard-of-practice site design and planning techniques)

- ➢ Commercial/Industrial
- ➢ Moderate Density Residential
- ➢ Estate Residential
- ➢ Rural Residential
- ➢ Agricultural
- ➢ Stream Corridors
- ➢ Depressional Wetlands

2) Arrangement of templates throughout the watershed was accomplished using the two ways listed below. Templates were based on an imaginary 40 acre parcel, with the exception of agriculture which was evaluated as a 160 acre parcel.

- According to land use patterns based on existing county and municipal comprehensive plans.
- Following improved conservation-based land use patterns

3) Templates and scenarios were then modeled using HSPF for their comparative effects on hydrologic systems.

- HSPF or Hydrological Simulation Program—FORTRAN (HSPF) is a mathematical model designed to allow simulation of hydrology and water quality. It is used to simulate the movement of water and sediment through watersheds and can be used to help predict environmental problems in a watershed.

Conclusions

- Hydrograph plots revealed that runoff event volumes and peak flows were substantially reduced under the conservation versions for all templates. The amount of detention required to meet the County NPDES release rate is also significantly lower under conservation practices.
- Peak water flows in streams following storm events were significantly lower in the conservation template scenarios.
- Conservation versions of moderate density residential and commercial templates have the highest base flows as can be seen in hydrographs.
- Estate residential templates have lower base flows than moderate density residential and commercial, even though the estate residential templates include more naturalized open space. This appears to be the result of infiltration storage that is included in the moderate density residential (road side infiltration trenches) and commercial templates (porous paving and infiltration bioswales). These features temporarily hold water, providing additional time for infiltration.
- In general, conservation templates outperform conventional templates, resulting in lower storm event volumes and peak flows and have the potential to substantially reduce watershed impacts of urbanization.

Case Study 3:

Monroe County, Pennsylvania

Graduate School of Design, Harvard University

The project utilized GIS and included interpretive satellite images, infrastructure plans, and field maps showing ecological sensitive areas. Their data was gathered from the EPA, U.S.GS, U.S. Census Bureau, The Nature Conservancy, and Cornell University. In addition to this information, graduate students compiled several new digital databases. Each map of the county in their analysis has a minimum of 5 million sampling points and a spatial resolution of 25 meters (Harvard 1994).

Eleven components were developed to create a total of six alternative future scenarios. These eleven components are described below:

1) Conservation A
    - Strict enforcement of the current development regulations.
2) Conservation B
    - Based on Best Management Practices for land conservation.
3) A Billboard Policy
    - This called for a removal of all the billboards that were not directly related to county businesses or events.
4) A Recreation Policy
    - This would emphasize recreation as the county's main source of income and focus conservation efforts on protection sources of recreation related activity.
5) A Focus on Mitigating the Major Traffic Congestion

- This effort would primarily involve the Pocono raceway and would allow the raceway to expand to its full development potential, while creating a conservation plan for the nearby Long Pond natural area.

6) Road improvements
    - These would be needed to accommodate the predicted increase in population.
7) Upgrading the old railroad alignment
    - This would be done in the hope that development associated with the railroad stations to the west of the county would occur away from sensitive areas in the east.
8) Planning the location of new railroad stations
    - These would be planned to encourage mixed use development.
9) Addressing the issue of sewer service
    - Most of the county's soil is not suitable to absorb the septic discharge therefore new development would need to be linked to a central sewer system.
10) Recommending two new categories of zoning:
    - Residential-Ex Urban (R-E) and Residential Mixed-Use (R-U).
11) Recommending "densifying" and "in-filling"
    - This would channel new growth into existing subdivisions and residential areas.

The following six alternative futures were developed from the above listed components:

1. Build – Out Alternative: represents the result of free-market forces resulting in suburbanization of the vast majority of the Poconos.

2. The Township Alternative: maintains local control while taking advantage of conserved open space.
3. Southern Alternative: focuses on development in the southern part of the region, allowing farms in the suburban areas and wilderness in the north to remain.
4. Spine Alternative: directs new development into a corridor between Mount Pocono and Stroudsburg, to be served with rail transportation.
5. Park Alternative: conserves all undeveloped land in the county and directs new development to a metropolitan corridor scale landscape reserve.
6. Follow the Monroe County Comprehensive Plan: results in strict enforcement of the current development guidelines.

