

## Lecture 27 Sustainability, Coastal Zone Management and GIS

### Learning Objectives

27.1 What is the foundation of an ecological city approach to development?

27.2 What is the significance of the link among planning, programming, and projects?

27.3 What is the purpose of indicators for coastal community development?

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### Beyond Growth Management: Toward Sustainability Management

27.1 What is the foundation of an ecological city approach to development?

More and more cities are recognizing the need for ecological approaches to development – so-called ecological city approach (White, R. 2002. *Building the Ecological City*, Boca Raton, CRC Press.) An ecological city approach to development requires

- active consideration of the relationships among *land, energy, transportation, and environmental health* as a
- foundation for *systems process modeling*.

Natural-human system – a collection of inter-related elements that influence one another

Need for system process models stems from guiding principles about sustainability, e.g., those of the Santa Monica Sustainable City Program (Beatley, Brower, Schwab p. 234-235).

- The concept of sustainability guides city policy, hence all activities associated with city work.
- Protection, preservation and restoration of natural environment is a high priority
- Environmental quality and economic health are mutually dependent
- All decisions have environmental implications
- Community awareness, responsibility, involvement and education are key elements of successful programs/policies
- Recognize the linkages with regional, state, national, and global community
- Environmental issues most important to the community should be addressed first, and the most cost-effective programs and policies should be selected
- Commitment to procurement decisions that minimize negative environmental and social impacts

Those guidelines lead to *green governance* of (city, business, and citizens) activity. Green governance follows from a trend toward the greening of business. Many industry sectors are now picking up on this idea because it is actually profitable to reduce waste streams – given the cost of dealing with forms of waste.

Green governance follows a “natural step” whereby nature’s functions and diversity are NOT systematically (Beatley, Brower, Schwab p. 236):

- subject to increasing concentrations of substances extracted from the earth’s crust;
- subject to increasing concentrations of substances produced by society;
- impoverished by physical displacement, overharvesting or other forms of ecosystem manipulation; and resources are used fairly and efficiently in order to meet basic human needs globally.

## **Principles of Ecological Coastal Development and GIS**

Those steps point up a need to understand flow and process using GIS. At the current time, GIS can implement *dynamic process models* in terms of characterizing the increments of waste processes, i.e. investigating the flows about what is connected to what based on two or more time periods as wastes and products move from place to place. That perspective about using GIS to characterize flows links well with *principles of ecological coastal development* (Beatley, Brower, and Schwab 2002, p. 281)

- Minimize the amount of water, energy, and other resources needed to build and operate buildings; incorporate renewable energy, including solar energy, into the design and siting of buildings.
- Use local building materials obtained from sustainability managed sources (e.g., sustainably harvested forests).
- Minimize waste during construction; use recycled building materials.
- Build compactly and conserve as much coastal land as possible in clusters away from wetlands, beaches, and other sensitive lands.
- Locate new development projects in close proximity to public transit and town centers and in areas where residents and workers can walk and ride bicycles, thereby reducing the need for automobiles.
- Choose in-town locations over rural or exurban sites; look for opportunities to strengthen and revitalize existing coastal towns and cities.
- Minimize the embodied energy of structures (i.e., the energy necessary to procure the materials for the building).
- Look for infill sites and opportunities to reuse built environment before developing in greenfield locations.
- Design and build to last; durability and quality should be favored over short-term profits (what about building to be recycled?).
- View every building project as an opportunity to restore and repair damage coastal ecosystems.
- Protect trees, vegetation, and existing elements of the natural landscape; build within nature's ecological envelope.
- Reduce impervious surfaces and maintain the natural hydrology of the landscape.
- Avoid hazardous coastal locations, such as inlet zones, floodplains, and high erosion zones.
- Strive to make projects affordable and create economically and ethnically diverse neighborhoods and communities.
- Design projects through an inclusive, participatory process; affected parties should be consulted and have the opportunity to influence designs.
- Incorporate features that educate future residents about ecological sustainability; make visible the natural processes on which we all rely.
- Search for designs that harmoniously blend projects into the natural and cultural landscape; design and build to strengthen sense of place.
- Incorporate design elements that strengthen connections for others and the broader community (connecting streets, trails and common spaces); discourage developments that separate and isolate from the broader community.