The analysis of the alternative futures for Monroe County was described first using a landscape design and infrastructure design. The future land use patterns were then developed in the form of a computer generated aerial view of each alternative landscape.

Tools for Visualizing Growth

Community Viz and *What if?* softwear packages are designed to aid in visualizing urban growth. Both softwear packages are capable of generating 2D maps and evaluating economic consequences of different build out scenarios. Community Viz also includes components which allow users to visualize urban growth in 3D.

Community Viz

Community Viz was designed for citizens without extensive programming skills. The program aims to provide the tools necessary to visualize alternative futures and the resulting land uses, environmental, and economic impacts. Through using the softwear, the goal is that citizens will be able to view and evaluate predicted results of policies to make decisions about how their communities should grow.

What are the components of Community Viz?

- Scenario Constructor – the scenario constructor is referred to as a "spatial spreadsheet" that can perform numerical computations on geographic data in real time. This module can be used to update 2D maps and charts to help users visualize the impacts of alternatives.
- Town Builder 3D – this module offers more detailed views than the scenario constructor and includes the creation of terrain models and 3-D models representing buildings, tree canopies, roads, rivers, fences, and other natural and man-made features.
- Policy Simulator – the policy simulator module will be particularly useful to the Etowah HCP, as it can provide economic and demographic forecasts based on alternative scenarios.

Why did we choose Community Viz for modeling growth in the Etowah?

1) The softwear has the ability to provide instantaneous visual feedback to changes in policies, plans and designs.
2) The policy simulator option allows modeling of economic impacts of growth scenarios.

What if?

What if? softwear for community planning was developed by Richard E. Klosterman, Ph.D., professor of Geography and Planning at the University of Acron, located in Acron, Ohio. Klosterman has over twenty years of experience in developing computer software for planning.

What if? is an interactive GIS-based system which supports all aspects of the land use planning process. The softwear can be used to conduct land suitability analysis, project future land use demand, allocate this demand to suitable locations, and evaluate the likely impacts of alternative futures (Klosterman, 2003).

The developers of Community Viz and *What if?* promote the joint use of both products in scenario consequence analysis. *What if?* is a stronger tool for analysis of growth data and trends; Community Viz is a stronger tool for visualization.

The *What if?* can be used to determine the amount of future demand for residential, industrial, commercial, preservation, and local land uses.

Specific uses of What if? include:

- Projecting population and employment growth.
- Characterizing future housing markets.

- Projecting employment markets and densities.
- Developing scenarios based on restricted amounts of open space and recreational land.

Conclusions & Recommendations for Alternative Futures Analysis in the Etowah Watershed

Through the course of evaluating Alternative Futures Analysis projects, we were struck by the amount of time and detail required to effectively accomplish these studies. It became clear that the processes involved in the data collection and analysis in the large-scale projects (over arching umbrella type) would consume more time and money than the Etowah HCP would be able to supply.

Most of the large-scale studies described in this paper were accomplished over a period of three to seven years. The project that was completed in the shortest amount of time was Case Study 2: Blackberry Creek. The Conservation Design Forum completed the Blackberry Creek study over a period of two years, with five full time staff.

The following questions remain unanswered:

- What is the pattern of growth in the Etowah watershed that will sustain the aquatic biota?
- Can we effectively determine the pattern of growth that will sustain the aquatic biota in the Etowah watershed without a full scale Alternative Futures study?
- Can we transfer the findings from other Alternative Futures studies to the Etowah?

    i.e. Are the soils, geology, level of permeability and other site specific considerations in the other studies similar enough to apply to the Etowah?

If it is determined that other studies are similar enough to transfer their conclusions, THEN we could use Community Viz and *What if?* to develop visual images of how that growth would appear. As we continue the process of planning for growth in the Etowah, Community Viz and *What if?* will be important tools for enhancing public involvement and support of the planning initiatives.

Appendixes

Appendix A:

Appendix A includes two additional Alternative Futures analyses. These studies were not included in the body of the report because they have fewer direct applications to the Etowah. We have included them in the appendix as reference cases. The primary goal the first additional case study is to improve visual attractiveness in the Upper San Pedro River Basin. The study was included because it provided a good model for public involvement in decision making.

The second additional case study utilized Transfer of Development Rights (TDR) in one of the build out scenarios and is included as a reference case as TDR is being considered for the Etowah watershed.

Appendix B:

This appendix includes descriptions of communities and projects which have used Community Viz softwear to model growth. Uses of the softwear range from a floodplain naturalization initiative in the Illinois River Valley to the development of an interstate interchange plan that would encourage development compatible to the region in Randolph, Vermont.

Appendix C:

Carl Steinitz, a recognized expert in the field of Alternative Futures Analysis, outlines a theoretical framework for the process of Alternative Futures Analysis in his book, Alternative Futures for Changing Landscapes: The Upper San Pedro River Basin in Arizona and Sonora. We have included an outline of this framework in Appendix C as a reference source.

Appendix A

<u>Additional Case Studies</u>

The Upper San Pedro River Basin:

Sonora Mexico (1997 – 2002)

Site Information:

Beginning in Sonora, Mexico the San Pedro River flows northward through Arizona before it joins the Gila River, which then flows into the Colorado River. This area is of particular importance because it is internationally recognized as critical bird habitat (breeding and migration grounds for 389 bird species). The area also ranks second behind Costa Rica's rainforests in mammal diversity. The natural beauty and resources of this area have made it attractive for development, which has resulted in changes in the landscape and a lowering of the groundwater table.

Alternative Futures Study:

Researchers developed a "scenario guide", which was a questionnaire to be distributed via public meetings and the project web site in the study area of Arizona. The Scenario Guide gave residents an opportunity to select or suggest their own strategies for planning and their priorities for the future of the region. The survey included questions relating to land development, land management and water use.

The suggested sets of options, given in the survey, were developed from issues raised during community meetings, municipal meetings, and reports in local media outlets. The results were used to develop scenarios that formed the basis for the alternative futures analysis. The scenarios fell into the three following categories:

- Plans Scenario: based on the current plans and accepts the current population forecast.
- Constrained Scenario: reduces the forecasted population by directing development into the currently developed areas.
- Open Scenario: assumes higher population than the forecast and removes the majority of the constraints on land development.

Each of these three scenarios is further refined using selected policy options that result in additional, closely related scenarios. There are ten scenarios that are derived from the three main scenarios.

The first model used in the San Pedro Valley analysis was the development model. This model selects locations for residential, commercial, and industrial projects that developers would likely make under various scenarios. This model must account for homebuyers' preferences for proximity. The model contained one industrial/commercial land use category and four housing categories. In order to obtain valuable citizen and developer information, homebuilders and real estate professionals were surveyed regarding the characteristics that affect the attractiveness for development. Based on this information land was classified as developable or undevelopable for residential purposes. (The key to a development model's success is to make it a Lowry-type model that uses five-year periods for patterns of development).

The second model used was a hydrological model. This model is used to simulate the flow processes of the groundwater system, processes including interactions of the groundwater with surface water and evapotranspiration, and the base flow processes of the surface water system.

The vegetation model was the third model used. The objective of this model was to define the regional habitat types using a classification system based on overall appearance with one or two common species as indicators. This model is needed to understand the dynamics of vegetation and spatial distribution. A vegetation model can also assess several of the major stresses on vegetation and forecast the changes in type and distribution within a study area.

A fourth model was the landscape ecological pattern model. This model helps to maintain the current mosaic, land cover patterns, and to preserve the current ecological diversity. In order for this model to work successfully, the relevant factors for ecological functioning need to be determined and defined. The landscape ecological pattern model can also be used to prioritize protection for large patches of vegetation.

A fifth model used was the single species potential habitat model. These are based on Fish and Wildlife criteria and the Habitat Suitability Index (HIS). This model can be run and completed for numerous individual species. The output generated is a potential habitat map for each individual species. This model also delineates total estimated potential habitat for each species.

Lastly a visual preference model was created. The objective of this model was to identify areas of scenic attractiveness in terms of the residents' responses to a photographic survey. This model then estimated how the visual attractiveness of the region might change. This model holds the attractiveness of the region's landscape constant and then evaluates each alternative future in terms of its visual impacts. The decline in visual attractiveness was the most widespread of any of the impacts assessed in the San Pedro Valley analysis. Visual attractiveness fell much more significantly in all the scenarios analyzed when compared to other indicators: meaning that no matter which alternative future is chosen visual attractiveness will fall.