## Linking Planning, Programming and Projects

27.2 What is the significance of the link among planning, programming, and projects?

The above sustainability principles set out fundamentals for policy development about projects. The *sustainable coastal community* characteristics (from lecture 26) and the above ecological guidelines together provide a basis for sustainable development policies. Development policies underpin how communities will change/transform themselves over time.

In community governance, policies direct three main decision support situations for which GIS can be used to implement policy – plans, improvement programs, and project implementations.

Heathcote (1998 p. 391), in a book titled *Integrated Watershed Management* describes a relationship between plans, programs and project implementation in the following way.

- a) plans articulate a long-term perspective, and thus guide improvement programs
- b) improvement programs are developed to match projects to social, economic, and environmental conditions in the world (i.e., what is needed, what can be done about community impairments – what needs fixing - over the medium term), and
- c) projects are proposed fixes to conditions causing those impairments at current/future time.

Linking the planning, improvement programming, and project implementation decision processes over time provides feedback about whether and how a community is moving in sustainable directions. GIS, because of its inherent integrative capacities, can be used as a decision support technology to foster sustainable development. Note: Beatley et al. 2002 refer to “project” development in light of ecological principles above. Heathcote 1998 suggests how to make the link from plans, to programs, to projects as a part of integrated watershed management.

Example: Salmon habitat recovery activity in terms of Plans, Programs, and Projects.

- **Plan** - [Salmon Habitat Plan 2006-2015 for the Green/Duwamish Watershed](#).
- **Program** – [Green/Duwamish Three-Year Work Program](#)
- **Projects** – [Green/Duwamish Ecosystem Restoration Projects](#)

## Indicators for Coastal Sustainable Development

27.3 What is the purpose of indicators for coastal community development?

*Indicators help monitor progress.* After project implementation, it is important to monitor how that project has impacted well-being. Beatley, Brower, and Schwab 2002, p. 289 suggest a set of indicators (most of which are mappable, and hence compiled with GIS) to be monitored over time for a coastal area. These indicators address the broad issue of socio-ecological well-being. Compare the following with the Puget Sound Partnership Vital signs.

### Land Development

- % of coastline urbanized
- Acres of greenfield land developed per year
- Acres and % of brownfield development for infill per year
- Acres of farmland or rural land lost each year

## Water

- Extent of fishable and swimmable waters; changes in water quality
- % changes over time of extent of pervious and impervious surfaces

## Hazard Exposure

- Number of structures in 60-year erosion zone
- Number of unelevated structures in the floodplain
- Number of structures built to older building codes
- Number of shelters (for coastal hazards – hurricane, tsunami) in relation to population

## Air - Number of days in violation of Clean Air Act

## Wetlands

- Acres of existing and protected wetlands
- Acres of coastal wetlands converted each year

## Forest and Habitat

- Acres changed in forest coverage
- Acreage in forest
- Extent and status of endangered species
- Extent and status of biodiversity hotspots

## Fisheries and Marine Resources

- Health of coral reefs, sea grasses, and other marine habitats
- Status and condition of local and regional fisheries
- Number, severity, and coverage of oil spills

## Equity and Affordability

- Housing affordability measure; median price to median income
- Unemployment rates

## Recreational and Coastal Access

- Number of beach access points
- Acres of public beach

## Energy and Resource Use

- Water consumption per capita
- Energy consumption per capita
- Recycling rate
- Solid waste generated per year
- Number of treatment plants with tertiary and advanced treatment

## Transportation and Mobility

- Modal share for walking, bicycle, and transit
- Percentage of built environment that is bicycle and/or pedestrian friendly