Additional Case Studies

Summit County, Colorado

David M. Theobald & N. Thompson Hobbs

In their framework document, Theobald and Hobbs recommended a process similar to the Upper San Pedro River Basin Analysis (previously discussed). Theobald and Hobbs illustrated their approach using Summit County, Colorado. Located 60 miles west of Denver, Summit County includes the resort areas of Vail, Breckenridge, and Keystone. In order to get stakeholder involved in determining conservation goals they held twelve community work sessions, over a year period. A county commissioner, planner, developer, wildlife manager, environmental advocates, and landowners were present at each of the twelve sessions.

The primary goal of the researchers was to facilitate discussion in the work sessions to vocalize the overall community conservation goals. From these sessions it was determined that the conservation of biodiversity was the primary goal of the community followed by maintenance of species important to the local economy (game species) and "watchable" species (i.e. birds).

Spatial modeling was the second component of this case study. Scientists and stakeholders collaborated to identify critical habitat areas. This was done using four maps: areas containing rare vegetation species, known areas of sensitive and rare species, habitat of economically important species, and areas of high neighborhood diversity. Nine build-out scenarios were then generated from this process.

Alternative Futures Analysis

The third component of the study was scenario analysis. It was determined that the Complete Build-Out (net), which uses current building restrictions and the total developable acres on each parcel of land, had the least number of predicted units. The Transfer of Development Rights and the Density Reductions scenarios were predicted to create an 11% reduction in total units in the study area. It was also found that cluster development and reducing density (one per 80) were the best methods to minimize impacts to biodiversity.

The last component is the evaluation and monitoring which ensures that the conservation plan is being carried out. The Summit County Task Force suggested field-based monitoring should be included in the plan. However as of publishing of this document, this recommendation had not been realized.

Appendix B

Community Viz Example 1

<u>Alternatives and Impact Analysis: Chickasaw National Recreation Area, Oklahoma</u>

One of the oldest units in the U.S. parks system, Chickasaw National Recreation Area in south-central Oklahoma covers approximately 10,000 acres. The area contains natural springs, streams and lakes, and attracts about 3.4 million visitors a year.

In 2002, the National Park Service began the development of a new General Management Plan for the park. This management plan will be used to guide management and policy for the park for the next 15-20 years. The park is using Community Viz as a tool for generating public input, developing alternatives, and performing impact analysis.

The Site Builder 3D module of Community Viz was used to create computerized 3D visualization images of the park, and was shown at initial public meetings

- The visualization demonstration helped participants understand the current state of the park, its physical relationship with surrounding lands and the state of its physical resources.
- The interactive process also helped generate excitement and conversation about the process of developing the management plan.

The Scenario Constructor module of Community Viz was then used to develop four preliminary management alternatives. Each alternative resulted in a different balance of resource protection, recreational opportunities, educational and interpretive activities. A 3D movie of each alternative was created, which allowed participants to visualize how the park might appear under different alternatives. When the proposed alternatives are finalized, the National Park Service will use Community Viz to perform quantitative analyses of the environmental and social impacts of the selected plan.

Community Viz Example 2

<u>Regional Drinking Water Protection: Laramie, Wyoming</u>

In 1997, the city of Laramie, Wyoming partnered with the U.S. EPA and the University of Wyoming to create a land use plan that would result in protection of the Casper Aquifer upon which the city draws its drinking water.

The group used Community Viz softwear to develop three land-use alternatives.

- Scenario 1: Continuation of current land-use trends.
- Scenario 2: A density-transfer that moved future development away from the aquifer area.
- Scenario 3: Implementation of aquifer protection policies such as minimum setbacks for water wells and sewage disposal systems.

Planners used Community Viz to determine the impacts of these three scenarios on water quality and quantity, municipal expenditures, local tax revenues, vehicular and pedestrian traffic, recreational access, landscape appearance, riparian coincidence, and vertebrate species distribution. Community Viz was also used during public meetings to present visualizations of each scenario and to illustrate the impacts of scenarios on key variables.

Community Viz Example 3

<u>Floodplain Naturalization: Illinois River Valley</u>

Over the past few years, the U.S. Fish & Wildlife Service and The Nature Conservancy (TNC) have been purchasing agricultural land along the Middle Illinois River Valley with the aim of eventually reconnecting the Emiquon Preserve floodplain with the Illinois

River. TNC would like to return the area to its previous state in order to create more habitat for native species, while also encouraging tourism to Mason and Fulton Counties, Illinois. Mason and Fulton are two of the most economically depressed counties in the Illinois River Area. In a partnership with the University of Illinois at Urbana-Champaign, Community Viz was used to model scenarios that would help "increase tourism while maintaining the small town feel of the nearby communities." Community Viz applications included predicting the number of visitors to the area, amount of accommodations needed throughout the year, and the cost to the counties to create tourism opportunities, as well as the social and fiscal consequences of the process. This included exploring the possibilities of campsite arrangements, allowing recreation activities in conjunction with preservation and the possibility of an Emiquon Lodge. The study was used during the preliminary planning phases of the process. The University of Illinois at Urbana-Champaign plans to explore additional scenarios in the future.

Community Viz Example 4

<u>Resource Management Plan: Lakeview District, Oregon</u>

The approximately 3.5 million acre tract of public land known as the Oregon Lakeview District is characterized by its abundant plant and animal life and extensive resources for outdoor recreation.

The Community Viz Professional Services Group (CVPSG) used the Lakeview District Resource Management Plan to demonstrate Community Viz applications for public engagement. Working with the Bureau of Land Management, four alternatives were evaluated with the following four priorities.

- Revenue from recreation and grazing
- Preservation of areas of critical environmental concern
- Offering highway vehicle access and use
- Fire risk management

The Bureau of Land Management in consultation with decision makers used the scenarios developed by the CVPSG team.

Community Viz Example 5

<u>Interchange Development: Randolph, Vermont</u>

The Two Rivers-Ottauquechee Regional Commission, an organization responsible for assisting Vermont towns with planning, received a Sustainable Challenge Grant from the EPA to conduct a land-use planning study for the town of Randolph.

The town's first project was addressing development at an interchange of I-89, where a town welcome center is projected to be built. The town's main concern was that the welcome center be a structure that would be sensitive to local building traditions and blend with the existing architecture.

The town established a development steering committee to work with the Site Builder 3D module of Community Viz to create a visual model of the current landscape and the interchange. They constructed a scenario for the proposed development, including the incorporation of digital photographs. The committee used the softwear to visualize effects of the proposed buildings and modify them to better suit community goals. Results were presented to the town public as part of an ongoing "Our Town, Your Town" program. The visualization process facilitated lively discussion at the community planning meets, and the town plans to continue using the softwear to assist in planning development and redevelopment for the town center.

Appendix C

Carl Steinitz, a recognized expert in the field of Alternative Futures Analysis, outlines a theoretical framework for the process in his book, Alternative Futures for Changing Landscapes: The Upper San Pedro River Basin in Arizona and Sonora. We have included an outline of this framework in as a reference source.

Outline of Theoretical Framework for Alternative Futures Analysis

Steinitz (2003) identifies six key processes that need to be identified and understood for the area under study in alternative futures analysis and modeling. The key processes are: geological, biological, visual, demographic, economic, and political.

Steinitz (2003) also identifies several strategies upon which one could base alternative futures analysis and modeling:

- Adopt a policy of land conservation that emphasizes outdoor recreation
- Concentrate new development in a corridor so that it may be serviced using public transportation
- Follow the comprehensive plan
- Allow development to be market driven
- Pursue the strategic development interests of each township
- Conserve all undeveloped land.

Steinitz (2003) recommends a framework format for scenario consequence analyses that consists of six steps that are to be addressed repeatedly throughout the analysis.

Step 1:

- Determine how the state of the landscape should be described in content, space, and time.
  - ➢ This issue is usually addressed using the data upon which the study is based plugged into representation models. Defining the area of the study and its' features.
  - ➢ The goal of this step is to define the entire study area. Establishing that areas adjacent to the area of interest might also be vital for maintaining biodiversity, therefore including these additional areas into the original area of interest. Also for larger study areas, a specific computer-generated GIS can be organized which contains spatially explicit data on the region to help describe how the area's dynamic processes work.

Step 2:

- Determine how the landscape operates, including its structural and functional relationships among its elements.
  - ➢ Process models are used to address this issue by providing the information for the various analyses that are the context of the study.
  - ➢ The goal of this step is to have a suite of computer based process models describe and evaluate the current landscape and the impacts of each alternative scenario.

Step 3:

- Provide the answer for whether or not the current landscape is working well.
  - ➢ Current stakeholders and cultural knowledge are used in evaluation models to answer this question.
  - ➢ The goal of this step is to collect data from the study area during a current period (maybe a three year period combined) for each of the process

models. This allows the impacts of future changes to be compared to a reference period.

Step 4:

- Develop and use of change models to determine how the landscape might be altered, which policies should be implemented, and when and where these policies and actions should be implemented.
  - Change models are used to answer these questions and are also the assumed data for the future.
  - The intent of this step is to create the alternative future scenarios. Since no single future can be certain Steinitz recommends each study consider a set of alternative scenarios that encompass various possibilities.

Step 5:

- Impact models produced from the previous process models give new information made under the changed conditions.
  - Here the results from the process models about the alternative futures are compared to the reference period and impact assessments are conducted.

Step 6:

- How should the changed landscape be used?
  - Responsible stakeholders and cultural knowledge are vital for answering this question because the decision models used to answer this question are based on the information they provide.
  - The intent of this step is to inform the decision-making process. The projected impacts, from the scenarios, can be used by stakeholders and other decision-makers to determine the desirability of the various policies that generated them.

These steps are intended to be repeated throughout the process and analysis. They should be reworded and formatted for the objectives of the study. For example, in Steinitz (2003), the research group's analysis of the San Pedro Valley analysis was conceptually divided into three steps.

- The first step was to describe the scope
  - Identify major issues and the physical setting as well as the areas of concern, existing plans and policy interventions and their political impact.
- The second step was to define the method
  - Identify the planning and policy choices that will affect the future changes and to understand the landscape conditions.
- The third and final step was to implement the method chosen to finish the analysis.
  - Identify the models and future scenarios that the analysis will test.

Theobald and Hobbs (2002) recommended a process similar to the Upper San Pedro River Basin Analysis (Appendix: Case Study 4) with significant emphasis on stakeholder involvement. With the help of the stakeholder group, they established conservation goals, assembled a list of the build out scenarios, and filtered the preliminary list to determine the indicators of impact.

The second component they suggest is using spatial modeling to provide a scientific basis for the decision-making about land use. Theobald and Hobbs (2002) indicated that three factors should always be considered when determining the spatial model:

1) Establishing Critical Habitat Areas
2) Developing the Alternative Development Scenarios
3) Listing the Potential Indicators of the Habitat.

Build-out scenarios should be constructed to examine the probable future development intensities and patterns. The two products that would be generated from build-out scenarios are maps showing development patterns that reflect the various assumptions and tables quantifying the number of new units, residents, and acreage consumed (Theobald & Hobbs 2002).

Theobald and Hobbs (2002) also suggest three critical indicators:

- The total number of housing units predicted under each scenario
- The total length of roads required to service development, excluding the primary road infrastructure: this measures the magnitude of the impacts associated with roads
- The total acreage of critical habitat affected by development: this is the most direct indicator.

The scenario analysis is the third component of Theobald and Hobbs analysis. This is the analysis of consequences of the various build-out scenarios on the critical habitat areas. The typical presentation is a matrix table containing descriptions of how different indicators react to different planning actions and the values that various indicators scored for each scenario (Theobald & Hobbs 2002).

The last component is the evaluation and monitoring of the conservation plan. The critical aspect of an effective evaluation and monitoring program is to translate the goals of the conservation plans into measurements that can be taken remotely or in the field (Theobald & Hobbs 2002).

Works Cited / Bibliography

Chesapeake Bay Program. 1998. "Integrating Build-Out Analysis and Water Quality Modeling to Predict the Environmental Impacts of Alternative Development Scenarios." Baltimore, Maryland.

Harvard University: Graduate School of Design.1994 "Alternative Futures For Monroe County, Pennsylvania." President and Fellows of Harvard University.

Theobald, D. M. and N. T. Hobbs. 2002 "A framework for evaluating land use planning alternatives: protecting biodiversity on private land." *Conservation Ecology* 6(1): 5. http://www.consecol.org/vol6/iss1/art5.

Steinitz, Carl, Hector Arias, Scott Bassett, Michael Flaxmam, Tomas Goode, Thomas Maddock III, David Mouat, Richard Peiser, and Allan Shearer. 2003. Alternative Futures for Changing Landscapes: The Upper San Pedro River Basin in Arizona and Sonora. Island Press: Washington.

United States Environmental Protection Agency. October 24, 2003. US EPA Etowah Basin Fact Sheet. http://www.epa.gov/region4/water/watersheds/targetedwatersheds/etowahbasin.htm. November 15, 2003.